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CONTENTS

Original scientific articles

Preliminary communications

Original scientific articles

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ESTIMATION OF AN EFFICIENT BENCHMARK PORTFOLIO FOR THE EASTERN EUROPEAN MARKET

Abstract

Purpose: This paper explores the mean-variance inefficiency of cap-weighted indices based on the CECE index as a benchmark.

Methodology: For the period from March 2014 to September 2021, several proxies of efficient portfolios were estimated: the Global Minimum Variance (GMV) portfolio, the Maximum Sharpe Ratio (MSR) portfolio and the portfolio with equal weights of constituents (EW). Diversification of strategies was also considered by analyzing the performance of a portfolio consisting of GMV and MSR that were weighted equally. Based on monthly data, 90 out-of-sample estimations were made for each strategy in order to compare their risk-return characteristics. Furthermore, to confirm the differences in the riskiness and returns of the estimated portfolios, the F-test and the Welch test were performed, respectively.

Results: The results show that all analyzed portfolios achieved superior performance compared to the CECE index with the GMV portfolio leading the way.

Conclusion: Research findings highlight the importance of market development and liquidity when pursuing popular scientific diversification methods.

Keywords: Efficient portfolio estimation, risk-reward ratio, diversification strategies, "smart" beta, the CECE Composite Index

1. Introduction

The market capitalization-weighted indices (cap-weighted indices) are typically used for the purpose of pursuing passive investment strategies. For a long time, such approach has often been presented in the context of the modern portfolio theory (MPT) and the CAPM (Capital Asset Pricing Model), without due consideration of the appropriate application of theoretical concepts in the practice of stock market investing. However, due to the fact that the optimal market portfolio (M) introduced

in the MPT is not observable in the real world, the cap-weighted indices are used as its approximation in the portfolio management process (Amenc et al., 2011). Empirical research has shown that such indices are often inefficient in terms of the risk-reward trade-off, meaning that they are not necessarily the optimal investment strategy for investors as they do not provide adequate compensation for systematic risk (Haugen & Baker, 1991; Grinold, 1992; Amenc et al., 2006).

Too high concentration leading to exposure to unrewarded risk factors and poor exposure to rewarded risk factors are often highlighted as the two main shortcomings of cap-weighted indices (Amenc et al., 2006; 2011; 2014). Therefore, alternative approaches to portfolio construction have been developed and presented in the literature to address these issues. Such approaches are called "smart" or scientific beta strategies and their aim is to construct a portfolio with better performance compared to its cap-weighted counterpart. In this paper, we focus only on efforts aimed at dealing with the first problem of cap-weighted indices, i.e., the efficient elimination of unrewarded risk in the portfolio.

The goal of this research is therefore to provide insight into the applicability of "smart" beta strategies in emerging markets. For this purpose, we focus on Eastern European markets represented by the CECE benchmark index available on the Vienna Stock Exchange. The index includes the most liquid stocks listed on the Budapest, Prague and Warsaw stock exchanges. All three countries are listed in the emerging markets category by the renowned index providers – the MSCI and the EDHEC-Risk Institute (Scientific Beta, 2022). We test the Maximum Sharpe Ratio (MSR), Global Minimum Variance (GMV) and Equal Weighting (EW) strategies.

The contribution of this paper lies in the out-of-sample testing, ensuring also the composition matching of the tested portfolios in relation to their cap-weighted benchmark. Thus, the appropriate framework for the performance analysis is set enabling the comparison of the results to other papers conducting similar research for the more and less developed financial markets. Our findings reveal that the pursued strategies outperform the cap-weighted benchmark in the case of analyzed emerging markets highlighting the importance of market liquidity.

The rest of the paper is structured as follows. A literature review is presented in the second section, while the data and methodology used in this research are presented in the third section. The empirical part is covered in the fourth section. Finally, the conclusion is given in the fifth section.

2. Literature review

For a developed market, it is well documented that it is possible to outperform the cap-weighted counterpart. Amenc et al. (2006) tested two weighting schemes – mean-variance optimization and equal weighting on an in-sample basis for the U.S. and European equity index markets. It was concluded that the existing stock market indices are highly inefficient compared to the mean-variance optimal portfolios. Amenc et al. (2011) and Amenc et al. (2013) provided details of the out-of-sample testing for the selected so-called "smart" or scientific beta strategies. Amenc et al. (2013) presented very thoroughly several "smart" beta strategies with weighting schemes, required parameters to be estimated and optimality conditions. Strategies tested in this paper are frequently pursued since, as presented in e.g. Amenc et al. (2013), this choice allows the examination of trade-off between optimality and estimation risk. Namely, the estimation of the MSR portfolio, which is optimal by construction, includes high estimation risk, since it requires the estimation of most parameters (the expected returns, volatilities and correlations of returns) than any other strategy. The opposite is the estimation of the EW portfolio which has no estimation risk (estimations of parameters are not needed) but the optimality risk is high.

Since the estimation of the expected return mostly presents the biggest challenge (Amenc et al., 2013), instead of the estimation of the MSR portfolio, focus should be placed on the estimation of the suboptimal portfolio. Such portfolio is the GMV portfolio as less estimation risk is involved (necessary inputs are only volatilities and correlations). However, GMV portfolios often suffer from a low-volatility bias by primarily targeting a low-volatility objective over decorrelation conditions (Clarke et al., 2011). None of the strategies mentioned above is dominant from an out-of-sample risk-adjusted perspective. Thus, DeMiguel et al. (2009) argue that the MSR strategy does not consistently outperform the EW strategy, while Amenc et al. (2013) argue that

the GMV strategy typically outperforms MSR, but often at the expense of portfolio concentration. For the Asian market, Padmanaban et al. (2013) tested equal-weighted, GMV and MSR portfolios. A considerable increase in the Sharpe ratio is obtained for all alternative portfolios, except for the GMV portfolio of FTSE China 25 stocks, which ends up with a lower Sharpe ratio than the cap-weighted counterpart (Padmanaban et al., 2013, p. 8).

Whether the application of these advances in less developed markets can lead to similar results is not completely clear and the literature on the topic is scarce. Madsstuen (2015) found that the MSR and GMV strategies in emerging markets did not outperform the global cap-weighted benchmark (although an emerging market benchmark should have been used). Nowak (2016) tested EW, GMV, MSR and fundamental weighting strategies, which outperformed the cap-weighted benchmark on the Warsaw Stock Exchange in the emerging Polish stock market (but it remains unclear whether an out-of-sample estimation was conducted).

In the research focusing on the undeveloped and illiquid Croatian market, scientific beta strategies exhibited poor performance. For instance, the MSR estimation in the Croatian stock market did not outperform the cap-weighted benchmark in the out-of-sample analysis for the entire observed period regardless of market conditions (expansion or recession) (Dolinar et al., 2017). The same was found to be true regarding the GMV portfolio estimation in (Zoričić et al., 2018), although the results were better than in the case of the MSR portfolio.

3. Data and methodology

3.1 Data and data sources

In this paper, the CECE Composite Index (CECE) listed on the Vienna Stock Exchange is used as a benchmark index for the Eastern European emerging stock market. It is a "free-float" index based on market capitalization and only the most liquid stocks are used as index constituents. In other words, the CECE index incorporates only actively traded stocks in Eastern Europe's capital markets, more precisely Budapest, Prague, and Warsaw stock exchanges. Thus, the composition of the CECE index is based on the stocks included in CTX (Czech Traded Index), HTX (Hungarian Traded Index), and PTX (Polish Traded Index), which are also weighed on the "free-float" market capitalization basis. All these indices were introduced to the market for the first time in 1996. For CTX, HTX, and PTX, the maximum weight for individual stocks is set to 25%, and for the CECE index to 20%.

The CECE Composite Index is a price index, so the derived monthly returns do not include any potential dividend yields. The index is expressed in euros (EUR) and dollars (USD), respectively. For the purpose of this paper, only the CECE EUR index is observed. The index has no restrictions related to the sector or national exposure. The values of the CECE index are displayed in real time on the Vienna Stock Exchange website. Regular revisions of the CECE index are carried out twice a year, in March and September.

The observation period in this paper covers the period beginning in March 2014 and ending in September 2021. For this analysis, 15 revisions of the CECE index are taken into account, in which the number of constituents varied from 24 to 33 stocks (Vienna Stock Exchange, 2022). Altogether, 52 stocks that were included in the CECE index at any point in time were analyzed.

3.2 Methodology

To test whether alternative approaches to portfolio optimization can outperform the CECE index (based on market capitalization), several portfolios were estimated: the GMV portfolio, the MSR portfolio, the EW portfolio, and a portfolio consisting of the GMV and MSR portfolios (50:50%). Amenc et al. (2013) suggested that it makes sense to use the GMV portfolio as a proxy for the most desired portfolio, i.e., the optimal benchmark MSR portfolio might suffer from efficiency costs since the out-of-sample estimation of such benchmark involves a high level of estimation risk. In the case of GMV portfolio estimation, only correlations and volatilities are required as inputs for the optimization process, while the estimation of the expected returns, the dominant source of the estimation error, is not required (Amenc et al., 2013, p. 31).

GMV and MSR portfolio estimation is always performed for the actual CECE index composition. This means that for each revision of the CECE index, it is necessary to create a new set of inputs (estimation of covariances from the period before the revision) and a new set of outputs (estimation of an out-of-sample performance) of the GMV and MSR portfolios. For the estimation of the ex-post covari-

ance matrix, we observe a 3-year period of monthly returns for each constituent stock before each CECE index revision. Such estimated covariance matrix is then used in the optimization process to estimate the optimal weights of the constituents for each portfolio separately. The estimation of optimal weights of constituents for GMV portfolios is performed using the following formula:

$$\boldsymbol{w}^* = arg\ \min_{\boldsymbol{w}} \frac{\boldsymbol{\Sigma^{-1}1}}{\boldsymbol{1'\Sigma^{-1}1}}, \quad (1)$$

where $\boldsymbol{w}^*$ is the vector of weights (i.e. optimal weights), $\boldsymbol{1}$ is the vector of ones, and $\boldsymbol{\Sigma}$ is the covariance matrix for expected returns of the constituents. Matrix elements (covariances and variances) are estimated using the following formula:

$$\sigma_{ij}^2 = \frac{1}{T-1}\sum_{t=1}^{T}(r_i - \overline{r_i})\left(r_j - \overline{r_j}\right), \quad (2)$$

where T represents the number of in-sample observations, r_i are monthly returns of stocks, and $\overline{r_i}$ represents the arithmetic mean of stock returns.

An MSR portfolio is then estimated that should best mimic the optimal market portfolio (M) from the MPT. Such a portfolio is optimal by its construction; however, it requires the highest number of estimated parameters (expected returns, volatilities, and correlation of stocks) than any other strategy with the estimation of the expected return presenting the biggest challenge (Amenc et al., 2013). Risk parameters are estimated in the same way as for the GMV portfolios, while the expected returns are estimated using the following formula:

$$E(r_i) = \frac{1}{T}\sum_{t=1}^{T} r_i\ , \quad (3)$$

where T represents the number of in-sample observations and r_i are monthly returns of stocks. In addition to the arithmetic mean, the median is also used to estimate the expected return, which yielded better results compared to the arithmetic mean (Table 1). The following formula is used to estimate the optimal weights of the constituents for the MSR portfolios:

$$\boldsymbol{w}^* = arg\ \max_{\boldsymbol{w}} \frac{\boldsymbol{w'\mu}}{\sqrt{\boldsymbol{w'\Sigma w}}}\ , \quad (4)$$

where $\boldsymbol{w}^*$ is the vector of weights (i.e. optimal weights), $\boldsymbol{\mu}$ is the vector of the expected returns, and $\boldsymbol{\Sigma}$ is the covariance matrix for the expected returns of the constituents.

Furthermore, to achieve greater portfolio deconcentration in the GMV and MSR portfolios, the constraint on the minimum weight for a constituent is imposed in the optimization process by defining the lower limit as follows:

$$w_i^* \geq \frac{1}{\lambda N}\ , \quad (5)$$

where w_i^* represents the optimal weight of stock i in the GMV and MSR portfolios, N is the number of constituents in each revision, and lambda (λ) represents a flexibility parameter (Amenc et al., 2011). A higher lambda implies a weaker constraint leading to a higher concentration of the GMV and MSR portfolios. In this paper, lambda is set arbitrarily to 4 and 1.5. Setting lambda to 1 reduces a GMV portfolio to an EW portfolio. The use of weaker constraints pronounces a serious concern regarding minimum variance portfolios as they are typically heavily concentrated in assets with the lowest volatility (Amenc et al., 2013, p. 31).

The rolling window of 36 months referring to 36 in-sample observations is used to estimate both the GMV and MSR portfolio out-of-sample. The out-of-sample performance of the GMV and MSR portfolios is assessed on a monthly basis. Namely, 15 revisions of the CECE index are covered (March 2014 - September 2021), so the rolling window of out-of-sample periods is carried over 7.5 years. In this way, the GMV and MSR portfolios are estimated 90 times, i.e., for each GMV and MSR portfolio, time series of 90 monthly returns are obtained.

4. Research findings

The out-of-sample performance of the estimated GMV and MSR portfolios for the whole observation period is compared to the CECE index, i.e., the benchmark index that is the market-cap counterpart. The results are shown in Table 1. In addition, the EW portfolio is observed as an additional portfolio for the purpose of performance comparison since it presents a naïve diversification strategy. The risk-reward ratio is used as a key performance measure. Returns are calculated based on monthly returns and refer to the geometric mean, while risk refers to their standard deviation. The estimation of the MSR portfolio based on the arithmetic mean and median is reported separately.

Table 1 Performance of the estimated portfolios and the CECE index

	CECE	GMV (λ = 4)	GMV (λ = 1.5)	MSR* (λ = 4)	MSR* (λ = 1.5)	MSR** (λ = 4)	MSR** (λ = 1.5)	EW
Return	0.00%[1]	0.67%	0.68%	0.64%	0.70%	0.86%	0.93%	0.56%
Risk	5.88%	3.21%	3.61%	4.46%	4.34%	4.63%	4.48%	4.48%
Risk-reward ratio	0.001	0.209	0.187	0.144	0.161	0.186	0.207	0.125

* Arithmetic mean used as a measure of expected returns.
** Median used as a measure of expected returns.

Source: Authors' calculation

As depicted in Table 1, all estimated portfolios managed to outperform the cap-weighted benchmark, including the EW portfolio. As expected, the EW portfolio achieved a higher return compared to the cap-weighted counterpart, surprisingly with lower risk. Research has shown that EW portfolios have significantly higher risk compared to cap-weighted and price indices, and that a higher risk-reward ratio is a result of the increase in the return due to the exposure to rewarded risk factors in spite of the accompanying increase in risk (Plyakha et al., 2012).

The F-test is performed to confirm the differences in the riskiness of the estimated portfolios, the EW portfolio, and the benchmark index. These differences in variances (riskiness) of all tested strategies and the benchmark index are statistically significant at the 1% level of significance. In addition, differences in variances (riskiness) between the GMV and MSR portfolios and the GMV and EW portfolios are statistically significant at the 1% level of significance, while the differences in variances (riskiness) between the MSR and EW portfolios are not statistically significant even at the 10% level of significance.

The Welch test was performed to test the differences in the returns of the estimated portfolios, the EW portfolio, and the benchmark index. These differences in returns of all tested strategies and the benchmark index are not statistically significant at the 10% level of significance. Furthermore, with the same level of significance, the differences in returns between the GMV and MSR portfolios, the GMV and EW portfolios, and the MSR and EW portfolios are not statistically significant.

Table 2 Performance of the estimated portfolios and their combinations with the arithmetic mean used for the estimation of the expected returns

	GMV (λ = 4)	MSR (λ = 4)	50% GMV + 50% MSR (λ = 4)	GMV (λ = 1.5)	MSR (λ = 1.5)	50% GMV + 50% MSR (λ = 1.5)
Return	0.67%	0.64%	0.67%	0.68%	0.70%	0.69%
Risk	3.21%	4.46%	3.58%	3.61%	4.34%	3.89%
Risk-reward ratio	0.209	0.144	0.186	0.187	0.161	0.177

Source: Authors' calculation

In addition to the performance of the estimated GMV and MSR portfolios that has already been presented (Table 1), Table 2 presents portfolios estimated as a combination of the optimization techniques for GMV and MSR portfolio estimation with the arithmetic mean used as an estimator for the expected return. The results suggest that the equally weighted portfolio of the GMV and MSR portfolios dominates over the MSR portfolio due to risk reduction yielding a higher risk-reward ratio (for both constraints set for the minimum weight for the constituents). However, due to higher risk and an (almost) equal return to the GMV portfolio, its performance is not superior to the GMV portfolio. Regardless of the constraint set for the minimum

1 More specifically, the average return of the CECE index was 0.00332%. All results in the tables are rounded to two decimal places for the sake of readability.

weight for the constituents, the performance of the portfolio with equal weights of the GMV and MSR portfolios is between the performance of the GMV and MSR portfolios.

Table 3 Performance of the estimated portfolios and their combinations with the median used for the estimation of the expected returns

	GMV (λ = 4)	MSR (λ = 4)	50% GMV + 50% MSR (λ = 4)	GMV (λ = 1.5)	MSR (λ = 1.5)	50% GMV + 50% MSR (λ = 1.5)
Return	0.67%	0.86%	0.77%	0.68%	0.93%	0.81%
Risk	3.21%	4.63%	3.71%	3.61%	4.48%	3.95%
Risk-reward ratio	0.209	0.186	0.208	0.187	0.207	0.204

Source: Authors' calculation

Similarly to Table 2, Table 3 presents portfolios estimated as a combination of the optimization techniques for GMV and MSR portfolio estimation but with the median used as an estimator for the expected return. As depicted in Table 3, an equally weighted portfolio of the GMV and MSR portfolios with λ = 4 dominates over the MSR portfolio due to risk reduction yielding a higher risk-reward ratio. In comparison to the GMV portfolio, the portfolio with equal weights of the GMV and MSR portfolios achieved a higher return with slightly higher risk. When a tighter constraint is set to the minimum weights for the constituents, the portfolio with equal weights of the GMV and MSR portfolios does not dominate over the MSR portfolio.

The F-test is performed to confirm the differences in the riskiness of the GMV and MSR portfolios and portfolios estimated as a combination of the optimization techniques for GMV and MSR portfolio estimation. These differences in variances (riskiness) of the MSR portfolio and a portfolio estimated as a combination of the GMV and MSR portfolios with λ = 4 are statistically significant at the 5% level of significance. However, this difference in riskiness is not statistically significant at the 1% level of significance. Regarding the GMV portfolio, the differences in variances (riskiness) of the GMV portfolio and a portfolio estimated as a combination of the GMV and MSR portfolios with λ = 4 and the median used as an estimator for the expected return are statistically significant at the 10% level of significance. However, this difference in riskiness is not statistically significant at the 5% level of significance. In other cases, the differences in the riskiness are not statistically significant at the 10% level of significance.

The Welch test was performed to test the differences in the returns of the estimated GMV and MSR portfolios and portfolios estimated as a combination of the optimization techniques for the GMV and MSR portfolios. The differences in returns of these strategies are not statistically significant at the 10% level of significance.

5. Discussion

In contrast to the results for the Croatian stock market (Dolinar et al., 2017), the results given in Table 1 suggest that it is possible to estimate the MSR portfolio with a higher return compared to the EW portfolio and the benchmark index. In addition, when the arithmetic mean is used as an estimator for the expected return, it can be noticed that the risk of the MSR portfolio is lower than the risk of the benchmark index and approximately equal to the risk of the EW portfolio, which could be interpreted as a result of a better diversification of unrewarded risk factors. Namely, Amenc et al. (2014) define scientific methods as a tool to achieve superior results compared to cap-weighted counterparts since they solve the problem of excessive exposure to unrewarded risk factors. These superior results (a higher return and lower risk compared to the EW portfolio and the benchmark index) are achieved when the limit for the minimum weight for the constituents of the MSR portfolio is set to 1.5 (λ = 1.5), which presents a stronger constraint on the minimum weight leading to higher deconcentration compared to the MSR portfolio with λ = 4. When the median is used for the estimation of the expected return instead of the arithmetic mean, the average return is higher compared to re-

sults when the arithmetic mean is used; however, the risk is also higher and closely resembles the risk of the EW portfolio if lambda is 1.5. Based on the presented results, the median proved to be a better estimator of the expected return than the arithmetic mean. It is more robust and can be more easily adapted to the data used for estimation.

As expected, the GMV portfolios achieved the lowest risk but also a higher return compared to the benchmark index, the EW portfolio, and the MSR portfolio, with weaker constraints on the minimum weight for the constituents ($\lambda = 4$) and the arithmetic mean used for the estimation of the expected return. As opposed to the MSR portfolio, the GMV portfolio achieved better performance with higher lambda ($\lambda = 4$), which is in line with the research of Zoričić et al. (2018), where the GMV portfolio performance is improved when a higher concentration in the portfolio is allowed. Generally, in this research, the GMV portfolio dominates the MSR portfolio, especially in the case when weaker constraints on the minimum weights for the constituents are used.

A combination of the optimization techniques for GMV and MSR portfolio estimation did not yield a portfolio with superior performance compared to the GMV or MSR portfolios. Moreover, the median proved to be a better estimator for the expected return for the MSR portfolio allowing for a higher return and a higher risk-reward ratio of the portfolio estimated as a combination of the GMV and MSR portfolios compared to the same portfolio when the arithmetic mean is used. Since only MSR estimation requires expected return estimation, this is due to better MSR estimation, which leads to the conclusion that the performance of a combined portfolio would be even better if enhanced techniques for the covariance matrix and expected return estimation were used. Since this was not tested in this paper, it could be considered as a limitation of the research.

The findings demonstrate that for emerging markets (in contrast to the undeveloped and illiquid Croatian market), the out-of-sample estimation results corroborate the findings for the developed markets, such as in Amenc et al. (2011; 2013). The results suggest that the selection of the most liquid shares traded on the stock exchanges leads to the possibility of outperforming the cap-weighted benchmark. Furthermore, to find a trade-off between optimality risk and estimation risk, strategies are often combined (i.e. diversification of strategies). This also exploits a low correlation of parameter estimation errors among strategies. Additionally, the performed tests showed that the differences in the riskiness of all estimated portfolios and the benchmark index are statistically significant at 1%, while the differences in the returns of the tested strategies and the benchmark index are not statistically significant at 10%.

6. Conclusion

This paper presents the out-of-sample testing of modern strategies available to research-driven investors for the developed markets, demonstrating the possibility to estimate mean-variance efficient portfolios that outperform market cap-weighted counterparts. In this paper, the CECE Composite Index (CECE) listed on the Vienna Stock Exchange is used as a benchmark index. The CECE index includes the most liquid stocks traded on stock exchanges in Eastern Europe, more precisely in Budapest, Prague, and Warsaw. As an alternative to weighting by market capitalization, scientific methods of diversification – GMV and MSR portfolio estimations – are used. Motivation for GMV and MSR portfolio estimation originates from the research conducted for the Croatian stock market for which the failure of the estimation of the MSR portfolio relative to the cap-weighted benchmark (Dolinar et al., 2017) can be attributed to poor estimation of stocks' expected returns since GMV portfolio estimation outperformed the MSR portfolio (Zoričić et al., 2018).

In addition to GMV and MSR portfolio estimation, the EW portfolio and a portfolio composed of a combination of the GMV (50%) and MSR (50%) portfolios were estimated. For the estimation of the expected return needed for the MSR portfolio, two different measures were used – arithmetic mean and median. The median was found to achieve superior results. In addition, to achieve greater portfolio deconcentration in the GMV and MSR portfolios, the constraint on the minimum weight for a constituent was imposed in the optimization process.

All the analyzed portfolios achieved better performance than the benchmark CECE index, including the EW portfolio, which is the result of a naïve diversification method. Therefore, investors in the Central Eastern Europe (CEE region) stocks have alternative strategies at their disposal that can be

used to estimate more efficient portfolios using constituents of the benchmark CECE index. As expected, the EW portfolio achieved a higher return compared to the cap-weighted counterpart. However, surprisingly, this was accompanied by lower risk in contrast to research that found EW portfolios to have significantly higher risk compared to their cap-weighted counterparts. In this research, the GMV portfolio dominates the MSR portfolio, especially in cases when weaker constraints on the minimum weights for the constituents are used. The GMV portfolio achieved better performance with higher lambda ($\lambda = 4$), which is in line with the research of Zoričić et al. (2018), where GMV portfolio performance is improved when a higher concentration in the portfolio is allowed. This could be explained by the fact that it is better to estimate a sub-optimal portfolio, i.e., a portfolio with certain optimality risk but decreased estimation risk (GMV), than the MSR portfolio. However, in this case, even the MSR portfolio achieved superior results compared to its cap-weighted counterpart. In contrast to the GMV portfolio, the MSR portfolio achieved better results with lower lambda ($\lambda = 1.5$, i.e., a tighter constraint on the minimum weight for the constituents) and when the median is used for the estimation of the expected returns.

In this paper, a combination of the GMV and MSR portfolios did not result in a portfolio with superior performance compared to the GMV or MSR portfolio. Since MSR portfolio estimation was improved with the median used as an estimator for the expected return, an open question remains whether the performance of the combined portfolio would be even better if advanced techniques for the covariance matrix (such as Martellini & Milhau (2017)) and expected return estimation were used, which could be tested in future research.

References

1. Amenc, N., Goltz, F. & Le Sourd, V. (2006). *Assessing the quality of stock market indices: Requirements for asset allocation and performance measurement*. EDHEC-Risk Institute. https://risk.edhec.edu/assessing-quality-stock-market-indices
2. Amenc, N., Goltz, F., Lodh, A. & Martellini, L. (2014). Towards smart equity factor indices: Harvesting risk premia without taking unrewarded risks. *The Journal of Portfolio Management*, *40*(4), 106-122. https://doi.org/10.3905/jpm.2014.40.4.106
3. Amenc, N., Goltz, F. & Martellini, L. (2013). *Smart Beta 2.0*. EDHEC-Risk Institute. https://risk.edhec.edu/publications/smart-beta-2-0. https://doi.org/10.3905/jii.2013.4.3.015
4. Amenc, N., Goltz, F., Martellini, L. & Retkowsky, P. (2011). Efficient indexation: An alternative to cap-weighted indices. *Journal of Investment Management*, *9*(4), 52-74.
5. Clarke, R., De Silva, H. & Thorley, S. (2011). Minimum-variance portfolio composition. *The Journal of Portfolio Management*, *37*(2), 31-45. https://doi.org/10.3905/jpm.2011.37.2.031
6. DeMiguel, V., Garlappi, L. & Uppal, R. (2009). Optimal versus naive diversification: How inefficient is the 1/N portfolio strategy?. *The Review of Financial Studies*, *22*(5), 1915-1953. https://doi.org/10.1093/rfs/hhm075
7. Dolinar, D., Zoričić, D. & Kožul, A. (2017). Towards the Estimation of an Efficient Benchmark Portfolio: The Case of Croatian Emerging Market. *Zagreb International Review of Economics & Business*, *20*(S1), 13-23. https://doi.org/10.1515/zireb-2017-0002
8. Grinold, R. C. (1992). Are benchmark portfolios efficient?. *Journal of Portfolio Management*, *19*(1), 34-40. https://doi.org/10.3905/jpm.1992.34
9. Haugen, R. A. & Baker, N. L. (1991). The Efficient Market Inefficiency of Capitalization-Weighted Stock Portfolios. *The Journal of Portfolio Management*, *17*(3), 35-40. https://doi.org/10.3905/jpm.1991.409335
10. Madsstuen, O. S. (2015). *Investments in emerging markets: alpha and the benefits of active portfolio management* [Master thesis, Norwegian University of Life Sciences, Ås]. Norwegian University of Life Sciences, Ås.
11. Martellini, L. & Milhau, V. (2017). Proverbial Baskets Are Uncorrelated Risk Factors! A Factor-Based Framework for Measuring and Managing Diversification in Multi-Asset Investment Solutions. *The Journal of Portfolio Management*, *44*, 8-22. https://doi.org/10.3905/jpm.2018.44.2.008
12. Nowak, K. (2017). Implementation of alternative index weighting to Warsaw Stock Exchange. *Copernican Journal of Finance & Accounting*, *5*(2), 163-179. https://doi.org/10.12775/CJFA.2016.021
13. Padmanaban, N., Mukai, M., Tang, L. & Le Sourd, V. (2013). *Assessing the Quality of Asian Stock Market Indices*. EDHEC-Risk Institute. https://climateimpact.edhec.edu/publications/assessing-quality-asian-stock-market-indices
14. Plyakha, Y., Uppal, R. & Vilkov, G. (2012). *Why does an equal-weighted portfolio outperform value- and price-weighted portfolios?*. Available at SSRN: https://ssrn.com/abstract=2724535 or http://dx.doi.org/10.2139/ssrn.2724535
15. Scientific Beta (2022). *Scientific Beta Universe Construction Rules*. https://www.scientificbeta.com/factor/#/documentation/ground-rules/scientific-beta-universe-construction-rules
16. Vienna Stock Exchange (2022). https://www.wienerborse.at/en/
17. Zoričić, D., Dolinar, D. & Lovretin Golubić, Z. (2018). A test of global minimum variance portfolio in the Croatian capital market. In *Proceedings of the 7th International Scientific Symposium ECONOMY OF EASTERN CROATIA - VISION AND GROWTH* (pp. 1165-1173). Osijek: Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek.

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DECODING THE GOVERNMENT BUDGET PUZZLE: UNVEILING THE DYNAMICS OF TAXES AND EXPENDITURES IN TURKEY THROUGH CONTINUOUS WAVELET TRANSFORM ANALYSIS

Abstract

Purpose: The relationship between public expenditure and revenue that determines the budget balance in the explanation of budget deficits is very important. This study aimed to examine the association between public spending and income in Turkey.

Methodology: This article applies the continuous wavelet transform method (CWT) to study the relationship between government revenues and expenditures in Turkey. The study, which covers the period 2006-2020, consists of monthly data. The following four CWT tools were used in the analysis: Wavelet Power Spectrum, Cross Wavelet Power, Wavelet Coherence, and Phase Difference.

Results: The results of the study, controlling taxes rather than expenditures, play a key role in reducing fiscal deficits in Turkey in the short term. It is revealed that the dynamics of the budget balance in the medium term can be explained by the spend-tax hypothesis and that the tax burden can be alleviated by spending cuts. In the long term, results were obtained that support the spend-tax hypothesis.

Conclusion: The paper reveals that taxes play an important role in controlling budget deficits in the short run. It turns out that the dynamics of the budget balance can be explained in the medium term by expenditure cuts and then the tax burden can be alleviated. In the long run, implementing fiscal policies based on public spending rather than taxation will be more effective against budget deficits.

Keywords: Government revenue, government expenditure, wavelet approach, continuous wavelet coherence, Turkey

1. Introduction

Many countries have had the issue of budget imbalances after 1970. The relationship between public expenditure and revenue that determines the budget balance in the explanation of budget deficits is very important. In the field of public finance, the relationship between these two variables has been studied by many academics. This study aimed to examine the association between public spending and income in Turkey. The Turkish economy often faces the issue of a budget deficit. However, except for the years 2009 and 2019, the Turkish budget deficits/GDP have been meeting the Maastricht criteria since 2006. Due to the repercussions of the 2008 mortgage crisis in Turkey, there were deviations in the budget deficits in 2009 and 2010. In addition, the volatility experienced in public revenues and expenditures in Turkey over the years has laid the groundwork for the investigation of this issue. In this context, the co-movement of the relationship between public income and expenditure from 2006:1 to 2020:7 was tested by wavelet analysis. Although there exist many studies in the literature related to this issue, there are no studies that have conducted relevant tests by wavelet analysis for Turkey. In this respect, the study is expected to contribute to the literature concerning its empirical analyses of time-frequency analyses with wavelet coherence analyses. The studies available in the literature often employ field analysis/correlation analysis or time series models/panel data models to analyze the relationships between public expenditure and revenue, which is where this study differs from them in terms of the research approach (Bilgili et al., 2020, p. 4). These analyses often yield parameter estimates that do not change or alter as a result of two to three structural breakings throughout the sample period. However, for all sampling and subsampling periods at various frequencies in Turkey for the monthly period, this article employs continuous wavelet model estimates. Therefore, at sub-sample periods that correspond to both the low frequency and the high frequency of the observed time series data, prospective changes in the interactions of variables are taken into account. The method utilized here emphasizes the utility of the wavelet methodology by demonstrating how government revenue and spending interact at different frequencies and across time. The study also provides critical information about the health of the tax-spending nexus from both a cyclical and anticyclical approach (Mutascu, 2017, p. 2). Based on this, the wavelet approach used in this study enables the relationship between tax and expenditure to be revealed more clearly and strongly.

The rest of this study is organized in the following way. The theoretical context and empirical literature are presented in sections 1 and 2, respectively. The method is described in Section 3. The data are described in Section 4, together with the outcomes of empirical estimates. Finally, Section 5 summarizes the research findings and makes recommendations for further research.

2. Theoretical background

Government expenditures and revenues are important in terms of budget balance. They are the main determinants of the budget balance. A budget imbalance is when expenditure exceeds revenue. This is called a budget deficit. Otherwise, a budget surplus occurs. The topic of the budget deficit is one of the most contentious ones in public finance. The literature on this subject is quite extensive. The budget deficit issue is explained by four primary theories derived from the literature. The hypotheses are as follows: (a) the tax and spend hypothesis, (b) the spend and tax hypothesis, (c) the fiscal synchronization hypothesis, and (d) the fiscal independence or institutional separation hypothesis.

According to the tax-and-spend theory, increases in tax revenues should result in changes in government spending. In other words, this theory proposes a one-way causal relationship between taxes and spending. This theory is consistent with the central tenet of the Keynesian model according to which macroeconomic stability is sought through the management of aggregate demand through taxation and spending measures in fiscal policy. The Friedman (1978) and Buchanan and Wagner (1977) hypotheses offer two alternative points of view on the tax-spend relationship. Tax-related expenses were first discussed by Friedman in 1978. According to Friedman (1978), tax increases only lead to an increase in government spending, and not a reduction in the budget deficit (Chang et al., 2002, p. 1554). In other words, raising taxes will not reduce the budget deficit since increased tax collections will put pressure on lawmakers to increase spending. As a result, cutting taxes would be the wisest course of action because it would result in less government spending. Buchanan and Wagner

(1977), however, made the opposing case. They underlined that expenditure and taxes do indeed correlate, but that this link is negative because of the fiscal illusions of the taxpayers. When taxes are dropped, people perceive public goods and services to be cheaper, which raises demand and encourages government spending. Buchanan and Wagner (1977) recommended reducing public spending by restricting government access to deficit finance in order to reduce deficits (Mutascu, 2016, p. 3).

Peacock and Wiseman (1961; 1979) proposed the spend-and-tax hypothesis, which is the reverse of the tax-and-spend hypothesis and it is based on the idea that spending generates income. They said that because of crises or other extreme circumstances, the government will temporarily raise spending, which will cause taxes to go up forever. Barro's (1974; 1979) research also supports this strategy. War, uncertain political situations, and other structural breaches may boost public spending to the point that taxes rise. Ricardian equivalence is consistent with the spend-tax idea. In the tax smoothing hypothesis, according to Barro (1979), it is best to raise tax rates and create a budget deficit to finance changes in government spending. Barro, therefore, rejected the notion that taxpayers suffer from fiscal illusion.

These theories contend that adjustments to government spending result in adjustments to government revenues (taxes). The spend-and-tax strategy, therefore, assumes a favorable one-way relationship between government spending and revenue.

The third hypothesis - financial synchronization - was primarily put forth by Musgrave (1966), Meltzer and Richard (1981). According to this theory, governments might alter taxes and spending at the same time. In other words, it is anticipated that this technique will involve a two-way or mutual interaction. Revenue and expenditure are set simultaneously under financial synchronization, and it is said that the public is aware of the advantages of government services relative to their costs (Musgrave, 1966). According to this idea, cutting spending and making serious efforts to raise revenues is the best course of action for addressing issues with the budget deficit.

Conversely, it was stressed by Wildavsky (1975) and Baghestani and McNown (1994) that public revenues and expenditures will be decided separately because several institutions are involved in the budgeting process and there isn't any fundamental agreement among them. This "institutional separation" theory implies that decisions regarding spending and income may be made independently of one another. In other words, this theory suggests that there is no connection between spending and income.

3. Empirical literature

The "tax and spend", "spend and tax", "fiscal synchronization", and "institutional separation" hypotheses are crucial for illuminating the connection between budget deficits, government spending, and government revenue. In this section, the empirical studies in the literature on this subject (for other countries and for Turkey) are reviewed and their results are summarized in Table 1 and Table 2 in Appendix 1. While some of the studies examined the long-term relationship using cointegration analysis, others considered the short-term relationship using error correction models. In addition, it was found that techniques of time series analysis and panel data analysis were applied.

The tax spending hypothesis, also known as the "tax-and-spend" hypothesis, is a theory in economics that suggests that governments can stimulate economic growth by increasing their level of spending and taxation. The idea is that by increasing government spending, the government can create demand for goods and services, which can in turn lead to increased production and economic growth. At the same time, by increasing taxation, the government can collect additional revenue, which can be used to fund increased spending and support further economic growth.

There is a significant body of research on the tax-spend hypothesis, and the evidence suggests that it can be an effective tool for stimulating economic growth. For example, it was found that there was a one-way relationship between revenues and expenditures in single-country empirical studies by Kollias and Paleologou (2006) (for Italy, Spain and Luxembourg), Westerlund et al. (2011), Apergis et al. (2012), Mutascu (2016) (for Czechia, Hungary and Slovenia), Linhares and Nojosa (2020) (for Germany, the United Kingdom and Italy), Salvi and Schaltegger (2021), and Nzimande and Ngalawa (2022) (for Botswana). However, not all research studies support the tax-spend hypothesis. Some studies have suggested that an increase in public

spending will increase taxes, particularly in countries with high levels of public debt. For instance, the spend-tax hypothesis has been supported by numerous studies, including Kollias and Paleologou (2006) (for France, Finland and the United Kingdom), Paleologou (2013) (for Greece), Mutascu (2016) (for Bulgaria), Tiwari and Mutascu (2016), Linhares and Nojosa (2020) (for France), Salvi and Schaltegger (2021), and Nzimande and Ngalawa (2022) (for Mauritius and Mozambique).

The causal relationship between public spending and income was discovered to be mutually bidirectional by Kollias and Paleologou (2006) (for Denmark, Greece, Ireland, the Netherlands, Portugal, and Sweden), Paleologou (2013) (for Sweden and Germany), Mutascu (2016) (Slovakia), Akram and Rath (2019), Linhares and Nojosa (2020) (for Spain), and Arvin et al. (2021) (the financial synchronization hypothesis). However, some research studies, such as those by Baghestani and McNown (1994), Kollias and Paleologou (2006) (for Austria, Belgium, and Germany), and Mutascu (2016) (for Estonia, Latvia, Romania, Lithuania, and Poland) found no evidence of a direct association between public expenditures and revenues. This indicates that there is no relationship between income and spending and that revenue and expenditure are independent (the institutional separation hypothesis).

In the Appendix in Table 1, given the empirical multi-country studies, there are studies in which the "tax-spend", "spend-tax", "financial synchronization", and "institutional separation" hypotheses are valid. Factors, such as country groups, time series, and methods appear to influence the results of these studies. Since Turkey is the country on which this study focuses, it is more accurate to focus on the studies in which Turkey is involved.

As seen in Table 2 in the Appendix, it was determined that there is causality from expenditures to taxes in studies conducted for Turkey, Pınar (1998), Akçoraoğlu (1999), Günaydın (2000), Günaydın (2004a), Çavuşoğlu (2008), Aysu and Bakırtaş (2018), Kamacı and Kurt (2021), Yıldız and Demirkılıç (2022). According to this result, the expenditures to be made in Turkey are first determined, and then the revenues to cover the planned expenditures are sought. The policy proposal that emerged from these studies is to reduce public expenditures. However, Darrat (1998), Günaydın (2004b), Payne et al. (2008), and Yılancı et al. (2020) demonstrated the tax-spend hypothesis for Turkey. In other words, it was discovered that raising taxes causes a decline in public spending. The policy proposal of these studies is that taxes be raised to decrease public deficits.

Akçağlayan and Kayıran (2010) found that there was no causal relationship between public expenditures and revenues for the period 1987-2005. This means that revenues and expenditures are decided independently. The findings of Çiçek and Yavuz (2014) confirm this result. However, it is not possible to separate the institutions that make tax and spending decisions in Turkey, as the central state budget is prepared by the government and comes into effect after it has been approved by the legislature.

There may be two reasons why these studies of Turkey reach different conclusions. The first reason is that the requirement of parameter constancy is not met in the estimated models due to political changes over time, especially in studies that include annual data and thus a long time interval, and this has not been demonstrated by any statistical tests. The second reason could be that the estimated econometric models are sensitive to the stationarity properties of the variables used and the lag lengths specified, but these sensitivities are ignored in econometric estimates (Çavuşoğlu, 2008, p. 146).

4. Methodology

In the time-frequency domain, time series are analyzed using the wavelet approach.[1] Despite its frequent use in macroeconomic research, wavelet analysis is not expressly employed in the study of public economics. In this paper, the area of public economics is addressed using four continuous wavelet transform tools, i.e. wavelet power spectrum, cross-wavelet power, wavelet coherence, and phase difference. This section describes these four wavelet analysis tools. Before introducing the tools, let us provide simple definitions of wavelet and continuous wavelet transform.

For the majority of applications, it is sufficient to demand the mother wavelet to have a zero mean, or $\int_{-\infty}^{\infty} \psi(t)dt = 0$, and functions with adequate decay. As a result, the function ψ must shift the t-axis higher and downward as it gets closer to zero; in other words, it must act like a tiny wave that gets weaker the farther it gets from the center. Effective

1 In this section, we refer to Torrence and Compo (1998) and Aguiar-Conraria et al. (2008).

localization in both time and frequency is made possible by this capability.

The continuous wavelet transforms (CWT) with respect to the wavelet ψ, and is a two-variable function $W_{x,\psi}(\tau,s)$, given a time series $x(t)$:

$$W_{x,\psi}(\tau,s) = \int x(t)\frac{1}{\sqrt{s}}\bar{\psi}\left(\frac{t-\tau}{s}\right)dt, \quad (1)$$

where s stands for a scaling factor that regulates the wavelet width, and τ stands for a translation parameter that regulates its position where the bar denotes complex conjugation.

A wavelet can only be stretched or compressed if s is greater than or less than 1, respectively, while it can only be translated if its position in time is changed[2].

Wavelet functions are a mathematical tool that comes in various forms, each with its own characteristics and uses. Some examples of wavelet functions include the Morlet, Mexican Hat, Haar, and Daubechies. Among these, the Morlet wavelet is particularly popular because it has both a real and an imaginary component, which allows it to capture both the amplitude and the phase of a signal. This makes it useful for various applications, from signal processing to image analysis. For this reason, we used Morlet wavelets in the analysis, a simple version is defined as follows:

$$\psi_\eta(t) = \pi^{-\frac{1}{4}} e^{i\eta t} e^{-\frac{1}{2}t^2}, \quad (2)$$

where ψ denotes the central frequency of the wavelet, here taken to be 6 to satisfy the admissibility condition (Farge, 1992), which is often used in economic applications[3].

The wavelet power spectrum is a measure of the local variance of a signal, and can be calculated as the square of the absolute value of the wavelet coefficient $|W_n^x|^2$. The statistical significance of this measure can be assessed by its comparison to the null hypothesis that the data is generated by a stationary process with a known background power spectrum (P_f). Torrence and Compo (1998) developed methods for calculating the wavelet power spectra of white and red noise processes, and provided the corresponding distributions for the local wavelet power spectrum under the null hypothesis:

$$D\left(\frac{|W_n^x(S)|^2}{\sigma_x^2} < p\right) = \frac{1}{2}P_f\chi_v^2 \quad (3)$$

at each time n and scale s. P_f indicates the mean spectrum at the Fourier frequency f that corresponds to the wavelet scale s (in our case, $s \approx \frac{1}{f}$). The variable v is equal to 1 or 2, for real or complex wavelets, respectively. For more general processes, one must depend on Monte Carlo simulations.

The concepts of cross wavelet power (XWT), wavelet coherency, and phase difference are extensions of the basic wavelet analysis tools that allow us to study the time-frequency dependencies between two time series. The cross wavelet transforms of two time series, *x (t)* and *y (t)*, are calculated as follows:

$$W_{xy}(\tau,s) = W_x(\tau,s)\overline{W_y}(\tau,s), \quad (4)$$

where W_x and W_y are the x and y wavelet transforms, respectively. The XWT is determined as $|W_{xy}(\tau,s)|$. The XWT of two time series is a measure of the local covariance between them at each time and frequency. This allows us to quantitatively assess the similarity of power between the two time series. In contrast, wavelet coherency (WTC) has the advantage of being normalized by the power spectrum of each time series. Similarly to Fourier spectral methods, the wavelet coherency (R_{xy}) of two time series, *x (t)* and *y (t)*, is defined as follows (Aguiar-Conraria et al., 2013, p. 395):

$$R_{xy}(\tau,s) = \frac{\left|S\left(W_{xy}(\tau,s)\right)\right|}{\sqrt{S(|W_{xx}(\tau,s)|)S\left(\left|W_{yy}(\tau,s)\right|\right)}}, \quad (5)$$

where S indicates a smoothing operator in both time and scale, and $0 \le R_{xy}(\tau,s) \ge 1$. As previously mentioned, one of the key benefits of utilizing a complex wavelet is that we can compute the phase of the wavelet transform for each series and, as a result, get information about potential delays in the undulation (cycles) of the two series as a function of time and scale frequency. Equation 6 may be used to get the phase difference from the cross-wavelet transform.

$$\phi_{xy}(s,\tau) = tan^{-1}\left(\frac{\Im\left(W_{xy}(s,\tau)\right)}{\Re\left(W_{xy}(s,\tau)\right)}\right) \quad (6)$$

The value of $\phi_{xy} \in [-\pi, \pi]$ in its entirety, as well as details about the signs of each component. The time

2 In fact, we are concerned with a discrete time series $x = \{x_t, t = 0, \dots, T-1\}$ of T observations with a uniform time step. It is necessary to discretize the integral in (1), which is altered by a sum over the T time steps.

3 See, for instance, Torrence and Compo, 1998; Aguiar-Conraria et al., 2008; Aguiar-Conraria et al., 2012.

series moves together at the appropriate frequency when the phase difference is zero. The series advances in phase If $\phi_{xy} \in \left[0, \frac{\pi}{2}\right]$ although time series y goes ahead of x. If $\phi_{xy} \in \left[-\frac{\pi}{2}, 0\right]$, x is in the lead. An antiphase relationship may be seen in the phase difference $(or - \pi)$. If $\phi_{xy} \in \left[\frac{\pi}{2}, \pi\right]$, then x leads. Time series y leads if $\phi_{xy} \in \left[-\pi, -\frac{\pi}{2}\right]$.

5. Data and empirical result

Using a wavelet method[4], the results of this study demonstrate the correlation (co-movements) between taxation and government expenditure in Turkey. Table 1 provides the symbols, explanations, and sources of the variables.

Table 1 Data explanations: 2006:1-2020:7

Variable	Definition	Acronym	Source
Government Revenue	Revenue comprised of taxes, social contributions, grants received, and other sources.	x	Republic of Turkey Ministry of Treasury and Finance
Government Expenditure	Total expenditure comprised of total expense and the net acquisition of non-financial assets	y	Republic of Turkey Ministry of Treasury and Finance

Source: Authors

The monthly data (2006M1-2020M7) in the study were taken from the database of the Ministry of Treasury and Finance (Turkey). Both series are translated from Turkish Lira into US Dollars and described in real terms to take inflation into account. These monthly series need to be adjusted for the seasons. Therefore, using the Census-X11 approach, these series were corrected for seasonal effects. Since GDP has cyclical impacts on the analysis and is not available in Turkey at monthly frequencies, the method of modifying variables by GDP was rejected in this study.

The wavelet transformation was used to measure the degree of linear relationship between two non-stationary time series in the frequency domain (Aguiar-Conraria et al., 2008, p. 2877). Before conducting the empirical study, we applied unit root tests to assess the stationarity of relevant variables. We used the Augmented Dickey-Fuller (ADF, 1979), Kwiatkowski–Phillips–Schmidt–Shin (KPSS, 1992), and Zivot-Andrew (ZA, 1992) tests to determine the statistical stationarity of the series. The ADF method tests the null hypothesis of a unit root, while the KPSS and ZA tests are designed to test for stationarity. The results of these unit root tests for government revenues and expenditures are summarized in Table 2.

Table 2 The unit root tests of government revenues and expenditures

	ADF (H0 = the series has a unit root)		KPSS (H0 = the series is stationary)		ZA (H0 = the series has a unit root with a structural break)	
Variable	Intercept	Trend and intercept	Intercept	Trend and intercept	Intercept	Trend and intercept
(x)	-3.776[a]	-3.696	0.467	0.358[a]	-3.345[a] *(k=5)*	-4.628 *(k=5)*
(y)	-2.876	-2.448	0.607	0.353[a]	-3.355[a] *(k=7)*	-3.781 *(k=7)*
Breakpoint in (x)					2009M12	2012M10
Breakpoint in (y)					2009M07	2012M10

Notes: (i) α denotes 1% levels of significance, which is significant. (ii) According to the Schwarz Information Criterion, k is the optimal lag.
Source: Authors

[4] R codes recommended by Rösch and Schmidbauer (2016) were used for all wavelet estimations.

The ADF test indicates that both series with trend and intercept are nonstationary in levels, and the null hypothesis cannot be rejected in either series. For both series, the KPSS test rejected the null hypothesis with intercept, that is, both series are nonstationary in levels. The ZA results demonstrate that for both series with intercept, the unit root null hypothesis cannot be rejected at a 1% significance level. The estimated breakpoint for the government revenue series is in 2009M12, and for the government expenditure series, it is in 2009M07. The estimated breakpoints coincide with the fact that the mortgage crisis experienced all over the world in 2008 affected Turkey as well, followed by the deteriorating economic conditions since the end of 2009. As a result, the variables are non-stationary series depending on the demands of the wavelet tool (Mutascu, 2017, p. 9).

Figure 1 (the wavelet analysis results are presented in Appendix 2) indicates that the wavelet power of x is high and significant at 0.25–1 month of scale, for the period 2006M8-2007M9, and 2018M4-2019M10. In addition, it demonstrates that the wavelet power of x is high and significant on the 8-month scale for the 2012M4-2014M4 periods. As seen in Figure 2 (in Appendix 2), the periods of the wavelet power of y show similarities with Figure 1.

In general, when the CWT power spectrum of the public revenues (x) and expenditures (y) series is analyzed, the 0.25-1-month and 8-month scales cover the periods mentioned above, the cross-wavelet power of the series should be taken into account since these similar features might appear as a result of a basic coincidence. Additional details about covariance and co-movement of the variables under consideration can be found in the cross-wavelet power. The XWT outcomes are displayed in Figure 3 (in Appendix 2).

Two series, government revenue, and government spending appeared to be evolving in terms of behavior. According to the XWT power spectrum analysis, Figure 3 monitors the co-movements between government revenue and spending, and it shows that in the short-term cycle (a 1-4 month frequency):

i. In the 2007-2014 period, the arrows pointing to the right and down indicate that the variables are in phase. This demonstrates that spending has a positive impact on income.

ii. In the 2016-2019 period, the variables are in an upward and to the right phase, showing that tax revenues positively affect government expenditure. However, the correlation between the variables during this period and one another appears to be much smaller than it was between the variables from 2007 to 2014.

In the medium-term cycle (over an 8-month frequency):

i. In the 2012-2014 period, the arrows pointing down and to the right indicate that the variables are in phase. The arrows point to the right and down, and expenditures have a positive impact on revenues.

We may learn about coherence and delay between the oscillations of two time series from the phase difference. We can determine the strength of the association using the cross-wavelet transform. Since there is some overlap between the two measurements and wavelet coherence has the benefit of being normalized by the power spectrum of the two time series, we chose to focus on wavelet coherence (WTC) rather than the wavelet cross-spectrum (XWT) for cross-wavelet analysis. A strong local correlation is a term used to describe regions with significant coherence between two countries (Aguiar-Conraria & Soares, 2011, p. 484). For these reasons, WTC was chosen as a better wavelet power tool over the XWT.

According to the WTC study and Figure 4 (in Appendix 2), which monitors changes in government revenues and expenditures in the short-term cycle (frequency of 2-8 months):

i. In the 2011 period, more spending led to higher revenues (frequency of 2-4 months), shown by the arrows pointing to the right and down. The 2010 plan aimed to boost the economy after the 2008 crisis by focusing on global crisis recovery, increased public investment, and more state revenue through taxes. As a result, public spending rose, reaching its peak in tax revenues in 2011.

ii. In the 2016-2017 period, government expenses had a negative impact on revenues (frequency of 2-4 months), indicated by the left and up arrows. Global events like war,

terrorism, decreased tourism, and political changes affected the budget, with internal turmoil in 2016 leading to an economic crisis in Turkey, impacting the budget negatively.

iii. In the 2019 period, government revenues positively led expenditures (frequency of 2-4 months), shown by the right and up arrows. Law No. 6736 of 2016 expanded the tax base, and increased income tax, corporate income tax, and value-added tax. Additionally, the corporate tax rate temporarily rose to 22% after 2017, leading to extra revenue being spent.

iv. In the 2006-2007 period, the left and up arrows indicated a negative impact of government spending on revenues (frequency of 4-8 months), confirming a structural breakpoint (Zivot & Andrews) in government revenues since 2009. Budget deficits increased due to the 2008 global crisis in Turkey, but reducing some tax rates (from 30% to 20% of the corporate tax rate) effectively countered a decline in demand.

v. In the 2008, 2010-2011, and 2012-2013 periods, the right and up arrows indicated a positive impact of government revenues on expenditures (frequency of 4-8 months). However, this association appeared comparatively weaker in the 2010–2011 period. After 2008, fiscal policy aimed to stimulate investment, and in 2010, the government increased taxes (the value-added tax and the special consumption tax) to control the rising budget deficit.

vi. In 2014, the right and down arrows showed positive impacts of expenditures on revenues (frequency of 4-8 months), following Law No. 6736 of 2013, which increased some tax revenues.

vii. In 2015, the arrows pointing up indicated no clear relationship between public expenditures and revenues (frequency of 4-8 months).

viii. In 2015, as the arrows point not to the right or to the left but up, there is no relationship between public expenditures and revenues (frequency of 4-8 months).

ix. In the 2018-2020 period, the right and up arrows revealed a positive relationship, where government revenue positively impacted spending (frequency of 4-8 months). Law No. 6736 of 2016 expanded the tax base and increased income tax, corporate income tax, and value-added tax. Additionally, the corporate income tax was raised from 20% to 22% in 2018, 2019, and 2020.

In a medium-term cycle (frequency of 8-24 months):

i. In the 2006-2007 and 2008-2011 periods, the arrows pointing down and to the right indicate that spending has a positive impact on income. However, this connection seems stronger in the 2006-2007 period compared to the 2008-2011 period (frequency of 14-16 months). The economic crisis led to increased public expenditures from 2008 to 2011, resulting in the highest growth in tax revenues in 2011. This is supported by the ZA structural breakpoint test, and interest expenses showed an upward trend from 2006 to 2009.

ii. In the 2015-2018 period, the arrows pointing up and to the right signify that increasing tax revenue leads to higher government spending (frequency of 14-24 months). An increase in some tax revenues was a result of Law No. 6736 enacted in 2016.

In the long-term cycle (frequency of over 24 months):

i. In the 2008-2011 period, the arrows pointing to the right and down indicate that expenditures have a positive impact on revenues (frequency of 24-32 months). The global crisis led to an increase in the share of public expenditures in GDP (40.10%). The ZA test reinforces the fact that this is a special time.

ii. In the 2014-2018 period, as the arrows point to the right and down, government expenditures positively influence revenues (frequency of over 32 months). After 2016, government expenditures increased due to internal turmoil in the country.

In summary, the tax-expenditure separation, expenditure-tax separation, and institutional separation hypotheses occurred in different periods and

with different frequencies. The results obtained partially correspond to those of the studies that treat the subject according to traditional methods, but only for certain periods and different frequencies (Pınar, 1998; Akçoraoğlu, 1999; Günaydın, 2000; Günaydın, 2004a; Çavuşoğlu, 2008, Darrat, 1998; Günaydın, 2004b; Akçağlayan & Kayıran, 2010). However, there is no evidence for the financial synchronization hypothesis for Turkey.

6. Conclusion

The relationship between public expenditures and tax revenues is important for reducing budget deficits. The fact that budget deficits have become a structural problem, especially in developing countries, has made the relationship between public expenditures and revenues even more important. The relationship between government expenditure and revenue has been studied by many researchers using traditional methods, such as area analysis/correlation analysis or time series models/panel data models. In contrast to previous research, this study employs a wavelet method using monthly data from 2006 to 2020 to examine the direction of causality between government expenditures and revenues in Turkey. The lead-lag relationship between variables under cyclical and anti-cyclical shocks is addressed in the study, which provides in-depth details about this relationship for special sub-periods and varied frequencies.

The results of the study support the view that taxes play an important role in controlling budget deficits. Accordingly, controlling taxes rather than expenditures plays a key role in reducing fiscal deficits in Turkey in the short term. It is revealed that the dynamics of the budget balance in the medium term can be explained by the spend-tax hypothesis and that the tax burden can be alleviated by spending cuts. In the long term, the results were obtained that support the spend-tax hypothesis. In this context, the implementation of fiscal policy based on public spending rather than tax policy will be more effective in the fight against budget deficits. However, it should be taken into account that public expenditures made without creating resources will cause an increase in the tax burden in the future.

Future studies should focus on more countries and data (which is a limitation of this study) to compare the duration and path of the budget deficit cycle (tax and spending). The limitations of our study do not limit the contribution to the field because this study aimed to provide empirical evidence by analyzing budget deficit cycles with the wavelet approach for the first time, specifically in Turkey (not to investigate them globally).

References

1. Aguiar-Conraria, L., Azevedo, N. & Soares, M. J. (2008). Using wavelets to decompose the time–frequency effects of monetary policy. *Physica A: Statistical Mechanics and its Applications*, *387*(12), 2863-2878. https://doi.org/10.1016/j.physa.2008.01.063
2. Aguiar-Conraria, L., Magalhães, P. C. & Soares, M. J. (2013). The nationalization of electoral cycles in the United States: a wavelet analysis. *Public Choice*, *156*, 387-408. https://doi.org/10.1007/s11127-012-0052-8
3. Aguiar-Conraria, L., Martins, M. M. & Soares, M. J. (2012). The yield curve and the macro-economy across time and frequencies. *Journal of Economic Dynamics and Control*, *36*(12), 1950-1970. https://doi.org/10.1016/j.jedc.2012.05.008
4. Aguiar-Conraria, L. & Soares, M. J. (2011). Business cycle synchronization and the Euro: a wavelet analysis. *Journal of Macroeconomics*, *33*(3), 477-489. https://doi.org/10.1016/j.jmacro.2011.02.005
5. Akçağlayan, A. & Kayıran, M. (2010). Türkiye'de kamu harcamaları ve gelirleri : nedensellik ilişkisi üzerine bir araştırma. *Eşkişehir Osman Gazi Üniversitesi İİBF Dergisi*, *5*(2), 129-146.
6. Akçoraoğlu, A. (1999). Kamu Harcamaları, kamu gelirleri ve keynesçi politikalar: Bir nedensellik analizi. *Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *1*(2), 51-65.
7. Akram, V. & Rath, B. N. (2019). Is there any evidence of tax-and-spend, spend-and-tax or fiscal synchronization from panel of Indian state? *Applied Economics Letters*, *26*(18), 1544-1547. https://doi.org/10.1080/13504851.2019.1584363
8. Apergis, N., Payne, J. E. & Saunoris, J. W. (2012). Tax-spend nexus in Greece: Are there asymmetries? *Journal of Economic Studies*, *39*(3), 327-336. https://doi.org/10.1108/01443581211245900
9. Arvin, M. B., Pradhan, R. P. & Nair, M. S. (2021). Are there links between institutional quality, government expenditure, tax revenue and economic growth? Evidence from low-income and lower middle-income countries. *Economic Analysis and Policy*, *70*, 468-489. https://doi.org/10.1016/j.eap.2021.03.011
10. Aysu, A. & Bakırtaş, D. (2018). Kamu harcamalariıve vergi gelirleri arasindaki asimetrik nedensellik ilişkisi: Türkiye örneği. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, (51), 1-19. https://doi.org/10.18070/erciyesiibd.327607
11. Baghestani, H. & McNown, R. (1994). Do revenues or expenditures respond to budgetary disequilibria? *Southern Economic Journal*, *61*(2), 311-322. https://doi.org/10.2307/1059979
12. Barro, R. J. (1974). Are government bonds net wealth?. *Journal of Political Economy*, *82*(6), 1095-1117. https://doi.org/10.1086/260266
13. Barro, R. J. (1979). On the determination of the public debt. *Journal of Political Economy*, *87*(5), 940-971. https://doi.org/10.1086/260807
14. Bilgili, F., Koçak, E., Kuşkaya, S. & Bulut, Ü. (2020). Estimation of the co-movements between biofuel production and food prices: a wavelet-based analysis*. Energy*, 213, 118777. https://doi.org/10.1016/j.energy.2020.118777
15. Buchanan, J. M. & Wagner, R. E. (1977). *Democracy in Deficit: The Political Legacy of Lord Keynes* (Vol. 8). Academic Press. https://doi.org/10.2307/1182640
16. Çavuşoğlu, T. (2008). Türkiye'de kamu gelirleri ve harcamaları arasındaki ilişki üzerine ekonomietrik bir analiz. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, *20*, 143-160.
17. Chang, T., Liu, W. R. & Caudill, S. B. (2002). Tax-and-spend, spend-and-tax, or fiscal synchronization: New evidence for ten countries. *Applied Economics*, *34*(12), 1553-1561. https://doi.org/10.1080/00036840110103265
18. Çiçek, G. H. & Yavuz, İ. S. (2014). Vergi-harcama paradoksu: Türkiye'de belediyeler üzerine bir araştırma. *Çağdaş Yerel Yönetimler*, *23*(4), 17-31.
19. Darrat, A. F. (1998). Tax and Spend, or Spend and Tax? An Inquiry into the Turkish Budgetary Process. *Southern Economic Journal*, *64*(4), 940-956. https://doi.org/10.2307/1061212

20. Dickey, D. A. & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366), 427-431. https://doi.org/10.2307/2286348

21. Farge, M. (1992). Wavelet transforms and their applications to turbulence. *Annual Review of Fluid Mechanics*, *24*(1), 395-458. https://doi.org/10.1146/annurev.fl.24.010192.002143

22. Friedman, M. (1978). The Limitations of Tax Limitation. *Policy Review*, *5*(Summer), 7-14.

23. Günaydın, İ. (2000). Türkiye'de kamu gelirleri ve kamu harcamaları arasındaki nedensel ilişkiler. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *5*(1), 55-74.

24. Günaydın, İ. (2004a). Gelir veya harcama ayarlamaları yoluyla bütçe dengesi sağlanabilir mi? Türkiye örneği. *İktisat İşletme ve Finans*, *19*(218), 84-98. https://doi.org/10.3848/iif.2004.218.5208

25. Günaydın, İ. (2004b). Vergi-harcama tartışması: Türkiye örneği. *Doğuş Üniversitesi Dergisi*, *5*(2), 163-181. https://doi.org/10.31671/dogus.2019.295

26. Kamacı, A. & Kurt, O. (2021). Kamu harcamaları ile vergi gelirleri ilişkisi: Pandemi öncesi ve sonrası için bir değerlendirme. *Journal of Life Economics*, *8*(4), 455-462. https://doi.org/10.15637/jlecon.8.4.05

27. Kollias, C. & Paleologou, S. M. (2006). Fiscal policy in the European Union: Tax and spend, spend and tax, fiscal synchronisation or institutional separation?. *Journal of Economic Studies*, *33*(2), 108-120. https://doi.org/10.1108/01443580610666064

28. Kwiatkowski, D., Phillips, P. C., Schmidt, P. & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?. *Journal of Econometrics*, *54*(1-3), 159-178. https://doi.org/10.1016/0304-4076(92)90104-Y

29. Law No. 6736 Regarding the Restructuring of Certain Receivables. (Official Gazette No. 29806).

30. Linhares, F. & Nojosa, G. (2020). Changes in the tax-spend nexus: Evidence from selected European countries. *Economics Bulletin*, *40*(4), 3077-3087.

31. Meltzer, A. H. & Richard, S. F. (1981). A rational theory of the size of government. *Journal of Political Economy*, *89*(5), 914-927. https://doi.org/10.1086/261013

32. Musgrave, R. (1966). Principles of budget determination. *Public finance: Selected readings*, 15-27.

33. Mutascu, M. (2016). Government Revenues and Expenditures in the East European Economies: A Bootstrap Panel Granger Causality Approach. *Eastern European Economics*, *54*(6), 489-502. https://doi.org/10.1080/00128775.2016.1204237

34. Mutascu, M. (2017). The tax–spending nexus: evidence from Romania using wavelet analysis. *Post-Communist Economies*, *29*(3), 431-447. https://doi.org/10.1080/14631377.2017.1319170

35. Nzimande, N. P. & Ngalawa, H. (2022). Tax-spend or spend-tax? The case of Southern Africa. *Economies*, *10*(4), 85. https://doi.org/10.1080/14631377.2017.1319170

36. Paleologou, S. M. (2013). Asymmetries in the revenue–expenditure nexus: A tale of three countries. *Economic Modelling*, *30*, 52-60. https://doi.org/10.1016/j.econmod.2012.09.022

37. Payne, J. E., Mohammadi, H. & Cak, M. (2008). Turkish budget deficit sustainability and the revenue-expenditure nexus. *Applied Economics*, *40*(7), 823-830. https://doi.org/10.1080/00036840600749904

38. Peacock, A. T. & Wiseman, J. (1961). *The Growth of Public Expenditure in the United Kingdom*. Oxford University Press.

39. Peacock, A. T. & Wiseman, J. (1979). Approaches to the analysis of government expenditure growth. *Public Finance Review*, *7*(1), 3-23. https://doi.org/10.1177/109114217900700101

40. Pınar, A. (1998). A model of government expenditures in Turkey. *Yapı Kredi Economic Review*, *9*(2), 51-71.

41. Republic of Turkey Ministry of Treasury and Finance (2023). *Statistics*. https://hmb.gov.tr/kamu-finansmani-istatistikleri

42. Rösch, A. & Schmidbauer, H. (2016). WaveletComp 1.1: A guided tour through the R package

43. Salvi, M. & Schaltegger, C. A. (2022). Tax more or spend less? Historical evidence from Switzerland's federal budget plans. *International Tax and Public Finance*, *30*(3), 678-705. https://doi.org/10.1007/s10797-021-09716-8

44. Tiwari, A. K. & Mutascu, M. (2016). The revenues-spending nexus in Romania: a TAR and MTAR approach. *Economic Research-Ekonomska Istrazivanja*, *29*(1), 735-745. https://doi.org/10.1080/1331677X.2016.1197549

45. Torrence, C. & Compo, G. P. (1998). A practical guide to wavelet analysis. *Bulletin of the American Meteorological Society*, *79*(1), 61-78. https://doi.org/10.1175/1520-0477(1998)079%3C0061:APGTWA%3E2.0.CO;2

46. Westerlund, J., Mahdavi, S. & Firoozi, F. (2011). The tax-spending nexus: Evidence from a panel of US state–local governments. *Economic Modelling*, *28*(3), 885-890. https://doi.org/10.1016/j.econmod.2010.10.016

47. Wildavsky, A. (1975). *Budgeting: A Comparative Theory of Budgetary Processes*. Little, Brown & Company.

48. Yılancı, V., Şaşmaz, M. Ü. & Öztürk, Ö. F. (2020). Türkiye'de kamu harcamaları ile vergi gelirleri arasındaki ilişki: Frekans alanda asimetrik testinden kanıtlar. *Sayıştay Dergisi*, (116), 121-139.

49. Yıldız, F. & Demirkılıç, Y. (2022). Kamu harcamaları ve vergi gelirleri ilişkisinin analizi: Türkiye örneği (1972–2020). *Vergi Raporu*, *273*(6), 57-81.

50. Zivot, E. & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics*, *20*(1), 25-44. https://doi.org/10.1198/073500102753410372

Appendix 1

See tables 1 and 2.

Table 1 Summary of empirical literature

Article	Country	Sample	Methods	Results			
				T→S	S→T	FS	IS
Baghestani and Mc-Known (1994)	USA	1955-1989	ECM				✓
Kollias and Paleologou (2006)	15 countries	1960-2002 1962-2002 1970-2002 1973-2002	VECM GC	Italy Spain Luxem-bourg	France Finland United Kingdom	Denmark Greece Ireland Netherlands Portugal Sweden	Austria Belgium Germany
Westerlund et al. (2011)	50 US state–local government	1963-1997	Panel Coin-tegration	✓			
Apergis et al. (2012)	Greece	1957-2009	TAR MTAR EG	✓			
Paleologou (2013)	Sweden Germany Greece	1965-2009	TAR MTAR		Greece	Sweden Germany	
Mutascu (2016)	Bulgaria Czech Republic Estonia Hungary Lithuania Latvia Poland Romania Slovenia Slovakia	1995-2012	Bootstrap Panel GC	Czech Republic Hungary Slovenia	Bulgaria	Slovakia	Estonia Latvia Romania Lithuania Poland
Tiwari and Mutascu (2016)	Romania	1999-2012	TAR MTAR		✓		
Akram and Rath (2019)	26 Indian States	1980-2015	Dumitrescu–Hurlin Panel Causality			✓	
Linhares and Nojosa (2020)	Germany, United Kingdom France Italy Spain	1995-2019	Wald Test	Germany United Kingdom Italy	France	Spain	
Arvin et al. (2021)	Low-income countries Lower middle-income coun-tries	2005–2019	GC			✓	
Salvi and Schaltegger (2021)	Switzerland	1850-2018	VECM	✓			
Nzimande and Ngalawa (2022)	14 Southern African Development Community member states	1980-2018	Bootstrap Panel GC	Botswana	Mauritius Mozam-bique		

Note: T-S, S-T, FS, and IS stand for tax-spend, spend-tax, fiscal synchronization, and institutional separation, respectively.

Source: Authors

Table 2 Empirical studies on the revenue–expenditure nexus for Turkey

Article	Country	Sample	Methods	Results			
				T→S	S→T	FS	IS
Pınar (1998)	Turkey	1924-1997	ECM GC		✓		
Darrat (1998)	Turkey	1967-1994	EG ECM	✓			
Günaydın (2000)	Turkey	1950-1999	VECM		✓		
Günaydın (2004a)	Turkey	1964-2001	VECM		✓		
Günaydın (2004b)	Turkey	1983-2003	VAR	✓			
Çavuşoğlu (2008)	Turkey	1987-2003	VAR GC		✓		
Payne et al. (2008)	Turkey	1968-2004	VECM GC TAR MTAR	✓			
Akçağlayan and Kayıran (2010)	Turkey	1987-2005	ECM				✓
Çiçek and Yavuz (2014)	Turkey	2007-2011	VECM GC				✓
Aysu and Bakırtaş (2018)	Turkey	2006-2017	Toda-Yamamoto Causality		✓		
Yılancı et al. (2020)	Turkey	2006-2019	VAR	✓			
Kamacı and Kurt (2021)	Turkey	2006-2021	DOLS		✓		
Yıldız and Demirkılıç (2022)	Turkey	1972-2020	Hacker and Hatemi-J Bootstrap Causality		✓		

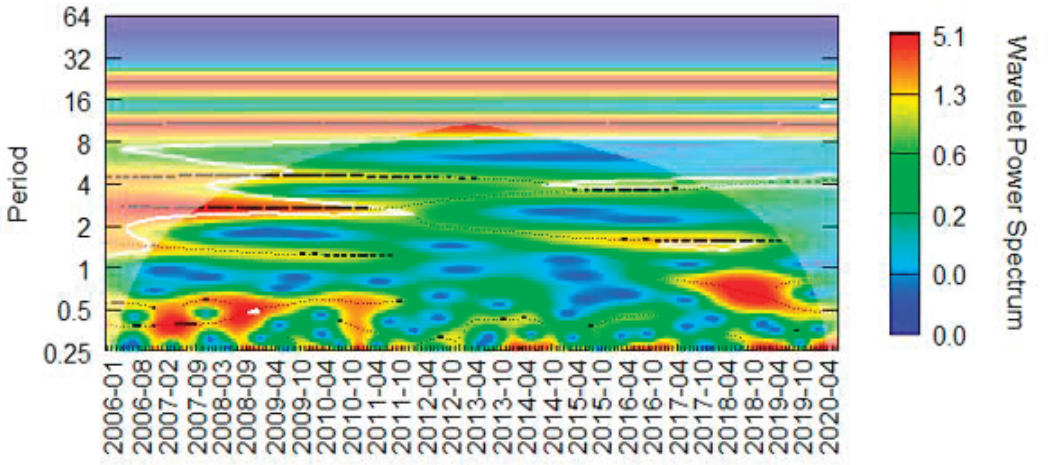
Note: T-S, S-T, FS, and IS stand for tax-spend, spend-tax, fiscal synchronization, and institutional separation, respectively.

Source: Authors

Appendix 2

See figures 1-4.

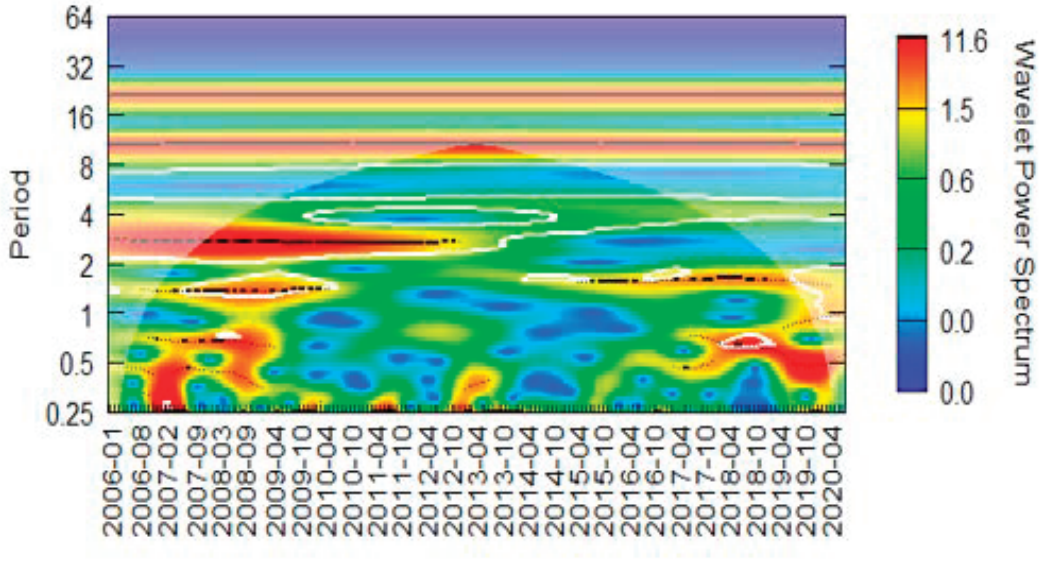
Figure 1 CWT power spectrum of (x)–government revenue, monthly series (2006:1-2020:7)



Note: (a) According to Monte Carlo simulation estimates, the thick white contour denotes a 5% significance level (95% confidence level) against red noise. (b) The plot is divided into dependable (full colors) and unreliable (pale colors) areas by the cone of influence, which is constructed as a light shadow and symbolizes the areas impacted by edge effects. (c) The strong power gradient of the major contours may be seen in the power ranges to the right of the CWT results. According to frequency intervals, blue and red denote the power with the lowest and the greatest coherency. (d) Time is shown on the X-axis, while frequency is represented on the Y-axis.

Source: Authors

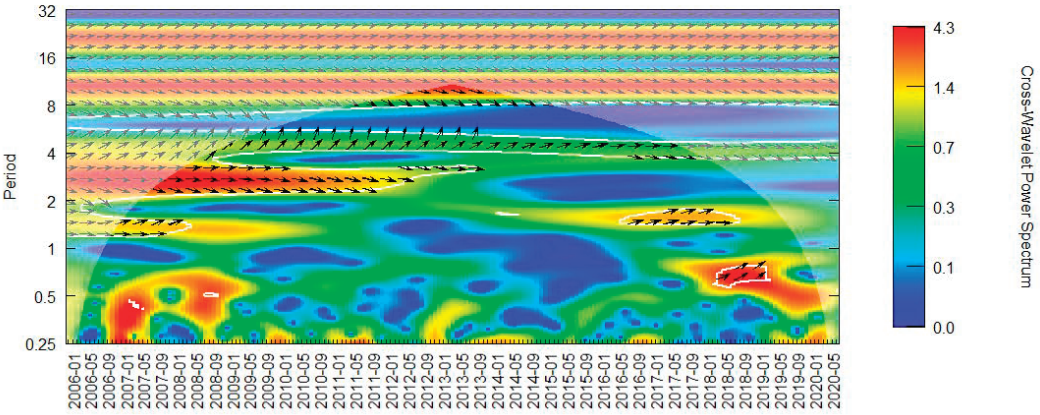
Figure 2 CWT power spectrum of (y)–government expenditure, monthly series (2006:1-2020:7)



Note: (a) According to Monte Carlo simulation estimates, the thick white contour denotes a 5% significance level (95% confidence level) against red noise. (b) The plot is divided into dependable (full colors) and unreliable (pale colors) areas by the cone of influence, which is constructed as a light shadow and symbolizes the areas impacted by edge effects. The strong power gradient of the major contours may be seen in the power ranges to the right of the CWT results. According to frequency intervals, blue and red denote the power with the lowest and the greatest coherency. (d) Time is shown on the X-axis, while frequency is represented on the Y-axis.

Source: Authors

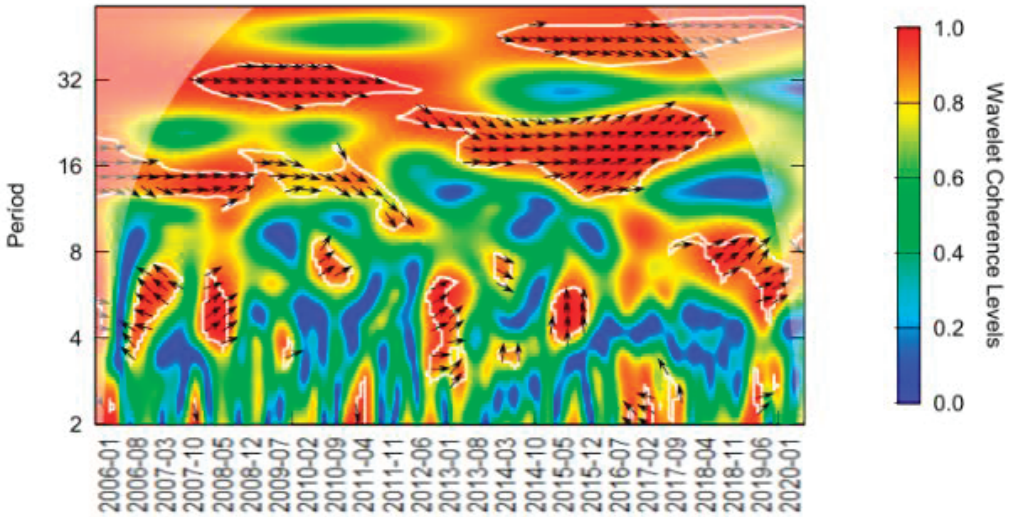
Figure 3 XWT of the pair (x)–(y), monthly series (2006:1-2020:7)



Note: (a) According to Monte Carlo simulation estimates, the thick white contour denotes a 5% significance level (95% confidence level) against red noise. (b) The plot is divided into dependable (full colors) and unreliable (pale colors) areas by the cone of influence, which is constructed as a light shadow and symbolizes the areas impacted by edge effects. The major contours have a strong power gradient, according to the power ranges to the right of the XWT findings. According to frequency intervals, blue denotes the lowest power (low coherency) and red denotes the highest power (high coherency). (d) The phase difference between the two series are shown by arrows. (e) Arrows pointing to the right (positively related) mean that the variables are in phase. Arrows pointing to the right and up indicate that government revenue is lagging, and government expenditure is leading, while arrows pointing to the right and down indicate that government expenditure is leading, and government revenue is lagging. (f) Arrows pointing to the left (negatively related) mean that the variables are out of phase. Arrows pointing to the left and up indicate that government expenditure is leading, and government revenue is lagging, while arrows pointing to the left and down indicate that government revenue is lagging, and government expenditure is leading. (g) Time is shown on the X-axis, while frequency is represented on the Y-axis.

Source: Authors

Figure 4 WTC of the pair (x)–(y), monthly series (2006:1-2020:7)



Note: (a) According to Monte Carlo simulation estimates, the thick white contour denotes a 5% significance level (95% confidence level) against red noise. (b) The plot is divided into dependable (full colors) and unreliable (pale colors) areas by the cone of influence, which is constructed as a light shadow and symbolizes the areas impacted by edge effects. The major contours have a strong power gradient, according to the power ranges to the right of the WTC findings. According to frequency intervals, blue denotes the lowest power (low coherency) and red denotes the highest power (high coherency). (d) The phase difference between the two series is shown by arrows. (e) Arrows pointing to the right (positively related) mean that the variables are in phase. Arrows pointing to the right and up indicate that government revenue is lagging, and government expenditure is leading, while arrows pointing to the right and down indicate that government expenditure is leading, and government revenue is lagging. (f) Arrows pointing to the left (negatively related) mean that the variables are out of phase. Arrows pointing to the left and up indicate that government expenditure is leading, and government revenue is lagging, while arrows pointing to the left and down indicate that government revenue is lagging, and government expenditure is leading. (g) Time is shown on the X-axis, while frequency is represented on the Y-axis.

Source: Authors

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EXPLORING SMARTPHONE-RELATED DIGITAL DIVIDE AMONG SOUTH KOREAN OLDER ADULTS

Abstract

Purpose: One of the crucial steps towards fully grasping the benefits of smartphone use for all is to explore the existence of a digital divide and its relationship to different outcomes of smartphone use. In so doing, this study explored the smartphone-related digital divide among South Korean older adults in terms of access, use and outcomes.

Design/methodology/approach: In-person interviews using questionnaires were conducted to collect the data from a total number of 372 older adults aged 60 and above in eleven community centers in the Seoul Metropolitan area in Korea, 223 of whom owned a smartphone.

Results: This study found that most participants use smartphones to communicate with personal relationships and support system. There were, however, differences among groups related to gender, age, and ICT training in terms of the extent of smartphone usage and participation in virtual communities. In three age groups of 60+, 70+ and 80+, a younger cohort and those with ICT training had higher smartphone literacy, harnessing the potential of smartphones. Those who used smartphones to stay connected to their social group and for entertainment showed a lower level of loneliness.

Conclusion: This study shows that older adults (i.e., 60+) are not a homogenous group when it comes to using smartphones. There are distinct differences in older smartphone users, especially in the age groups 60+, 70+ and 80+. Older adults should be encouraged to use smartphones for better connectivity with their social groups and entertainment, potentially decreasing their feeling of loneliness.

Keywords: Older adults, digital divide, smartphone, loneliness, South Korea

1. Introduction

Digital literacy stands for "the ability to harness the potential of digital tools" (IFLA, 2017), which is an essential precondition of digital inclusion in today's information society. To be digitally literate means that one can use technology to its fullest effect efficiently, effectively, and ethically to meet information needs in personal, civic, and professional lives (IFLA, 2017). However, according to Gann (2019), the three main barriers to digital inclusion are lack of access, skills, and motivation. These are found to influence older adults' use of the internet and smartphones (Juznic et al., 2006). These barriers lead towards the division between 'haves' and 'have-nots' in terms of digital access and skills, which is aptly described as the *grey digital divide* (Juznic et al., 2006; Millward, 2003; Morris & Brading, 2007).

Although research into internet and ICT use among older adults has been rapidly growing over the last two decades (for example, Álvarez-Dardet et al., 2020; Friemel, 2016; Hill et al., 2015; Morris & Brading, 2007; Schehl et al., 2019; Vroman et al., 2015), relatively little research has been undertaken into smartphone-related digital divide among older adults (Hong et al., 2018). So far, the primary focus of digital divide research has been on internet access (e.g., the first-level digital divide) and internet skills and use (e.g., the second-level digital divide) (Scheerder et al., 2017). However, recent studies suggest that more focus needs to be placed on the third-level digital divide, where tangible outcomes of internet use are highlighted (Scheerder et al., 2017).

One of the most important features of smartphones is internet connectivity, which enables 24/7 connectivity through either apps or a mini browser for countless purposes, including searching for information, connecting to a social network, or downloading music, videos, and related content (Anshari et al., 2016, p. 719). Past research into older adults and smartphones examined perceived difficulties and usability (Barnard et al., 2013; Petrovičič et al., 2018), use and dependency (Park et al., 2013), or privacy concerns and attitude (Ketelaar & van Balen, 2018). Positive outcomes of smartphone use for older adults include a wider range of activities such as social networking, shopping (van Deursen & Helsper, 2015; Vroman et al., 2015) and an improved quality of life thanks to the smartphone apps designed to help manage health of older adults (Doughty, 2011; Joe & Demiris, 2013; Steinhubl et al., 2013). However, previous studies also show that older adults tend to use their mobile devices primarily for two activities: making/receiving phone calls and texting (Fernández-Ardèvol, 2011; Renaud & Biljon, 2010), indicating that the growth in smartphone ownership among older adults does not equate with increased ability or willingness to harness the full potential of smartphones.

Our focus on South Korea (hereafter Korea) derives from it being one of the most wired countries in the world with the highest internet penetration rate at 96% (Poushter et al., 2018) and the highest-ranked country in the OECD 2019 Digital Government Index (DGI) (OECD, 2019). Smartphone ownership was recorded among 95% of Korean adults (Silver, 2019). However, internet use and smartphone adoption among Korean older adults continue to lag behind those of younger generations. People aged 65 and above in Korea account for 14.8% of the country's population (Statistics Korea, 2019), only 59.9% of whom reported internet use and only 65.2% smartphone ownership (NIA, 2018). These statistics testify to the existence of the grey digital divide, which we wish to explore further.

Therefore, this study aims to explore Korean older adults' smartphone use and digital divide across groups, differing in gender, age, and ICT training. According to van Dijk (2005), an individual's characteristics (e.g., age, gender, intelligence, and health) are indicators known in digital divide literature to influence technology access, use, the extent of resources, and the amount of time available for digital activities. A unique aspect of the current study is that it examines the differences in smartphone use, skills, and outcomes across three age groups: 60+, 70+ and 80+, and sheds light on similarities and differences *within* this cohort rather than *in comparison to* younger cohorts. In digital divide literature, 80+ is a rarely researched demographic.

2. Literature review

2.1 The three levels of the digital divide

Research has found three different levels of the digital divide: the first-, second-, and third-level (Scheerder et al., 2017). The first level of the digital divide concerns physical access to the internet, and this has previously dominated digital divide

research and theory (van Dijk, 2018). This initial focus has shifted beyond mere access to the skills and use, which is the second-level digital divide. More recent studies explore the third-level digital divide, whereby researchers focus on the benefits and outcomes of using digital media, discussing the context and effects of digital media (non)use (van Dijk, 2018).

Research on the first-level digital divide found that internet access is unequally distributed among individuals with different demographic characteristics, such as age, gender, socio-economic status, ethnicity, and geography (e.g., Helsper, 2010; Mossberger et al., 2003). These factors also determine skills and use, which represent the second-level digital divide. For example, Blank and Groselj's (2014) study on three main dimensions of internet use revealed that age, educational level, and employment status cause a large proportion of the differences in the second-level digital divide. In other words, the first- and second-level digital divide have similar determinants, although the relative influence of these determinants depends on the type of skills and use measured (van Deursen & van Dijk, 2011). The growth in adoption and connectivity worldwide (e.g., internet and smartphone) has made the digital divide discourse based on access (the first-level digital divide) less relevant and the focus shifted to digital skills and differences in use (the second-level digital divide) (Scheerder et al., 2017). In this regard, researchers distinguished between mere skills to operate devices and literacy, harnessing the potential of digital tools (Mossberger et al., 2003; van Deursen & van Dijk, 2011). In recent years, there has also been a growing interest in the outcomes of internet, ICT, or digital technology use, namely, the third-level digital divide. For example, studies explored digital exclusion (Formosa, 2013), associations between internet use and loneliness (Stockwell et al., 2020), and the relationship between digital divide determinants and outcomes from internet use (van Deursen et al., 2017).

2.2 *Loneliness and depression: exploring connections with digital technologies among older adults*

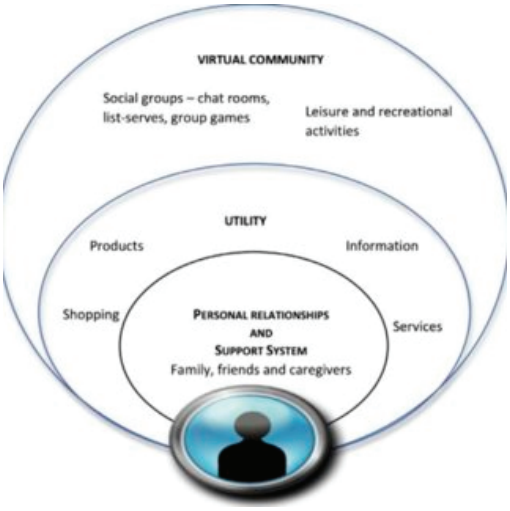
According to Jopling (2015), loneliness is a complex concept, whose causes and consequences are impossible to determine without reference to the individual and their own values, needs, wishes, and feelings. Not only does loneliness involve psychological and social aspects relating to age, gender, marital status, social contacts, interests, friendships, health, and cognition, it also is a cultural construct and a lifestyle issue (Dakers, 2018). In addition, loneliness is a fluid experience - it can come and go over a short time or persist in the longer term (Goodman et al., 2015). In other words, the subjective experience of feeling lonely can be chronic for some, and for others, it is a transient or fleeting experience. As loneliness is a subjective psychological perception about the number of social contacts that one has compared to what one would like to have, it differs from social isolation, which is the objective absence of social contacts and social connectedness (Goodman et al., 2015). Meanwhile, loneliness and depression are very closely associated with each other. Loneliness has a significant impact on psychological health and wellbeing, as loneliness contributes to both psychological distress and depression (Goodman et al., 2015). In a similar vein, depression, security, age, occupation, smoking habits, and income level were found influential in the emergence of loneliness among older adults (Aylaz et al., 2012).

The relationship between the use of digital technology and its impact on loneliness and depression is of particular relevance in this study. Due to its complexity, it is challenging to examine a direct cause-effect relationship between one's use and engagement of digital technology and the level of loneliness. So far, findings have been inconclusive (Song et al., 2014, p. 447). While some argued that internet use and computer-mediated interaction might benefit users in decreasing loneliness and depression (Carpenter & Buday, 2007; Shaw & Grant, 2002), other studies found precisely the opposite (Moody, 2001; Morgan & Cotten, 2004). Regarding smartphones, no association was found between smartphone use and severity of loneliness, depression, or anxiety (Rozgonjuk et al., 2018). Furthermore, there are methodological concerns such as how best to approach such an individual and personal experience with quantifiable measures that allow generalizability. For example, the way older people use the internet is as important as the amount of time they spend on the internet (Sum et al., 2008). This indicates that a qualitative, in-depth, and exploratory approach is needed as much as a quantitative and measurable one.

2.3 *Conceptualizing the digital divide through the information and communication technology social networking model*

Vroman et al. (2015) conceptualized the use of ICT among older adults and proposed a socio-ecological model (Fig. 1). It provides a useful theoretical framework for this study on three grounds. Firstly, it offers a way to interpret the attitudinal and motivational patterns of older adults' smartphone literacy, addressing the issues of use and skills (the second-level digital divide) and outcomes (the third-level digital divide). Secondly, it considers individual preferences and inherent values that may lead to either self-initiation of or resistance to smartphone use. Thirdly, it is a person-centered model that affords a contextualized appreciation for older adults' reasons and needs for ICT, which is suitable for the purpose of this study to explore smartphone literacy and its implications on individual psychological factors such as loneliness and depression.

Figure 1 Information and communication technology social networking motivation model



Source: Vroman et al. (2015, p. 165)

At the core of this three-tiered, person-centered model (Figure 1) is the older adult with his or her attitudes, needs and ICT capacity (Vroman et al., 2015, p. 163). The first level - personal relationships and support system - reflects one's primary interest, need, and most frequent use pattern - social networking activities with family and friends. This level is considered as the level with the greatest personal salience for older adults. Past research into older adults' smartphone use shows that older adults tend to use their mobile devices primarily for two activities: making/receiving phone calls and texting (Fernández-Ardèvol, 2011; Renaud & Biljon, 2010). However, we would like to understand to what extent these findings apply to Korean older adults and if so, with whom they mostly communicate via smartphones. This leads us to the second-level digital divide research question:

RQ1. How do older adults use their smartphones in terms of frequency and duration of daily use, and with whom?

The next level - utility - shows that older adults use ICT for various functions: for example, accessing information about products and services and conducting daily tasks such as shopping. Progress from the first to the second level may occur due to the exchanges between family and friends (e.g., hyperlinks via email). Previous research highlighted some positive outcomes of smartphone use for older adults: these include a wider range of activities such as social networking, shopping (van Deursen and Helsper, 2015; Vroman et al., 2015) and an improved quality of life thanks to smartphone apps designed to help manage health of older adults (Doughty, 2011; Joe & Demiris, 2013; Steinhubl et al., 2013). However, despite the growth in smartphone ownership among older adults, their ability to harness the potential of smartphones still varies. Therefore, we aim to investigate further the second-level digital divide by asking the following research question:

RQ2. How skilled are older adults in using a smartphone by type and frequency of various smartphone functions used?

The final level - virtual community - represents the stage in which an older adult makes connections with their virtual community, that is, the least personally intimate social network. Examples of activities at this level are sharing common interests and further connectivity through online group activities such as interactive games and book clubs. What we are interested in is finding out the outcomes of Korean older adults' use of smartphones in relation to its impacts on levels of loneliness and depression. Hence the next research question addresses the second and the third digital divide.

RQ3. How do smartphone use and skills among older adults influence levels of loneliness and depression?

The theoretical model proposed by Vroman et al. (2015) was developed from quantitative analyses, which may not fully encapsulate older adults' experiences, as pointed out by Hill et al. (2016). Furthermore, older adults are not a homogeneous group in terms of their digital technology use due to the differences in their past employment, motivation, and existing knowledge (Lee & Coughlin, 2014). However, the strengths of Vroman et al.'s model, as described earlier, outweigh the weaknesses and most importantly, this model provides a useful framework to explore and analyze potential outcomes of smartphone use (the third-level digital divide) on individuals such as a correlation between smartphone use or skills and loneliness and depression.

3. Methods

3.1 Procedure and measures

An in-person interview method using questionnaires was employed to address the above research questions. Older adults aged 60 and above were interviewed in eleven community centers in the Seoul Metropolitan area in Korea in March 2018. Firstly, the usage frequency of various mobile phone functions was collected based on a 5-point-scale (1 = never, 5 = very often). Mobile functions include making/receiving calls, sending/receiving texts, taking pictures, clock/alarm, calculator, calendar/diary, social network sites (such as Facebook, Katok, etc.), entertainment (such as watching a movie/drama, listening to music, playing games), internet search, GPS (car/driving navigation), taking memo, etc. Secondly, in terms of the frequency of social contacts, participants were asked about the frequency of contacts via mobile phone communication with their children, siblings, and friends, on a 10-point-scale (0 = no contact, 9 = almost every day). Thirdly, we also examined whether a participant had any ICT training because researchers considered ICT training as an important factor to determine older adults' satisfaction and connectedness with family and community (Feist & McDougall, 2013). Fourthly, to measure loneliness, we utilized a three-item measurement tool developed in the UK (Jopling, 2015). This tool is designed to measure loneliness using a 5-point-scale (1 = strongly agree; 5 = strongly disagree) across the following three items: I am content with my friendships and relationships; I have enough people I feel comfortable asking for help at any time, and My relationships are as satisfying as I would want them to be. Fifthly, the Patient Health Questionnaire-9 (PHQ-9) was used to measure the level of depression. PHQ-9 was translated into Korean in 2008 as a self-report form of measurement tool developed to diagnose depression at the primary care facility in 1999, with its validity and reliability confirmed (Han et al., 2008; Park et al., 2010). Eight items were measured on a 4-point-scale (0 = not at all; 3 = almost every day). Lastly, health-related information was measured using Speake et al.'s (1989) Subject Health Status. It consists of three items related to current health perception, past comparative health perception, and peer comparison health perception. For each item, we asked participants to assess their health using a 5-point-scale (1 = very bad; 5 = very good).

3.2 Participant demographics

The data were collected from a total number of 372 older adults, 223 of whom owned a smartphone. The latter was used in this study to explore the second- and third-level digital divide. The average age of the participants (N=223) was 73.87 years. A total of 61.9% of smartphone owners were female. Most of the participants were either married (61.4%) or widows/widowers (30.5%), with two to four children (83.9%). However, many of them were living in one- or two-member households (70.4%). The majority of them were religious (77.1%), and the largest group were Christians (33.2%). Most of the participants were retired (83.9%), with an average income of 1.41 million KRW (approximately 1,285 US dollars). Regarding the knowledge and skills in technology, slightly more than half of the participants (56.5%) had received ICT training.

Table 1 Demographic profile of smartphone owners

Variable	Options	Frequency (N)	Percentage (%)
Age (years)	60 - 69	55	24.7
	70 - 79	127	57.0
	80 and above	41	18.4
Gender	Male	85	38.1
	Female	138	61.9
Marital status	Married	137	61.4
	Separated	7	3.1
	Divorced	9	4.0
	Widowed	68	30.5
	Never married	2	0.9
Religion	None	51	22.9
	Christian	74	33.2
	Catholic	39	17.5
	Buddhist	50	22.4
	Won Buddhist	1	0.4
	Other	8	3.6
Retired	Yes	187	83.9
	No	36	16.1
ICT education	Yes	126	56.5
	No	97	43.5

Source: Authors' work

4. Results and discussion

4.1 Exploring the first- and second-level digital divide among Korean older adults

The first and second research questions in our study were formulated to gain insight into how older adults use their smartphones in terms of frequency and duration of daily use, and with whom, and how skilled they are when it comes to the type and frequency of various smartphone functions used. We asked participants to reveal how often they use their smartphones, how frequently they use various functions, and how frequently they communicate with various individuals and groups using smartphones. The results reveal that the Korean older adults, on average, spend 1 hour and 46 minutes per day on their smartphones. However, their usage duration varies up to 2 hours and 3 minutes per day, indicating differences in the average amount of time older adults spend using their smartphones (the longest duration reported was 12 hours and 9 minutes). Moreover, the results reveal that older Korean adults aged between 60 and 69 years spend on average 2 hours per day on their smartphones, while those aged 80+ spend 40 minutes less than their younger peers.

In addition, we observed the differences in using various smartphone functions (see Table 2). Smartphones were used mostly to make or receive calls, which makes older Korean adults no different from their European peers (Fernández-Ardèvol, 2011). Other basic functions such as texts, photos, clock/alarm, calendar/diary, and social networking services (SNS) were used occasionally, while many entertaining functions that enable listening to music, playing games, and watching movies were rarely explored. This makes a stark contrast to smartphone use by other age groups in Korea. Park et al. (2013) found that most Koreans use numerous advanced features and functions of smartphones such as information searching, emails, music downloads,

maps, schedule management, SNS and gaming. Further analysis of differences in the use of smartphone functions in relation to demographic characteristics showed some interesting results. In particular, female older adults were found to play games more frequently (ΔM = 0.55, p = 0.002), while male older adults used the navigation function more frequently (**ΔM** = 0.40, p = 0.031).

Table 2 Details of smartphone functions used and communication activities

		Group									
		All (N=223)		Male (N=85)		Female (N=138)		95% CI			
	Variables	**M**	**SD**	**M**	**SD**	**M**	**SD**	**Lower**	**Upper**	**t**	**p**
Functions used[a]	Making/receiving calls	4.35	1.00	4.40	1.02	4.32	0.99	-0.19	0.36	.618	.537
	Sending/receiving texts	3.75	1.41	3.79	1.39	3.73	1.42	-0.33	0.44	.268	.789
	Taking pictures	3.45	1.31	3.37	1.38	3.50	1.28	-0.49	0.23	-.717	.474
	Clock/alarm	3.36	1.55	3.37	1.57	3.35	1.54	-0.40	0.45	.115	.909
	Calendar/diary	3.35	1.46	3.31	1.43	3.37	1.48	-0.47	0.34	-.325	.746
	SNS (Facebook, Katok, etc.)	3.15	1.64	3.15	1.65	3.15	1.64	-0.46	0.46	-.009	.993
	Calculator	2.79	1.52	2.82	1.51	2.77	1.53	-0.37	0.48	.250	.803
	Entertainment (listening to music)	2.74	1.55	2.60	1.53	2.83	1.56	-0.67	0.19	-1.081	.281
	Taking memo	2.68	1.50	2.69	1.48	2.67	1.51	-0.40	0.44	.092	.927
	Internet search	2.68	1.56	2.72	1.56	2.65	1.57	-0.37	0.50	.297	.767
	GPS (car/driving navigation)	2.05	1.39	2.30	1.42	1.90	1.36	0.01	0.79	2.032	.043*
	Playing games	1.86	1.37	1.52	1.09	2.07	1.49	-0.91	-0.20	-3.085	.002*
	Entertainment (movie/drama)	1.79	1.26	1.75	1.15	1.81	1.33	-0.41	0.30	-.323	.747
Communication with[b]	Children	7.41	1.89	7.12	1.93	7.57	1.85	-0.97	0.07	-1.708	.089**
	Friends/neighbors/societies	7.33	1.93	7.07	1.95	7.48	1.91	-0.94	0.13	-1.490	.138
	Brothers/sisters/relatives	6.16	2.16	5.59	2.06	6.49	2.15	-1.51	-0.30	-2.938	.004*
	People from the community centers	6.61	2.60	6.43	2.64	6.72	2.58	-1.06	0.48	-.751	.454
	Spouse	7.64	2.10	7.96	1.77	7.36	2.32	-0.08	1.27	1.731	.086**
	Religious groups	6.12	2.60	5.83	2.47	6.25	2.66	-1.38	0.55	-.855	.394

Note: *p ≤ 0.05, **p ≤ 0.10. [a]Measured on a 5-point scale, 1 = never, 5 = very often. [b]Measured on a 10-point-scale (0 = no contact, 9 = almost every day).

Source: Authors' work

The results from Table 2 also show that the participants used their smartphones to mostly communicate with their children and friends, approximately once a week. Somewhat surprisingly, their spouses were their frequent point of contact. This might be due to the fact that just over 60% of the participants were married and living with spouses. In comparison to their female counterparts, Korean male older adult were found to communicate with their spouses more frequently (ΔM = 0.60, p = 0.086), while they communicated with their children and relatives less frequently (p = 0.089 and p = 0.004).

When observing differences among those who had or did not have ICT training and how they use their smartphones, the results revealed that compared to those without ICT training, those with ICT training indicated a higher level of frequency regarding the use of most functions, except making/receiving calls (ΔM = -0.048, p = 0.724) and clock/alarm (ΔM = -0.227, p = 0.289). Additionally, the group with ICT training used smartphones more often to communicate with their siblings and relatives (ΔM = 0.657, p = 0.031).

Table 3 Differences between age groups to determine the second-level digital divide

		Age groups							
		60-69 (N=55)		70-79 (N=127)		80+ (N=41)		ANOVA	
	Variables	M	SD	M	SD	M	SD	F	p
Functions used[a]	Making/receiving calls	4.58	0.71	4.30	1.01	4.17	1.22	2.313	.101
	Sending/receiving texts	4.16[3]	1.03	3.94[3]	1.30	2.63[1,2]	1.61	19.212	.000
	Taking pictures	4.02[2,3]	1.03	3.45[1,3]	1.27	2.68[1,2]	1.44	13.465	.000
	Clock/alarm	3.91[2,3]	1.26	3.35[1,3]	1.54	2.65[1,2]	1.67	7.981	.000
	Calendar/diary	3.87[2,3]	1.28	3.34[1,3]	1.40	2.68[1,2]	1.61	8.040	.000
	SNS (Facebook, Katok, etc.)	3.75[2,3]	1.43	3.14[1,3]	1.59	2.36[1,2]	1.74	8.629	.000
	Calculator	3.08[3]	1.49	2.89[3]	1.47	2.08[1,2]	1.51	5.756	.004
	Entertainment (listening to music)	2.96	1.54	2.72	1.50	2.51	1.71	.970	.381
	Taking memo	3.06[3]	1.51	2.71[3]	1.44	2.08[1,2]	1.48	14.990	.000
	Internet search	3.42[2,3]	1.45	2.67[1,3]	1.55	1.72[1,2]	1.23	5.041	.007
	GPS (car/driving navigation)	2.34[3]	1.55	2.12[3]	1.37	1.49[1,2]	1.10	4.578	.011
	Playing games	2.08[3]	1.52	1.93[3]	1.40	1.33[1,2]	0.90	3.781	.024
	Entertainment (movie/drama)	1.88	1.36	1.78	1.23	1.71	1.23	.219	.803
Communication with[b]	Children	7.60	2.05	7.30	1.91	7.49	1.57	.538	.585
	Friends/neighbors/societies	7.39	2.10	7.36	1.73	7.13	2.31	.251	.778
	Brothers/sisters/relatives	6.23[3]	2.18	6.42[3]	2.04	5.22[1,2]	2.29	4.388	.014
	People from the community centers	6.35	2.86	6.63	2.45	7.00	2.73	.580	.561
	Spouse	7.88	1.81	7.70	2.06	6.84	2.69	1.701	.186
	Religious groups	5.80	2.43	6.36	2.53	5.82	2.98	.717	.490

Note: $p \leq 0.05$. [a]Measured on a 5-point scale, 1 = never, 5 = often. [b]Measured on a 10-point-scale (0 = no contact, 9 = almost every day). 60-69 = Group 1; 70-79 = Group 2; 80+ = Group 3. The superscript '1' indicates a statistically significant difference (at $p<0.05$) from group 1. The superscript '2' indicates a statistically significant difference (at $p<0.05$) from group 2. The superscript '3' indicates a statistically significant difference (at $p<0.05$) from group 3.

Source: Authors' work

In our sample, we had three different age groups of Korean older adults. By observing differences among them, the ANOVA results reveal some interesting findings (see Table 3). The youngest among older adults (e.g., aged 60-69) were the most frequent users of most smartphone functions, except for making or receiving calls (p = 0.101), watching movies (p = 0.803), and listening to music (p = 0.381). The latter puts them shoulder to shoulder with other groups as they all used smartphones frequently to make or receive calls, and their smartphones were least used for watching movies or listening to music. Further, Tukey's posthoc tests have indicated that most differences were found between those aged 80+ and the other two groups, both in the functions used and in communicating with their brothers, sisters, and relatives.

Overall, our findings testify to the evidence that Korean older adults used smartphones to keep up with family and friends. This reflects older adults' primary interests and needs, which corresponds to Vroman et al.'s (2015) primary level of communication – social networking activities with family and friends are considered as the level with the greatest personal salience for older adults. Moreover, there were significant differences among age groups and groups with or without ICT training, indicating younger and more ICT educated to use more smartphone functions and spend more time connecting with family and friends. These differences lead us to confirm the existence of the first- and second-level of the grey digital divide among Korean older adults and that not all have the ability to harness the potential of smartphones.

4.2 Exploring the third-level digital divide among Korean older adults

The third research question was formed to bring a better understanding of how older adults' smartphone use and skills, with considerations of overall health, influence levels of loneliness and depression. We asked participants to self-indicate whether they feel lonely and depressed and to evaluate their overall health. The results showed that participants did not feel lonely or depressed and that they perceived themselves to be in a moderate health condition (see Table 4). However, some differences between the sexes were observed. Males indicated to be less happy with their current relationships (ΔM = 0.29, p = 0.046) and that they did not have enough people to ask for help when needed (ΔM = 0.41, p = 0.009). In addition, females felt slightly more tired (ΔM = 0.23, p = 0.070), yet indicated a higher level of overall health (ΔM = 0.28, p = 0.075). We also wanted to observe whether there were any differences between a group that received ICT training and a group without any ICT training. There were no statistically significant differences in how they reported on loneliness, depression, and overall health. Moreover, the same was observed for different age groups. The ANOVA test results showed no statistically significant differences among the three different age groups.

Table 4 Details of a smartphone owner's perception of loneliness, depression and overall health

		Group									
		All (N=223)		Male (N=85)		Female (N=138)		95% CI			
	Variables	M	SD	M	SD	M	SD	Lower	Upper	t	p
Loneliness (reversed)[a]	My relationships with others meet my expectations.	2.32	1.10	2.39	1.04	2.27	1.13	-0.18	0.42	.779	.437
	I have enough people that I can ask for help when needed.	2.20	1.12	2.45	1.10	2.04	1.10	0.10	0.70	2.652	.009*
	I am happy with the current relationships with friends and others around me.	2.05	1.05	2.22	1.06	1.93	1.03	0.01	0.57	2.009	.046*
Depression[b]	Disturbed sleeping patterns	.94	1.05	0.84	1.06	1.00	1.05	-0.45	0.12	-1.133	.258
	Feeling tired	.70	.91	0.56	0.86	0.79	0.93	-0.48	0.02	-1.823	.070**
	Losing appetite, losing weight or overeating	.50	.83	0.42	0.81	0.55	0.85	-0.37	0.09	-1.195	.233
	Disinterested in things, no pleasure/fun	.50	.77	0.58	0.82	0.46	0.73	-0.09	0.33	1.139	.256
	Depressed, annoyed, frustrated	.50	.79	0.49	0.75	0.50	0.81	-0.22	0.21	-.087	.930
	Hard to focus on newspaper or TV	.38	.76	0.38	0.74	0.38	0.77	-0.20	0.21	.040	.969
	Feeling that I am letting down myself or family	.31	.64	0.35	0.71	0.28	0.60	-0.11	0.25	.790	.430
	People around me can notice that my movement is sluggish, or my speech is too slow, or agitated or hyper	.23	.55	0.25	0.56	0.21	0.55	-0.11	0.19	.523	.601
Overall health[c]	Better than my peers (the same age group)	3.83	1.17	3.74	1.20	3.89	1.15	-0.47	0.17	-.932	.352
	Overall good health	3.70	1.17	3.52	1.22	3.80	1.13	-0.60	0.03	-1.788	.075**
	Worse than in the past (reversed)	3.30	1.20	3.27	1.24	3.33	1.18	-0.38	0.27	-.334	.739

Note: *p ≤ 0.05, **p ≤ 0.10. [a]Measured on a 5-point scale, 1 = strongly agree, 5 = strongly disagree. [b]Measured on a 4-point-scale (0 = not at all, 3 = almost every day). cMeasured on a 5-point scale (1 = very bad, 5 = very good).

Source: Authors' work

To observe whether smartphone usage skills were connected to loneliness and depression, we performed two linear regression analyses (using the Enter method) to predict loneliness and depression based on smartphone functions used. A significant regression equation was found for loneliness [$F(20,52) = 1.637$, $p = 0.079$, $R^2 = 0.386$]; it was shown that loneliness was negatively influenced by making or receiving calls ($\beta = -0.267$, $p = 0.048$) and watching movies ($\beta = -0.344$, $p = 0.058$), but it was positively influenced by the use of memo function ($\beta = 0.283$, $p = 0.097$). On the other hand, no

statistically significant equations were found for depression and the evaluation of overall health. Overall, our findings testify to the evidence that Korean older adults perceive themselves to be in moderately good health and not depressed or lonely. The latter could also be attributed to their skills and use of smartphones. That is, a different set of smartphone functions were associated with reducing the feeling of loneliness. Similarly to the studies of van Deursen and Helsper (2015), and Vroman et al. (2015), these findings support the idea that smartphones can benefit older adults. More importantly, smartphone use was shown to help users reduce loneliness, corroborating the results obtained in the computer-mediated setting studies of Carpenter and Buday (2007) and Shaw and Grant (2002).

5. Conclusion

For the last few decades, we have witnessed many benefits from the internet in terms of enhancing global connectivity and communication. This has been even more amplified by the use of smartphones, which enable 24/7 connectivity in various situations, places, and settings. However, one of the crucial steps towards fully grasping the benefits of smartphone use *for all* is to explore the existence of the digital divide and its relationship to different outcomes from smartphone use. In so doing, this study explored smartphone use, skills, and outcomes of Korean older adults. The importance of this study lies in the fact that it sets the basis for understanding the three levels of the digital divide, with a specific focus on unfolding differences across three age groups: 60+, 70+ and 80+, rather than comparing these groups to younger generations.

In our study, a questionnaire-based in-person interview method was used with the aim to understand 'if', 'how', and 'why' older adults aged 60 and above in the Seoul Metropolitan area use smartphones. The results of our research bring to light all three levels of the grey digital divide, exposing differences among older adult groups in fully harnessing the potential of the smartphone. More specifically, our results show that smartphones are owned by the majority of older adults but the group not owning a smartphone is still prominent. Among those owning a smartphone, the devices are predominately used to make and receive calls from their children, friends, and spouses. Hence, we found evidence that older adults in all three age groups used smartphones in Vroman et al.'s (2015) primary level of communication with personal relationships and support system. This was the most frequently used pattern of connecting with friends and family, reflecting primary interests and needs of older adults. This finding also makes Korean older adults no different from their European peers, which may help generalize the use of smartphones cross-culturally.

Moreover, we found evidence of the other two levels of smartphone use according to Vroman et al.'s (2015) model. Younger older adults were much more prone to using all other smartphone functions compared to their older peers, making them champions of smartphone literacy. Functions such as games and navigation were rarely used but when they were used, user profiles were different: more female participants played games on smartphones, whereas more males used the navigation function. In terms of connecting with virtual communities, SNS activity was rarely shown. This indicates older adults' shyness or reluctance or lack of literacy to engage with the least personally intimate social network such as online interest groups. Although it was not at the level of a virtual community, those who had ICT training were more confident in communicating with a broader range of people via smartphones. For example, those who had ICT training used smartphones more frequently to communicate with their siblings, relatives, and people from their community centers. This confirms previous research findings that ICT training facilitates users to acquire and improve digital skills and competence.

Lastly, this study also contributes to a better understanding of the benefits of using smartphones among older adults. Our results found evidence that using smartphones to stay connected to their social group and for entertainment such as watching movies aids in decreasing the feeling of loneliness. Nowadays, this finding is even more relevant due to COVID-19 pandemic, which resulted in a majority of the world's population being confined to self-isolation, strict social distancing rules and avoidance of in-person contact with members outside the household. Also, older adults were shown to be the group most jeopardized by the pandemic. Hence, using smartphones to stay connected with their social groups and to be entertained is even more critical to reducing loneliness that may come as a result of the pandemic. However, our study was conducted two years before the virus outbreak,

making this finding a good starting point to test these pandemic-related assumptions.

Our study is not without limitations. Those who used various smartphone functions were a minority so that it is hard to generalize the exact impact of smartphone use and literacy on an individual's psychological factors. Due to the sample size and the participant demographics, our findings have limited applicability. The same age groups that own a smartphone but live in rural areas may result in different findings. In addition, a more detailed investigation into the type of ICT training, length, and intensity of the training will provide more practical lessons for making suitable training programs for older adults. Future research can also examine, both at the micro- (individual) and macro- (societal) level, different experiences of digital technology engagement (e.g., tablets and wearable technology) among older adults and how society can better prepare literacy training programs for more beneficial outcomes.

References

1. Álvarez-Dardet, S. M., Lara, B. L. & Pérez-Padilla, J. (2020). Older adults and ICT adoption: Analysis of the use and attitudes toward computers in elderly Spanish people. *Computers in Human Behavior*, *110*, 106377. https://doi.org/10.1016/j.chb.2020.106377
2. Anshari, M., Alas, Y., Hardaker, G., Jaidin, J. H., Smith, M. & Ahad, A. D. (2016). Smartphone habit and behavior in Brunei: Personalization, gender, and generation gap. *Computers in Human Behavior*, *64*, 719-727. https://doi.org/10.1016/j.chb.2016.07.063
3. Aylaz, R., Aktürk, Ü., Erci, B., Öztürk, H. & Aslan, H. (2012). Relationship between depression and loneliness in elderly and examination of influential factors. *Archives of Gerontology and Geriatrics*, *55*(3), 548-554. https://doi.org/10.1016/j.archger.2012.03.006
4. Barnard, Y., Bradley, M. D., Hodsgon, F. & Lloyd, A. D. (2013). Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. *Computers in Human Behavior*, *29*(4), 1715-1724. https://doi.org/10.1016/j.chb.2013.02.006
5. Blank, G. & Groselj, D. (2014). Dimensions of Internet use: Amount, variety and types. *Information, Communication and Society*, *17*(4), 417-435. https://doi.org/10.1080/1369118X.2014.889189
6. Carpenter, B. D. & Buday, D. (2007). Computer use among older adults in a naturally occurring retirement community. *Computers in Human Behavior*, *23*(6), 3012-3024. https://doi.org/10.1016/j.chb.2006.08.015
7. Dakers, S. (2018). *The minister for loneliness will need all the friends she can get*. https://www.theguardian.com/society/2018/jan/23/tracey-crouch-minister-loneliness-friends-powerful-vested-interests
8. van Deursen, A. & van Dijk, J. (2011). Internet skills and the digital divide. *New Media & Society*, *13*(6), 893-911. https://doi.org/10.1177/1461444810386774
9. van Deursen, A. J. A. M. & Helsper, E. J. (2015). The Third-Level Digital Divide: Who Benefits Most from Being Online?. In Adams, R. G. et al. (Eds.), *Communication and Information Technologies Annual (Studies in Media and Communications, Vol. 10)* (pp. 29-52). Emerald Group Publishing Limited. https://doi.org/10.1108/S2050-206020150000010002
10. van Deursen, A. J. A. M., Helsper, E., Eynon, R. & van Dijk, J. A. G. M. (2017). The compoundness and sequentiality of digital inequality. *International Journal of Communication*, *11*, 452-473.
11. van Dijk, J. A. G. M. (2005). *The Deepening Divide: Inequality in the Information Society*. Sage.
12. van Dijk, J. A. G. M. (2018). Afterword: The state of digital divide theory. In Ragnedda, M. & Muschert, G. W. (Eds.), *Theorizing Digital Divides* (pp. 199-206). Routledge. https://doi.org/10.4324/9781315455334-16
13. Doughty, K. (2011). SPAs (smart phone applications) – a new form of assistive technology. *Journal of Assistive Technologies*, *5*(2), 57-66. https://doi.org/10.1108/17549451111149296
14. Fernández-Ardèvol, M. (2011). Interactions with and through mobile phones: What about the elderly population?. *Wi: Journal of Mobile Media*, Spring. http://wi.mobilities.ca/interactions-with-and-through-mobile-phones-what-about-the-elderly-population/
15. Feist, H. & McDougall, K. (2013). Older people's use of new communication technologies and research findings and policy implications. *Australian Population and Migration Research Centre Policy Brief*, *1*(8), 1-7.
16. Formosa, M. (2013). Digital exclusion in later life: A Maltese case study. *Humanities and Social Sciences*, *1*(1), 21-27. https://doi.org/10.11648/j.hss.20130101.14
17. Friemel, T. N. (2016). The digital divide has grown old: Determinants of a digital divide among seniors. *New Media and Society*, *18*(2), 313-331. https://doi.org/10.1177/1461444814538648
18. Gann, B. (2019). Digital Inclusion and Health in Wales. *Journal of Consumer Health on the Internet*, *23*(2), 146-160. https://doi.org/10.1080/15398285.2019.1608499

19. Goodman, A., Adams, A. & Swift, H. J. (2015). *Hidden Citizens: How can we identify the most lonely older adults?* Campaign to End Loneliness. https://www.campaigntoendloneliness.org/wp-content/uploads/CEL-Hidden-People-report-final.pdf

20. Han, C. S., Ahnjo, S. M., Kwak, J. H., Pae, C. U., Steffens, D. & Jo, I. H. (2008). Validation of the patient health questionnaire-9 Korean version in the elderly population: the Ansan geriatric study. *Comprehensive Psychiatry*, *49*(2), 218-223. https://doi.org/10.1016/j.comppsych.2007.08.006

21. Helsper, D. J. (2010). Gendered Internet Use across Generations and Life Stages. *Communication Research, 37*(3), 352-374. https://doi.org/10.1177/0093650209356439

22. Hill, A., MacNamara, Á., Collins, D. & Rodgers, S. (2016). Examining the Role of Mental Health and Clinical Issues within Talent Development. *Frontiers in Psychology*, *6*, 2042. https://doi.org/10.3389/fpsyg.2015.02042

23. Hong, S. G., Trimi, S. & Kim, D. W. (2018). Smartphone use and internet literacy of senior citizens. *Journal of Assistive Technologies*, *10*(1), 27-38. https://doi.org/10.1108/JAT-03-2015-0006

24. International Federation of Library Associations and Institutions (IFLA) (2017). *IFLA Statement on Digital Literacy*. https://www.ifla.org/publications/node/11586

25. Joe, J. & Demiris, G. (2013). Older adults and mobile phones for health: A review. *Journal of Biomedical Informatics*, *46*(5), 947-954. https://doi.org/10.1016/j.jbi.2013.06.008

26. Jopling, K. (2015). *Promising approaches to reducing loneliness and isolation in later life*. Age UK and the Campaign to End Loneliness. https://www.campaigntoendloneliness.org/wp-content/uploads/Promising-approaches-to-reducing-loneliness-and-isolation-in-later-life.pdf

27. Juznic, P., Blazic, M., Mercun, T., Plestenjak, B. & Majcenovic, D. (2006). Who says that old dogs cannot learn new tricks? A survey of internet/web usage among seniors. *New Library World*, *107*(1226/1227), 332-345. https://doi.org/10.1108/03074800610677308

28. Ketelaar, P. E. & van Balen, M. (2018). The smartphone as your follower: The role of smartphone literacy in the relation between privacy concerns, attitude and behaviour towards phone-embedded tracking. *Computers in Human Behavior*, *78*, 174-182. https://doi.org/10.1016/j.chb.2017.09.034

29. Lee, C. & Coughlin, J. F. (2014). Older adults' adoption of technology: An integrated approach to identifying determinants and barriers. *Journal of Product Innovation Management*, *32*(5), 749-759. https://doi.org/10.1111/jpim.12176

30. Millward, P. (2003). The 'grey digital divide': Perception, exclusion and barriers of access to the Internet for older people. *First Monday*, *8*(7). https://doi.org/10.5210/fm.v8i7.1066

31. Moody, E. J. (2001). Internet use and its relationship to loneliness. *Cyberpsychology, Behavior, and Social Networking*, *4*(3), 393-401. https://doi.org/10.1089/109493101300210303

32. Morgan, C. & Cotten, S. R. (2004). The relationship between internet activities and depressive symptoms in a sample of college freshmen. *Cyberpsychology, Behavior, and Social Networking*, *6*(2), 133-142. https://doi.org/10.1089/109493103321640329

33. Morris, A. & Brading, H. (2007). E-literacy and the grey digital divide: a review with recommendations. *Journal of Information Literacy*, *1*(3), 13-28. https://doi.org/10.11645/1.3.14

34. Mossberger, K., Tolbert, C. J. & Stansbury, M. (2003). *Virtual Inequality: Beyond the Digital Divide*. Georgetown University Press.

35. National Information Society Agency (NIA) (2018). *National Informatization White Paper*.

36. OECD (2019). *Digital Government Index: 2019 results*. http://www.oecd.org/gov/digital-government-index-4de9f5bb-en.htm

37. Park, N., Kim, Y-C., Shon, H. Y. & Shim, H. (2013). Factors influencing smartphone use and dependency in South Korea. *Computers in Human Behavior*, *29*(4), 1763-1770. https://doi.org/10.1016/j.chb.2013.02.008

38. Park, S. J., Choi, H. R., Choi, J. H., Kim, K. W. & Hong, J. P. (2010). Reliability and validity of the Korean version of the Patient Health Questionnaire-9 (PHQ-9). *Anxiety and Mood*. *6*(2), 119-124.

39. Petrovičič, A., Rogelj, A. & Dolničar, V. (2018). Smart but not adapted enough: Heuristic evaluation of smartphone launchers with an adapted interface and assistive technologies for older adults. *Computers in Human Behavior*, *79*, 123-136. https://doi.org/10.1016/j.chb.2017.10.021

40. Poushter, J., Bishop, C. & Chwe, H. (2018). *Across 39 countries, three-quarters say they use the internet*. Pew Research Center. https://www.pewresearch.org/global/2018/06/19/across-39-countries-three-quarters-say-they-use-the-internet/

41. Renaud, K. & Biljon, J. (2010). Worth-centered mobile phone design for older users. *Universal Access in the Information Society*, *9*(4), 387-403. https://doi.org/10.1007/s10209-009-0177-9

42. Rozgonjuk, D., Levine, J. C. Hall, B. J. & Elhai, J. D. (2018). The association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use over one week. *Computers in Human Behavior*, Vol. *87*, 10-17. https://doi.org/10.1016/j.chb.2018.05.019

43. Scheerder, A., van Deursen, A. & van Dijk, J. (2017). Determinants of Internet skills, uses and outcomes. A systematic review of the second- and third-level digital divide. *Telematics and Informatics*, *34*(8), 1607-1624. https://doi.org/10.1016/j.tele.2017.07.007

44. Schehl, B., Leukela, J. & Sugumaran, V. (2019). Understanding differentiated internet use in older adults: A study of informational, social, and instrumental online activities. *Computers in Human Behavior*, *97*, 222-230. https://doi.org/10.1016/j.chb.2019.03.031

45. Shaw, L. H. & Grant, L. M. (2002). In defense of the Internet: The relationship between Internet communication and depression, loneliness, self-esteem, and perceived social support. *Cyberpsychology, Behavior, and Social Networking*, *5*(2), 157-171. https://doi.org/10.1089/109493102753770552

46. Silver, L. (2019). *Smartphone Ownership is Growing Rapidly around the World, but Not Always Equally*. Pew Research Center. https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/

47. Statistics Korea (2019). *2018 Population and Housing Census.* https://kostat.go.kr/portal/eng/pressReleases/8/1/index.board?bmode=readandbSeq=andaSeq=378503andpageNo=1androwNum=10andnavCount=10andcurrPg=andsearchInfo=srchandsTarget=titleandsTxt=2018+Population+and+Housing+Census

48. Speake, D. L., Cowart, M. E. & Pellet, K. (1989). Health perceptions and lifestyles of the elderly. *Research in Nursing and Health*, *12*(2), 93-100. https://doi.org/10.1002/nur.4770120206

49. Song, H., Zmyslinski-Seelig, A., Kim, J., Drent, A., Victor, A., Omori, K. & Allen, M. (2014). Does Facebook make you lonely?: A Meta Analysis. *Computers in Human Behavior*, *36*, 446-452. https://doi.org/10.1016/j.chb.2014.04.011

50. Steinhubl, S. R., Muse, E. D. & Topol, E. J. (2013). Can mobile health technologies transform health care?. *Journal of the American Medical Association*, *310* (22), 2395-2396. https://doi.org/10.1001/jama.2013.281078

51. Stockwell, S., Stubbs, B., Jackson, S., Fisher, A., Yang, L. & Smith, L. (2020). Internet use, social isolation and loneliness in older adults. *Ageing and Society*, *41*(12), 1-24. https://doi.org/10.1017/S0144686X20000550

52. Sum, S., Mathews, R. M., Hughes, I. & Cambell, A. (2008). Internet Use and Loneliness in Older Adults. *CyberPsychology & Behavior*, *11*(2), 208-211. https://doi.org/10.1089/cpb.2007.0010

53. Vroman, K., Arthanat, S. & Lysack, C. (2015). "Who over 65 is online?"' Older adults' dispositions toward information communication technology. *Computers in Human Behavior*, Vol. 43. pp. 156-166. https://doi.org/10.1016/j.chb.2014.10.018

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DETERMINANTS OF PROFITABILITY OF THE IT INDUSTRY IN CROATIA

Abstract

Purpose: Two research questions are posed in the paper that investigate and analyze the relationship between profitability and microeconomic determinants of business activity classified under J62 in the Republic of Croatia on a sample of 280 IT firms in the period from 2019-2021.

Methodology: The present research is based on the resource-based view (RBV) approach - firm-specific determinants of firm profitability. Multiple regression analysis was conducted to investigate the determinants of industry profitability, as determined by ROA and ROE.

Results: Further analyses investigated a correlation between the identified internal factors and the profitability of IT firms. Finally, two profitability models were set up, defined by a single set of internal factors with different correlations and statistical significance. It was shown that the independent variables *Debt* (DBT), *Total assets* (SIZE), and *EBIT* have statistical significance in both models, ROA and ROE demonstrate a strong correlation, the variables *Stratification* and *Current liquidity* (CL) show a correlation with the ROA model, and the lagged variables have different predictive abilities in terms of mROE.

Conclusion: The results of multiple regression analysis show that there is a correlation between internal factors and profitability at the firm level.

Keywords: ROA, ROE, determinants of profitability, IT industry, multiple regression analysis

1. Introduction

Analysis of the state and level of development of the Croatian IT industry in the national economy was published by the Croatian Chamber of Economy (HGK, 2020; 2020a; 2021; 2022). According to data from the annual financial reports of entrepreneurs, in 2021, the IT sector participated in the Croatian non-financial sector with 4.5% of firms, 3.9% of employees, 3.7% of income and 6.3% of exports (HGK, 2022, p. 5), where micro and small enterprises recorded above-average growth in income, exports, EBITDA and average wages in the period from 2017-2021 (HGK, 2022, p. 4).

In view of the abundance and importance of the IT activity as a fast-growing industry, it is necessary to ask the following research questions: (i) RQ_1 - Do internal factors correlate with the profitability of the IT industry in Croatia?, and (ii) RQ_2 - What is the relationship between the identified internal factors and profitability in the Croatian IT industry? (Vuković et al., 2020; Margaretha & Supartika,

2016). The objectives of the paper are to determine and examine the relationship between profitability and microeconomic determinants of the IT industry in the Republic of Croatia on a sample of 280 IT firms in a three-year period based on 36,632 values and 38 balance sheet and profit and loss account positions, by virtue of which 824 observations were calculated. The collected data were tested by evaluating the time series of data using a standardized statistical methodology present in similar papers, i.e. multivariate regression analysis (Bhutta & Hasan, 2013).

The rest of the paper is organized in five sections. The second section reviews the literature on the relationship between the factors that shape the profitability of different industries in the Croatian research environment. Normality testing in large samples as well as sample and variable design are described in the third section. The statistical model of multiple regression analysis is presented in Section 4. Analysis results are also presented in Section 4 and discussed in Section 5. The limitations of the research and concluding remarks are given in Section 6.

2. Literature review and hypothesis formulation

According to Škuflić et al. (2018, p. 340), the determinants of profitability can be classified into four categories: global determinants, national determinants, industry determinants, and determinants of corporate profitability, in accordance with the contributions of Porter (1980), Oster (1990) and Scherer (1980), correlating the structural characteristics of individual industries and the causes of differences in profitability among industries through the structure-conduct-performance (SCP) paradigm (Škuflić & Mlinarić, 2015, p. 480). On the other hand, according to Yazdanfar (2013, p. 151), the RBV approach assumes that firm performance is mainly determined by internal rather than external variables (Barney, 1991), and explains firm performance in different ways, e.g. by explaining profitability mainly with specific characteristics, resources and capabilities at the firm level (Wernerfelt, 1984). Based on Mackey (2008) and McGahan and Porter (2002), Stierwald (2010, p. 5) summarizes the results of selected variance decomposition studies and illustrates that, depending on the size and period of the sample, either firm or industry effects play a central role in determining firm profitability.

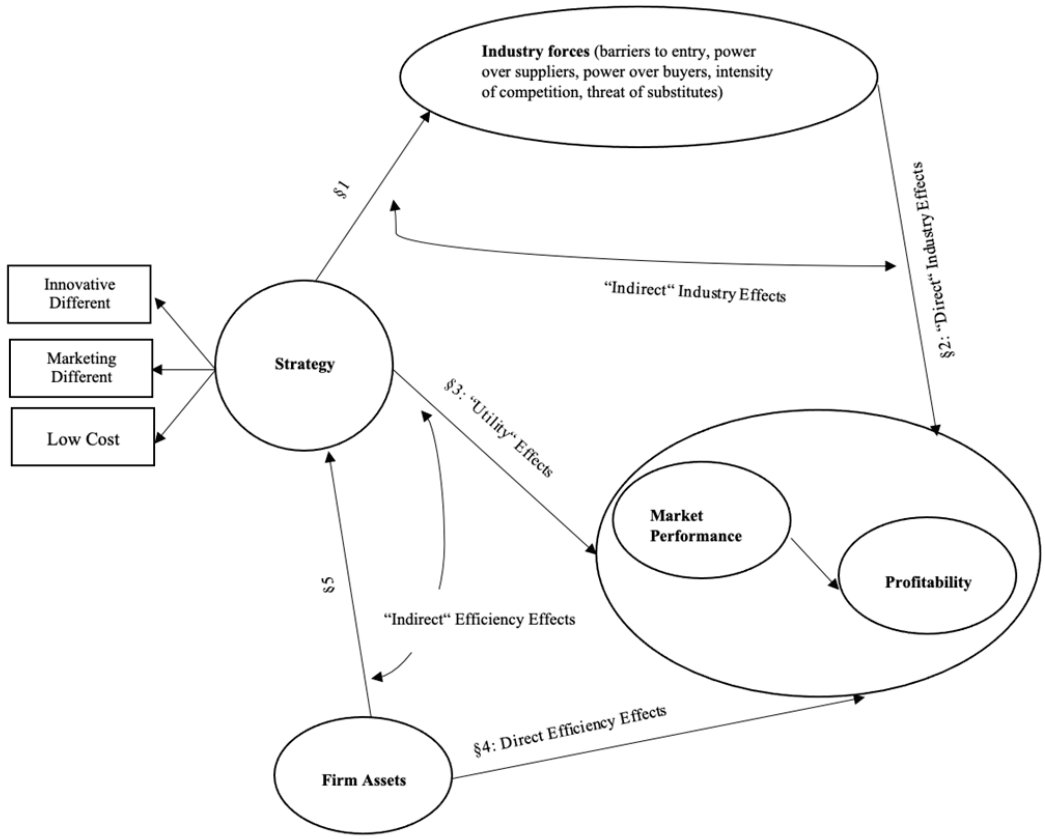
Spanos and Lioukas (2001, p. 922) conclude that according to Schmalensee (1985) and McGahan and Porter (1997), industry effects explain an important portion of profit variability, whereas Hansen and Wernerfelt (1989), Rumelt (1991) and Mauri and Michaels (1998) report that firm effects are more important than industry effects on firm performance. Therefore, profitability determinants at the firm level are influenced by exogenous and endogenous variables depending on the level of influence of internal management policies. Exogenous variables such as industry-specific variables (measured by the Herfindahl-Hirschman index or capital intensity) and macro-economic variables (measured by the inflation rate and the growth rate of economy) (Pervan et al., 2019, p. 974), which do not depend on the impact of firm management policies (Dimitrić et al., 2018, p. 334), are beyond the scope of this research.

A conceptual framework of profitability factors is given in Figure 1. The paths of Dehning and Richardson (2002, pp. 9-10) show how researchers have measured IT, business process performance or firm performance. In path 1, researchers typically measure firm performance using market metrics (Tobin's q) or accounting metrics (ROA, ROE, ROS), path 2 includes business process performance (gross margin, inventory turnover, customer service, quality, efficiency, profit margin, revenue metrics), path 3 shows firm performance, and path 4 presents contextual factors using business performance metrics (firm size, industry, financial health of the firm, growth options, and IT intensity).

The following internal determinants of profitability are usually emphasized in research studies as those that a firm can influence through its management policy: firm size, leverage, productivity, allocations to research and development, lagged earnings, investment, liquidity, and solvency (Škuflić & Mlinarić, 2015, p. 482), calculated using adjusted financial indicators and additionally classified, according to Tailab (2014), into financial and non-financial factors. In particular, metrics differ from industry to industry, especially as analysts tracking specific industries create and use specialized metrics designed to capture important elements of profitability and risk within that industry, such as revenue per passenger mile for airlines and loan loss provisions as a percentage of total loans for banks

(Wahlen et al., 2022, p. 247). Profitability is measured by relating various categories of earnings to assets, income and/or capital (Dimitrić et al., 2018, p. 338). In this paper, profitability can be expressed as a function of two dependent variables (dvROA, dvROE) that are statistically significantly related. ROA is important for analysts who are interested in the profitability and efficiency of the firm's core operations (Wahlen et al., 2022, p. 295), while ROE can be a particularly useful indicator of profitability as it indicates the efficiency of using capital, not just tangible assets.

Figure 1 Conceptual framework of profitability factors



Source: Spanos & Lioukas (2001)

Wahlen et al. (2022, p. 307) analyze profitability through four levels, where ROA interprets different levels of profitability ratios. According to these authors, the first level refers to profitability ratios for the firm as a whole (i.e., ROA - return on total assets, ROCE - return on common equity), while the second level breaks down the first level into: (2a) profit margin for ROA or ROE and asset turnover, and (2b) capital structure leverage for ROCE (operating vs. financial leverage). At the next level, ROA is broken down into other levels, with profit margin broken down into (2ai) various percentages of expenses to sales, i.e. asset turnover (2aii), which is further broken down into receivables turnover, inventory turnover and fixed asset turnover. Level 4 uses product and geographic segment data to analyse ROA, profit margin and asset turnover in more detail. Therefore, it is initially argued that **(H1)**: There is a correlation between internal factors and profitability.

Based on the reviewed literature, auxiliary hypotheses were set up according to Margaretha and Su-

partika (2016) and other authors (Yazdanfar, 2013; Öhman & Yazdanfar, 2017). However, previous studies have shown contradictory results that make generalisations questionable (Alarussi & Alhaderi, 2018, p. 443). Hence the paper tests conflicting features of the correlation between the internal determinants of non-financial firms and their profitability, such as Baum et al. (2006, p. 6).

A firm prefers to have a high current ratio because it means that it has enough current assets to pay its current liabilities, with an increase compared to the previous period indicating an improvement in a firm's ability to pay its current liabilities and vice versa (Horngren et al., 2012, p. 214). Some previous studies have shown positive effects in 2,154 Indian firms (Al-Homaidi et al., 2020), while Raheman and Nasr (2007) and Eljelly (2004) show a negative relationship between profitability and liquidity indicators. The assumption was formulated by hypothesis **H1a**: There is a correlation between current liquidity and profitability in the period 2019-2021 for J62. Previous literature has shown mixed effects of debt on firm profitability (Joh, 2003, p. 296), highlighting at the same time the positive, negative and mixed effects of debt, as shown by Habib et al. (2016). Nevertheless, the position of this factor is initially presented as **H1b**: There is a correlation between the debt ratio and profitability in the period 2019-2021 for J62.

Financial stability plays a significant role in defining liquidity and working capital, with smaller coefficient values indicating a greater share of working capital (Smith, 1987; Eljelly, 2004), which improves liquidity and profitability. On the other hand, fixed asset financing through other sources directly affects the way of using financial leverage, but it does not affect corporate ownership (Yazdanfar, 2013, p. 448). Ebaid (2009, p. 485) concludes that the choice of capital structure generally has a weak to no impact on the financial performance of listed firms in Egypt and that financial leverage has a negative impact on firm performance as measured by ROA, i.e. it has no significant impact on firm performance as measured by ROE or gross profit margin. The reviewed literature indicates indeterminate and divided research results, thus **H1c**: There is a correlation between financial stability and profitability in the period 2019-2021 for J62. In the paper, total assets were employed as one of the most commonly used variables for measuring firm size by the logarithm value of total assets. The results of recent research have revealed a positive size. Nevertheless, some studies found a negative predictive value (Hardwick, 1997; Dilling-Hansen, 2005; Margaretha & Supartika, 2016), which implies **H1d**: There is a correlation between size and profitability in the period 2019-2021 for J62.

The reviewed literature referring to the sales growth variable confirms dichotomous points of view. A positive relationship was established by many researchers such as Salman and Yazdanfar (2012), Grinyer and Mckiernan (1991), and Lazar (2016), in contrast to Margaretha and Supartika (2016), who confirmed a negative impact of lagged sales on current profitability. Auxiliary hypothesis **H1e** reads: There is a correlation between sales and profitability in the period 2019-2021 for J62. The number of IT firms in the country reached 5,718 and accounted for 4.2% of the total number of firms in the non-financial sector of the Croatian economy (HGK, 2020, p. 52), and the EBIT variable seems to be a justified choice. EBIT is calculated as operating revenues minus operating expenses, which leads to hypothesis **H1f**: There is a correlation between EBIT and profitability in the period 2019-2021 for J62.

McDonalds' (1999, p. 115) econometric results over the 1984-1993 period suggest that lagged profitability is a significant determinant characterized by persistence and cyclicality of firm profitability. A number of previous studies, e.g. by Yazdanfar (2013), Dilling-Hansen (2005), Goddard et al. (2005) and Stierwald (2010), have found a positive relationship between lagged and current profitability.Taking into account cyclicality and persistence, it is argued in **H1g**: There is a correlation between lagged and current profitability for J62.

3. Research metodology

3.1 Data collection and sample design

The scope of the IT industry is defined by the following areas and codes within sections of the National Classification of Activities (NKD 2007; NACE Rev. 2): C26, G46, G47, J58, J62, J63 and S95 (HGK, 2022, p. 21). The IT industry therefore consists of: (i) provision of IT services, (ii) manufacture of IT equipment and components, and (iii) sale of IT equipment, components and software. The scope of the IT industry defined in this way corresponds to the definition of the IT industry provided by the OECD in 2006 that excludes the telecom operator activity (HGK, 2020, p. 14). Division J62 covers computer programming (mainly micro-enterprises), comput-

er consultancy, computer equipment management and other information technology and computing services (NKD 2007; NACE Rev. 2; ISIC Rev. 4). Every financial enterprise in Croatia must annually submit data on a wide range of financial activities such as income and expenses, i.e. these data are confidential and remote access has been authorized as part of the specific research project (Škuflić et al., 2018, p. 347). Unconsolidated AFS data presented in the balance sheet and profit and loss account of the Financial Agency (FINA) for the period 2019-2021 were collected for firms with J62 activities and a turnover of more than HRK 7.5 million in 2021.

3.2 Description and operationalization of variables

The data collected from the FINA database include the necessary positions in the balance sheet and the profit and loss account for the basic calculations in Excel of the values of dependent and independent variables of profitability. Table 1 provides an overview of dependent and independent variables used in further analyses, symbols, and a description and calculation of variables using the methodology of displaying the relationship between variables by Wahlen et al. (2022) and Milenković et al. (2019).

Table 1 Overview of dependent and independent variables

Dependent variables	Symbol	Variable description	Expected relationship	
Return on assets	ROA	Net income / total asset ratio	ROA ± ROE	
Return on equity	ROE	Net income / total equity ratio		
Explanatory variables	**Symbol**	**Variable description**	**Expected relationship**	
Current liquidity ratio	CL	Current assets / Current liabilities	–	*
Debt ratio	DBT	Total liabilities / Total assets	–	+
Financial stability	FS	Long-term assets / Long-term liabilities	*	*
Size	SIZE	Natural algorithm of the total assets	–	–
Sales growth	SGR	$(Sales_t - Sales_{t-1}) / Sales_{t-1}$	+	*
Earnings before income and tax	EBIT	Operating revenues – Oper. expenses	+	+
Lagged profitability	lagROA	ROA_{t-1} = 20/19; ROA_{t-2} = 21/19	±	*
Lagged profitability	lagROE	ROE_{t-1}= 20/19; ROE_{t-2}= 21/19	*	±

Note: + positive relationship; – negative relationship; * no relationship

Source: Author's estimate

Two indicators - total assets and EBIT - are numerical indicators. Sales growth is a relative indicator of dynamics calculated as $Sales_t$ - $Sales_{t-1}$/ $Sales_{t-1}$. The income growth indicator includes only business revenue (the sales index), and the annual values are calculated cumulatively with respect to 2020/2019, 2021/2020 and 2021/2019 (base year). The financial stability ratio was measured by the ratio of long-term assets to long-term sources of financing, where the (non)inclusion of the own equity position was not of particular importance. For the sake of caution, both indicator values were calculated, and if the firm did not have an expressed value, for example, of long-term debt in MS Excel, 0 was calculated for such positions. In the paper, the correlation is explained in terms of a positive and a negative relationship between dependent and independent variables, and the initial expectations are shown in Table 1.

4. Research methodology and results

4.1 ROA model (Model 1) and ROE model (Model 2)

An empirical examination of profitability factors of IT firms was carried out by using multiple linear regression. A general form of a multiple linear regression model (Eq. 1) can be written following Horvat and Mijoč (2019); if the relationship between x is linear, then the expanded form of the equation is as follows (Eq. 2):

$$y = f(x_1, x_2, ..., x_i, ..., x_k) + \varepsilon \quad \text{(Eq. 1)} \quad \overset{\text{x is linear}}{\rightarrow} \quad y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_j x_j + ... + \beta_k x_k + \varepsilon \quad \text{(Eq. 2)}$$

where y is a dependent, regressor, endogenous or output variable, $x_1, x_2, ..., x_k$ are independent, regressor, exogenous or input variables, while *e* is a random error in the model, i.e., an error term, and β_0, $\beta_1,..., \beta_k$ are population parameters, where β_0 is the constant term and $\beta_1,..., \beta_k$ are the coefficients of the independent variables. The following initial profitability models were established (Eq. 3 and Eq. 4):

$$ROA_t = \beta_0 + \beta_1 CL_t + \beta_2 DBT_t + \beta_3 FS_t + \beta_4 SIZE_t + \beta_5 SGR_t + \beta_6 EBIT_t + \beta_{7_{lagg}} ROA_t + e_t. \quad \text{(Eq. 3)}$$

$$ROE_t = \beta_0 + \beta_1 CL_t + \beta_2 DBT_t + \beta_3 FS_t + \beta_4 SIZE_t + \beta_5 SGR_t + \beta_6 EBIT_t + \beta_{7_{lagg}} ROE_t + e_t. \quad \text{(Eq. 4)}$$

4.2 Descriptive statistics

Table 2 presents a summary of descriptive statistics of dependent and independent variables used in the study that indicate several performances of the observed activity. ROE can be expressed as the product of ROA by measuring total equity and total assets. In most industries, a 10% return on assets is considered good and most firms strive for a return on equity of 15% or higher (Horngren et al., 2012, p. 599). So, it can be concluded that ROE (mean 45.1%) is higher than ROA (mean 21.9%) for all IT firms, which is a healthy sign for J62 firms because they earn more for their stockholders than they pay for interest. A high ROA indicates that an IT firm generates more income for each unit of assets it owns, and a high ROE means that an IT firm has more profit for each unit of equity it owns. It is assumed that high ROA and ROE mean that an IT firm uses its resources well and operates efficiently, which in the long run can lead to higher revenues and an increase in the firm's market value. On the other hand, low ROA and ROE indicate problems in doing business, which is manifested through high operating costs, low efficiency in the use of resources, high financing costs or low income earned from product sales, which leads to lower profitability (Ebaid, 2009).

In the selected activity code, service firms account for 87.7%, of which 65.4% deal with computer programming (HGK, 2022, p. 5). In 2021, IT firms dealing with computer programming accounted for 60.4% of business revenue of IT service firms, i.e., 38.1% of revenue of the entire IT industry, whose revenue was 2.8 times higher than IT retail revenue and 1.6 times higher than IT producer revenue (HGK, 2022, p. 7), which is attributable to exceptional fragmentation of the Croatian IT industry, deep capillarity of profit and profitability inhomogeneity.

Table 2 Descriptive statistics

Variable	Mean	Median	St. Deviation	Minimum	Maximum	N
ROA	21.90	16.80	30.70	-192.40	408.70	809
ROE	45.10	36.40	73.60	-648.80	1,078.10	809
CL	399.70	222	592.30	104	7,469	809
DBT	50.40	41.70	53.50	1.30	718,60	809
FS	42.90	0	583.40	0	14,816.85	809
$FS_{ownequity}$	43.80	23.30	146.80	-10.10	35.20	809
SZ	23,595.918	8,703.327	54,975.684	8,737	763,932.288	809
EBIT	3,986.700	1,832.133	6,944.297	-15,396.460	61,714.566	809
$SGR_{(20/19)}$	51.50	0.10	840.80	-1	13.824	809
$SGR_{(21/20)}$	501.90	0.20	8.224	-0.50	135.224	809
$SGR_{(21/19)}$	68.50	0.30	1.013	-0.70	16,583.20	809
$laggROA_{21/19}$	1.60	1	3.80	-14.60	42.40	788
$laggROA_{20/19}$	1.40	1	2.60	-5.70	33.80	788
$laggROE_{21/19}$	1.20	0.90	2.60	-24	20.40	788
$laggROE_{21/19}$	1.10	0.90	1.70	-10.70	15.30	788

Source: Author's estimate

In addition, a large standard deviation, which is almost twice as large as the mean, shows that profits are widely dispersed and that the sample is not homogeneous in terms of profitability (Stierwald, 2010, p. 12). The results of Pearson's correlation for the variables of interest for 809 observations are shown in Appendix 1. The results of the correlation matrix show that EBIT plays a positive and significant role in achieving the profitability of Croatian IT firms, compared to the negative value of the SIZE variable. Other independent variables showed an inversely proportional relationship, while the remaining variables were not statistically significant. In respect of the correlations between the independent variables, as shown by the results of Gharaibeh and Khaled (2020, p. 283), the values of the correlation matrix are below 0.80, which means that these variables are not strongly correlated and there is no multicollinearity.

4.3 Regression results

SPSS parametric models were used for data analysis. Profitability models were tested in the same way, and the results presented in an aggregated manner are reported in the model summary table (Table 3), the ANOVA table (Table 4) and regression tables (tables 5 and 6), following the multiple regression decision diagram by Hair et al. (2009). The aim of the model summary is to determine the R^2, i.e., adjusted R^2, value. Second, the ANOVA table shows the F-ratio for testing H_0, while the P-value determines the level of confidence. According to Mason and Perreault (1991, p. 268), regression tables contain the regression coefficients, their standard errors and the associated t-tests.

The R column represents the value of the multiple correlation coefficient and is used to determine the quality of the prediction of the dependent variable (R1=0.747 ROA model; R2=0.527 ROE model). The R-squared column indicates the coefficient of determination, i.e. the proportion of the variance of the dependent variable that can be explained by independent variables. The ROA coefficient of determination is 0.558, which corresponds to 55.8% of the variability of the dependent variable that can be explained by the independent variables, which means that the strength of the relationship is good, as expected. In the second model, R2 is 0.278 and accounts for 27.8% of the variability of the dependent variable that can be explained by the independent variables, which describes the strength of the relationship as sufficiently good.

The adjusted R^2 is 0.554, indicating 55.4% of the variance proxied by ROA, and it is 0.273, indicating 27.3% of the variance proxied by ROE (Tailab, 2014: R^2 for ROE=0.10 and ROA=0.337). The adjusted R^2 is slightly smaller than the exact value of R^2 for 0.004 and 0.005, respectively, which is less than 0.009 in Shrestha (2020, p. 41). This means that if the model were derived from the population and not from a sample, it would explain about 0.4% and 0.5% less variance in the result. The Durbin-Watson statistic was used as a test for autocorrelation in the residuals of a regression analysis (Hayes & Cai, 2007; Wooldridge, 2016; Garefalakis et al., 2016). The above results show that the models are acceptable in explaining the effects of the independent variables on profitability proxied by ROA/ROE.

Table 3 Model summary for ROA and ROE

Model Summary [ab]					
Model	R	R^2	Adjusted R^2	SEE	Durbin-Watson
1 ROA	.747[c]	0.558	0.554	20.524	1.411
2 ROE	.527[d]	0.278	0.273	63.352	1.847

a. Dependent variable: ROA

b. Dependent variable: ROE

c. Predictors: (Constant), Stratification, EBIT, $SGR_{20/19}$, $SGR_{21/20}$, Current liquidity (CL), ROE, Total assets (SIZE), Debt (DBT) – model 1

d. Predictors: (Constant), $LAGROE_{20/19}$, Total assets (SIZE), ROA, Debt (DBT), EBIT – model 2

Source: Author's estimate

In addition, an extensive literature in marketing, statistics and other quantitative fields suggests various ways to diagnose or manage multicollinearity (Mason & Perreault, 1991, p. 268). Recognising multicollinearity is important because multicollinearity does not reduce the explanatory power of the model, but rather the statistical significance of the independent variables. The presence of multicollinearity between independent variables was tested using the variance inflation factor as $(1 - R_k^2)^{-1}$, where R_i^2 is the unadjusted coefficient of determination for the regression i of the independent variable on the other variables (Mason & Perreault, 1991, p. 270). A large VIF for an independent variable indicates a strong collinear relationship with other variables, which should be taken into account or adjusted for in the model structure and the selection of independent variables. In models 1 and 2, VIF < 5, whose dispersion is between 1.020 and 1.947, indicates that the mutual collinearity between the variables is extremely low (Marquardt, 1970). The results of the ANOVA are shown in Table 4.

Table 4 Significance test and model summary for ROA and ROE

ANOVA[a c]

	Model	Sum of squares	df	Mean Square	F	Sig.
1	Regression	425378.455	8	53172.307	126.224	.000[b]
	Residual	337001.844	800	421.252		
	Total	762380.299	808			
2	Regression	1209169.422	5	241833.884	60.254	.000[d]
	Residual	3138607.700	782	4013.565		
	Total	4347777.122	787			

a. Dependent variable: ROA

b. Predictors: (Constant), Stratification, EBIT, $SGR_{20/19}$, $SGR_{21/20}$, Current liquidity (CL), ROE, Total assets (SIZE), Debt (DBT) – model 1

c. Dependent variable: ROE

d. Predictors: (Constant), $laggROE_{20/19}$, Total assets (SIZE), ROA, Debt (DBT), EBIT – model 2

Source: Author's estimate

The results of the first regression model (F_1=126.224) indicate that there is significant predictive ability of the independent variables (p<0.001) for the dependent variable (the ROA model), where F_1 (425,378.455; 337,001.844)=126.224; p<0.001. Statistical predictive ability of independent variables for the dependent variable ROE is also confirmed in the ROE model, F_2=60.254, because a combination of predictors has a statistically significant influence (p<0.001), which is written as F_2 (1209169,422; 3138607,700)=60.254; p<0.001. The ROA model and the ROE model are denoted as Model 1 and Model 2, respectively. Tables 5 and 6 provide evaluations of the ROA/ROE model coefficients and the significance of independent variables.

The coefficient t fulfils the criterion t>0, which means that the individual predictors are significant in explaining the dependent variable. However, some predictors have a negative t-value (e.g. SIZE -1.064E-07), which indicates reverse regression, i.e. the higher the value of the relevant predictor, the lower the value of the dependent variable, ceteris paribus. In the Sig. column, it is possible to check how significant a particular predictor is in the profitability models. If p<0.05, it is concluded that the observed coefficient is statistically significantly different from 0, i.e. that the corresponding variable is needed in the study and is therefore retained in the model. If, on the other hand, p>0.05, it is concluded that the coefficient is not statistically significantly different from 0. In this case, the ROA regression model is statistically significant and sufficiently reliable (p<0.05).

5. Discussion

One main and seven auxiliary hypotheses were set up in the paper. The aim of the paper was to determine a correlation between internal factors and

the profitability of IT firms as well as to identify predictive relationships between independent variables and ROA and ROE. In the initial analysis, all independent variables were used. The calculated regression models are statistically significant with a high percentage of explained variance in both models ($p<0.05$). It was shown that eight independent variables had a statistically significant influence in the ROA model. In the ROE model, predictive significance of five independent variables was determined, confirming in this way that the profitability of a firm can be predicted by internal factors, thus accepting H1 (ANOVA F and Sig.<0.005), which confirms the RBV approach. Table 7 shows the status of the remaining research hypotheses based on the results of statistical analysis, where those hypotheses with a positive and/or negative correlation are confirmed compared to unconfirmed hypotheses, where one of the independent variables shows no correlation with profitability.

Table 7 Hypothesis testing

Hypothesis	Test result	ROA model	ROE model
H1a	Accepted	CL is negatively related to ROA.	CL is not related to ROE.
H1b	Accepted	DBT is positively related to ROA.	DBT is negatively related to ROE.
H1c	Rejected	FS is not related to ROA.	FS is not related to ROE.
H1d	Accepted	SIZE is negatively related to ROA.	SIZE is negatively related to ROE.
H1e	Accepted/Rejected	SGR is positively related to ROA.	SGR is not related to ROE.
H1f	Accepted	EBIT is positively related to ROA.	EBIT is positively related to ROE.
H1g	Rejected	Lagged ROA is not related to ROA.	Lagged ROA is not related to ROE.
	Rejected	Lagged ROE is not related to ROA.	LaggROE is positively related to ROE.

Note: +ROA +ROE = accepted; –ROA –ROE = accepted; *ROA*ROE = rejected; –ROA /+ *ROE = rejected

Source: Author's estimate

The first row in regression tables shows the coefficients of the regression constant of the expected ROA (and ROE) when all other variables are equal to zero. The regression equation suggests a positive value of ROA and a negative value of ROE, but a strong relationship of the regressor variables ROA/ROE with each other and in relation to the regressor variables EBIT (positive) and SIZE measured by the book value of assets (negative). The impact of ROE on ROA is positive (r=.444) and statistically significant ($p<0.001$) with a beta coefficient of 0.347, which means that for every percentage increase in ROE, a positive change in ROA is expected by 0.347%. The correlation between ROA and ROE is also positive (r=.444) and statistically significant ($p<0.001$), and an increase in ROA by 1% leads to an increase in ROE by 0.566%. The interrelationship of the dependent variables of profitability is as expected, as previously confirmed by Hutchinson and Gul (2004) and Antle and Smith (1986), which means that an increase in ROE leads to an increase in ROA, and *vice versa*. However, these variables cannot be observed separately and in isolation.

The EBIT variable has positive (r(ROA)=.308; r(ROE)=.153) and statistically significant effects ($p<0.001$) on the profitability of IT firms, and represents operating profit before interest and depreciation. In the profitability models, a proportional relationship is evident, where a 1% increase in EBIT leads to higher ROA and ROE by 0.258% and 0.113%, respectively. A higher EBIT occurs when the sales price exceeds the variable cost per unit, where the sales price must be high enough to ensure the contribution margin (the sales price minus the variable cost) and cover fixed costs (Morris & Daley, 2009, p. 63). A higher level of the EBIT margin is desirable because such firms retain a larger portion of their income after covering business costs than those with a lower value of this indicator (Periša et al., 2017, p. 233).

Table 5 Model ROA

Coefficients[a]											
Model ROA		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Err.	Beta			Zero-order	Partial	Part	Tolerance	VIF
model 1	(Constant)	37.134	2.339		15.876	0.000					
	Stratification	-2.076	0.711	-0.076	-2.920	0.004	-0.042	-0.103	-0.069	0.814	1.228
	ROE	0.145	0.010	0.347	13.995	0.000	0.444	0.443	0.329	0.898	1.113
	CL	-0.003	0.001	-0.064	-2.570	0.010	0.144	-0.091	-0.060	0.880	1.136
	DBT	-0.343	0.017	-0.597	-20.675	0.000	-0.526	-0.590	-0.486	0.663	1.508
	SZ	-1,064E-07	0.000	-0.190	-6.736	0.000	-0.103	-0.232	-0.158	0.692	1.445
	$SGR_{20/19}$	0.002	0.001	0.066	2.793	0.005	-0.003	0.098	0.066	0.980	1.020
	$SGR_{21/20}$	0.001	0.000	0.205	7.537	0.000	-0.014	0.257	0.177	0.750	1.333
	EBIT	1,143E-06	0.000	0.258	8.476	0.000	0.308	0.287	0.199	0.594	1.683
a. Dependent Variable: ROA (N = 809)											

Source: Author's estimate

Table 6 Model ROE

Coefficients[a]											
Model ROE		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Err.	Beta			Zero-order	Partial	Part	Tolerance	VIF
model 2	(Constant)	-11.858	5.046		-2.350	0.019					
	ROA	1.357	0.095	0.566	14.234	0.000	0.441	0.454	0.432	0.585	1.710
	DBT	0.443	0.050	0.322	8.900	0.000	-0.005	0.303	0.270	0.704	1.420
	SZ	-1,495E-07	0.000	-0.098	-2.302	0.022	-0.097	-0.082	-0.070	0.514	1.947
	EBIT	1,196E-06	0.000	0.113	2.546	0.011	0.154	0.091	0.077	0.472	2.117
	$_{lagg}ROE_{20/19}$	2.958	1.326	0.068	2.230	0.026	0.048	0.080	0.068	0.986	1.014
a. Dependent Variable: ROE (N = 788)											

Source: Author's estimate

The results of Gharaibeh and Khaled (2020, p. 284) show that firm size, growth and leverage have a positive influence on EBIT, in contrast to leverage, business risk and tangible assets. A positive relationship between profitability and EBIT was also confirmed in the study conducted by Ali (2020), so H1f must be accepted.

In this research, the effect opposite to EBIT in terms of profitability is shown by firm size (SIZE) measured by the logarithmic asset values as (r(ROA)=-.103; r(ROE)=-.101) and a statistically significant variable (0.003 vs. 0.004<0.01). The research results show that a decrease in the size of the firm by one unit leads to a decrease in the profitability proxied by ROA by 0.19% (Stratification -.076) with a simultaneous decrease in the return on capital of 0.098. Negative predictive ability of firm size has been proven by previous research studies. According to Margaretha and Supartika (2016, p. 134), the larger a firm, the lower its profitability (and vice versa) because it is more difficult for larger firms to manage their organisational effectiveness by overcoming problems in the bureaucratic management structure. Other studies such as Ramadan et al. (2011, p. 180) have shown that the estimated effect of size does not support the significant economies of scale for Jordanian banks. In view of all this, hypothesis H1d is considered to be confirmed.

The debt ratio showed a dual inverse relationship with the profitability of IT firms. As expected, the debt ratio is statistically significantly related to return on assets, where a 1% increase in the debt ratio leads to a decrease in profitability of 0.597%. A negative correlation between the debt ratio and profitability was previously observed by Goddard et al. (2005) and some other authors. On the other hand, the debt ratio in Model 2 has a beta coefficient of 0.322, and it can be concluded that the optimal ratio of liabilities and assets has a positive effect on the profitability proxied by ROE. Furthermore, Gill et al. (2011, p. 12) found positive relationships between the debt ratio and profitability in the service and manufacturing industries (service industry: B=0.486; R^2=0.081; SEE=0.301; F=3.689; manufacturing industry: B=0.397; R^2=0.203; SEE=0.138; F=6.942), and these results indicate that an increase in debt is associated with an increase in profitability, which is consistent with the results reported by Abor (2005), confirming H1b.

Based on tables 5 and 6, it can be concluded that sales growth has a significant positive effect exclusively through return on assets of Croatian IT firms, which partially confirms H1e. The coefficient of sales growth measured by lagged income has a positive statistical significance (of 0.066 and 0.205, respectively) in return on assets. Positive values of historical sales results of 1% lead to positive beta values and higher revenue compared to Jordanian service firms that generate as much as 1.09% more profit (Gharaibeh & Khaled, 2020). The obtained values are as expected for a very simple reason (Table 1). As the sales volume increases, costs increase proportionally, which guarantees lower current profitability. On the other hand, firms consider investment opportunities with the aim of ensuring greater investments, firm growth and future earnings (Margaretha & Supartika, 2016, p. 135). In terms of the effect of sales growth and profitability measured by ROE, the results show that there is no evidence that historical sales growth figures are related to current profitability of the Croatian IT firms (Roper, 1999; Fitzsimmons et al., 2005).

The same was found for the financial stability variable measured by the share of long-term assets in long-term liabilities, which does not have any statistically significant influence in relation to Pearson's coefficient of correlation and regression analysis, which is in line with the results of Abor (2005). The HGK 2021 analysis (p. 12) emphasizes that investments were focused on a smaller number of firms, i.e., only 15% of the total number of IT firms reported the investment value of new fixed assets greater than zero, which makes up 58% of all investments in the IT sector. Thus, lagged profitability variables mostly show no relationship with current profitability of Croatian IT firms, as confirmed by Suarez et al. (2013). In this regard, the positive value of the laggROE variable in relation to capital can indicate the degree of efficiency of reinvestment, i.e., profit retention as a short-term source of raising capital to finance current investment projects. With such a conservative approach, IT firms strive to grow and survive in view of the strong growth of competition, the rapid entry of new firms in the market and the mortality in the industry, as concluded by Suarez et al. (2013, p. 12). Therefore, H1g was not confirmed (Table 1/Table 6).

Similarly to Alarussi and Alhaderi (2018, p. 452), the results of the study show unexpected results in relation to liquidity. It indicates that the two objectives of liquidity and profitability are inversely related to each other (Raheman & Nasr, 2007, p. 289),

i.e., no relationship between current liquidity and ROE was established (Ghasemi & Razak, 2017). Table 5 predicts that the profitability of IT firms in Croatia is negatively and significantly related to current liquidity proxied by ROA. The unstandardized beta of current liquidity is -.064, indicating that a 1% decrease in current liquidity leads to an increase in return on assets. This indicates that higher liquidity leads to less funding engaged in generating income (and consequently profit), which enables a lower yield proxied by ROA. In the first model, this is because profitability does not depend on the cash base and liquidity is important for financial institutions such as banks, but not for non-financial firms, as Alarussi and Alhaderi (2018, p. 452) note. Pervan et al. (2019, p. 976) found that current liquidity has no statistically significant relationship with profitability. They explain this phenomenon by the fact that managers of firms with low liquidity must invest a lot of time and effort to convert receivables into cash or to negotiate additional short-term financing with suppliers and banks. However, the research studies by Majumdar (1997, p. 240) and Sur and Chakraborty (2011, p. 7) have established the neutrality of the relationship and claimed that liquidity is strongly significant to the productivity equation, i.e. it essentially represents the working capital dimension.

6. Concluding remarks

The aim of this paper was to examine the factors that determine firm profitability in the J62 sector in the period from 2019 to 2021 at the firm level. After data processing by correlation analysis, some independent variables were omitted that did not have statistically significant predictive ability in explaining a certain dependent variable. Finally, as expected, two profitability models were obtained - the ROA model and the ROE model, which confirmed five research hypotheses, while the remaining two hypotheses were not confirmed. Taking into account the correlation values and the regression analysis results, it can be concluded that there is statistically significant prediction in terms of ROA of the following variables: stratification, ROE, current liquidity, debt ratio, firm size, lagged sales growth, and EBIT. However, the independent variables, financial stability and lagged ROA do not have a significant impact on ROA, as suggested by the literature and the results of multiple linear regression analysis. Regressor variables ROA, debt ratio, firm size, EBIT and lagged ROE have predictive ability for ROE. Other independent variables in the ROE model were not used in further analyses since they did not show any statistically significant relationship, which indicates that the variables removed from the study have no impact on the profitability of Croatian IT firms.

In the Croatian context, the existence of research studies in the analyzed activity is not proven. Therefore, the results obtained for the profitability factors are applicable at several levels. First, at the micro level, the corporate environment, which includes managers, owners of IT firms and shareholders, should take into account the identified internal factors of profitability in order to achieve successful management goals in IT firms in Croatia, as called for by Škuflić et al. (2018, p. 351), especially when examining the relationship between isolated micro-determinants that are directly related to the firm's profitability (Vuković et al., 2020, p. 508). Second, the established determinants of profitability should be viewed as a synergistic upgrade of continuous annual editions of HGK analysis in the IT industry. Third, the research results will possibly have positive effects on the shaping of national policies in terms of strengthening the IT industry and increasing competitiveness in order to reduce the possibility of profit shifting in regional and global frameworks. Finally, researchers can additionally measure the robustness of profitability models by other scientific approaches in terms of improving and upgrading previous results. Azhagaiah and Candasamy (2011, p. 382) suggest that future studies could also be conducted to find out whether there is a significant relationship between fixed assets, asset structure, investment and volatility, advertising expenditure, probability of bankruptcy and uniqueness of the product, profit volatility of firms, etc. in terms of capital structure and profitability. In addition, at the firm level, the established determinants of profitability can be extended horizontally and vertically for other endogenous and exogenous variables within the four categories of profitability determinants by using longer time series data and certain dynamic models in the same or different industries.

However, the research results have certain long-term and short-term limitations. The quality of the obtained results depends on the reliability and accuracy of FINA (secondary) data. The time series of data includes a detailed set of values in a three-

year period that includes the COVID year - 2020, i.e., a longer time trend could not be covered due to lack of resources (Azhagaiah & Candasamy, 2011, p. 381). Likewise, Wahlen et al. (2022, p. 295) emphasize that the traditional analysis of financial ratios has certain disadvantages for start-up firms and firms with early high-growth stages of their life cycles, and as a result, adjusted financial statements are used to enable capitalization of technological assets and subsequent depreciation, as shown in the study of Lev & Sougiannis (1996). At the same time, researchers should focus in their future research on broader areas and codes within sections of the National Classification of Activities (NKD 2007; NACE Rev. 2). For example, in April 2022, the largest IT firm Ericsson Nikola Tesla d.d. re-registered from NKD C26.30 to J62.01, and as of 2022, it will be analyzed in the group of IT service providers (HGK, 2022, p. 7), which could leave a mark on code C26 in relation to industrial profitability.

References

1. Abor, J. (2005). The effect of capital structure on profitability: empirical analysis of listed firms in Ghana. *Journal of Risk Finance*, *6*(5), 438-445. https://doi.org/10.1108/15265940510633505
2. Al-Homaidi, E. A., Tabash, M. I., Al-Ahdal, W. M., Farhan, N. H. & Khan, S. H. (2020). The liquidity of Indian firms: empirical evidence of 2154 firms. *Journal of Asian Finance, Economics and Business*, *7*(1), 19-27. https://doi.org/10.13106/jafeb.2020.vol7.no1.19
3. Alarussi, A. S. & Alhaderi. S. M. (2018). Factors affecting profitability in Malaysia. *Journal of Economic Studies*, *45*(3), 442-458.
4. Ali, A. (2020). Do the giant players enjoy profitability?. Analytical study of pharmaceutical industry of India. *Journal of Talent Development and Excellence*, *12*(2s), 3249-3260. https://doi.org/10.1108/JES-05-2017-0124
5. Antle, R. & Smith, A. (1986). An empirical investigation of the relative performance evaluation of corporate executives. *Journal of Accounting Research*, *24*(1), 1-39. https://doi.org/10.2307/2490802
6. Azhagaiah, R. & Candasamy, G. (2011). The Impact of Capital Structure on Profitability with Special Reference to IT Industry in India vs. Domestic Products. *Managing Global Transitions*, *9*(4), 371-392.
7. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120. https://doi.org/10.1177/014920639101700108
8. Baum, C. F., Schafer, D. & Talavera, O. (2006). The effects of short-term liabilities on profitability: a comparison of German and US firms. *Boston College Working Papers in Economics*, *636*, 1-24. https://doi.org/10.2139/ssrn.967260
9. Bhutta, N. T. & Hasan, A. (2013). Impact of firm specific factors on profitability of firms in food sector. *Open Journal of Accounting*, *2*(2), 19-25. https://doi.org/10.4236/ojacct.2013.22005
10. Dehning, B. & Richardson, V. J. (2002). Returns on investments in information technology: A research synthesis. *Journal of Information Systems*, *16*(1), 7-30. https://doi.org/10.2308/jis.2002.16.1.7
11. Dilling-Hansen, M. (2005). *Small firms' performance and ownership structure* (School of Economics and Management Working Paper). Aarhus: School of Economics and Management.
12. Dimitrić, M., Tomas Žiković, I. & Matejčić, V. (2018). Odrednice profitabilnosti hotelskih poduzeća – usporedna analiza Primorsko-goranske županije i Republike Hrvatske. In Koški, D. et al. (Eds), *Financije–teorija i suvremena pitanja* (pp. 329-350). Faculty of Economics in Osijek.
13. Ebaid, I. E.-S. (2009). The impact of capital-structure choice on firm performance: empirical evidence from Egypt. *The Journal of Risk Finance*, *10*(5), 477-487. https://doi.org/10.1108/15265940911001385
14. Eljelly, A. (2004). Liquidity–profitability tradeoff: an empirical investigation in an emerging market. *Indian Journal of Community Medicine*, *14*(2), 48-61. https://doi.org/10.1108/10569210480000179
15. Fitzsimmons, J. R., Steffens, P. & Douglas, E. J. (2005). Growth and profitability in small and medium sized Australian firms. In *Proceedings of AGSE Entrepreneurship Exchange*. Melbourne. https://doi.org/10.2139/ssrn.1263734
16. Garefalakis, A. Mantalis, G., Lemonakis, C., Vassakis, K. & Spinthiropoulos, K. (2016). Determinants of profitability in aviation industry of Europe and America. *International Journal of Supply Chain Management*, *5*(2), 131-136.
17. Gharaibeh, O. & Khaled, M. H. B. (2020). Determinants of profitability in Jordanian services companies. *Investment Management and Financial Innovations*, *17*(1), 277-290. https://doi.org/10.21511/imfi.17(1).2020.24
18. Ghasemi, M. & Ab Razak, N. H. (2017). Determinants of Profitability in ACE Market Bursa Malaysia: Evidence from Panel Models. *International Journal of Economics & Management*, *11*, 847-869.
19. Gill, A., Biger, N. & Mathur, N. (2011). The effect of capital structure on profitability: Evidence from the United States. *International Journal of Management*, *28*(4), 3-15.

20. Goddard, J., Tavakoli, M. & Wilson J. (2005). Determinants of profitability in European manufacturing and services: Evidence from a dynamic panel model. *Applied Financial Economics*, *18*(15), 1269-1282. https://doi.org/10.1080/09603100500387139

21. Grinyer, H. P. & McKiernan, P. (1991). The Determinants of Corporate Profitability in the UK Electrical Engineering Industry. *British Journal of Management*, *2*(1), 17-32. https://doi.org/10.1111/j.1467-8551.1991.tb00012.x

22. Habib, H., Khan, F. & Wazir, M. (2016). Impact of debt on profitability of firms: Evidence from non-financial sector of Pakistan. *City University Research Journal*, *6*(01), 70-80.

23. Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E. (2009). *Multivariate Data Analysis* (7th ed). Pearson.

24. Hansen, G. & Wernerfelt, B. (1989). Determinants of firm performance: the relative importance of economic and organizational factors. *Strategic Management Journal*, *10*(5), 399-411. https://doi.org/10.1002/smj.4250100502

25. Hardwick, P. (1997). Measuring cost inefficiency in the UK life insurance industry. *Applied Financial Economics*, *7*(1), 37-44. https://doi.org/10.1080/096031097333835

26. Hayes A. F., Cai L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior Research Methods*, *39*(4), 709-722. https://doi.org/10.3758/BF03192961

27. HGK (2020). *Analiza stanja hrvatske IT industrije*. https://www.hgk.hr/documents/analiza-stanje-hr-it-industrije-2019602bb9ea75583.pdf

28. HGK (2020a). *Analiza hrvatske IT industrije 2014.-2019*. https://www.hgk.hr/documents/analiza-hrvatske-it-industrije-20142019-kb602bb6ffa49ca.pdf

29. HGK (2021). *Analiza stanja hrvatske IT industrije*. https://hgk.hr/documents/analiza-stanje-hr-it-industrije-2020-finale61af63d15c67c.pdf

30. HGK (2022). *Pregled stanja hrvatske IT industrije u 2021*. https://hgk.hr/documents/pregled-stanja-hrvatske-it-industrije-u-2021638a05d188c2f.pdf

31. Horngren, C. T., Harrison W. T. & Oliver M. S. (2012*). Financial & Managerial Accounting* (3rd ed). Pearson Prentice Hall.

32. Horvat, J. & Mijoč, J. (2019). *Istraživački SPaSS*. Naklada Ljevak & Faculty of Ecoomics in Osijek.

33. Hutchinson, M. & Gul, F. A. (2004). Investment opportunity set, corporate governance practices and firm performance. *Journal of Corporate Finance*, *10*(4), 595-614. https://doi.org/10.1016/S0929-1199(03)00022-1

34. Joh, S. W. (2003). Corporate governance and firm profitability: evidence from Korea before the economic crisis. *Journal of Financial Economics*, *68*(2), 287-322. https://doi.org/10.1016/S0304-405X(03)00068-0

35. Lazar, S. (2016). Determinants of Firm Performance: Evidence from Romanian Listed Companies. *Review of Economics and Business Studies*, *9*(1), 53-69. https://doi.org/10.1515/rebs-2016-0025

36. Lev, B. & Sougiannis, T. (1996). The capitalization, amortization and value-relevance of R&D. *Journal of Accounting and Economics*, *21*(1), 107-138. https://doi.org/10.1016/0165-4101(95)00410-6

37. Mackey, A. (2008). The Effect of CEOs on Firm Performance. *Strategic Managment Journal*, *29*(12), 1357-1367. https://doi.org/10.1002/smj.708

38. Majumdar, S. K. (1997). The impact of size and age on firm-level performance: some evidence from India. *Review of Industrial Organization*, *12*, 231-241. https://doi.org/10.1023/A:1007766324749

39. Margaretha, F. & Supartika, N. (2016). Factors Affecting Profitability of Small Medium Enterprises (SMEs) Firm Listed in Indonesia Stock Exchange. *Journal of Economics, Business and Management*, *4*(2), 132-137. https://doi.org/10.7763/JOEBM.2016.V4.379

40. Marquardt, D. W. (1970). Generalized Inverses, Ridge Regression and Biased Linear Estimation and Nonlinear Estimation. *Technometrics*, *12*, 591-612. https://doi.org/10.2307/1267205

41. Mason, C. H. & Perreault Jr, W. D. (1991). Collinearity, power, and interpretation of multiple regression analysis. *Journal of Marketing Research*, *28*(3), 268-280. https://doi.org/10.1177/002224379102800302

42. Mauri, A. J. & Michaels, M. P. (1998). Firm and industry effects within strategic management: an empirical examination. *Strategic Management Journal*, *19*(3), 211-219. https://doi.org/10.1002/(SICI)1097-0266(199803)19:3<211::AID-SMJ947>3.0.CO;2-T

43. McDonald, J. (1999). The determinants of firm profitability in Australian manufacturing. *The Economic Record*, *75*(229), 115-126. https://doi.org/10.1111/j.1475-4932.1999.tb02440.x

44. McGahan, A. & Porter, M. (1997). How much does industry matter, really? *Strategic Management Journal*, *18*(S1), 15-30. https://doi.org/10.1002/(SICI)1097-0266(199707)18:1+%3C15::AID-SMJ916%3E3.0.CO;2-1

45. Milenković, N., Andrašić, J. & Andrašić, S. (2019). Hotel specific determinants of liquidity-evidence from the hotels in AP Vojvodina. In Bevanda, V. & Štetić, S. (Eds.). *Proceedings of the 4th International thematic monograph Modern management tools and economy of tourism sector in present era* (pp. 123-137). Association of Economists and Managers of the Balkans & Faculty of Tourism and Hospitality Ohrid. https://doi.org/10.31410/tmt.2019.123

46. Morris, J. R. & Daley, J. P. (2009). *Introduction to Financial Models for Management and Planning*. CRC Press. https://doi.org/10.1201/9781420090550

47. Öhman, P. & Yazdanfar, D. (2017). Short- and long-term debt determinants in Swedish SMEs. *Review of Accounting and Finance*, *16*(1), 106-124. https://doi.org/10.1108/RAF-08-2015-0118

48. Oster, S. (1990). *Modern Competitive Analysis*. Oxford University Press.

49. Periša, A., Kurnoga, N. & Sopta, M. (2017). Multivariate analysis of profitability indicators for selected companies of Croatian market. *Journal of Economics*, *8*(3), 231-242.

50. Pervan, M., Pervan, I. & Ćurak, M. (2019). Determinants of firm profitability in the Croatian manufacturing industry: evidence from dynamic panel analysis. *Economic Research-Ekonomska istraživanja*, *32*(1), 968-981. https://doi.org/10.1080/1331677X.2019.1583587

51. Porter, M. E. (1980). *Competitive Strategy*. Free Press.

52. Raheman, A. & Nasr, M. (2007). Working capital management and profitability - Case of Pakistani firms. *International Review of Business Research Papers*, *3*(1), 279-300.

53. Ramadan, I. Z., Kilani, Q. A. & Kaddumi, T. A. (2011). Determinants of bank profitability: Evidence from Jordan. *International Journal of Academic Research*, *3*(4), 180-191.

54. Roper, S. (1999). Modelling small business growth and profitability. *Small Business Economics*, *13*, 235-252. https://doi.org/10.1023/A:1008104624560

55. Rumelt, R. (1991). How much does industry matter? *Strategic Management Journal*, *12*(3), 167-185. https://doi.org/10.1002/smj.4250120302

56. Salman, A. K. & Yazdanfar, D. (2012). Profitability in Swedish SME Firms: A Quantile Regression Approach. *International Business Research*, *5*(8), 94-106. https://doi.org/10.5539/ibr.v5n8p94

57. Scherer, F. M. (1980). *Industrial Market Structure and Economic Performance.* Rand McNally College Pub. Co.

58. Shrestha, N. (2020). Detecting multicollinearity in regression analysis. *American Journal of Applied Mathematics and Statistics*, *8*(2), 39-42. https://doi.org/10.12691/ajams-8-2-1

59. Smith, K. J. (1987). Trade Credit and Informational Asymmetry. *Journal of Finance*, *42*, 863-872. https://doi.org/10.1111/j.1540-6261.1987.tb03916.x

60. Spanos, Y. E. & Lioukas, S. (2001). An examination into the causal logic of rent generation: contrasting Porter's competitive strategy framework and the resource-based perspective. *Strategic Management Journal*, *22*(10), 907-934. https://doi.org/10.1002/smj.174

61. Stierwald, A. (2010). *The Causes of Profit Heterogeneity in Large Australian Firms*. (Melbourne Institute Working Paper No. 7/10). Melbourne: Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

62. Suarez, F. F., Cusumano, M. A. & Kahl, S. J. (2013). Services and the business models of product firms: An empirical analysis of the software industry. *Management Science*, *59*(2), 420-435. https://doi.org/10.1287/mnsc.1120.1634

63. Sur, D. & Chakraborty, K. (2011). Evaluating relationship of working capital and profitability: A study of select multinational companies in the Indian pharmaceutical sector. *Journal of Management Research*, *10*, 7-22.

64. Škuflić, L., Mlinarić, D. & Družić, M. (2018). Odrednice profitabilnosti građevinskog sektora u Hrvatskoj. *Proceedings of Rijeka Faculty of Economics: Journal of Economics and Business*, *36*(1), 337-354. https://doi.org/10.18045/zbefri.2018.1.337

65. Škuflić, L. & Mlinarić, D. (2015). Mikroekonomske determinante profitabilnosti Hrvatske hotelske industrije. *Ekonomski pregled*, *66*(5), 477-494.

66. Tailab, M. (2014). The effect of capital structure on profitability of energy American firms. *International Journal of Business and Management Invention*, *3*(12), 54-61.

67. Vuković, B., Milutinović, S., Mirović, V. & Milićević, N. (2020). Analiza profitabilnosti logističkih kompanija u zemljama Balkana, *Promet*, *32*(4), 497-511. https://doi.org/10.7307/ptt.v32i4.3311

68. Wahlen, J. M., Baginski, S. P. & Bradshaw, M. (2022). *Financial Reporting, Financial Statement Analysis and Valuation* (7th ed). Cengage Learning.

69. Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(1), 171-180. https://doi.org/10.1002/smj.4250050207

70. Wooldridge, J. M. (2016). *Introductory Econometrics: A Modern Approach* (6th ed). Cengage Learning.

71. Yazdanfar, D. (2013). Profitability determinants among micro firms: evidence from Swedish data. *International Journal of Managerial Finance*, *9*(2), 150-160. https://doi.org/10.1108/17439131311307565

72. Zakon o Nacionalnoj klasifikaciji djelatnosti (Narodne novine 98/94).

Appendix 1 Correlation matrix

		ROA	ROE	CL	DBT	FS	FS2	SZ	$SGR_{20/19}$	$SGR_{21/20}$	$SGR_{21/19}$	EBIT	$lagg ROA_{21/19}$	$lagg ROA_{20/19}$	$lagg ROE_{21/19}$	$lagg ROE_{20/19}$
ROA	Pearson Corr.	1														
	Sig. (2-tailed)															
	N	809														
ROE	Pearson Corr.	.444**														
	Sig. (2-tailed)	0.000														
	N	809														
CL	Pearson Corr.	.144**	-0.007													
	Sig. (2-tailed)	0.000	0.846													
	N	809	809													
DBT	Pearson Corr.	-.526**	-0.003	-.296**												
	Sig. (2-tailed)	0.000	0.932	0.000												
	N	809	809	809												
FS	Pearson Corr.	-0.011	-0.021	0.004	-0.036											
	Sig. (2-tailed)	0.750	0.548	0.905	0.313											
	N	809	809	809	809											
FS2	Pearson Corr.	-.070*	-0.058	-.101**	0.056	0.008										
	Sig. (2-tailed)	0.045	0.101	0.004	0.109	0.824										
	N	809	809	809	809	809										
SZ	Pearson Corr.	-.103**	-.101**	0.019	-0.043	-0.001	0.030									
	Sig. (2-tailed)	0.003	0.004	0.587	0.220	0.976	0.390									
	N	809	809	809	809	809	809									
$SGR_{20/19}$	Pearson Corr.	-0.003	0.010	-0.019	.116**	-0.005	-0.013	-0.025								
	Sig. (2-tailed)	0.940	0.777	0.597	0.001	0.898	0.710	0.482								
	N	809	809	809	809	809	809	809								
$SGR_{21/20}$	Pearson Corr.	-0.014	.144**	-0.030	.456**	-0.004	-0.022	-0.024	-0.004							
	Sig. (2-tailed)	0.685	0.000	0.395	0.000	0.899	0.532	0.504	0.914							
	N	809	809	809	809	809	809	809	809							
$SGR_{21/19}$	Pearson Corr.	-0.004	0.024	-0.022	.162**	-0.005	-0.015	-0.027	.995**	.097**						
	Sig. (2-tailed)	0.910	0.487	0.539	0.000	0.888	0.667	0.442	0.000	0.006						
	N	809	809	809	809	809	809	809	809	809						
EBIT	Pearson Corr.	.308**	.153**	.179**	-.228**	-0.008	-0.044	.501**	-0.027	-0.008	-0.028					
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.812	0.208	0.000	0.439	0.818	0.427					
	N	809	809	809	809	809	809	809	809	809	809					
$lagg ROA_{21/19}$	Pearson Corr.	-0.034	-0.003	-0.030	0.005	-0.009	0.014	-0.048	-0.048	-0.060	-0.053	-0.034				
	Sig. (2-tailed)	0.343	0.938	0.399	0.895	0.800	0.686	0.175	0.182	0.091	0.135	0.335				
	N	809	809	809	809	809	809	809	809	809	809	809				
$lagg ROA_{20/19}$	Pearson Corr.	-0.008	0.011	-0.063	-0.029	-0.019	.174**	-0.003	-0.054	-0.012	-0.054	-0.020	.388**			
	Sig. (2-tailed)	0.816	0.766	0.079	0.413	0.592	0.000	0.931	0.133	0.735	0.127	0.577	0.000			
	N	809	809	809	809	809	809	809	809	809	809	809	788			
$lagg ROE_{21/19}$	Pearson Corr.	-0.015	0.063	-0.035	.182**	-0.004	-0.035	-0.053	.114**	.338**	.147**	-0.011	.513**	.091*		
	Sig. (2-tailed)	0.672	0.078	0.331	0.000	0.918	0.323	0.135	0.001	0.000	0.000	0.758	0.000	0.011		
	N	809	809	809	809	809	809	809	809	809	809	809	788	788		
$lagg ROE_{20/19}$	Pearson Corr.	0.018	0.048	0.040	-.104**	-0.018	-0.038	-0.006	.084*	-0.013	.083*	0.020	.269**	.432**	.198**	
	Sig. (2-tailed)	0.611	0.180	0.260	0.003	0.611	0.284	0.867	0.018	0.723	0.020	0.579	0.000	0.000	0.000	
	N	809	809	809	809	809	809	809	809	809	809	809	788	788	788	

*. Correlation is significant at the 0.05 level (2-tailed) **. Correlation is significant at the 0.01 level (2-tailed).

Source: Author's estimate

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SUSTAINABLE DEVELOPMENT – A NEW TREND OF RETAIL CHAIN REPORTING IN THE REPUBLIC OF CROATIA

Abstract

Purpose: The aim of this paper is to collect and analyze data on sustainable development of nine leading retail chains in the Republic of Croatia (according to sales revenue in 2021). The focus of this research is on finding out the extent to which retail chains report on their sustainable business practices through publicly available websites, as well as precise segments of sustainable development.

Methodology: The research included retail chains whose predominant activity, according to the National Classification of Activities (NKD) 47.11, is the retail sale of various products, particularly food, beverages or tobacco, in non-specialized stores. The research was conducted from September 20 to November 20, 2022. The data were collected from the official websites of these retail chains, and the analysis primarily relied on descriptive statistics.

Results: The collected information indicates that most retail chains in the Republic of Croatia do not report on the direct impact of their business practices on sustainable development, nor do they outline their intention to directly influence consumer behavior regarding sustainable development through their business practices. Customer trends are changing, and those retail chains that prioritize sustainable development as a business strategy gain a competitive edge.

Conclusion: Unfortunately, in terms of sustainable development, retail chains in the Republic of Croatia did not take global trends seriously. Only a third of them make reports on sustainable development, and some have only recently become more actively engaged in such practices.

Keywords: Sustainable development, retail chains, business practices, climate change

1. Introduction

In most countries, retail chains are some of the main drivers of innovation and economy (Dabija et al., 2017, p. 297; Pantano, 2014, p. 344) because they receive information on the needs of both customers and producers. Since the beginning of the pandemic caused by the SARS-CoV-2 virus (severe acute respiratory syndrome coronavirus 2), the trend among customers has shifted towards a healthy diet and care for the environment. Another concern for customers is related to the outcome

of the war in Ukraine, which broke out at the end of February 2022. The war caused certain disruptions in the supply of gas and electricity, and oil prices fluctuate every week. Since the pandemic, supply chains have not taken root compared to the pre-pandemic period. The lack of certain materials caused additional delays, postponements, etc. in the production chain.

Furthermore, customers are bombarded on a daily basis with a large amount of information related to climate change through social networks, news, and other sources of information. In addition, customers feel that significant changes are taking place in the environment, such as dry and hot periods, which consequently have an impact on fires, the drying up of rivers, and drinking water sources. The growing concern about the state of the Earth, coupled with the realization concerning its fragility, raises the question of how we can combat pollution by setting an example.

This is precisely the way in which retail chains that sell groceries can act to send an important message to customers about how and in which way their work affects the reduction of pollution, but also encourage sustainable business practices. Nowadays, customers are well informed and knowledgeable because they look for sources of information that will make it easier for them to decide which product to buy prior to making a purchase decision. One of the important things to which customers pay attention are declarations, the composition of a product, and the country of origin. Retail chains conduct sustainable business practices to a greater or lesser extent. On the one hand, some of the leaders in the Republic of Croatia have stopped selling plastic bags, so you can no longer buy them at the cash register, but on the other hand, they have left plastic bags in the fruit and vegetable department. Retailers must be aware that the source of information and purchasing decisions are not covered only by the availability of goods, an affordable and attractive price, or an item on sale, but also by being informed about how that particular trader or retail chain views the future, especially in terms of sustainable development and pollution. Retailers can significantly influence producers since by observing the habits of customers to whom they have first-hand access, they can impose their conditions on producers. In addition to influencing producers, the influence on the supply chain and the arrangement of one's own sales facilities also play an important role. In the supply chain, they may demand shorter deadlines for the delivery of goods and alternative sources of transport, which emit less harmful gases into the atmosphere, and encourage local production. Furthermore, arranging one's own sales facilities, installing solar panels on roofs, using rainwater, and informing customers through various channels, such as social networks, reports, achievements, etc. – all of the above refers to economic and environmental factors. The social factor should primarily be seen through the attitude towards employees, as well as the surrounding community.

The knowledge gap is evident in the lack of consolidated data when it comes to activities undertaken by retail chains in terms of sustainable development that encompasses three key aspects, i.e., sustainability, economic efficiency, and society. At the moment, this data remains unknown.

The aim of this paper is to gather, analyze, and compare data on sustainable retail businesses in the Republic of Croatia, and evaluate their contribution to the society in which they operate.

The paper consists of five sections. The introductory part outlines the issues covered in the paper. The second section focuses on reviewing previous research on sustainability reporting, with an emphasis on reporting by retail chains and their impact on consumers. The third section covers the framework and research methodology, including a sample description and data collection methods. The fourth section outlines the research results, while the fifth section provides a discussion pertaining to the data gathered, as well as a comparison with large retail chains worldwide. The final section presents the conclusion, limitations of the research, and further study recommendations.

2. Literature review

Ćuzović and Mladenović (2017, p. 144) point out that the development and application of the concept of sustainable development has a relatively long history. However, its intensive use was recorded at the turn of the century. There are various definitions of sustainability in the literature, often with different terminology and occasionally overlapping meanings (Wiese et al., 2012, p. 320). According to Brundtland (1987), sustainable development is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. On the other hand, Diesen-

dorf (2000, p. 23) believes that sustainable development should encompass types of economic and social development that would protect and improve the natural environment and social equality. Jamieson (1998, p. 184) states that most people, when they think about the meaning of sustainability, believe that sustainability revolves around human survival and the prevention of ecological disasters. In his progressive thinking, Dernbach (2003, p. 247) points out that the biggest challenge for sustainable development in the coming decades will be to operationalize it, and to make an effective transition towards it in communities, places, and companies around the world. At the same time, he adds that the concept of sustainable development is intended to be jointly resolved, which would thereby solve the problems related to global environmental degradation and global poverty without jeopardizing the advantages of traditional development.

In the past, sustainable development was often associated with the concept known as the triple bottom line, i.e., profit, planet, and the people (Lim, 2022, p. 5) – or, according to its creator Elkington (1998, p. 18), the original version reads: economic, environmental, and social well-being. Norman and MacDonald (2004, p. 243) point out that behind the triple bottom line paradigm there is an idea that the success of companies lies not only in the economic, i.e., financial success, but also in social, ethical, and environmental success. Environmental sustainability emphasizes the need to protect and preserve natural resources, and these are the values supported by competitive and successful multinational companies (Berry et al., 1998, p. 38). Sparks (2018, p. 70) notes that retail chains are in close proximity to wider debates on environmental sustainability, and cites the example of disposal of plastic packaging, as well as concerns about a high level of food waste.

Sustainable development is increasingly coming to light; on a global scale, it represents a component that is increasingly being emphasized, and retailers (retail chains) can play a big role in this regard as they represent a link between producers and customers (Jones et al., 2011, p. 256). They are key conduits for information with great power to increase awareness and influence purchasing choices by placing products in their sales areas that will promote sustainable development (European Commission, 2009a, p. 13). Sorescu et al. (2011, p. 5) describe retailers as orchestrators of two-sided platforms, which serve as an ecosystem where value is created and delivered to customers. Maintaining a competitive advantage requires constant improvements in the quality of the service and innovative business models linked to elements of sustainability (Bilinska et al., 2018). Retailers should place greater emphasis on the concern for sustainable development through their own strategic models, and this kind of process is necessary (Arnold, 2015). García et al. (2022, p. 227) point out that retailers should not only implement activities aimed at improving sustainability, but also allow and encourage their customers to intervene and participate in the development of such actions. Tascioglu et al. (2019, p. 443) carried out a study and found that there is a positive consumer reaction, through an increase in purchases, commitment, satisfaction, and loyalty, towards retailers that support environmental and social sustainability, with an emphasis on lower price policies. In line with this, Devinney et al. (2010, p. 2) believe that customers are more radical and more economically conservative in surveys and research compared to when they make payments at the cash register.

Sustainability reporting has become a matter of topical interest in recent years because it is no longer enough to make claims about the level of sustainability of companies, but it is also necessary to demonstrate their efforts in terms of sustainability (Zrnić et al., 2020, p. 271). Carp et al. (2019, p. 17) state that sustainability reporting is an instrument by which companies complete a standard set of financial data with data on organizational involvement in environmental protection and society as a whole. Thaslim and Aksa (2016, p. 24) point out that sustainability reporting has now become a part of branding, and it is believed that it will improve the company's reputation among stakeholders. Ruiz-Real et al. (2018, p. 1) add that sustainable development is a key element for retailers since it can become an important source of competitive advantage. Online reporting describes a new approach to digital reporting that is based on support through modern information and communication technology (ICT), specifically the Internet (Isenmann et al., 2007, p. 487). Since the Internet is now the main instrument through which organizations can build relationships with stakeholders, sustainability reporting is carried out through an online communication channel, especially corporate websites (Nazahah & Noorain, 2017, p. 232).

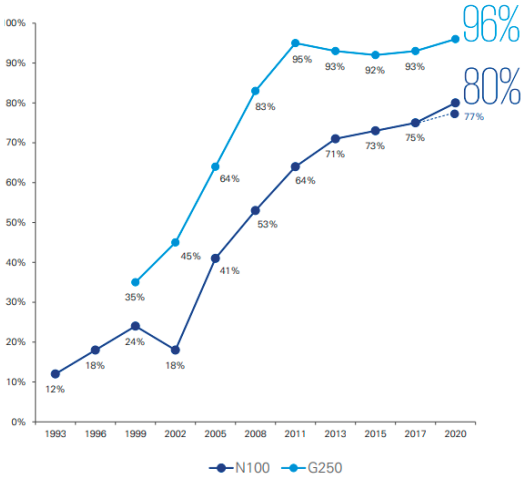
The Internet has become the place from which we get the most information, and Google was used as the main source of information for this research. The official websites of the top nine retail chains in the Republic of Croatia were browsed through. The research was based on gathering information, i.e., on determining two key questions: 1) whether retail chains report on sustainable development on their official websites, and 2) to which extent they integrate sustainable development management within their business practices. Similar studies have been conducted by Jones et al. (2011) in October 2009 on eight of the world's leading retail chains (Walmart, Costco, Carrefour, Tesco, etc.), and by Saber and Weber (2019) in Germany, in which they focused on a comparison of reporting on sustainable development of German supermarkets and discount stores.

Saber and Weber (2019, p. 1198) pointed out two important limitations of their research. The first limitation was that they objectively examined the market but did not interview managers employed in specific supermarkets or discount stores. The second limitation was that the research was conducted by a single person, making it impossible to verify intercoder reliability (ICR). Since the research was conducted in Germany, they suggested that it should also be conducted in other countries to determine differences between retail formats (supermarkets - discounters).

Carp et al. (2019, p. 17) stated that the main limitation of their research was the focus and analysis of companies listed on the Bucharest Stock Exchange, as well as the sole use of qualitative variables in measuring sustainability reporting. In line with this, a suggestion for further research was to expand the study to other developing European countries.

According to the KPMG study published in 2020, a trend of increasing reporting on sustainable development at the global level was observed year after year. The company conducted the study for 11 years in a row. Figure 1 shows two lines; the first, dark blue, line indicates the N100 group, and the second, light blue, line indicates the observed G250 group. The N100 refers to a global sample of 5,200 companies, specifically the top 100 companies by revenue in each of the 52 countries involved in this study. The G250 refers to the 250 largest companies in the world by revenue, as defined in the 2019 Fortune 500 list. At the same time, large global companies are usually leaders in sustainable development reporting and their activities often predict trends that are subsequently adopted (Threlfall et al., 2020, p. 4). The abscissa shows the years in which the research was conducted, and the ordinate shows the percentages. Threlfall et al. (2020) have noted some valuable insights, particularly regarding the recognition of the importance of sustainable development reporting by large companies; namely at the inception of the research in 1993, only 12% of them prepared reports, compared to a significant 80% in 2020.

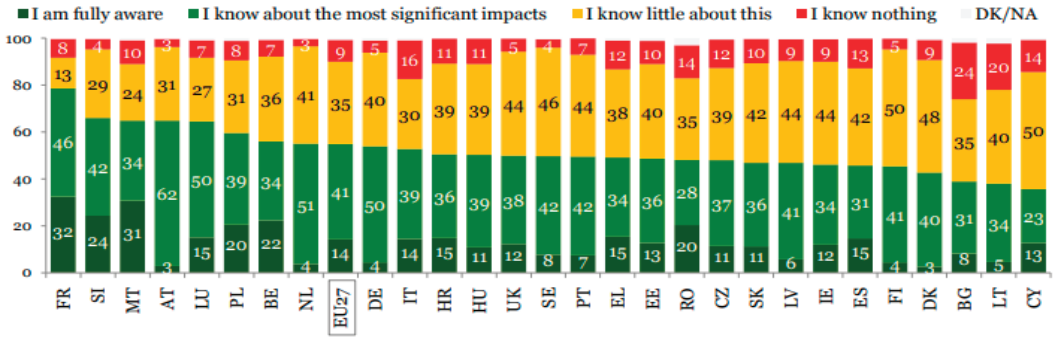
Figure 1 Global sustainable development reporting since 1993: the N100 and the G250 (KPMG)



Source: Threlfall et al., 2020, p. 10

The European Commission (2009b) conducted a study in 27 member states, including the Republic of Croatia, by telephone and face-to-face, in which a total of 26,500 citizens participated. When asked about their awareness of the impact of purchased products on the environment, only 15% of respondents declared that they are fully aware of the impact of purchased products on the environment (European Commission, 2009b, p. 11).

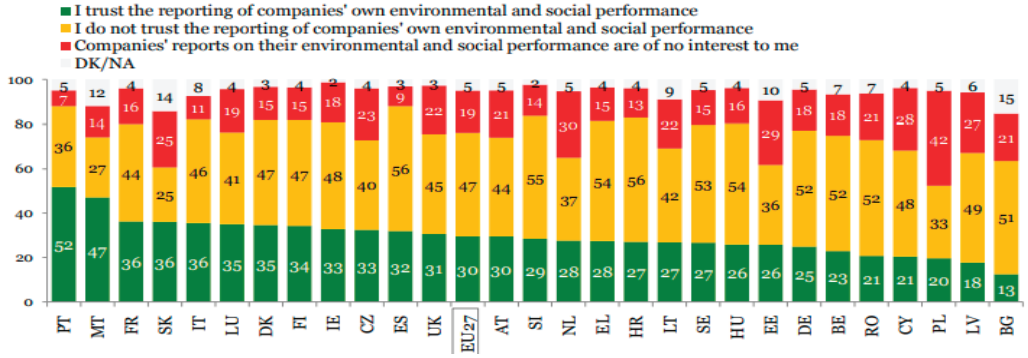
Figure 2 Importance of the impact of a product on the environment



Source: European Commission, 2009b, p. 11

When asked whether customers trust the environmental and social performance reports of companies, 27% of respondents said that they trust companies and their reports regarding environmental and social performance. It should be emphasized that this particular research was conducted in 2009.

Figure 3 Confidence in the environmental and social performance reports of companies



Source: European Commission, 2009b, p. 32

The awareness of customers 13 years ago was significantly different; one could say that they were not so focused on sustainable development, ecology, and climate change. The recession, which had a great impact on the future of Europeans and consequently Croats, probably prompted a shift in thinking. The recession spread rapidly from the United States of America to the rest of the world, with the consequences largely felt in 2009. However, the Republic of Croatia, included in the research at the time, was far below the European average (European Commission, 2009b, p. 32).

In this regard, the following section will process information collected from the websites of the nine largest retail chains in the Republic of Croatia, and analyze and summarize in a table the manner in which large retail chains inform customers about their involvement in sustainable development.

3. Reference framework and research methodology

Retail chains conducting business in the Republic of Croatia are included in the research. They are ranked according to the revenue generated from sales in 2021. The information given in the table (Table 1), which refers to sales revenue, EBIT margin, current liquidity ratio, debt ratio, and the number of employees, was taken from the info.BIZ.fina.hr website. The Financial Agency (FINA) is a leading Croatian company in the field of providing financial and electronic services. Although state-owned, FINA operates solely on the market princi-

ple[1]. The Financial Agency has the info.BIZ service in its portfolio of products and services. It is a service that enables insight into data on the operation and financial position of all business entities, as well as the business environment in which they operate. The info.BIZ service displays basic data, addresses, financial data, ratings, and business indicators of entrepreneurs, financial institutions, non-profit organizations, and budgetary entities for the last five years[2]. The retail chains included in this research are valued and recognized by customers in the Republic of Croatia, but also by foreign citizens who come to the Republic of Croatia as tourists, mainly in the summer months. They have different types of sales facilities, ranging from small city markets to supermarkets and hypermarkets on the outskirts of larger cities. Konzum Plus is at the very top, both in terms of sales revenue and the number of employees, with over 600 sales facilities, and Studenac is at the very top in terms of the number of facilities with over 1,000 facilities, which are smaller in size, consist mostly of city markets and have limited offers of goods and services. Of the nine listed retail chains, only Pevex, a retail chain selling construction materials, home furnishing products, tools, and electrical appliances, has a smaller section of food items (mostly sweets and snacks), as well as household cleaning products. Another retail chain is dm - drogerie markt Hrvatska, which primarily offers cosmetics, body care products, household cleaning items, and foodstuffs in eco-friendly packaging. The remaining seven retail chains focus solely on consumer goods, food items, and non-food products.

Table 1 Top nine retail chains in the Republic of Croatia

Data for 2021	Sales revenue (in HRK billion)	EBIT (%)	Current liquidity ratio	Debt ratio	Number of employees
Konzum plus	10.71	2.70%	0.37	1.02	9.881
Lidl HR	6.61	7.35%	0.67	0.51	2.846
Spar HR	5.37	0.81%	0.62	0.74	3.558
Plodine	5.18	6.58%	0.63	0.65	3.656
Kaufland HR	4.28	1.88%	0.95	0.33	2.072
Tommy	3.6	4.79%	0.8	0.9	3.158
Pevex	2.52	14.28%	3.16	0.34	2.031
Studenac	2.35	1.40%	0.64	0.73	2.878
dm - HR	1.99	4.57%	1.31	0.74	1.057

Source: FINA, 2022c, processed by the authors

Jones et al. (2011) conducted a study on the eight largest retail chains in the world, while Saber and Weber (2019) focused on Germany, i.e., they compared and analyzed sustainability reporting between leading discount stores and supermarkets.

Unlike Jones et al. (2011), who divided reporting into environment, society, and economic indicators, Saber and Weber (2019) divided reports into products, environment, employees, and society. In terms of comparison, they conclude that there is a greater significant difference in sustainable development reporting between supermarkets and discount stores (2019, p. 1198). At the same time, the study provides insight into how supermarkets and discount stores, namely seven of them, all report on sustainable development (2019, p. 1192). The amount of data on which a certain retail chain provides reports is shown at the bottom of the table. Rewe ranks first with 26 items it reports on sustainable development, while Netto and Norma report on the smallest number of items, 11 each. Sustainability reporting of retail chains in Germany began in 2009 (Saber & Weber, 2019, p. 1190), while according to research, the reporting of retail chains in the Republic of Croatia is still in its infancy since it started in 2017.

1 https://www.fina.hr/tko-smo

2 https://www.fina.hr/-/servis-info-biz

Figure 4 Availability of data in sustainability reports

Availability of data	Edeka	Rewe[b]	Aldi Süd	Aldi Nord	Netto	Penny[b]	Norma	Sum across all retailers
Product Σ	4	8	4	9	2	7	6	40
1. Organic items	X	X		X	X	X	X	6
2. Regional items	X	X				X	X	4
3. Fair-trade items	X	X		X				3
4. MSC, ATC items (sustainable fish)		X	X	X	X	X		5
5. FSC/PEFC certification		X	X	X		X		4
6. KAT certified eggs		X		X		X	X	4
7. Certified palm oil		X	X	X		X		4
8. Otherwise certified products (UTZ, animal welfare, Pro Planet, WWF, etc.)	X	X	X	X		X		5
9. Vegan/vegetarian items				X			X	2
10. Lactose/gluten free items							X	1
11. Genetically unmodified items				X			X	2
Environment Σ	7	12	6	5	5	11	3	49
1. Carbon footprint		X	X			X		3
2. Total CO_2 emissions		X	X	X	X	X		5
3. Direct energy consumption	X[a]	X		X	X	X		5
4. Indirect energy consumption	X[a]	X		X	X	X		5
5. Green building	X	X				X		3
6. Electricity	X	X				X		3
7. Heating	X							1
8. Cooling systems		X	X			X		3
9. Lighting			X		X			2
10. Energy production, photovoltaic		X	X	X		X		4
11. Recycling		X	X			X	X	4
12. Total amount of waste	X	X		X			X	4
13. Logistics (utilization trucks, distance to store, CO_2 emission, emission class)	X	X			X	X	X	5
14. Banishment of plastic bags		X				X		2
Employees Σ	4	5	6	4	3	5	2	29
1. Non-determinate work contracts	X	X	X	X		X		5
2. Employment organization	X	X	X	X	X	X	X	7
3. Women in leadership	X	X	X	X		X		5
4. Percentage apprenticeships	X	X	X	X	X	X	X	7
5. Take-over quota apprenticeships			X					1
6. Employee satisfaction			X					1
7. Employee turnover rate		X			X	X		3
Society Σ	1	1	3	1	1	1	0	8
1. Social assessments (BSCI)	X	X	X	X		X		5
2. Money donations			X		X			2
3. Use of food waste			X					1
Total sum per retailer Σ	16	26	19	19	11	24	11	126

Source: Saber and Weber, 2019, p. 1192

Data from Jones et al.'s study (2011) on the eight world's largest retail chains are presented later in the text. Unlike Saber and Weber, Jones et al. (2011) divided the report into environmental, social, and economic categories. According to the summarized research results given in Table 2, it is evident that most of the ten leading global retailers recognize and report on a wide range of impacts their business practices have on the environment, society, and economy (2011, p. 264). Carrefour, Target, and Tesco cover all areas within the environmental, social, and economic categories, while others have certain categories they do not cover, such as Kroger and Metro. According to the report, the aforementioned two chains did not mention a single component in their reports that would relate to the economic role in sustainable development through job creation, value for customers, and relationships with suppliers.

Table 2 The sustainability issue – retailer summaries

Sustainable development	Walmart	Carrefour	Tesco	Metro	Home Depot	Kroger	Target	Costco
Environmental								
Climate change and carbon emissions	✓	✓	✓	✓	×	✓	✓	✓
Energy consumption	✓	✓	✓	✓	×	✓	✓	✓
Water management	✓	✓	✓	×	×	×	✓	✓
Waste management	✓	✓	✓	✓	✓	✓	✓	×
Logistics	✓	✓	✓	✓	✓	×	✓	×
Conserving natural resources	✓	✓	✓	×	×	✓	✓	×
Environmentally friendly products	✓	✓	✓	✓	✓	✓	✓	✓
Social								
Responsible sourcing	✓	✓	✓	×	×	✓	✓	×
Food safety	×	✓	✓	×	×	✓	✓	×
Working conditions at suppliers	✓	✓	✓	✓	×	✓	✓	✓
Health and safety	✓	✓	✓	×	✓	✓	✓	✓
Local community links	✓	✓	✓	×	✓	✓	✓	✓
Economic								
Employment creation	✓	✓	✓	×	×	×	✓	✓
Value for customers	✓	✓	✓	×	×	×	✓	×
Supplier relationships	✓	✓	✓	×	✓	×	✓	×

Source: Jones et al., 2011, p. 261

4. Research results

The research conducted in the Republic of Croatia was based on two similar studies that were conducted by Jones et al. (2011) and Saber and Weber (2019).

In order to structure the data from the official websites into one table, the very method of grouping according to the environmental, social, and economic categories was taken from the research of Jones et al. (2011, p. 261).

The first part of the table shows the environment and related areas, specifically water management, waste management, energy consumption, conservation of natural resources, climate change, and carbon emissions. The second part refers to society, food safety, responsible food choices, working conditions at suppliers' premises, health and safety, and connection with the local community. The third part refers to economic indicators, job creation, value for customers, and relationships with suppliers.

Table 3 Sustainable development – comparison of leading retailers

Sustainable development	Konzum	Lidl	Spar	Plodine	Kaufland	Tommy	Pevex	Studenac	DM-Hrvatska
Environmental									
Climate change and carbon emissions	×	✓	×	×	✓	×	×	×	×
Energy consumption	✓	✓	×	×	✓	×	×	×	×
Water management	✓	✓	×	×	✓	×	×	×	×
Waste management	✓	✓	×	×	✓	×	×	×	×
Logistics	×	×	×	×	✓	×	×	×	×
Conserving natural resources	×	✓	×	×	✓	×	×	✓	×
Environmentally friendly products	×	✓	×	×	✓	×	×	×	×
Social									
Responsible sourcing	✓	✓	✓	×	✓	×	×	×	×
Food safety	✓	✓	✓	×	✓	×	×	×	×
Working conditions at suppliers	×	×	×	×	✓	×	×	×	×
Health and safety	✓	✓	✓	×	✓	×	×	✓	✓
Local community links	✓	✓	✓	×	✓	✓	×	✓	✓
Economic									
Employment creation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Value for customers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Supplier relationships	✓	✓	✓	×	✓	×	×	×	×

Source: Processed by the authors according to Jones et al.'s table, 2011, p. 261

When searching the official websites of retail chains, it was observed that Konzum Plus, Lidl, and Kaufland have separate sustainable development reports. Konzum Plus published its annual report for 2021 consisting of 153 pages, while Lidl publishes its reports for a two-year period. The first and the second report were published for 2017/2018 (75 pages) and for 2019/2020 (102 pages), respectively. Kaufland published its first annual report in 2020 (107 pages), which referred to a two-year period, i.e., 2018 (from March 1, 2018 to February 28, 2019) and 2019 (from March 1, 2019 to February 29, 2020), which also includes a section on sustainable development.

Other retail chains among the top nine in terms of sales revenue in the Republic of Croatia do not publish annual reports on sustainable development. Unlike Konzum or Lidl, for instance, dm - drogerie markt does not keep records of sustainable business practices on its official website. However, it does refer customers to the ways to enhance awareness of sustainable development, so that alongside the advice provided on dm's official website, customers are encouraged to implement these practices.

Konzum Plus divided its annual report into financial and non-financial indicators. On p. 57 of the report, it describes the company's involvement in the educational loyalty program, which was launched in 2021. The main goal is to draw customer attention to nature conservation with an emphasis on protected animal species. Konzum Plus collected and donated HRK 207,000 to the Blue World Institute, and these funds are intended for research, education, and activities aimed at protecting dolphins in the Adriatic. The company is also society-oriented through holiday humanitarian campaigns, along with being the largest food donor in Croatia. In terms of environmental protection, the company implemented and certified an environmental management system in all of its facilities according to the ISO 14001 standard in 2010 (Konzum, 2021). The report highlights great emphasis they place on employees through education, training, work-life balance, managing career development, and employee rewards.

Furthermore, the report details electricity and water consumption, incorporating data from 2019, 2020, and 2021. Savings in terms of electricity and water consumption are evident from the observed years. Additionally, the report outlines the quantities of waste produced in tons for the period from 2020 to 2021, categorized into cardboard and plastic packaging, edible waste oil, etc.

The report did not include any goals for a certain period, to which extent and in which direction the company will attempt to reduce the amount of waste, the carbon footprint, and electricity, water, and gas consumption. The supply of sales facilities and logistics from renewable energy sources were not specified in the report.

Kaufland Hrvatska's sustainability report underscores its societal and community roles through its affiliations with national and international networks. These include membership in the corporate social responsibility community, attainment of the Tvrtka prijatelj zdravlja (Company – a Friend of Health) certificate in 2019, adoption of the Volunteer Charter in 2019, and participation in the UN Global Compact initiative. The company places a strong emphasis on the health of people and the planet by prioritizing responsible sourcing and fair business practices. It also focuses on developing strategies aimed at reducing plastic and waste. Through the four goals set by the UN in 2015 for the period until 2030, Kaufland Hrvatska contributes most significantly to the following categories: Goal 2 (Zero hunger), Goal 3 (Health and well-being), Goal 12 (Sustainable consumption and production), and Goal 13 (Climate action). Special emphasis is placed on Goal 12 (Sustainable consumption and production), which led to the establishment of a strategic direction in 2018.

As for Goal 12.3 (Food waste), the Schwarz Group (comprising Kaufland and Lidl) aims to reduce food waste by 50% by the end of 2030. This reduction will extend to selected raw materials within the supply chain. The above refers to its own production; food waste will be reduced by 50% by 2025 (in comparison with the base year 2017 and in relation to the quantity placed on the market) (Kaufland, 2018).

It fosters organizational values towards its employees, such as efficiency, dynamism, and fairness. As is the case with Konzum Plus, the emphasis is put on work-life balance, health and safety of employees, training, and education.

In addition to reporting on electricity consumption, the company publishes a comparison of consumption for two periods – 2018 and 2019. The report highlights the company's own production of electricity from photovoltaic panels. The annual production of self-generated electricity accounts for

17% of the company's subsidiary electricity needs. Greenhouse gas emissions are classified into three areas:

- Area 1: Direct emissions, which encompass emissions directly originating from facilities owned or controlled by Kaufland,
- Area 2: Indirect energy emissions, which account for emissions stemming from the production of energy purchased by Kaufland from suppliers,
- Area 3: Other indirect emissions, which includes other emissions such as logistics procurement, distribution of Kaufland magazines, and paper consumption.

According to the report, when comparing data from 2018 and 2019, greenhouse gas emissions were reduced by 12.8% (Kaufland, 2018).

Lidl Croatia stands out as the only retail chain among the top nine to report on its engagement in sustainable development for the second time in a row. The first report was published for 2017 and 2018, and the second one referred to 2019 and 2020. Anchored in their sustainability strategy and the motto "A Better Tomorrow", Lidl also conducts surveys to identify key areas of focus from the perspective of customers, employees, suppliers, the media, etc. The difference between the first and the second research lies not only in the number of respondents (252 in the first and 550 in the second report), but also in the areas on which the business strategy should be focused in terms of raw materials, supply chains, and customers. In addition to reporting on the waste disposal quantities, the company focuses on numerical targets for specific products. For instance, by the end of 2025, the company aims to increase the share of fish carrying certain labels (certificates), and by the end of 2025, a minimum of 15% of their paper range will incorporate recycled fibers. Like Kaufland, a member of the Schwartz Group, Lidl also reports on water consumption and waste disposal, and provides a comparative analysis over a two-year period (Lidl, 2019).

5. Discussion

By reviewing the official websites of the leading nine retail chains (ranked by sales revenue) in the Republic of Croatia, it was observed that only a few of them make reports on their engagement in sustainable development. This engagement pertains to three areas: economic, ecological, and social. In their annual reports, one national and two foreign retail chains highlight the segments in which they have made progress in economic, social, and environmental areas. The earliest available report dates back to 2017, indicating a noteworthy delay in the public release of these reports, despite their clear content. Why highlight this now? The answer probably lies in the fact that, in daily communication via reporting channels, public attention is drawn to the fact that each of us, by setting an example, can significantly contribute to preserving the Earth, i.e., to sustainable development. If we look at the official websites of the world's major retail chains, it becomes apparent that they have been publishing reports on their official websites for over a decade on sustainable development, greenhouse gas emissions, the impact of their business practices on the ecosystem, and their approach to maintaining the highest-quality supply chain in their business practices. Is this a trend they decided to incorporate into their business strategies? This very fact, according to the opening words of several retail chains, was highlighted by the presidents of the management boards.

Lidl underscores its strategic approach to sustainable development with its motto "A Better Tomorrow" (words of the CEO of Lidl Hrvatska), while Kaufland, with its motto "Deeds, Not Words", highlights its commitment to a comprehensive business model, with a strong emphasis on sustainable development. Retail chains such as Lidl and Kaufland (both members of the Schwartz Group) also regularly publish reports on sustainable development in their countries of origin and in the Republic of Croatia.

From the aforementioned, it is evident that retail chains in the Republic of Croatia do not follow the global reporting trend – currently, the numbers are relatively modest. However, as stated earlier, it is often the leaders who set new goals. Therefore, the retail chains (Konzum, Lidl, Kaufland) in the Republic of Croatia can be viewed as reporting leaders at the micro-level (within the retail sector in the Republic of Croatia), and their activities set further goals, especially for those who have yet to embrace such practices.

In their reports, it is imperative that retail chains focus on highlighting concrete results rather than merely outlining goals. Jones et al. (2011, p. 268)

suggest that definitions and obligations regarding sustainable development reporting may be driven by business imperatives, placing more emphasis on revenue and margin rather than sustainable efficiency.

Bilinska et al. (2018, p. 11) advocate for increased customer involvement in sustainable development such that retail chains emphasize their responsibility and impact on the environment. In this age of rapid technological and informational progress, communication has become one of the essential components. Retail chains should actively encourage customers to behave responsibly and guide them towards products aligned with sustainable development principles. A monthly report, presented in the form of an information desk (such as a tablet in the sales area), could serve as a valuable tool. This would provide customers with insights into information on the involvement of the retail chain in sustainable practices and the results achieved so far.

The procurement department is one of the key parts of the retail chain when it comes to negotiations with suppliers, i.e., brand producers.

In terms of the brands they sell, retail chains should inform consumers more transparently about the reduction of greenhouse gas emissions, or disclose the product's impact on sustainable development directly on the packaging. Furthermore, they should also take into consideration product packaging that is in line with sustainability practices and introduce new product lines that benefit both the environment and society. During store renovations, it is recommended to recycle old materials and use them in new stores. Installing solar panels on store rooftops and setting up electric vehicle charging stations in parking lots in front of the stores, alongside more transparent reporting on past and planned initiatives, are also crucial steps. Additionally, in larger stores, the installation of monitors displaying daily updates on energy savings, water savings through rainwater collectors on store rooftops, food donations, etc. can contribute to ongoing sustainability efforts to keep consumers informed. It is also suggested to initiate projects engaging customers directly in sustainable development efforts. One such example is to offer products that allow consumers to directly donate money (with a retail chain also contributing a portion) towards reducing harmful gas emissions. The products included in the project could involve local agricultural farms, livestock farms, food processing and manufacturing facilities, etc. Finally, retail chains are to provide daily reports on the reduction of harmful gas emissions into the atmosphere, the funds collected, and the future goals set in this context.

Sustainability certifications stand out another consideration for retail chains. By obtaining these certifications, retail chains commit to both maintaining a specified standard in their operations and reporting on it, while being dedicated and consistent in the process. This sends a message not only to consumers but also to competitors in the market.

Naturally, retail chains generate revenue from the sale of goods and services and, unfortunately, the competitive pressure is relentless. The question arises: Can retail chains maintain a competitive advantage and high standards at the same time? Thaslim and Aksa (2016, p. 39) conclude that sustainability reporting can certainly be one of the main drivers for increasing company performance and efficiency in financial and non-financial terms.

6. Conclusion and recommendation for further research

Unfortunately, in terms of sustainable development, retail chains in the Republic of Croatia have not fully embraced global trends. Only a third of them have published reports on sustainable development, with some beginning to engage in such practices only recently. It can be stated that these practices are still in their infancy, and it is crucial for others to join in as soon as possible. Surely, this should not be done with the aim of generating even more revenue or quality advertising, because that will derail the meaning and direction. Rather it is essential for everyone to be aware of sustainable development. It is the retailers on a global level who are one of the main drivers of economies and innovations in sales, which is why they are aware of the fact that their contribution is monitored and expected on both a macro- and micro-level. The changes are evident and they have intensified after the pandemic. Customers are increasingly turning to organic products and local producers, and more actively participating in waste separation practices. Being informed prior to making a purchase is essential for making a purchase decision. It is only a matter of time before customers start to overwhelmingly favor those actively involved in sustainable development.

Retail chains should more frequently report on the quantities and periods during which they contributed to the reduction of greenhouse gas emissions into the atmosphere, which activities they carried out, and whether and to what extent their business practices affected biodiversity. They should disclose the number of products currently produced sustainably, such as recycled plastic bottles, and information as to whether they have reduced the amount of plastic packaging in the fruit and vegetable departments. Retail chains should also outline when and how, due to reduction in profit, they decided to purchase and source more expensive yet ecologically acceptable products for the environment and the producer.

By intensifying the implementation of sustainable business practices through product advertisements and regular reporting on related improvements, retailers will directly impact consumer awareness of the importance of environmental conservation and the role of each individual in that process. Further implications are oriented towards future generations, who will in turn adopt environmental care more consciously and effectively, with retailers viewing products not only through the lens of profitability but also sustainability.

This research has several limitations. Firstly, the research was conducted objectively without direct contact with retailers, i.e., the managers responsible for sustainability development and implementation. The second research limitation is that it only included retail chains dealing with mixed goods, while other sectors, such as textiles, furniture, and household goods, were not covered in this study.

Further research should undoubtedly be focused on the opinions of customers. A survey should be conducted to see if customers are buying from those who contribute to sustainable development, and, when making purchasing decisions, if they are aware of the extent to which a certain retail chain is involved in sustainable development processes. Drawing from KPMG's research, a study should be conducted in the Republic of Croatia for companies whose securities are traded on the Zagreb Stock Exchange and see if and since when trading companies have been keeping records on sustainable development.

At the same time, further research can build upon the scientific work of Saber and Weber (2019). Furthermore, discount stores and supermarkets can be compared with respect to sustainable development reporting in the Republic of Croatia.

References

1. Arnold, M. (2015). Fostering sustainability by linking co-creation and relationship management concepts. *Journal of Cleaner Production*, *140*(1), 179-188. https://doi.org/10.1016/j.jclepro.2015.03.059
2. Berry, M. A. & Rondinelli, D. A. (1998). Proactive Corporate Environmental Management: A New Industrial Revolution. *The Academy of Management Executive (1993-2005)*, *12*(2), 38-50. https://doi.org/10.5465/ame.1998.650515
3. Bilińska-Reformat, K., Kucharska, B., Twardzik, M. & Dolega, L. (2018). Sustainable development concept and creation of innovative business models by retail chains. *International Journal of Retail & Distribution Management*, *47*(2), 2-18 https://doi.org/10.1108/ijrdm-04-2017-0071
4. Brundtland, G. H. (1987). *Our Common Future: Report of the World Commission on Environment and Development.* http://www.un-documents.net/ocf-ov.htm
5. Carp, M., Păvăloaia, L., Afrăsinei, M.-B. & Georgescu, I. (2019). Is Sustainability Reporting a Business Strategy for Firm's Growth? Empirical Study on the Romanian Capital Market. *Sustainability*, *11*(3), 658. https://doi.org/10.3390/su11030658
6. Ćuzović, S. & Mladenović, S. S. (2017). Managing Environmental Component of Sustainable Development in Trade Sector of Serbia. In Renko, S. & Pestek, A. (Eds.), *Green Economy in the Western Balkans* (pp. 141-173). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78714-499-620171007
7. Dabija, D. C., Pop, N. A. & Săniuță, A. (2017). Innovation in Do-It-Yourself Retail: An Empirical Study on Generation X among Professional Craftsmen and Consumers. *Economics and Sociology*, *10*(2), 296-311. https://doi.org/10.14254/2071-789X.2017/10-2/22
8. Dernbach, J. C. (2003). Achieving Sustainable Development: The Centrality and Multiple Facets of Integrated Decisionmaking. *Indiana Journal of Global Legal Studies*, *10*, 247-284. https://doi.org/10.2979/gls.2003.10.1.247
9. Devinney, T. M., Auger, P. & Eckhardt, G. M. (2010). *The Myth of the Ethical Consumer*. Cambridge University Press.
10. Diesendorf, M. (2000). Sustainability and sustainable development. In Dunphy, D. et al. (Eds.), *Sustainability: The Corporate Challenge of the 21st Century*. Allen & Unwin.
11. Elkington, J. (1998). Accounting for the triple bottom line. *Measuring Business Excellence*, *2*(3), 18-22. http://dx.doi.org/10.1108/eb025539
12. European Commission (2009a). *Smarter and Cleaner: Consuming and Producing Sustainably*. https://ec.europa.eu/environment/eussd/pdf/brochure_scp.pdf
13. European Commission (2009b). *Europeans' attitudes towards the issue of sustainable consumption and production*. https://europa.eu/eurobarometer/surveys/detail/704
14. Fina (2022a). *Tko smo*. https://www.fina.hr/tko-smo
15. Fina (2022b). *Predstavljen servis info.BIZ*. https://www.fina.hr/-/servis-info-biz
16. Fina (2022c). *info.BIZ*. https://infobiz.fina.hr
17. García, A. M., Saura, I. G. & Molina, M. E. R. (2022). How does sustainability affect consumer satisfaction in retailing. In Bhattacharyya, J. et al. (Eds.), *Social and Sustainability Marketing* (pp. 225-244). Routledge. https://doi.org/10.4324/9781003188186-9
18. Isenmann, R., Bey, C. & Welter, M. (2007). Online reporting for sustainability issues. *Business Strategy and the Environment*, *16*(7), 487-501. https://doi.org/10.1002/bse.597
19. Jamieson, D. (1998). Sustainability and beyond. *Ecological Economics*, 24(2/3), 183-192. https://doi.org/10.1016/S0921-8009(97)00142-0
20. Jones, P., Comfort, D. & Hillier, D. (2011). Sustainability in the global shop window. *International Journal of Retail & Distribution Management*, *39*(4), 256-271. http://dx.doi.org/10.1108/09590551111117536

21. Kaufland (2018). *Sustainability report (2018-2019)*. https://tvrtka.kaufland.hr/ljudi-okolis/izvjestaj-o-odrzivosti.html

22. Konzum (2021) *Annual report for 2021*. https://www.konzum.hr/novosti/godisnji-izvjestaj-2021

23. Lidl (2017). *Sustainability report (2017-2018)*. https://tvrtka.lidl.hr/pdf/show/70171

24. Lidl (2019). *Sustainability report (2019-2020)*. https://tvrtka.lidl.hr/pdf/show/70172

25. Lim, W. M., (2022). Empowering Marketing Organizations to Create and Reach Socially Responsible Consumers for Greater Sustainability. In Bhattacharyya, J. et al. (Eds.), *Social and Sustainability Marketing*, (pp. 3-7) Routledge. https://doi.org/10.4324/9781003188186-1

26. Nazahah, A. R. & Noorain, O. (2017). Online communication and sustainability reporting: The managerial issues. *Jurnal Komunikasi: Malaysian Journal of Communication*, *33*(3), 231-249. https://doi.org/10.17576/JKMJC-2017-3303-14

27. Norman, W. & MacDonald, C. (2004). Getting to the Bottom of "Triple Bottom Line". *Business Ethics Quarterly*, *14*(2), 243-262. https://doi.org/10.5840/beq200414211

28. Pantano, E. (2014). Innovation drivers in retail industry. *International Journal of Information Management*, *34*(3), 344-350. https://doi.org/10.1016/j.ijinfomgt.2014.03.002

29. Ruiz-Real, J., Uribe-Toril, J., Gázquez-Abad, J. & de Pablo Valenciano, J. (2018). Sustainability and Retail: Analysis of Global Research. *Sustainability*, *11*(1), 1-18. https://doi.org/10.3390/su11010014

30. Saber, M. & Weber, A. (2019). How do supermarkets and discounters communicate about sustainability? A comparative analysis of sustainability reports and in-store communication. *International Journal of Retail & Distribution Management*, *47*(11), 1181-1202. https://doi.org/10.1108/ijrdm-08-2018-0156

31. Sorescu, A., Frambach, R. T., Singh, J., Rangaswamy, A. & Bridges, C. (2011). Innovations in Retail Business Models. *Journal of Retailing*, *87*(1), 3-16. https://doi.org/10.1016/j.jretai.2011.04.005

32. Sparks, L. (2018). Sustainable Development and Food Retailing: UK Examples. In Lavorata, L. & Sparks, L. (Eds.), *Food Retailing and Sustainable Development* (pp. 67-80). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78714-553-520181004

33. Tascioglu, M., Eastman, J., Bock, D., Karl Manrodt, K. & Shepherd, C. D. (2019). The impact of retailers' sustainability and price on consumers' responses in different cultural contexts. *The International Review of Retail, Distribution and Consumer Research*, *29*(4), 430-455. https://doi.org/10.1080/09593969.2019.1611619

34. Thaslim, M. K. A. & Aksa, R. A. (2016). Sustainability reporting – Its then, now and the emerging next!. *World Scientific News*, *42*, 24-40.

35. Threlfall, R., King, A., Schulman, J. & Bartels, W. (2020). *The time has come. The KPMG Survey of Sustainability Reporting 2020*. https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2020/11/the-time-has-come.pdf

36. Zrnić, A., Pekanov Starčević, D. & Crnković, B. (2020). Recent trends in sustainability reporting: Literature review and implications for future research. *Econviews*, *33*(1), 271-283.

37. Wiese, A., Kellner, J., Lietke, B., Toporowski, W. & Zielke, S. (2012). Sustainability in retailing – a summative content analysis. *International Journal of Retail & Distribution Management*, *40*(4), 318-335. http://doi.org/10.1108/09590551211211792

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RISK-RETURN-VOLUME CAUSALITY ON THE CROATIAN STOCK MARKET

Abstract

Purpose: Causality between stock returns, volatility and traded volume for 10 most liquid stocks from Zagreb Stock Exchange (ZSE) is examined in this paper.

Methodology: The paper relies on historical daily data regarding return, standard deviation and turnover for the period from 2015 to 2021. Vector Autoregressive Models (VARs) were estimated for each stock individually. Based on estimated VAR models, Granger-causality tests were performed to estimate causality between trading volume, stock returns and volatility for most liquid stocks from the Croatian stock market.

Results: Results strongly confirm that traded volume Granger causes volatility. Return remained irrelevant in terms of predicting traded volume and volatility of stock returns.

Conclusion: Causality from return to volatility or causality from volatility to return can be confirmed only in shorter periods. Traded volume causes volatility for the majority of stocks regardless of how volatility was calculated. Causality from volatility to return and causality from volatility to volume are valid for half of the sample and need to be further investigated.

Keywords: Stock returns, return volatility, trading volume, Granger causality, Zagreb Stock Exchange

1. Introduction

The literature on financial markets is traditionally focused on stock returns and volatility, while trading activity has attracted only peripheral attention. Trading data are generally available along with stock prices and can be easily obtained for every single stock. It still remains unclear whether trading volume is variable that contains specific information about future stock returns or volatility. Return volume-volatility relationships have been well investigated around the world. Two approaches have been identified; in the first case, causality was analyzed by observing one stock at a time, and in the second case by observing market indices. Similar research has not been conducted for Zagreb Stock Exchange (ZSE) stocks. In this paper, the Granger causality test is applied to examine the direction of return-volume-volatility causalities for ten most liquid stocks from Zagreb Stock Exchange. The following three key research questions are investigated: 1) Do return and volume Granger cause volatility, 2) do

traded volume and volatility Granger cause return, and 3) Do volatility and return cause traded volume for 10 stocks from ZSE.

According to the OECD (2021, p. 34), the Croatian stock market is characterized by low levels of liquidity in the secondary market and it is dominated by trades in a few individual stocks. In 2019, the overall turnover ratio for the three segments of the regulated market was only 1.5%. For the most liquid market, the Prime Market, it was only 3%. In that period, the turnover ratio for peer stock exchanges was significantly higher with 19% for the Warsaw Stock Exchange, 9% for the Prague Stock Exchange and an average of 58% for all stock exchanges in the European Union. Infrequent trading brings uncertainty to investors in terms of whether it will be possible to trade stock at a specific time and at a current market price.

This paper is structured as follows: Section 2 provides a brief review of literature; Section 3 discusses data and methodology. Results are presented in Section 4 and further elaborated in Section 5. The last section, Section 6, contains concluding remarks.

2. Previous research

Return-volume-volatility causality has been the subject of numerous studies. In this paper, previous research is sorted into two groups; the first group comprises papers that observe these relations at market level through observation of market indices, and the second group contains research results where these relations were observed by examining a single stock at a time. These two approaches yield some differences in results.

Many authors reported unidirectional linear causality from returns to volume by observing market indices. Unidirectional linear causality from returns to volume was reported in Tudor (2009) in the case of the Romanian stock market, Iqbal & Riaz (2015) observed the FTSE100 market index, Griffin et al. (2007) analyzed markets in 46 countries, Brüggemann et al. (2014) observed 16 selected European countries, Srinivasan et al. (2010) examined Asia-Pacific stock markets, Pisedtasalasai & Gunasekarage (2007) investigated emerging markets in South-East Asia-Indonesia, Malaysia, Philippines, Singapore and Thailand, and Chen et al. (2001) observed stock indices (the US, Japan, the UK, France, Canada, Italy, Switzerland, the Netherlands and Hong Kong). Dritsaki (2014) found an opposite interaction between return and trading volume in the direction from trading volume towards Athens Stock Exchange return.

When observing a volatility-volume relationship, many studies implied unidirectional causality from volume to volatility at the market level, e.g. Dritsaki (2014) for the Athens Stock Exchange, Tudor (2009) for the Romanian stock market, Le & Mehmgursed (2009) in Nordic countries - Sweden, Denmark, Norway, and Finland, Gursoy et al. (2008) in 12 emerging markets, and Pisedtasalasai & Gunasekarage (2007) observed emerging markets in South-East Asia-Indonesia, Malaysia, Philippines, Singapore and Thailand.

Yonis (2014) found a bi-causal relationship between volatility and volume for tiger economics except for the case of South Korea, explaining that volatility contains information to predict volume and vice versa. Similarly, Lu & Lin (2010) found a general bidirectional causal relationship between volatility and trading volume on the Taiwan stock market, and De Medeiros & Doornik (2006) for a theoretical portfolio composed of 57 stocks belonging to the Brazilian stock exchange index (Bovespa). Mubarik & Javid (2009) observed the Pakistani market and reported that Granger causality test results suggest that there is a feedback relationship between market return and volume. Hiemstra and Jones (1994) found evidence of significant bidirectional nonlinear causality between returns and volume for the Dow Jones Price Index.

Iqbal & Riaz (2015) and Gursoy et al. (2008) investigated a relationship between trading volume and volatility and reported that volume may be a good proxy for a stock-level analysis, but not for a market-level analysis. Iqbal & Riaz's (2015) study suggests that past volume does not cause returns, but there is evidence that past returns cause volume, suggesting that no bidirectional association is found among volume and returns for market and individual stocks. Other authors who observed market indices, Brüggemann (2014), Pisedtasalasai & Gunasekarage (2007) and Yonis (2014), also concluded that no evidence was found for the impact of trading volume on returns. Pisedtasalasai & Gunasekarage (2007) observed emerging markets in South-East Asia-Indonesia, Malaysia, Philippines, Singapore and Thailand, and found evidence of asymmetry in the relationship between stock returns and trading volume, i.e. returns are important in predicting their future dynamics as well as those

of trading volume, but trading volume has a very limited impact on the future dynamics of stock returns.

Research that examined volume-volatility-return relationships by observing a single stock at a time confirmed unidirectional causality from return to volume. Evidence that return causes volume was found in Gündüz and Hatemi-J (2005) in the case of Russia and Turkey, Miloudi et al. (2016) for the French stock market, Mubarik & Javid (2009) in the case of individual Pakistani market stocks, Kumar & Thenmozhi (2012) for developed and emerging markets, Gurgul et al. (2005) for Polish companies listed in the Wig20, and Ligocká (2019) for 67 companies listed on the Warsaw Stock Exchange.

Many research studies confirmed unidirectional causality from volume to volatility when one stock at a time was observed. Unidirectional causality from volume to volatility for stocks was confirmed in Ananzeh et al. (2013), who investigated 7 individual stocks from the Amman Stock Exchange (ASE), Baklaci & Kasman (2006), who observed the Turkish stock market, and Kiymaz & Girard (2009), who examined 30 stocks included in the Istanbul Stock Exchange. Unidirectional causality from volume to volatility was well documented in the case when market indices were observed.

Some researchers who observed a single stock at a time found a causal relationship from volatility to volume. Unidirectional causality from volatility to volume was found in Mestel et al. (2003) for 31 companies listed on the Austrian stock market, Baklaci & Kasman (2006) for stocks from the Turkish stock market, and Kumar & Thenmozhi (2012) for emerging markets.

Gündüz and Hatemi-J (2005) found a bidirectional causality relationship between stock prices and volume for Hungary. In the case of Poland, they found bidirectional causality between stock prices and volume and unidirectional causality running from market turnover to stock prices.

Kumar & Thenmozhi (2012) showed that trading volume does not Granger cause returns and volatility. On the contrary, some other studies determined the importance of trading volume as an information variable; Zada (2021) observed all companies listed on the Saudi Stock Market, Zolotoy & Melenberg (2007) examined a large sample of cross-listed firms, Mubarik & Javid (2009) observed the Pakistani market, Choi et al. (2013) analyzed the Asian stock markets, and Bohl and Henke (2003) observed 20 Polish stocks.

3. Data and methodology

A data set in this paper consists of 10 stocks from Zagreb Stock Exchange (ZSE). The observed stocks are constituents of the CROBEX10 index. These stocks are top 10 CROBEX index constituents by free float market capitalization and turnover. All stocks had more than 200 daily observations in a year, only one stock (KOEI) had 190 daily observations in 2018 and 2019. This general information is essential for such small market, where infrequent trading is an obstacle to conducting representative research. Daily prices and traded volumes were obtained from the ZSE database for the period from January 2015 to the end of December 2021. Three variables were calculated daily and individually for each stock, i.e. stock return, natural logarithm of turnover and standard deviation. These variables were calculated for the period from the beginning of January 2015 to the end of December 2021. In the further analysis causality between stock return, volatility and traded volume was estimated for one stock at a time.

At the beginning of the analysis, all series were tested for stationarity using the augmented Dickey-Fuller test. Testing for unit roots is essential since vector autoregressive models require all variables to be stationary. All series confirmed to be stationary except in five cases where series of standard deviations were calculated from the past 90 returns. These exceptions are reported in tables 2-11 and these variables were not taken further into the estimation of vector autoregressive models (VARs) and Granger causality testing. VAR models were specified using strictly stationary variables in level form (Gujarati & Sangeetha, 2007, p. 853). A VAR model is used to model a relationship among the observed variables. In the VAR model, all variables are endogenous, which practically means that every variable can be explained by lagged values of itself and other observed variables. In this study, three equations were estimated. Return can be explained by lagged values of return and lagged values of log turnover and lagged values of standard deviation. Turnover can be explained by its own lagged past values, lagged values of return and lagged values of standard deviation. Standard deviation was regressed to its own lagged past values and lagged val-

ues of log turnover and return. Estimations in VAR models are performed by using the OLS method. The Schwarz criterion was applied to choose an appropriate autoregressive lag length l.

The following VAR models were observed:

$$R_t = \alpha_1 + \sum_{i=1}^{l} \beta_{1i} R_{t-i} + \sum_{i=1}^{l} \gamma_{1i} TURN_{t-i} + \sum_{i=1}^{l} \delta_{1i} STDEV_{t-i} + \varepsilon_{1t}, \quad (1)$$

$$TURN_t = \alpha_2 + \sum_{i=1}^{l} \beta_{2i} TURN_{t-i} + \sum_{i=1}^{l} \gamma_{2i} R_{t-i} + \sum_{i=1}^{l} \delta_{2i} STDEV_{t-i} + \varepsilon_{2t}, \quad (2)$$

$$STDEV_t = \alpha_3 + \sum_{i=1}^{l} \beta_{3i} STDEV_{t-i} + \sum_{i=1}^{l} \gamma_{3i} R_{t-i} + \sum_{i=1}^{l} \delta_{3i} TURN_{t-i} + \varepsilon_{3t}, \quad (3)$$

where R is stock return calculated as the natural logarithm of the daily change in stock prices $\ln\left(P_{it}/P_{i,t-1}\right)$, TURN denotes trading volume calculated as the natural logarithm of turnover series, ε_t are error terms, and l denotes the autoregressive lag length.

Standard deviation of stock returns (STDEV) is calculated using the following expression:

$$STDEV_i = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(R_i - \overline{R}_i)^2}, \quad (4)$$

where R_{it} is stock return of stock i in period t, $t \in [1,..,T]$, and $\overline{R}_i$ is the expected stock return of stock i.

Standard deviation was calculated from past returns. Since there is no unique procedure for calculating standard deviation as a measure of volatility from past returns, standard deviation for each day was calculated using the exact number of past returns (T). STDEV5, STDEV15, STDEV30, and STDEV90 were calculated using five past returns (T=5), fifteen past returns (T=15), thirty returns (T=30), and ninety returns (T=90), respectively. Each VAR model has four variations depending on which a measure of volatility was applied, i.e., Model 1 (STDEV5), Model 2 (STDEV15), Model 3 (STDEV30), and Model 4 (STDEV90). This approach can also be understood as an additional validity check of the obtained results.

The lag length was estimated for each model individually using the Schwarz criterion. The obtained VAR models were submitted to root test an LM autocorrelation test.

An important feature of VAR models is that they allow us to test the direction of causality. Once the VAR models have been estimated, causality can be tested using the Granger causality test. Causality is referred to as the ability of one variable to predict and therefore cause the other (Asteriou & Hall, 2007, p. 281). Causality testing can have the following four possible outcomes: 1) x causes y, 2) y causes x, 3) bidirectional causality, i.e., x causes y and y causes x, and 4) independence. In this paper, we investigate causality between three variables: return, volume and volatility.

4. Results

This paper contributes to the field of research on the return-volatility-volume relationships on small stock markets. The direction of causalities between return, traded volume and volatility for stocks from Zagreb Stock Exchange is examined in this paper. Related research on this topic does not give a unique answer about the direction of these causalities in the case of different markets and in the case of adopting a different approach, i.e., a market level analysis or a stock level analysis. VAR models are estimated and causality is tested for one stock at a time, as suggested in Iqbal & Riaz (2015) and Gursoy et al. (2008). Standard deviation was applied as a measure of volatility since it is widely adopted by both scientists and small investors. Expected values of four different standard deviations, stock returns and natural logarithms of turnover are given in Table 1. Among standard deviations presented, standard deviation calculated for the entire 7-year period has the highest value. All standard deviations calculated for shorter periods have a smaller value. STDEV90 has the highest value and it is closest to the standard deviation calculated for the whole sample. This conclusion holds for all ten stocks. The most traded stocks according to the natural log of turnover are: PODR, HT and RIVP, with the last two exhibiting a normal distribution of traded volumes.

Table 1 Descriptive statistics of standard deviations, returns and volumes

Ticker / Stock		STDEV5	STDEV15	STDEV30	STDEV90	R	TURN
ADPL AD Plastik	Mean	0.0128	0.0135	0.0140	0.0146	0.0003	11.48
	Std. Dev.	0.0095	0.0082	0.0077	0.0063	0.0159	1.49
ADRS2 Adris Grupa	Mean	0.0091	0.0098	0.0102	0.0109	0.0001	12.75
	Std. Dev.	0.0068	0.0059	0.0055	0.0044	0.0116	1.47
ARNT Arena Hospitality Group	Mean	0.0122	0.0133	0.0138	0.0148	0.0000	11.21
	Std. Dev.	0.0104	0.0091	0.0086	0.0073	0.0163	1.69
ATGR Atlantic Grupa	Mean	0.0107	0.0112	0.0114	0.0118	0.0004	11.31
	Std. Dev.	0.0076	0.0062	0.0055	0.0045	0.0126	1.86
ATPL Atlantska Plovidba	Mean	0.0263	0.0285	0.0293	0.0300	0.0001	11.61
	Std. Dev.	0.0168	0.0131	0.0110	0.0076	0.0316	1.61
ERNT Ericsson Nikola Tesla	Mean	0.0106	0.0115	0.0120	0.0124	0.0002	11.83
	Std. Dev.	0.0081	0.0064	0.0054	0.0042	0.0131	1.31
HT HT	Mean	0.0067	0.0074	0.0077	0.0081	0.0001	13.48*
	Std. Dev.	0.0052	0.0043	0.0037	0.0027	0.0085	0.95
KOEI Koncar	Mean	0.0140	0.0146	0.0149	0.0152	0.0002	11.03
	Std. Dev.	0.0084	0.0061	0.0053	0.0041	0.0158	1.79
PODR Podravka	Mean	0.0101	0.0109	0.0113	0.0121	0.0005	13.22
	Std. Dev.	0.0089	0.0076	0.0069	0.0054	0.0132	1.65
RIVP Valamar Riviera	Mean	0.0111	0.0120	0.0125	0.0131	0.0003	13.34*
	Std. Dev.	0.0094	0.0084	0.0081	0.0071	0.0150	1.01

* HT-TURN passes the Jarque- Bera normality test 0.099487 (prob. 0.951473)
**RIVP-TURN passes the Jarque-Bera normality test 1.47 (prob. 0.48058).

Source: Author´s calculations

Research data is composed of series of standard deviations, stock returns and natural logs of turnover for every single stock. The ADF test was applied to test the stationarity of series. All series were stationary except STDEV90 series for stocks ERNT, ATPL, KOEI, ADRS2 and HT. These series were not taken into further estimation of VAR models and Granger causality testing. In this paper, a strict rule was applied that all series must be stationary, and preferably all series must be taken into analysis at level form. In further analysis, VAR models were estimated according to equations 1, 2 and 3 for each stock individually. The lag length was selected according to the Schwarz criterion. The Granger causality test was performed based on the estimated VAR models to determine the direction of return-volatility-volume causalities. The results of the obtained test statistics are presented in tables 2-11, each table summarizes results for one stock at a time. The causality test results are presented in four columns, each column reports results for one of the four different standard deviations applied in the model along with the optimal lag length.

Table 2 Granger causality test results for the AD Plastik stock

ADPL	Model 1		Model 2		Model 3		Model 4	
Number of lags	Chi-sq	6	Chi-sq	2	Chi-sq	2	Chi-sq	4
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.	STDEV90	Prob.
R→STDEV	32.35	0.0000	15.59	0.0007	1.65	0.4388	5.37	0.3727
TURN→STDEV	17.55	0.0075	10.21	0.0061	7.34	0.0255	14.65	0.0120
STDEV→R	36.98	0.0000	0.87	0.6470	4.39	0.1115	43.40	0.0000
TURN→R	5.83	0.4423	4.44	0.1085	4.35	0.1136	4.74	0.4486
STDEV→TURN	6.15	0.4071	2.46	0.2918	3.47	0.1761	6.96	0.2233
R→TURN	2.06	0.9138	0.43	0.8080	0.60	0.7392	2.05	0.8424

*All series are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -7.74 (0.0000), STDEV15 -5.56 (0.0000), STDEV30 -4.96 (0.0000), STDEV90 -3.26 (0.0170), R -15.00 (0.0000), TURN -11.01 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 2, there is one bilateral causal relation between volatility and return when standard deviation is calculated from past five returns. This bilateral causality is not confirmed in models 2, 3 and 4. Unidirectional causality from return to volatility appears in Model 2. Unidirectional causality from volatility to return appears in Model 4. The only proven causal relation in all four models is causality from traded volume to volatility. The results show that all lagged coefficients of volume are statistically significant, indicating a unidirectional casual relation from traded volume to volatility (STDEV5, STDEV15, STDEV30, and STDEV90).

Table 3 Granger causality test results for the Adris Grupa stock

ADRS2	Model 1		Model 2		Model 3	
Number of lags	Chi-sq	6	Chi-sq	1	Chi-sq	1
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.
R→STDEV	24.08	0.0005	2.34	0.1264	2.15	0.1422
TURN→STDEV	22.86	0.0008	6.53	0.0106	12.88	0.0003
STDEV→R	25.65	0.0030	0.65	0.4194	0.02	0.8566
TURN→R	5.11	0.5293	0.04	0.8347	0.13	0.7184
STDEV→TURN	7.04	0.3173	20.19	0.0000	12.63	0.0004
R→TURN	4.13	0.6597	0.00	0.9846	0.02	0.8813

*All series except STDEV90 are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -8.55 (0.0000), STDEV15 -5.18 (0.0000), STDEV30 -4.37 (0.0003), STDEV90 -2.78 (0.06), R -21.00 (0.0000), TURN -10.93 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

In Table 3, a causal relation from traded volume to volatility is the only causal relation proven in all three models. The results show that all lagged coefficients of volume are statistically significant and indicate unidirectional causality from volume to volatility (STDEV5, STDEV15, and STDEV30). Bilateral causality between volatility and volume is confirmed in Model 2 and Model 3, where standard deviation was calculated from past fifteen and thirty returns. This bilateral causality is not confirmed in Model 1. Bilateral causality between volatility and return was confirmed in Model 1, where standard deviation is calculated from past five returns.

Table 4 Granger causality test results for the Arena Hospitality Group stock

ARNT	Model 1		Model 2		Model 3		Model 4	
Number of lags	Chi-sq	6	Chi-sq	4	Chi-sq	4	Chi-sq	4
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.	STDEV90	Prob.
R→STDEV	82.84	0.0000	66.43	0.0000	27.29	0.0000	18.28	0.0011
TURN→STDEV	16.90	0.0096	3.73	0.4440	3.40	0.4927	12.53	0.0138
STDEV→R	51.9	0.0000	22.83	0.0001	26.01	0.0000	42.51	0.0000
TURN→R	3.42	0.7550	3.41	0.4919	3.64	0.4574	3.24	0.5189
STDEV→TURN	12.86	0.0449	13.69	0.0083	18.83	0.0008	16.76	0.0022
R→TURN	2.44	0.8752	0.71	0.9496	0.82	0.9356	1.17	0.8837

*All series are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -7.98 (0.0000), STDEV15 -5.02 (0.0000), STDEV30 -4.73 (0.0001), STDEV90 -2.99 (0.0357), R -16.59 (0.0000), TURN -14.12 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 4, bilateral causality between return and volatility can be confirmed. All observed coefficients are statistically significant as a group in all four models. Return causes standard deviation and standard deviation causes return, no matter how volatility was measured. Bilateral causality between volatility and volume was confirmed for the ARNT stock in models 1 and 4. Volatility causes volume and volume causes volatility when standard deviation from 5 and 90 returns was calculated. Unidirectional causality from volatility to volume was confirmed in models 2 and 3. When observing return and volume, all observed coefficients in both directions in all four models are not statistically significant, indicating independence between return and volume.

Table 5 Granger causality test results for the Atlantic Grupa stock

ATGR	Model 1		Model 2		Model 3		Model 4	
Number of lags	Chi-sq	2	Chi-sq	2	Chi-sq	2	Chi-sq	4
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.	STDEV90	Prob.
R→STDEV	1.36	0.5056	0.72	0.6976	2.29	0.3185	0.35	0.8391
TURN→STDEV	17.61	0.0002	10.32	0.0058	8.21	0.0164	10.78	0.0046
STDEV→R	1.81	0.4052	5.94	0.0513	3.38	0.1847	2.49	0.2880
TURN→R	8.52	0.0142	8.59	0.0137	8.62	0.0135	8.36	0.0153
STDEV→TURN	2.06	0.3576	4.54	0.1035	7.23	0.0269	7.35	0.0253
R→TURN	4.93	0.0850	4.89	0.0867	4.84	0.0889	4.55	0.1026

*All series are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -6.57 (0.0000), STDEV15 -5.02 (0.0000), STDEV30 -4.74 (0.0001), STDEV90 -2.99 (0.0357), R -16.59 (0.0000), TURN -14.12 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 5, volume is relevant for the ATGR stock. Volume causes volatility (STDEV5, STDEV15, STDEV30, and STDEV90) and volume causes return in all four models. Return-volume causality is bidirectional in models 3 and 4.

Table 6 Granger causality test results for the Atlantska Plovidba stock

ATPL	Model 1		Model 2		Model 3	
Number of lags	Chi-sq	6	Chi-sq	3	Chi-sq	3
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.
R→STDEV	13.28	0.0388	0.77	0.8561	8.49	0.0369
TURN→STDEV	44.79	0.0000	10.50	0.0148	12.84	0.0050
STDEV→R	11.42	0.0762	0.73	0.8655	4.33	0.2277
TURN→R	33.33	0.0000	22.36	0.0001	20.57	0.0001
STDEV→TURN	1.50	0.6095	2.07	0.5574	3.02	0.3889
R→TURN	10.96	0.0897	8.16	0.0428	8.76	0.0326

*All series except STDEV90 are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -10.30 (0.0000), STDEV15 -5.64 (0.0000), STDEV30 -4.78 (0.0001), STDEV90 -2.81 (0.0568), R -39.68 (0.0000), TURN -5.32 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

Results presented in Table 6 are very similar to those for the ATGR stock. Volume is significant in all three models. Volume causes volatility (STDEV5, STDEV15, and STDEV30) and volume causes return in all three models. Return causes volatility in Model 1 and Model 3, where standard deviation was calculated from past five and thirty returns. Bilateral causality exists between return and volume in models 2 and 3. Causality from volatility to volume is not significant in all three models, and all observed coefficients are not statistically significant, indicating that volatility (STDEV5, STDEV15, and STDEV30) does not cause volume.

Table 7 Granger causality test results for the Ericsson Nikola Tesla stock

ERNT	Model 1		Model 2		Model 3	
Number of lags	Chi-sq	6	Chi-sq	2	Chi-sq	2
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.
R→STDEV	19.66	0.0032	2.33	0.3119	5.28	0.0713
TURN→STDEV	29.36	0.0001	16.80	0.0002	10.68	0.0048
STDEV→R	9.69	0.1384	1.56	0.4578	2.71	0.2575
TURN→R	4.74	0.5776	1.27	0.5311	1.18	0.5543
STDEV→TURN	10.60	0.1017	3.25	0.1966	2.49	0.2877
R→TURN	6.92	0.3285	1.79	0.4085	1.75	0.4169

*All series except STDEV90 are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -9.20 (0.0000), STDEV15 -5.33 (0.0000), STDEV30 -4.33 (0.0004), STDEV90 -2.08 (0.2539), R -46.77 (0.0001), TURN -16.16 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 7, volume causes volatility in all three models when standard deviation is calculated from past five, fifteen and thirty returns. Causality from volume to volatility is the only significant causality in all three models for the ERNT stock. No other causality is significant, besides causality from return to volatility when volatility is calculated from past five returns (Model 1).

Table 8 Granger causality test results for the HT stock

HT	Model 1		Model 2		Model 3	
Number of lags	Chi-sq	6	Chi-sq	2	Chi-sq	2
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.
R→STDEV	23.60	0.0006	6.07	0.4800	1.30	0.5689
TURN→STDEV	47.62	0.0000	16.12	0.0003	25.73	0.0000
STDEV→R	11.84	0.0656	1.90	0.3859	1.88	0.3912
TURN→R	9.77	0.1675	5.15	0.0762	6.52	0.0385
STDEV→TURN	5.44	0.4885	5.94	0.0512	6.29	0.0430
R→TURN	7.47	0.2796	3.63	0.1632	4.02	0.1342

*All series except STDEV90 are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -8.21 (0.0000), STDEV15 -5.84 (0.0000), STDEV30 -4.93 (0.0001), STDEV90 -2.78 (0.06), RETURN -44.29 (0.0001), LNVOL -6.92 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

Results for the HT stock are very similar to those for the ERNT stock. Volume causes volatility in all three models when standard deviation is calculated from past five, fifteen and thirty returns. Bidirectional causality between volume and volatility is confirmed in Model 3, where standard deviation is calculated based on the past thirty returns. Unidirectional causality from volume to return is significant only in Model 3. Return appeared to be relevant in Model 1. Return causes volatility in Model 1, where volatility is calculated from past five returns.

Table 9 Granger causality test results for the Koncar stock

KOEI	Model 1		Model 2		Model 3	
Number of lags	Chi-sq	1	Chi-sq	1	Chi-sq	2
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.
R→STDEV	0.65	0.4215	2.57	0.1091	5.07	0.0793
TURN→STDEV	2.74	0.0978	1.32	0.2503	1.43	0.4884
STDEV→R	7.25	0.0071	1.39	0.2382	2.19	0.3353
TURN→R	9.06	0.0026	8.76	0.0031	10.14	0.0063
STDEV→TURN	0.18	0.6713	1.31	0.2520	3.17	0.2050
R→TURN	0.29	0.5875	0.30	0.5842	0.95	0.6234

*All series except STDEV90 are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -8.63 (0.0000), STDEV15 -4.28 (0.0005), STDEV30 -4.17 (0.0008), STDEV90 -2.12 (0.2382), R -45.11 (0.0001), TURN -17.55 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 9, volume causes return in all three models, where three different standard deviations were applied. All lagged coefficients of volume in all three models are statistically different from zero. Volatility Granger causes return in Model 1. A causal relation from volume to volatility was not confirmed for the KOEI stock.

Table 10 Granger causality test results for the Podravka stock

PODR	Model 1		Model 2		Model 3		Model 4	
Number of lags	Chi-sq	6	Chi-sq	2	Chi-sq	2	Chi-sq	2
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.	STDEV90	Prob.
R→STDEV	60.30	0.0000	30.72	0.0000	22.00	0.0000	19.62	0.0001
TURN→STDEV	26.38	0.0002	15.82	0.0004	15.24	0.0005	3.5	0.1739
STDEV→R	31.43	0.0000	0.42	0.8102	2.41	0.2995	4.83	0.0894
TURN→R	5.06	0.5360	2.15	0.3413	1.50	0.4729	1.7	0.4268
STDEV→TURN	9.22	0.1616	6.76	0.0340	3.30	0.1920	3.58	0.1667
R→TURN	1.66	0.2641	0.26	0.8781	0.28	0.8711	0.27	0.8747

*All series are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -9.07 (0.0000), STDEV15 -5.64 (0.0000), STDEV30 -5.59 (0.0000), STDEV90 -3.30 (0.0152), R -47.38 (0.0001), TURN -9.82 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

Results for the PODR stock indicate that both return and traded volume cause volatility. Causality from return to volume is statistically significant in all four models, while causality from volume to volatility is significant in models 1, 2 and 3. Bidirectional causality between volatility and return is reported in Model 1, where volatility is calculated from past five returns. Bidirectional causality between volatility and volume is confirmed in Model 2, where volatility is calculated based on the past fifteen returns.

Table 11 Granger causality test results for the Valamar Riviera stock

RIVP	Model 1		Model 2		Model 3		Model 4	
Number of lags	Chi-sq	6	Chi-sq	1	Chi-sq	5	Chi-sq	5
Causality relation	STDEV5	Prob.	STDEV15	Prob.	STDEV30	Prob.	STDEV90	Prob.
R→STDEV	67.01	0.0000	19.89	0.0000	4.65	0.4654	2.72	0.7432
TURN→STDEV	80.55	0.0000	28.19	0.0000	18.90	0.0020	12.58	0.0277
STDEV→R	30.54	0.0000	0.23	0.6255	59.7	0.0000	89.56	0.0000
TURN→R	9.15	0.1652	0.00	0.9652	12.88	0.0245	11.56	0.0413
STDEV→TURN	12.82	0.0461	35.65	0.0000	20.21	0.0011	15.6	0.0081
R→TURN	6.16	0.4055	0.15	0.6995	5.02	0.4136	5.87	0.3090

*All series are stationary at level form. Augmented Dickey-Fuller test statistics with corresponding probabilities; STDEV5 -7.60 (0.0000), STDEV15 -5.03 (0.0000), STDEV30 -5.26 (0.0000), STDEV90 -3.09 (0.0273), R -15.03 (0.0000), TURN -11.73 (0.0000). No root lies outside the unit circle. VAR models satisfy the stability condition.

Source: Author´s calculations

According to results given in Table 11, it can be concluded that return causes volatility only in models 1 and 2. Volatility causes return in models 1, 3 and 4, while volume causes return in models 3 and 4. Volatility causes traded volume and volume causes volatility in all four models. The results confirm bidirectional causality between traded volume and volatility in all four models regardless of how volatility was calculated (STDEV5, STDEV15, STDEV30, and STDEV90).

5. Discussion

Table 12 shows a summary of the results for 10 observed stocks and four models applied. Models 1, 2 and 3 were calculated for all 10 stocks, while Model 4 was calculated only for those stocks where STDEV90 series proved to be stationary at level form, i.e., for 5 stocks altogether.

Table 12 Number of significant causal relations

Causality relation	Model 1	Model 2	Model 3	Model 4
R→STDEV	8	4	3	2
TURN→STDEV	9	8	8	4
STDEV→R	6	1	2	3
TURN→R	3	3	5	2
STDEV→TURN	2	4	5	3
R→TURN	0	1	1	0

Source: Author´s calculations

Assuming that every investor can rely on standard deviation as a measure of volatility, daily standard deviations were calculated from past, 5, 15, 30, and 90 daily returns. This approach additionally supported the results, while the results of all four models are confirmed by each other. This is evident in the case of causality from volume to volatility and causality from return to volume. In all three models and in the last fourth model, it is confirmed that volume causes volatility. Irrespective of the method used to calculate volatility, it is clear that volume causes volatility. Volume causes volatility (9 out of 10 stocks in Model 1) and this result is confirmed further in models 2 and 3 (8 out of 10 stocks) and model 4 (4 out of 5 stocks). These results were well documented when observing one stock at a time (Ananzeh et al., 2013; Baklaci & Kasman, 2006; Kiymaz & Girard, 2009; Dritsaki, 2014; Tudor, 2009; Le & Mehmed, 2009; Gursoy et al., 2008; Pisedtasalasai & Gunasekarage, 2007; and Le & Mehmed, 2009).

The results strongly confirm that return does not cause volume. Return does not cause traded volume (0 significant results in Model 1) and this conclusion is confirmed further in models 2 and 3 (1 significant result out of 10 stocks) and Model 4 (0 significant results out of 5 stocks). This conclusion is in line with Mestel et al. (2003), who observed stocks from the Austrian stock exchange.

The results indicate that return causes volatility (8 stocks) and volatility causes returns (6 stocks) only in Model 1, where standard deviation is calculated from previous 5 returns. The return-volatility relationship is proven to be bidirectional for five stocks when Model 1 was applied (standard deviation was calculated based on the past five returns). Return volatility causality appears less frequently in models 3 and 4. All VAR models for all 10 stocks require 4 lags in order to estimate Model 1. This roughly means that past 4 standard deviations cause return.

Although the obtained results are very clear, they are very difficult to interpret. It has been proven that traded volume causes volatility measured by standard deviation, independently of the length of series of stock returns used for the calculation of standard deviation. The results strongly support the conclusion that return has no impact on turnover. Turnover does not cause return; this causality appears in only few cases. It seems that turnover contains information valuable to investors, and this information is reflected in volatility. Turnover does not Granger cause returns, but it is confirmed that it has a significant impact on the average deviation of stock returns from expected return. A possible explanation is that past turnover data incorporate decisions of investors whether to buy or sell stock in certain quantities and somehow determine how far stock returns will move from expected return. It is possible that past turnover data control expected return rather than daily returns. However, this assumption is beyond the scope of this research and should be further examined. The impact of turnover on volatility is persistent and valid for standard deviations calculated from past 5, 15, 30, and 90 returns.

Return causes volatility and volatility causes return only within a very short period, and this bidirectional causality is confirmed only in Model 1. This causality is expected since standard deviation is calculated in this model from past 5 returns, therefore in this short period return causes volatility and volatility causes volume. Return volatility and volatility return causality becomes insignificant in the remaining models because past returns do not contain all valuable information to predict future volatility. Generally speaking, investors who observe past traded volumes are one step ahead compared to investors who observe only volatility. It remains to be investigated what trading volume incorporates, investor reactions to news, reactions to past trading activity or information from fundamental data. Further research should focus on possible traded volume-expected return causality.

These results open numerous questions as to whether return-volume-volatility relationships depend on the length of the observed time period, whether the selection/ calculation of volatility measure affects results, why standard deviation as a volatility measure fails to cause return and traded volume, and generally, whether volume could be more helpful in predicting future returns/volatility.

6. Conclusions

In this paper, empirical relationships between stock returns, return volatility and trading volume (the natural log of turnover) were examined for 10 stocks from Zagreb Stock Exchange. Research design relies on historical daily data on return, volatility and traded volume for the period from 2015 to 2021. Standard deviations were calculated from past 5, 15, 30, or 90 returns. Vector Autoregressive Models (VARs) were estimated for each stock individually. Based on estimated VAR models, Granger-causality tests were performed to estimate causality between trading volume, stock returns and volatility. The results strongly confirm unidirectional causality from traded volume to volatility regardless of the model applied for the calculation of a volatility measure (standard deviation from past 5, 15, 30, or 90 returns). Causality from volume to volatility was well documented in previous studies. Generally, results give strong evidence that trading volume contains valuable information not available from prices. Morgan (1976) suggested that volume is regarded as a major risk factor contributing to the volatility of returns, especially in less liquid and thin markets, including emerging markets.

The results also give clear and strong evidence that return does not Granger cause volume. Return does not cause traded volume (0 significant results in Model 1) and this finding is confirmed further in models 2 and 3 (1 significant result out of 10 stocks) and Model 4 (0 significant results out of 5 stocks). Returns appear to be significant relative to volatility only if volatility is calculated from past five returns (Model 1). According to Model 1, in 8/10 cases return Granger causes volatility and in 6/10 cases volatility Granger causes return. It can roughly be said that return-volatility causality is valid only when the observed period is no longer than 10 trading days. This is in line with Gurgul et al. (2005), who concluded that trading volume cannot improve short-run return forecasts and vice versa. Causality from volatility to return and causality from volatility to volume are valid only for half of the sample and should be further investigated. Further research should investigate return-volatility-volume relationships in the short and long term. All similar research studies should be cross-checked by applying different volatility measures. Conclusions relating to top 10 stocks should not be extended to the entire market due to the infrequent trading of ZSE stocks. The observed stocks had more than 200 daily observations in a year; however, one stock had only 190 daily observations in 2018 and 2019.

References

1. Ananzeh, I. E. N., Jdaitawi, Q. M. & Al-Jayousi, A. M. (2013). Relationship between market volatility and trading volume: Evidence from Amman stock exchange. *International Journal of Business and Social Science*, *4*(16), 188-198.
2. Asteriou, D. & Hall, S. G. (2007). *Applied Econometrics*. Palgrave Macmillan.
3. Baklaci, H. & Kasman, A. (2006). An empirical analysis of trading volume and return volatility relationship in the Turkish Stock Market. *Ege Academic Review*, *6*(2), 115-125.
4. Bohl, M. T. & Henke, H. (2003). Trading volume and stock market volatility: The Polish case. *International Review of Financial Analysis*, *12*(5), 513-525. https://doi.org/10.1016/S1057-5219(03)00066-8
5. Brüggemann, R., Glaser, M., Schaarschmidt, S. & Stankiewicz, S. (2014). *The Stock Return-Trading Volume Relationship in European Countries: Evidence from Asymmetric Impulse Responses* (Working Paper No. 2014-24). Konstanz: Department of Economics, University of Konstanz.
6. Chen, G. M., Firth, M. & Rui, O. M. (2001). The dynamic relation between stock returns, trading volume, and volatility. *Financial Review*, *36*(3), 153-174. https://doi.org/10.1111/j.1540-6288.2001.tb00024.x
7. Choi, K. H., Kang, S. H. & Yoon, S. M. (2013). Relationship between Stock Returns and Trading Volume: Domestic and Cross-Country. Evidence in Asian Stock Markets. In *Proceedings of the 2013 International Conference on Economics and Business Administration* (pp. 33-39).
8. De Medeiros, O. R. & Doornik, B. F. N. V. (2006). *The empirical relationship between stock returns, return volatility and trading volume in the Brazilian stock market*. Available at SSRN: https://ssrn.com/abstract=897340. https://doi.org/10.2139/ssrn.897340
9. Dritsaki, C. (2014). The Dynamic Relationship between Stock Volatility and Trading Volume from the Athens Stock Exchange. *International Journal of Empirical Finance*, *3*(3), 152-165.
10. Griffin, J. M., Nardari, F. & Stulz, R. M. (2007). Do investors trade more when stocks have performed well? Evidence from 46 countries. *The Review of Financial Studies*, *20*(3), 905-951. https://doi.org/10.1093/rfs/hhl019
11. Gujarati, D. N. & Sangeetha, N. (2007). *Basic Econometrics* (4th ed). McGraw-Hill.
12. Gündüz, L. & Hatemi-J, A. (2005). Stock price and volume relation in emerging markets. *Emerging Markets Finance and Trade*, *41*(1), 29-44. https://doi.org/10.1080/1540496X.2005.11052599
13. Gurgul, H., Majdosz, P. & Mestel, R. (2005). Joint dynamics of prices and trading volume on the Polish stock market. *Managing Global Transitions*, *3*(2), 139-156.
14. Gursoy, G., Yuksel, A. & Yuksel, A. (2008). Trading volume and stock market volatility: evidence from emerging stock markets. *Investment Management and Financial Innovations*, *5*(4), 200-210.
15. Hiemstra, C. & Jones, J. D. (1994). Testing for linear and nonlinear Granger causality in the stock price-volume relation. *The Journal of Finance*, *49*(5), 1639-1664. https://doi.org/10.1111/j.1540-6261.1994.tb04776.x
16. Iqbal, H. & Riaz, T. (2015). The empirical relationship between stocks returns, trading volume and volatility: evidence from stock market of United Kingdom. *Research Journal of Finance and Accounting*, *6*(13), 180-192.
17. Kiymaz, H. & Girard, E. (2009). Stock market volatility and trading volume: an emerging market experience. *IUP Journal of Applied Finance*, *15*(6), 5-32.
18. Kumar, M. & Thenmozhi, M. (2012). Causal effect of volume on stock returns and conditional volatility in developed and emerging market. *American Journal of Finance and Accounting*, *2*(4), 346-362. https://doi.org/10.1504/AJFA.2012.046876
19. Le, Q. T. & Mehmed, M. (2009). *The relationship between trading volume, stock index returns and volatility: Empirical evidence in Nordic countries*. [Master thesis, Lund University]. Lund: Lund University.

20. Ligocká, M. (2019). The empirical relationship between stock returns and trading volume: the case of Polish companies. *Acta academica*, *19*(2), 42-53. https://doi.org/10.25142/aak.2019.019

21. Lu, W. C. & Lin, F. J. (2010). An empirical study of volatility and trading volume dynamics using high-frequency data. *The International Journal of Business and Finance Research*, *4*(3), 93-101.

22. Mestel, R., Gurgul, H. & Majdosz, P. (2003). The empirical relationship between stock returns, return volatility and trading volume on the Austrian stock market. *University of Graz, Institute of Banking and Finance, Research Paper*, *4*(6), 231-244.

23. Miloudi, A., Bouattour, M. & Benkraiem, R. (2016). *Relationships between Trading Volume, Stock Returns and Volatility: Evidence from the French Stock Market*. No. hal-01363700.

24. Morgan, I. G. (1976). Stock prices and heteroscedasticity. *The Journal of Business*, *49*(4), 496-508. https://doi.org/10.1086/295881

25. Mubarik, F. & Javid, A. Y. (2009). Relationship between stock return, trading volume and volatility: Evidence from Pakistani stock market. *Asia Pacific Journal of Finance and Banking Research*, *3*(3).

26. OECD (2021), *OECD Capital Market Review of Croatia: Capital market reforms for recovery and improved business dynamics in Croatia*. *OECD Capital Market Series*. http://www.oecd.org/corporate/OECD-Capital-Market-Review-Croatia.htm

27. Pisedtasalasai, A. & Gunasekarage, A. (2007). Causal and dynamic relationships among stock returns, return volatility and trading volume: Evidence from emerging markets in South-East Asia. *Asia-Pacific Financial Markets*, *14*(4), 277-297. https://doi.org/10.1007/s10690-008-9063-3

28. Srinivasan, K., Devanadhen, K. & Deo, M. (2010). Price changes, trading volume and time-varying conditional volatility: Evidence from Asia Pacific stock market. *International Review of Applied Financial Issues and Economics*, *2*(2), 379.

29. Tudor, C. (2009). *Testing the Impact of Trading Volume on Market Return and Volatility: The Case of the Romanian Stock Market*. Available at SSRN: https://ssrn.com/abstract=1327687

30. Yonis, M. (2014). *Trading Volume and Stock Return: Empirical Evidence for Asian Tiger Economies* [Master thesis, Umeå University]. Umeå: Umeå University.

31. Zada, R. S. E. (2021). The Relationship between Trading Volume, Stock Returns and Volatility in the Saudi Stock Market. *Qalaai Zanist Journal*, *6*(3), 790-822. https://doi.org/10.25212/lfu.qzj.6.3.27

32. Zolotoy, L. & Melenberg, B. (2007). *Trading Volume, Volatility and Return Dynamics: Individual and Cross-Market Analysis*. Available at SSRN: https://ssrn.com/abstract=1032193. https://doi.org/10.2139/ssrn.1032193

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EXPLORING RETURN INTENTIONS FROM THE YOUNG MIGRANT'S POINT OF VIEW

Abstract

Purpose: This paper investigates migration behaviors of young migrants to identify the main factors influencing their return intentions. Recognizing that return migration decision-making is a complex and multidimensional process, the paper sheds light on two under-researched topics in migration literature: return migration intentions and young migrants.

Methodology: Using a mixed theory approach that accounts for both individual and contextual factors as determinants of possible return, the paper utilizes data obtained through surveys of Croatian migrants. It proposes an ordered logit regression model based on three composite variables—economic success, social integration, and cultural shock—to calculate the return intention probability.

Results: The results show that the variables of economic success, social integration, and cultural shock, which were determined through factor analysis, play a significant role in shaping return migration intentions. In particular, the perceived level of social integration has the most significant influence on the likelihood of intention to return, indicating that young migrants are not solely or predominantly motivated by economic factors.

Conclusion: The findings suggest that the factors influencing migrants' return intentions overlap, and as a result, no single theory is adequate for providing a comprehensive understanding of young migrants' return intentions. For the majority of Croatian migrants, it seems that the *myth of return* does not exist; they do not plan to return. These findings constitute a valuable foundation for developing migration policy recommendations for both the host and home countries.

Keywords: Return intentions, international migration, youth, myth of return, Croatia

1. *Introduction*

International migration as a global phenomenon has stimulated the scientific debate on academic scholars across various branches of social sciences (anthropology, sociology, economics, demography, law, and political sciences), yet return migration has proved to be a research topic less investigated but equally challenging (de Haas & Fokkema, 2011;

Piotrowski & Tong, 2013; Tezcan, 2019; Bensassi & Jabbour, 2022). In recent years, interest in return migration has been increasing, displaying the multifaceted character of return migration (Bilecen, 2022). Furthermore, return and reintegration represent significantly different processes from immigration and integration in the receiving countries, mostly because the sending states are in the position of geopolitical marginality (Vathi et al., 2023). Return migration of ex-communist or socialist countries in Central and Eastern Europe (CEE), particularly in recent times, has not received scholarly attention it deserves (Roth, 2018).

While much of the theoretical and empirical migration literature sees migrations as permanent, one cannot omit the fact that many migrants move temporarily (e.g., Dustmann & Görlach, 2016; Bossavie et al., 2021) or with the intention to return to their home country. The *myth of return* has been present for a long time in migration literature (e.g., Dahya 1973; Anwar 1979; Mansour, 2020; Cakmak, 2021), and it refers to the idea of returning to the home country, not necessarily doing that. Namely, the myth of return embodies various processes (social, psychological, political, and cultural) through which migrants uphold the idea of return even if real-life circumstances suggest otherwise. According to Carling (2015), this myth cannot be considered only as an individual expectation of future events; it is based on collective ideas with a normative aspect.

In addition, the definition of return migration is not clear-cut, primarily due to the ambiguity of the term "return" itself. This definition can vary depending on a number of factors, including the duration of migration, the nationality of migrants, the intention to return (permanent or temporary), and whether it is voluntary or forced, as in cases of deportation or coercion (Kuschminder, 2022). Furthermore, return migration can be distinguished based on factors such as migrant motives, expectations, needs, etc. Schiele (2021), for instance, examined how life satisfaction affected migrant returns to Germany. According to the study, cross-country disparities in return intentions can be explained by the anticipated cross-country variations in the gains or losses in life satisfaction experienced by returning migrants. Weber and Saarela (2023) investigated how income and family formation trajectories varied across the analyzed motives and how these influenced the risks of return migration. They emphasized that return migration risks are influenced by both the initial migratory purpose and the trajectory at the destination. Thus, this heterogeneity of migrants is making the scientific debate on migration challenging since it opens up possibilities for various theoretical considerations and methodological issues. This paper refers to return migration simply as the relocation of migrants to their home country.

Return migration to CEE countries is particularly interesting, given significant geographical mobility experienced in this region, including the phenomenon of individuals returning to their home countries (Martin & Radu, 2012). The process of return migration from these new European Union (EU) member states is often scrutinized through an economic lens, with the return home predominantly analyzed using economic parameters (Koštialová & Hofreiter, 2018). These returnees are frequently viewed as catalysts for development due to their investments in saved capital and the transfer of human capital. Despite sharing a common history of political regimes and the experience of transitioning to market economies that started in the 1990s, the entire CEE region exhibits diversity in economic, social, and institutional aspects (King & Kuschminder, 2022).

Existing studies on return migrants in CEE countries reflect various issues such as return migration and employment mobility between pre-migration and after return (Jephcote et al., 2023), emergence of returnee entrepreneurship (Gittins et al., 2015; Anghel et al., 2017), income premia for work experience abroad, occupational choices and selectivity patterns (Martin & Radu, 2012). However, return migration is not only an economic phenomenon but it also contributes to social innovations. A Slovak study (Koštialová & Hofreiter, 2018) observed how young migrants become actors of change and thus modify life in their immediate circle, community and even society. They emphasize that as relevant as economic topics are social remittances and cultural innovation that are realized through the transfer of experiences, knowledge, skills and norms, which young returning migrants bring from the host countries (Koštialová & Hofreiter, 2018). This illustrates the importance and relevance of research on return migration.

This paper aims to explore migration behaviors of young migrants in order to identify the main factors that influence their intentions to return home, taking into account that the decision-making process related to return migration is complex and

multidimensional. It employs the ordered logit regression method to examine the data obtained by surveying 1,043 Croatian migrants. This is because the responses of the dependent variable, return intentions of young migrants, have a natural ordering. The ordered logit method has already been used in migration literature (e.g., Guo, 2016; Tabuga, 2018), particularly to analyze migration behavior and decision-making.

This paper contributes to migration literature in several ways. It focuses on *return migration intentions* and *young migrants*, both issues underresearched in migration literature, yet on the rise when it comes to academic and broader policy concerns. Although research on return migration intentions has a long history dating back to the 1960s, the focus has been primarily on the migration-development nexus (Faist, 2008; Geiger & Steinbrink, 2012), as well as on adult migrants. Young migrants are still a less researched topic in migration studies, as are (their) return intentions (Darren et al., 2014; de Haas et al., 2015). By using the mixed theory approach, this paper focuses on return intentions of younger people, considering individual and contextual factors as determinants of possible return. By detecting these determinants, one can create better policy measures not only to encourage people to return, but also to encourage them to stay in their home country.

The remainder of the paper is organized as follows. The next section delineates the theoretical background and gives a brief review of the literature in this field. Section 3 describes the data and method used in the analysis and provides background information about return intentions of young migrants. Section 4 presents and discusses the main findings obtained by the econometric analysis, while Section 5 concludes with policy recommendations and suggestions for further research.

2. Theoretical background with a literature review

2.1 Multifaceted nature of return migration motives

There is no universal migration theory that can capture the complexity of migration (de Haas, 2014). Several authors provide a comprehensive overview of various migration theories explaining different degrees of explanatory power offered by each theory and methodological approach (e.g., Massey et al., 1993; Hagen-Zanker, 2008; de Haas, 2014). The micro and macro migration theories used to investigate initial migration decisions can be used as theoretical underpinnings for return migration research. Theories are not mutually exclusive. On the contrary, they are often complementary to each other, proving that the decision to migrate or return is often influenced by many factors that are socioeconomic in nature.

Different theories are used to assess or explain various facets of the international migration phenomenon (Massey et al., 1993). For example, according to neoclassical theory, people migrate to different countries because of wage differences, i.e., migrants expect higher earnings in host countries (Todaro, 1969). The new economics of labor migration considers the decision to migrate a household decision, whereby migrants hope to generate higher incomes and accumulate savings, while at the same time they tend to remit part of their income to the household in their home country (Stark & Bloom, 1985). A structural approach suggests that utility-maximizing individuals make decisions taking into account the broader institutional, social and market context. Thus, the social network of migrants plays a significant role in decision-making according to social capital theory (Bourdieu, 1986), and global trends significantly impact incentives to migrate, as suggested by a transnational approach (Pries, 2004). Cumulative causation theory suggests that individual decisions to migrate can, over time and through social networks, encourage others to migrate, resulting in circular and cumulative causation (Myrdal, 1957). Thus, no single theory is self-sufficient. The same holds for return migration research as return itself is influenced by the initial motivation for migration, the duration of the stay abroad and the conditions under which the return takes place, not only in the host country but in the home country as well (Cassarino, 2004, according to Ghosh, 2000).

Return migrants can be differentiated in terms of their motives to return, as well as their responses to situations in the host and home countries related to economic, social, political and institutional conditions (e.g., a new government, the end of war, a desire to raise children in the country of origin). For example, Battistella (2018) identified four major types of return: (*i*) return of achievement, which happens when the original goal of migration is met; (*ii*) return of completion, which occurs when the contract is done even though the migrant would

rather stay, but it is not an option; (*iii*) return of setback, which is caused by a migrant's desire to end the migration process due to personal reasons, dissatisfaction with work and the like, and (*iv*) return of crisis, when a migrant returns due to political or security reasons in the home or host country, or it can be forced return.

The pull-push theory (Lee, 1966) identified several factors that explain the direction and extent of migration, including objective and subjective factors such as status perception, satisfaction with one's own life and aspirations. Push factors are those that motivate individuals to voluntarily or by force leave their home country (war, natural disasters, bad economic conditions, unemployment, etc.). Pull factors are those that attract migrants to move to the host country. They include better employment opportunities, better quality of life, having a family or friends in a certain country, a better social or health system, a better political situation, and the like. This theory is interesting in the sense that it can also be applied to return migration.

That said, we build our research on return migration using neoclassical theory, the new economics of labor migration, and a structural approach that encompasses a social network and transnational approach. These theories respond to the complexity of return migration by relating return migration as an individual decision to earn a higher income elsewhere (a neoclassical theory approach), which is often made on behalf of and for the whole family (the new economics of labor), taking into account economic, social, political and other contexts (a structural approach). Each selected approach addresses one facet of migration returns. The neoclassical approach sees migration as a permanent move to the host country and return as a failure to do so, because the migrant has failed in his or her attempt to take advantage of higher earnings. When it comes to the new economics of labor, migration to the host country is of a temporary nature and return is understood as a success story in the host country, where the migrant has met his or her original goals of higher income, savings and remittances to the household. Finally, in terms of the structural approach, return is considered to be a question of context and it is evaluated as a success or a failure depending on the reality of the home economy and society (Cassarino, 2004).

The issue of young migrants and their intentions to return is particularly interesting. Young migrants comprise over 10 percent of the 232 million international migrants and represent the most mobile social group (International Labor Organization, 2023). Young people's decision to migrate corresponds to the prevailing migration theory, according to which it is a response to better labor opportunities, educational attainment, or it may be part of a broader household strategy for risk diversification (Heckert, 2015). Hall (2021) also suggests that the reasons why young people migrate are related to either high unemployment or underemployment, labor market flexibility, various governance failures, gender inequality, etc. It is equally challenging to investigate return migration of young people in general, i.e., their return intentions, since they are determined by ties to the host and home country at the same time (Carling & Pettersen, 2014). A further challenge arises from the disparity between the intention to return and actual return, which makes the research more complex, but still valuable from a public policy perspective (Waldorf, 1995). Cassarino (2013) uses the notion of returnee's preparedness, which does not refer only to the willingness of migrants to return, but also to their readiness to return. This is a voluntary act of the migrant that requires time and willingness to mobilize tangible and intangible resources and social capital, as well as to collect information on circumstances and conditions in their home country in order to actually return. Resource mobilization and the returnee's preparedness can be used to explain why some returnees become actors of development while others do not (Cassarino, 2013).

Hall (2021) outlines three issues hindering research on youth migration and development. Firstly, insufficient age-disaggregated data restricts a comprehensive insight into youth migration patterns. Secondly, dataset biases toward certain regions hinder a global understanding of youth migration dynamics. Thirdly, limited data on distinctions between general international and internal/irregular migration, such as those absorbed into the informal economy, hinder understanding of their impact on development and government efforts to optimize their contributions.

The research on young Croatian migrants and their intentions to return presented in this paper expands the empirical resources on return migration in the CEE countries and reveals some of the pull factors that need to be taken into consideration when creating migration policies.

2.2 Return migration in the Republic of Croatia

The Republic of Croatia has been dealing with a significant emigration problem for a long time, with a constant population outflow outpacing the inflow. Migration statistics show that this situation is ongoing, with long-term negative net migration. According to the migration pattern, 63.5% of emigrants were men, and people aged 20 to 39 made up the largest age group (45.9%) (Croatian Bureau of Statistics, 2022). Working on a proactive immigration policy would be of great national importance, given the economic and demographic repercussions of these numbers.

The Republic of Croatia has grappled with a persistent emigration challenge, marked by a continuous outflow of population that exceeds incoming individuals. Migration data underscore the endurance of this situation, with a constant negative trend of net migration from foreign nations. In 2021, for instance, 64.2 percent of Croatian citizens chose to emigrate abroad, while 29.6 percent relocated to the Republic of Croatia. According to migration patterns, 63.5 percent of emigrants were male, and individuals aged 20 to 39 constituted the largest age demographic with 45.9 percent (Croatian Bureau of Statistics, 2022). In the light of these statistics, the formulation of a proactive immigration policy takes on significant national importance due to the economic and demographic implications associated with these figures.

Return migration in general and youth migration and its impact on development in particular are rather under-researched, even though Croatia is recording an increase in emigration with all the negative social and economic consequences. To the best of our knowledge, return migration of Croatian (young) emigrants has not been systematically analyzed. More attention has been paid to emigration flows. Thus, the expansion of the theoretical and empirical knowledge on return migration of Croatian emigrants would serve as a qualitative input in the effective design of migration policy.

Earlier studies on emigration trends include analysis conducted by e.g. Vidović and Mara (2015), Župarić-Iljić (2016), Jurić (2017) and Draženović et al. (2018), each contributing to the discussion of emigration outflows in Croatia. These authors drew attention to an important issue of Croatian migration research – inaccurate migration statistics and methodological problems. According to Vidović and Mara (2015), there were no reliable migration data since the number of emigrants depends on the self-reporting of emigrants to the Ministry of Interior. The same applies to immigrants. Župarić-Iljić (2016) also warned of the methodological problems that indicate the need to compare the number of emigrants to the number of immigrants at the final destination. The same difficulties with methodology and data collection are still present.

There are several studies on migration motivation in Croatia. Rajković Iveta and Horvatin (2017) identified economic motives as the most important but not the only factors – in their study, they emphasize psychological reasons caused by nepotism and corruption. Jurić (2017) investigated the more recent emigration of Croats to Germany and found out that the main motive for leaving is the assumption that work ethics and honesty as values are not institutionalized in Croatia, which jeopardizes the morality of Croatian society. Becic et al. (2019) explored the role of labor market indicators in migration movements and confirmed that differences in wages, as well as precarious employment, influence international movements, supporting both traditional and recent economic migration theories. A recent study on migration motivation of young people in Croatia (Perić Pavišić et al., 2022) shows that migration motivation of Croatian youth is a combination of push and pull factors, whereby pull factors are perceived as stronger motivation than push factors. Among push factors, respondents identified a generally bad situation in their home country (a social situation, a low standard of living, insecurity, lack of perspective, uncertainty). The most important pull factors identified were better economic conditions and quality of life in the host country. This was also confirmed in another study on Croatian migrations (Kozić et al., 2020). A study carried out by Vukić et al. (2023) showed that young Croatians see the possibility to migrate to EU countries as a type of internal migration, and they make decisions based on information about the situation in Croatia and the potential host country. Most respondents in the study expressed their intention not to stay abroad permanently. Although these are migration-motivating factors, their identification is necessary for the analysis of return intentions, since their elimination might have a positive impact thereon.

The issue of return migration is related to the efforts of governments to attract back the population

that emigrated. This requires national strategies and policies aiming to promote returning migrants to remit funds, bring back their knowledge and skills obtained abroad, enable them to have certain rights such as dual citizenship, and the like (Lang, 2013). In the case of Croatia, the importance of emigration and the process of joining the EU have had an impact on the development of national migration policies. The first formal policy document on migration was adopted in 2007, in the midst of the EU accession process followed by the development of the legal and institutional framework necessary to regulate migrations (Knezović & Grošinić, 2017).

More recent government actions aimed at return migration are envisaged in different acts, strategic documents and programs focused on returnees. For example, the Central State Office for Croats Abroad is defined by the Act on Relations of the Republic of Croatia with Croats Abroad (Official Gazette, *124/11*, *16/12*) and aims at conducting various activities to help create conditions for return migration to Croatia, propose policies that inspire and assist return and the integration of returnees. The Government introduced the scheme titled *I choose Croatia* ("Biram Hrvatsku") aimed at motivating emigrants to return with incentives to start a business and to encourage demographic revival in the parts that suffered significant migration outflows (Croatian Employment Service, 2023). Furthermore, the *Central State Office* for Demography and Youth has created the *National Youth Program 2023-2025*, approved by the Government of the Republic of Croatia (2023), which includes strategic goals such as the necessity to create conditions for youth not to emigrate, as well as to encourage return and integration of those who left. The implementation and capacities of these institutional efforts have yielded some results (Petrić, 2023), yet the net migration remains negative (according to the Croatian Bureau of Statistics (2022), the highest and the lowest net migration were recorded in 2017 with -31,799 and in 2020 with -632, respectively), indicating that programs and policies still lack significant effectiveness.

Research on Croatian emigrants and their reasons for considering return may help policymakers identify relevant pull factors. This information can serve as a foundation for evaluating and potentially modifying existing migration policies, along with developmental strategies.

3. Data, descriptive statistics and method

The present study utilized data obtained through an online structured questionnaire survey conducted in 2018. The survey gathered responses from 1,043 participants, aged between 18 and 35, who had already emigrated from Croatia and were active users of one or more social network sites dedicated to Croatian emigrants, such as "Croats in Ireland" or "Croats in Germany". An online questionnaire was made accessible through these networks, allowing any eligible emigrant to voluntarily participate. Moreover, the collected data were anonymized to ensure confidentiality and privacy.

Table 1 presents the socio-demographic characteristics of the sample. The data show that a significant proportion of respondents were female, accounting for 64.02% of the sample. Most participants emigrated alone, belonged to the age group of 25 to 31 years, and were married (42.84%). The educational background of the majority of respondents included completed four years of secondary school education. Although a considerable number of participants were employed, they were primarily working outside of their professional fields (48.54%). Most of the respondents resided in Germany, Austria, or Switzerland, followed by Great Britain, Ireland, Sweden, Norway, Finland, and Denmark, and the smallest number of respondents resided in the Mediterranean (Greece, Spain, and Portugal).

We cannot confirm with certainty whether this sample represents the broader population of Croatian emigrants because the exact socio-demographic profile of Croatian emigrants is mostly unknown. However, for the purpose of comparison, the Croatian Bureau of Statistics (2019) data indicate that there were 35,515 Croatian inhabitants who emigrated in the year of our survey (2018). Most of them were men, accounting for 55.06% of the emigrants. The statistics also indicate that the most numerous age group was between 20 and 39 years. Similar patterns in emigration statistics can be observed in subsequent years. Furthermore, our sample size significantly exceeds the recommended guideline of 10:1, as suggested in the literature (Hair et al., 2014). Consequently, despite the uncertainty surrounding the socio-demographic profile, the findings derived from this ample sample offer valuable insights into migration trends within the Croatian emigration population.

Table 1 Descriptive statistics

Variable		Obs	Mean	Frequencies
Demographic	Return intention	1,030	1.577	No: 55.73%; maybe: 30.87%; yes: 13.40%
	Gender	1,034	0.360	Male: 35.98%; Female: 64.02%
	Marital status	1,034	2.149	Single: 27.25%; in a relationship: 29.21%; married: 42.84%
	Age	1,030	2.107	18-24: 20.68%; 25-31: 47.96%; 32-35: 31.36%
	Educational level	1,035	4.397	Primary school and lower: 1.16%; 3-year secondary school: 17.00%; 4-year secondary school: 36.71%; University: 31.01% Master's degree, PhD: 4.11%;
	Working status in the host country	1,030	3.101	Unemployed: 9.51%; Student: 6.41% Employed outside of profession: 48.54%; Employed in the profession: 35.53%
	Migration way	1,030	1.842	Alone: 41.94%; Coupled: 31.94%; With the family: 26.12%
	Migration year	1,037	0.650	Before 2017: 65%; After 2017: 35%
	Destination preference	1,027	1.621	Continental: 57.74%; Anglo: 27.07%; Nordic: 10.52%; Mediterranean: 4.67%
				VIF
Situation-driven	Economic success	1,016	4.123	1.25
	Social integration	985	3.066	1.47
	Cultural shock	986	2.818	1.46
	Crime perception	972	2.870	1.10

Source: Authors' own research

As descriptive statistics show, the majority of young Croatian emigrants do not intend to return to their home country – only 13.4% do. Interestingly, another study (Perić Pavišić et al., 2022) shows quite equivalent results: only 23.4% of respondents claim they intend to return to their home country, while almost one third (30.2%) do not. Moreover, the same study emphasizes the importance of social identity, i.e., belonging to a certain social group, which can be related to social integration in our study as a significant predictor of young people's intention to return. A Polish study (Eade et al., 2007) also confirmed that young people's plans to stay or return were often open-ended, with some pursuing a strategy of 'intentional unpredictability', while others always meant to return.

The dependent variable in this study is return intentions of young Croatian migrants. It was measured by asking the respondents if they plan to return to Croatia, with the following three response categories: no, maybe – I have not decided yet, yes. In line with Snel et al. (2015), we treated the latter category as a meaningful category under the assumption that migrants, who do not know how long they will stay in the host country, make "intentional unpredictability", which is, as stated by Snel et al. (2015), typical of post-accession migrants from CEE countries. Values from 1 to 3 were associated respectively to these three ranked levels of migration intentions, whereby the baseline category, or "reference case", is given to the variable when it takes the level 1.

Drawing on the theoretical and empirical literature on general migration, youth migration and return migration briefly reviewed in the previous section, the paper assumes that return migration decision-making is a multifaceted and multidimensional process. It is predominantly the process in which a migration unit (an individual or a household),

guided by a strategic plan and goals, makes decisions determined not only by its demographic characteristics and transnational experience, but also by the perception of economic, social and institutional factors in the home and host countries. Since it cannot be explained by relying on a theory that puts into focus a single variable or a factor composed of one-dimensional variables, we have used a mixed theory approach. Accordingly, we constructed three composite variables – economic success, social integration, and cultural shock, which became independent variables. The former is in line with neoclassical economics and the new economics of labor migration, while the second two variables, social integration and cultural shock, draw from the social network and transnational approach, respectively. These variables were created to get a clearer picture of return intentions, and at the same time, avoid multicollinearity issues. Considering the variance inflation factors (VIF), this is successfully done and hence multicollinearity is not an issue (the highest VIF does not exceed 2, as shown in Table 1). Factor analysis enabled us to reveal the composition of each index. Among a set of twelve items on return migration intentions stated in the questionnaire, using the principal component factor method and the Kaiser off criterion, factor analysis extracted three factors that explain 58.51% of variance. Economic success was measured by satisfaction with the standard of living in the host country, satisfaction with income and employment compliance with qualifications. Social integration was measured by social life opportunities, evaluation of established social relations, the feeling of stress and the perception of work overload. Cultural shock included the feeling of nostalgia and loneliness, the perception of host country as a "new homeland" and the perception of emigration as a bad decision.

The calculated values of Cronbach's alphas (0.6910, 0.7886, 0.7349, respectively) suggest that each of them has been internally consistent, indicating that they are suitable for further analytic procedures. Hence, their factor scores are calculated as a weighted sum of the selected items, whereby the rotated factor loadings (via varimax orthogonal rotation) were used as weights. Finally, the variables are rescaled to the values 1-5 to correspond to other variables, particularly to the crime perception (defined as a feeling of walking safe alone in the dark, walking alone during the day and being home alone at night) variable, which represents our last variable subset. This variable addresses the question of security and trust in the policy and legal system and it generally reflects the perception of institutional quality. A common name for the economic success, cultural shock, social integration and crime perception variables, which is used in this paper, is the situation-driven variables.

The higher the values of the economic success or crime perception variables, the more the respondents are satisfied with their own economic success, they consider their life in the host country less safe than in their home country, and consequently have less trust in institutions in the host country. Likewise, the higher the value of the cultural shock or social integration variables, the more the respondents experience cultural shock and feel less integrated in the host country.

As for the situation-driven variables, respondents are mostly satisfied with economic success achieved in the host countries. The highest average grade of 4.12 supports that finding. In addition, the average grade of cultural shock (2.82) suggests they have not perceived the socio-economic situation in the host country as a shock. Transnational practices such as travelling or communication facilitated by modern technology is the reason for such perception as well as the migration tradition and the numerous Croatian migrant communities established in the host countries. Furthermore, considering the average grade given for the social integration variable (3.07), they feel neither socially integrated nor disintegrated in the host country. Moreover, the average value of the crime perception variable (2.87) indicates that the respondents feel relatively safe in the host country, and hence, have more trust in the institutions in the host countries than in Croatia. Wilcoxon signed-rank z test statistics support these findings; they indicate that all situation-driven variables are significantly different from the neutral stance ("neither agree nor disagree") except the social integration variable (for economic success: $z = 25.842$, $p = 0.000$: for social integration $z = 1.133$, $p = 0.257$; for cultural shock $z = -7.362$, $p = 0.000$; for crime perception $z = -3.512$, $p = 0.000$). Further analysis performed by an ordered logit regression method needs to reveal the impact of explanatory variables on return intentions of young migrants.

An ordered logit regression model was used as a tool to model the factors that affect the outcomes of return migration intentions. This allows us to predict the dependent categorical variable, migra-

tion intentions, which is measured at a three-level ordinal scale, as previously explained. We possess four independent explanatory variables: crime perception, economic success, social integration, and cultural shock. These variables were assessed on a scale ranging from 1 to 5. A rating of 1 signifies a very high perceived crime level and cultural shock, as well as very low levels of economic success and social integration. A rating of 3 denotes a neutral response, while a rating of 5 indicates a very low perceived crime level and cultural shock, as well as a very highly perceived achieved economic success and social integration. A detailed description of an ordered logit regression model can be found in Fullerton and Xu (2016).

The Brant, Wolfe Gould and likelihood ratio tests, which provide chi-square statistics, may be used to test if the proportional odds assumption holds. The underlying null hypothesis is that the relationship is proportional, i.e. parallel. If the assumption, i.e. the null, is violated, parameter estimation will be inconsistent (Eluru & Yasmin, 2015). In that case, the generalized ordered logit/partial proportional odds model may be used as a superior alternative, as suggested by Williams (2016).

4. Results with discussion

Based upon logit regression, we present a model in the form of log odds. It provides the results of the proportional odds logit model (POM) with the situation-driven variables only (see Table 2).

Table 2 Logistic model results

	Estimated Coefficient	Robust Standard Error
Crime perception	-0.021	0.060
Social integration	1.401*	0.111
Economic success	-0.273**	0.117
Cultural shock	0.162***	0.096
Obs.	964	
Log pseudolikelihood	-759.8365	
Wald chi2(4)	278.47 (p < .000)	
Pseudo R^2	0.175	
Brant test	3.95 (p = 0.413; df = 4)	
Wolfe Gould	4.022 (p = 0.403, df = 4)	
Likelihood ratio	4.035 (p = 0.401; df = 4)	

Note: Return intentions is the dependent variable. The user-written command "oparallel" was used to test the odds assumption in STATA 16.0. *, ** and *** denote significance at the 1%, 5% and 10% levels.

Source: Authors' own research

The Wald chi-square of 278.47 with a p-value of .000 indicates that the model is statistically significant, compared to the null model with no predictors. Likewise, the values of McFadden's pseudo R-squared suggest the model fits the data in a satisfactory way. In addition, the Brant, Wolfe Gould and likelihood ratio tests confirm that the proportional odds assumption is not violated.

In the estimated model, the statistically significant and positive coefficients of the social integration and cultural shock variables show that migrants who feel they are less socially integrated in the host country or have less transnational experiences and hence consider that it is harder to live and work in the host country than in Croatia, are 4.06 and 1.18 times more likely to express return intentions, respectively, while other variables in the model are held constant. The statistically significant and negative coefficient of the economic success variable shows that the respondents who perceive that they have achieved economic success in the host country are 0.76 times more likely to express the intention

to stay there, ceteris paribus. In addition, those who perceive it is safer in Croatia than in the host country are 0.98 times more likely to express their intention to return, while all other variables are constant.

The results show that the reasons shaping return migration intentions are overlapping; they are obviously multifaceted and multi-determined. A significant effect of economic success supports neoclassical migration theory which hypothesizes that failure to achieve economic success, i.e. expected earnings in the host country, provides an important motive to return.

The same was found in a study on Turkish emigrants to Germany - their return or return intentions are hypothesized to be mainly the result of their economic failure (Bettin et al., 2018). At the same time, transnational experiences and the density of social network matter, as hypothesized by the corresponding theories. A study conducted in Thailand (Tong & Piotrowski, 2010) emphasizes existing family and other social ties in the home country as a significant predictor of return intentions. The above-mentioned Turkish study (Bettin et al., 2018) found that several life events do have an important role in shaping intentions to return. Entering the empty-nest stage, becoming unemployed, and becoming employed in the host country increases the likelihood of return intention, while partnership dissolution and childbirth act as a deterrent.

In a nutshell, the results show that the social integration variable has the largest impact on the probability of a migrant expressing return intention. Tabuga (2018) also claimed that migrant networks are significant during the later stages of migration planning rather than in the initial phase. From the host country's point of view, this is valuable information. A country must ensure their full social integration if it wants to attract young people. From the home country's perspective, the valuable information is associated with the results with regard to the perception of institutional quality and economic success. To keep young talents at home, it should create a positive, optimistic, favorable business environment, full of opportunities, as well as stable, effective and efficient institutions. The role of the government is important, which is in line with proposal of the new economics of labor.

Our results, emphasizing the importance of social integration and cultural shock and adding to Borozan and Barković Bojanić's (2012) findings, also suggest that Croatian young people are not exclusively and predominantly economic migrants, and emigration will not stop even if expected earnings are equalized internationally. It seems that Croatian young migrants are looking for better opportunities in all spheres of life.

5. Conclusion

Return migration has received less attention in the migration literature even though it is equally challenging for both academia and policy makers. However, a review of the existing literature reveals that sustainable return migration represents a complex issue that is particularly important when viewed in the light of the return migration-development nexus due to potential returnees in terms of financial and human capital.

This paper is focused on the return intentions of young people, who are of both economic and demographic importance to the host and home countries. Thus, from the policy perspective, understanding return intentions of young people serves as a valuable input for public policy makers in terms of keeping them as citizens and labor force. Our research offers new empirical evidence for Croatian emigrants as potential returnees, who share many socioeconomic similarities with expatriates from other CEE countries and for whom research on return motives is scarce, in order to better understand return motives, intentions, and readiness to return. Given that the outcome categories of return migration intentions are ordered in terms of the intensity of intentions, the ordered logistic regression method was chosen for the analysis. It took the natural ordering of responses into account to examine the effect of situation-driven variables on return intentions of Croatian young migrants.

The research results have once again proved that no single theory can explain the complexity of migration and that often contrasting theories have a better explanatory effect. Our empirical research was built upon a mixed theory approach, which proved theoretically and empirically that economic determinants play an important role in return intentions, yet non-economic factors are gaining momentum in this decision process. Namely, factors such as social acceptance, integration and intensity of cultural shock in the host country are highly "valued" in terms of intentions to stay, as well as social ties

to the home country, the perception of safety in the host and home country and age.

Our findings reveal that return intentions of young migrants remain open to further empirical research. There are several suggestions for further research. A decision to return is as complex as the decision to migrate, thus many factors are included in the decision-making process. To capture this complexity, a more holistic approach is needed when investigating potential returnees and their reintegration into the economy and society in the home country. In addition to the economic perspective, it would be valuable to include a sociological and psychological approach since return encompasses challenges of a social and psychological nature. Returnee adaptation to the political, social, and cultural environments after gaining international migration experience should be the focus of the sociological perspective. The psychological perspective should consider the changes in returnee's own life in terms of work ethics, attitudes, beliefs and behavior in general. Collecting data on Croatian emigrants should be enhanced with particular emphasis on their socio-economic and demographic profiling in order to capture emigrants as a diverse group of people. Furthermore, it would be beneficial to investigate potential transnational relationships and networks they develop, both formal and informal back home. Research should focus on good practices abroad and the measures used to assist voluntary return.

By contrasting theoretical perspectives and expanding empirical research using various methodological approaches to migration, particularly examining economic and non-economic factors that impact migration decision-making, we can deepen our understanding of return intentions and be a step closer to comprehending the complexity of the entire migration process, which is in turn beneficial to policy interventions in both home and host countries.

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References

1. Act on Relations of the Republic of Croatia with Croats Abroad (*Official Gazette of the Republic of Croatia 124/11*, *16/12*).
2. Anghel, R., Botezat, A., Coșciug, A., Manafi, I. & Roman, M. (2017). *International migration, return migration, and their effects: A comprehensive review on the Romanian case* (CELSI Discussion Paper No. 43). Bratislava: Central European Labor Studies Institute (CELSI). https://doi.org/10.2139/ssrn.2895293
3. Anwar, M. (1979). *The Myth of Return: Pakistanis in Britain.* Heinemann.
4. Battistella, G. (2018). *Return migration: A conceptual and policy framework*. Center for Migration Studies. https://cmsny.org/publications/2018smsc-smc-return-migration/7. https://doi.org/10.14240/cmsesy030818
5. Becic, M., Sosic, M. M. & Jasprica, D. (2019). The role of precarious employment in emigration flows from Croatia. *Montenegrin Journal of Economics*, *15*(4), 173-182. https://doi.org/10.14254/1800-5845/2019.15-4.13
6. Bensassi, S. & Jabbour, L. (2022). Beyond experience and capital. Is there a return to return migration? *The Journal of Development Studies*, *58*(4), 730-751. https://doi.org/10.1080/00220388.2021.1988076
7. Bilecen, T. (2022). To Stay or to Return? A Review on Return Migration Literature. *Migration Letters*, *19*(4), 367-385. https://doi.org/10.33182/ml.v19i4.2092
8. Bettin, G., Cela, E. & Fokkema, T. (2018). Return intentions over the life course: Evidence on the effects of life events from a longitudinal sample of first- and second-generation Turkish migrants in Germany. *Demographic Research*, *39*, 1009-1038. https://doi.org/10.4054/DemRes.2018.39.38
9. Borozan, D. & Barkovic Bojanic, I. (2015). Migration motives of university students: An empirical research. *International Migration*, *53*(1), 66-82. https://doi.org/10.1111/imig.12016
10. Bossavie, L., Gorlach, J. S., Ozden, C. & Wang, H. (2021). *Temporary migration for long-term investment (*Policy Research Working Paper No. 9740). Washington, DC: World Bank. https://doi.org/10.1596/1813-9450-9740
11. Bourdieu, P. (1986). The Forms of Capital. In Richardson, J. G. (Ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241-258). Greenwood Press.
12. Cakmak, M. (2021). Take me back to my homeland dead or alive! The myth of return among London's Turkish-speaking community. *Frontiers in Sociology*, *6*, 630558. https://doi.org/10.3389/fsoc.2021.630558
13. Carling, J. (2015). Myth of Return. In Stone, J. et al. (Eds.), *The Wiley Blackwell Encyclopedia of Race, Ethnicity, and Nationalism*. Wiley Blackwell. https://doi.org/10.1002/9781118663202.wberen228
14. Carling, J. & Pettersen, S.V. (2014). Return migration intentions in the integration–transnationalism matrix. *International Migration,* 52(6), 13-30. https://doi.org/10.1111/imig.12161
15. Cassarino, J. P. (2004). Theorising return migration: The conceptual approach to return migrants revisited. *International Journal on Multicultural Societies*, *6*(2), 253-279.
16. Cassarino, J. P. (2013). Theorizing return migration: The conceptual approach to return migrants revisited. *REMHU: Revista Interdisciplinar da Mobilidade Humana*, *21*, 21-54. https://doi.org/10.1590/S1980-85852013000200003
17. Dahya, B. (1973). Pakistanis in Britain: transients or settlers? *Race and Class, 14*(3), 241-277. https://doi.org/10.1177/030639687301400302
18. Croatian Bureau of Statistics (2019). *Migration of population of the Republic of Croatia, 2018. First Release*. https://web.dzs.hr/Hrv_Eng/publication/2019/07-01-02_01_2019.htm
19. Croatian Bureau of Statistics (2022). *Migration of population of the Republic of Croatia, 2021. First Release*. https://podaci.dzs.hr/2022/en/29029

20. Croatian Employment Service (2023). *Biram Hrvatsku – mobilnost radne snage*. https://mjere.hr/mjere/biram-hrvatsku-mobilnost-radne-snage-2023/

21. Darren P., Smith, P. R. & Sage, J. (2014). Youth migration and spaces of education. *Children's Geographies*, *12*(1), 1-8. https://doi.org/10.1080/14733285.2013.871801

22. de Haas, H. & Fokkema, T. (2011). The effects of integration and transnational ties on international return migration intentions. *Demographic Research*, *25*, 755-782. https://doi.org/10.4054/DemRes.2011.25.24

23. de Haas, H. (2014). *Migration theory – Quo Vadis?* (IMI Working Paper No. 100). Oxford: International Migration Institute.

24. de Haas, H., Fokkema, T. & Fihri, M. F. (2015). Return migration as failure or success? The determinants of return migration intentions among Moroccan migrants in Europe. *Journal of International Migration and Integration*, *16*(2), 415-429. https://doi.org/10.1007/s12134-014-0344-6

25. Draženović, I., Kunovac, M. & Pripužić, D. (2018). Dynamics and determinants of emigration: The case of Croatia and the experience of new EU member states. *Public Sector Economics*, *42*(4), 415-447. https://doi.org/10.3326/pse.42.4.3

26. Dustmann, C. & Görlach, J. S. (2016). The economics of temporary migrations. *Journal of Economic Literature*, *54*(1), 98-136. https://doi.org/10.1257/jel.54.1.98

27. Eade, J., Drinkwater, S. & Garapich, M. (2007). *Class and Ethnicity: Polish Migrant Workers in London*. Centre for Research on Nationalism, Ethnicity and Multiculturalism. https://doc.ukdataservice.ac.uk/doc/6056/mrdoc/pdf/6056uguide.pdf

28. Eluru, N. & Yasmin, S. (2015). A note on generalized ordered outcome models. *Analytic Methods in Accident Research*, *8*, 1-6. https://doi.org/10.1016/j.amar.2015.04.002.

29. Faist, T. (2008). Migrants as transnational development agents: an inquiry into the newest round of the migration-development nexus. *Population, Space and Place*, *14*(1), 21-42. https://doi.org/10.1002/psp.471

30. Fullerton, A. & Xu, J. (2016). *Ordered Regression Models: Parallel, Partial, and Non-parallel Alternatives*. CRC Press. https://doi.org/10.1201/b20060

31. Geiger, M. & Steinbrink, M. (2012). Migration und Entwicklung: Merging Fields in Geography. In Geiger, M. & Steinbrink, M. (Eds). *Migration und Entwicklung: Geographischer Perspektiven* (pp. 7-36). Institut für Migrationsforschung und Interkulturelle Studien (IMIS) - Universität Osnabrück.

32. Ghosh, B. (2000). Towards a new international regime for orderly movements of people. In Ghosh, B. (Ed.), *Managing Migration. Time for a New International Regime?* (pp. 6-26). Oxford University Press. https://doi.org/10.1093/oso/9780198297642.003.0002

33. Gittins, T., Lang, R. & Sass, M. (2015). The effect of return migration driven social capital on SME internationalisation: A comparative case study of IT sector entrepreneurs in Central and Eastern Europe. *Review of Managerial Science*, *9*, 385-409. https://doi.org/10.1007/s11846-014-0161-5

34. Government of the Republic of Croatia (2023). *Decision on adopting the National Youth Program for the period 2023-2025* (*Official Gazette of the Republic of Croatia 61/2023).*

35. Guo, M. (2016). Residential difference and settlement intention: Based on ordered logit model. *Open Journal of Business and Management*, *4*(3), 513-518. https://doi.org/10.4236/ojbm.2016.43055

36. Hair Jr., J. F., Rashwan, A., Shawky, A., Rapheb, M. A. & Bary, A. A. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, *26*(2), 106-121. https://doi.org/10.1108/EBR-10-2013-0128

37. Hall, S. (2021). *Youth, Migration and Development: A New Lens for Critical Times* (KNOMAD Paper No. 41). Washington, DC: World Bank.

38. Heckert, J. (2015). New perspective on youth migration: Motives and family investment patterns. *Demographic Research*, 33, 765-800. https://doi.org/10.4054/DemRes.2015.33.27

39. Hagen-Zanker, J. (2008). *Why do people migrate? A review of the theoretical literature*. (MGSoG Working Paper No. 002). Maastricht: Maastricht Graduate School of Governance. https://doi.org/10.2139/ssrn.1105657
40. International Labour Organization (2023). *Youth and Migration*. https://www.ilo.org/global/topics/labour-migration/policy-areas/youth-and-migration/lang--en/index.htm
41. Jephcote, C., Williams, A. M., Li, G. & Janta, H. (2023). Return migration and employment mobility: a pan-European analysis. *Journal of Ethnic and Migration Studies*, *49*(17), 4435-4459. https://doi.org/10.1080/1369183X.2022.2142104
42. Jurić, T. (2017). Suvremeno iseljavanje Hrvata u Njemačku: karakteristike i motivi. *Migracijske i etničke teme*, *3*, 337-371. https://doi.org/10.11567/met.33.3.4
43. King, R. & Kuschminder, K. (Eds.). (2022). *Handbook of Return Migration*. Edward Elgar Publishing. https://doi.org/10.4337/9781839100055
44. Knezović, S. & Grošinić, M. (2017). *Migration Trends in Croatia*. Hanns-Seidel-Stiftung, Institut za razvoj i međunarodne odnose. https://www.irmo.hr/wp-content/uploads/2017/03/HSS-Migration-Trends-2017-02-KB-za-tisak2.pdf
45. Kuschminder, K. (2022). Forced, regulated and flexible temporariness in return migration. *Journal of Ethnic and Migration Studies*, *48*(16), 3879-3893. https://doi.org/10.1080/1369183X.2022.2028352
46. Koštialová, K. & Hofreiter, R. (2018). *Returning young migrants - Slovak Republic*. PROMISE (GA693221). http://www.promise.manchester.ac.uk/wp-content/uploads/2019/03/Individual-case-study-Slovakia-returning-migrants.pdf
47. Kozić, K., Bodor, T., Lončarević, Š., Krstulović, L., Slavić Miljenović, J. & Šterc, S. (2020). Analiza stavova ispitanika o razlozima recentnog iseljavanja mladih iz RH u razdoblju između 2015. i 2018. godine. In Perić Kaselj, M. (Ed.). *Proceedings of the international scientific-professional conference Migrations and Identity: Culture, Economy, State* (pp. 1044-1061). Zagreb: Institute for Migration and Ethnic Studies.
48. Lang, T. (2013). *Return migration in Central Europe: Current trends and an analysis of policies supporting returning migrants.* Leibniz-Institut für Länderkunde e.V. (IfL). https://www.ssoar.info/ssoar/handle/document/35966
49. Lee, E. S. (1966). A theory of migration. *Demography*, *3*, 47-57. https://doi.org/10.2307/2060063
50. Martin, R. & Radu, D. (2012). Return Migration: The Experience of Eastern Europe. *International Migration*, *50*(6), 109-128. https://doi.org/10.1111/j.1468-2435.2012.00762.x
51. Mansour, K. (2020). The myth of return. *Orient*, *61*(4), 35-42.
52. Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J. E. (1993). Theories of international migration: A review and appraisal. *Population and Development Review*, *19*(2), 431-466. https://doi.org/10.2307/2938462
53. Myrdal, G. (1957). *Rich Lands and Poor: The Road to World Prosperity*. Harper.
54. Perić Pavišić, K., Šakić, V. & Rihtar, S. (2022). Suvremene migracijske motivacije mladih Hrvatske — vrijednosni i identitetski aspekti. *Pilar: časopis za društene i humanističke studije*, *17*(32(1)), 119-134. https://doi.org/10.5559/pi.17.32.06
55. Petrić, I. (2023). *Preko vladine mjere u Hrvatsku se vratilo 165 ljudi. Najčešće stižu iz 5 država*. Index. https://www.index.hr/vijesti/clanak/preko-vladine-mjere-u-hrvatsku-se-vratilo-165-ljudi-najcesce-stizu-iz-5-drzava/2477953.aspx
56. Piotrowski, M. & Tong, Y. (2013). Straddling two geographic regions: The impact of place of origin and destination on return migration intentions in China. *Population, Space and Place*, *19*(3), 329-349. https://doi.org/10.1002/psp.1715

57. Pries, L. (2004). Transnationalism and migration: New challenges for the social sciences and education. In Luchtenberg, S. (Ed.), *Migration, Education and Change* (pp. 15-39). Routledge. https://doi.org/10.4324/9780203299760_chapter_2

58. Rajković Iveta, M. & Horvatin, T. (2017). Contemporary Emigration from Croatia to Ireland with a Special Focus on Young People from Slavonia. *Migracijske i etničke teme*, *33*(3), 247-274. https://doi.org/10.11567/met.33.3.1

59. Schiele, M. (2021). Life satisfaction and return migration: Analyzing the role of life satisfaction for migrant return intentions in Germany. *Journal of Ethnic and Migration Studies*, *47*(1), 110-129. https://doi.org/10.1080/1369183X.2020.1763786

60. Snel, E., Faber, M. & Engbersen, G. (2015). To stay or return? Explaining return intentions of Central and Eastern European labour migrants. *Central and Eastern European Migration Review*, *4*(2), 5-24.

61. Stark, O. & Bloom, D. E. (1985). The new economics of labor migration. *American Economic Review*, *75*(2), 173-178.

62. Tabuga, A. (2018). *Analyzing decisiveness of migration intentions: Social kinship that matters* (PIDS Discussion Paper No. 2018-06). Quezon City: Philippine Institute for Development Studies.

63. Tezcan, T. (2019). Return home? Determinants of return migration intention amongst Turkish immigrants in Germany. *Geoforum*, *98*, 189-201. https://doi.org/10.1016/j.geoforum.2018.11.013

64. Todaro, M. P. (1969). A model of labor migration and urban unemployment in less developed countries. *American Economic Review*, *59*(1), 138-148.

65. Tong, Y. & Piotrowski, M. (2010). The effect of remittances on return migration and its relation to household wealth: The case of rural Thailand. *Asia-Pacific Population*, *25*(2), 53-96. https://doi.org/10.18356/e9b54764-en

66. Vathi, Z., King, R. & Kalir, B. (2023). Editorial introduction: The shifting geopolitics of return migration and reintegration. *Journal of International Migration and Integration*, *24*(Suppl 2), 369-385. https://doi.org/10.1007/s12134-022-00974-x

67. Vidovic, H. & Mara, I. (2015). *Free Movement of Workers, Transitional Arrangements and Potential Mobility from Croatia* (WIIW Research Report No. 402). Vienna: The Vienna Institute for International Economic Studies.

68. Vukić, A., Perić Kaselj, M. & Škiljan, F. (2023). Knowledge of social space – Motives and intentions of youth for migrating within the European Union. *Sociologija i prostor: časopis za istraživanje prostornoga i sociokulturnog razvoja*, *61*(1(226)), 223-247.

69. Waldorf, B. (1995). Determinants of international return migration intentions. *Professional Geographer*, *47*(2), 125-136. https://doi.org/10.1111/j.0033-0124.1995.125_x.x

70. Weber, R. & Saarela, J. (2023). Who migrates and who returns in a context of free mobility? An analysis of the reason for migration, income and family trajectories. *European Journal of Population*, *39*(1), 17. https://doi.org/10.1007/s10680-023-09667-2

71. Williams, R. (2016). Understanding and interpreting generalized ordered logit models, *Journal of Mathematical Sociology*, *40*(1), 7-20. https://doi.org/10.1080/0022250X.2015.1112384

72. Župarić-Iljić D. (2016). *Iseljavanje iz Republike Hrvatske nakon ulaska u Europsku uniju*. Friedrich Ebert Stiftung. https://bib.irb.hr/datoteka/855708.FES_Iseljavanje_web.pdf

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DOES CORRUPTION AFFECT THE IMPACT OF FINANCIAL DEVELOPMENT ON ENTREPRENEURSHIP? EVIDENCE FROM EMERGING ECONOMIES

Abstract

Purpose: This study examines the relationship between financial development, corruption, and entrepreneurship in a sample of 21 emerging economies from 2008 to 2020.

Methodology: Utilizing the Generalized Method of Moments (GMM) econometric approach, we explore the interactive dynamics between these variables.

Results: Our findings indicate that higher levels of corruption are associated with increased entrepreneurial activity in these economies. This can be attributed to the prevalence of corrupt practices, such as bribery, which serve as a means for entrepreneurs to overcome barriers and initiate businesses. Conversely, while financial development has a positive influence on entrepreneurship, its impact is not statistically significant. However, when considering a combined effect of financial development and corruption, a positive net impact is observed. This suggests that corruption can facilitate access to financial resources for entrepreneurs in these emerging economies. These findings support the notion of the "grease the wheels effect".

Conclusion: This study provides valuable insights into the complex interplay between financial accessibility, corruption, and entrepreneurship in emerging economies, informing policymakers and stakeholders on strategies to foster entrepreneurship and drive sustainable economic growth.

Keywords: Financial development, corruption, entrepreneurship, emerging countries, generalized method of moments

1. Introduction

Empirical research on the impact of corruption on entrepreneurship lacks consensus and remains mostly theoretical. There are two opposing theories in the literature regarding the relationship between corruption and economic growth. The "grease the wheels" hypothesis suggests that corruption stimulates economic growth by overcoming bureaucratic

inefficiencies, allowing businesspeople, politicians, and administrators to drive growth in the presence of strict regulations (Méon & Weill, 2010; Acemoglu & Verdier, 2000; Aidis et al., 2008). Conversely, the "sand in the wheels" hypothesis argues that corruption hinders economic growth by impeding efficient production and innovation (Chen & Cheng, 2019; Dutta & Sobel, 2016; Urbano et al., 2019). Both theories can be applied to understand the impact of corruption on entrepreneurship. In highly regulated countries, corruption may facilitate entrepreneurship by mitigating the negative effects of regulations. However, corruption can also impede entrepreneurship by creating obstacles, such as arbitrary confiscation of gains without bribes, particularly in weak institutional settings (Fisman & Svensson, 2007; Avnimelech et al., 2014). Additionally, corruption undermines fair competition, discouraging individuals from pursuing entrepreneurship (Szyliowicz & Wadhwani, 2007; Chowdhury et al., 2018). In countries with widespread corruption, individuals may be hesitant to become entrepreneurs as success depends on collusion rather than fair competition (Svensson, 2003; Anokhin & Schulze, 2009). The prevalence of corruption diminishes the rewards of risk-taking, deterring entrepreneurial activity. Therefore, it is crucial to empirically examine the effects of corruption on entrepreneurship.

An enabling institutional environment plays a crucial role in facilitating entrepreneurial endeavors. It provides the necessary support and infrastructure for entrepreneurs to thrive and create wealth through innovation. Conversely, when the institutional environment is unfavorable, it dampens entrepreneurial motivation, increases transaction costs, and creates barriers to the establishment of new ventures (Gu & Qian, 2019; Chen & Cheng, 2019). Therefore, the institutional environment, particularly in terms of controlling corruption, has great significance in fostering entrepreneurial development. According to Thai and Turkina (2014), entrepreneurship flourishes in the presence of robust economic and political institutions, effective laws and regulations, corruption control, property rights, and good governance. Access to financial resources and financing is also considered vital to the growth of new businesses, alongside other factors that influence entrepreneurial activities (Cumming et al., 2017; Zivari et al., 2020). In the absence of a well-developed financial system, entrepreneurs face difficulties in accessing capital and tools to mitigate the risks associated with their ventures (Omri, 2020; Thai & Turkina, 2014).

The impact of corruption on a country's financial sector is a significant factor, as highlighted by Sayılır et al. (2018). Corruption is generally defined as an illegal payment made to government officials in order to gain advantage that would not be possible otherwise, or a misuse of public positions for personal gain, as defined by Rose-Ackerman and the World Bank, respectively (Sharma et al., 2020). These definitions highlight the abuse of power for personal interests as the core essence of corruption. Recent research has shown a growing interest in exploring the relationship between corruption and financial development, with compelling evidence supporting the notion that corruption plays a crucial role in shaping the development of financial systems (Tran et al., 2020; Ajide, 2020). While existing theories and research acknowledge the significant influence of corruption on the conditions surrounding entrepreneurial activities (Hannafey, 2003; Uribe-Toril et al., 2019), our understanding of the relationship between corruption, financial development, and entrepreneurship remains limited. Furthermore, the impact of financial development on corruption and entrepreneurship is intricate, bidirectional, and varies across different countries. Empirical research on this subject is also insufficient, and the results are inconclusive. The purpose of this article is to provide insights into these complex issues.

This study makes three contributions. First, it addresses a gap in previous research by examining the simultaneous and interactive effects of financial development and corruption control on entrepreneurial activities. Previous studies have primarily focused on the relationship between entrepreneurship and corruption or between financial development and entrepreneurship, but not the combined effect of all three factors.

Second, the study expands the scope of investigation by including developing countries. Many previous studies have mainly focused on entrepreneurial activities in developed countries due to limited access to entrepreneurship data in developing nations. By including emerging countries in the analysis, this study provides a more comprehensive understanding of the factors influencing entrepreneurship.

Third, this study fills a research gap at the domestic level by examining combined and interactive effects of financial development, corruption control, and entrepreneurship in a sample of emerging countries. Prior research has not specifically explored these variables together within the context of emerging countries during the study period, making this study unique in its focus.

This paper is structured as follows: in Section 2, we delve into the existing literature on economic growth, corruption, financial development, and their interconnections. Section 3 outlines the research methodology employed and the data sources utilized in this study. The subsequent section, Section 4, presents the econometric tests that were conducted to investigate the relationships between the aforementioned factors. Lastly, in Section 5, we provide concluding remarks that summarize the main findings and implications of the study.

2. Literature review

2.1 The relationship between corruption and entrepreneurship

There are two predominant theories that seek to explain the relationship between corruption and economic growth, often referred to as the "grease the wheels" and "sand the wheels" perspectives. The first theory, known as the "grease the wheels" hypothesis or the efficiency hypothesis of corruption, posits that corruption can actually facilitate entrepreneurial progress. For instance, when firms engage in bribery, it can help streamline bureaucratic processes by reducing red tape and enabling faster access to bank loans with fewer bureaucratic hurdles (Liu et al., 2020).

According to this line of thinking, corruption can contribute to the improvement of public administration efficiency by decreasing administrative waiting times and easing the burden of strict and inefficient government regulations (Liu et al., 2019; Mohammadi Khyareh, 2017). Moreover, corruption allows companies to circumvent unfavorable policies, thereby enhancing their access to financial resources, particularly in countries where financial and public institutions are weak (Son et al., 2020). As a result, corruption not only reduces the costs associated with extensive regulations, but it also lowers the barriers to access to financial resources by promoting collaboration and collusion between entrepreneurs and government officials (Liu et al., 2019; Chowdhury & Audretsch, 2020).

On the other hand, the sand-the-wheels hypothesis, also known as the inefficiency hypothesis of corruption, postulates that corruption acts as an obstacle to the growth of entrepreneurship. Supporters of this hypothesis argue that in the contexts characterized by high levels of corruption, prospective entrepreneurs are less inclined to engage in entrepreneurial activities due to the exorbitant costs associated with corruption (Rashid et al., 2021). As corrupt practices become more pervasive, corrupt officials gradually shift their focus towards informal economic pursuits. Once the price entrepreneurs must pay for engaging in corruption reaches a certain threshold, it serves as a deterrent that dissuades potential entrepreneurs from embarking on their business ventures (Liu et al., 2019). Furthermore, corruption contributes to a sense of disillusionment among aspiring entrepreneurs who lack strong and dependable relationships with authorities, similar to those enjoyed by larger corporations (Kakeh Baraie et al., 2017).

Extensive research has been undertaken regarding the relationship between entrepreneurship and corruption, leading to a substantial body of empirical literature. For instance, Wiseman (2015) conducted a study across different states in the United States and found compelling evidence suggesting that corruption, serving as an indicator of institutional quality, exerts a negative influence on productive entrepreneurship. In a similar vein, Anokhin and Schulze (2009) concluded from their analysis that countries with effective control and reduction of corruption tend to witness a notable rise in entrepreneurial activity and innovation.

However, it is worth noting that the findings are not uniformly consistent. Dreher and Gassebner (2013) conducted research that revealed a positive association between corruption and entrepreneurship, particularly in countries burdened by excessive regulations. Similarly, Szyliowicz and Wadhwani (2007) discovered a positive relationship between corruption and entrepreneurship in the contexts where stringent regulations prevail. Thus, while some studies suggest that corruption hampers productive entrepreneurship and innovation, other research points to a more complex relationship where corruption might have divergent effects depending on the regulatory environment. The interplay between corruption, entrepreneurship, and regula-

tions remains a nuanced and multifaceted subject, warranting further investigation and analysis in future studies. Given the association between corruption and entrepreneurial activates, we advance the following:

H1: Higher levels of corruption are associated with lower levels of entrepreneurial activities.

2.2 Corruption, financial development and entrepreneurship

Since Schumpeter's seminal work in 1912, economists have devoted considerable attention to the analysis of the concept of financial development. A well-functioning financial system, which facilitates the allocation of funds from savers to borrowers, plays a critical role in promoting entrepreneurship. However, several factors can impede the progress of financial systems, and corruption stands out as a significant obstacle. Corruption erodes property rights, creating a disincentive for entrepreneurs to make further investments, even when collateral for accessing foreign credit is available. This underscores a negative relationship between financial development and corruption (Tran et al., 2020). Moreover, the lack of transparency diminishes the credibility of the financial system, erodes investor trust, and amplifies market volatility. Consequently, corruption acts as "sand" that hinders the advancement of financial development (Cooray & Schneider, 2018). An alternative perspective suggests that corruption can lubricate economic activity and potentially facilitate beneficial transactions. This occurs when corruption compels individuals to counter illicit government behavior through illegal means such as bribery (Song et al., 2020). However, this perspective is applicable only in the context of weak governance structures.

Additionally, research on the relationship between financial development and entrepreneurship has gained attention, shedding light on various aspects of this connection. Schumpeter's theory (1912) laid the foundation by emphasizing the role of financial provision in entrepreneurship. According to Schumpeter, banks play a pivotal role in selecting capable borrowers and providing the necessary credit for entrepreneurial endeavors, making financial development a crucial factor in fostering entrepreneurship.

While comprehensive research on this topic is limited, empirical studies have provided valuable insights. The majority of these studies suggest a positive relationship between financial development and entrepreneurship. Dutta and Meierrieks (2021) found evidence of a positive impact, especially when financial development is accompanied by well-functioning economic and political institutions. Similarly, Omri (2020) highlighted the role of good governance as a policy lever that strengthens financial development and positively influences effective entrepreneurship. Studies conducted by Kar and Özsahin (2016) in emerging economies, Fan and Zhang (2017) in Chinese provinces, and Zhou and Quan (2019) in China have also yielded similar results. However, it is important to acknowledge that limited access to financial resources remains a significant constraint for entrepreneurs, as highlighted by Wilson et al. (2018), Cumming et al. (2018), and Omri and Mabrouk (2020). These studies emphasize the challenges entrepreneurs face in obtaining necessary financial support for their ventures, particularly in developing countries.

Empirical studies have explored the connection between financial development and the quality of institutions, particularly with respect to corruption control. For instance, Ajide (2020) demonstrated that financial development can serve as a tool for reducing corruption in Africa. Son et al. (2020) argued that corruption is positively correlated with the ratio of non-performing loans, thereby exacerbating vulnerabilities in the banking system. Cooray and Schneider (2018) conducted a study on the relationship between corruption and the development of the financial sector, concluding that higher levels of financial development are associated with lower levels of administrative corruption.

The theoretical and empirical literature lacks consensus regarding the type and direction of the relationship between corruption and financial development. Therefore, further research is necessary to analyze the mechanisms through which these two variables interact in order to determine their impact on entrepreneurial activities. The present study aims to shed light on this issue. Therefore, we propose the following hypothesis:

H2: Financial development can moderate the relationship between corruption and entrepreneurship, making the relationship stronger for countries with high financial development.

3. Data and methodology

3.1 Data

The study aims to examine how financial development, corruption control, and entrepreneurship are interconnected in selected emerging countries, as classified by the IMF. It builds upon established theoretical frameworks and draws inspiration from previous empirical studies conducted by Dhahri and Omri (2018) and Gaies et al. (2021).

$$LTEA_{i,t} = \beta_0 + \beta_1 LTEA(-1)_{i,t} + \beta_2 CC_{i,t} + \beta_3 LFD_{i,t} + \beta_4 LGDP_{i,t} + \beta_5 LRENT_{i,t} + \beta_6 LUN_{i,t} + \beta_7 LPOP_{i,t} + \beta_8 LEDU_{i,t} + \beta_9 LTR_{i,t} + \delta_i + \varepsilon_{i,t} \quad (1)$$

In equation (1), variable names preceded by "L" indicate that those variables are represented in logarithmic form. The dependent variable TEA measures nascent entrepreneurship and is derived from the Global Entrepreneurship Monitor (GEM) index. This index reflects the percentage of the population aged 18 to 64 who own and manage new businesses, paying wages to employees and/or owners for at least three months (Chowdhury et al., 2019).

The Corruption Control (CC) index, obtained from the Worldwide Governance Indicators (WGI), quantifies the extent of public sector power abuse for private gain (Kaufmann, 2007). The CC index ranges from 2.5 (indicating high corruption) to -2.5 (indicating low corruption). To facilitate interpretation, the scale of this variable is inverted by multiplying the index values by -1, so that a value of 2.5 corresponds to high corruption and -2.5 corresponds to low corruption. Consequently, a higher corruption index is expected to have a negative impact on entrepreneurial activities.

Financial development (FD) represents the amount of credit allocated by banks to the private sector as a percentage of GDP. Financial development is anticipated to have a positive influence on entrepreneurial activities. GDP denotes per capita gross domestic product, while RENT indicates the level of access to natural resources (such as oil, natural gas, coal, mines, and forests) as a percentage of GDP. UN represents the unemployment rate, POP signifies the population growth rate, EDU represents the gross enrollment rate in secondary education, and TR denotes trade openness. The inclusion of δ_i captures country-fixed effects, and $\varepsilon_{i,t}$ represents the error term in the equation.

Additionally, equation (2) is considered to investigate the interactive role of corruption and financial development on entrepreneurship.

$$LTEA_{i,t} = \beta_0 + \beta_1 LTEA(-1)_{i,t} + \beta_2 CC_{i,t} + \beta_3 LFD_{i,t} + \beta_4 L(\mathrm{CC} * \mathrm{FD})_{it} + \beta_5 LGDP_{i,t} + \beta_6 LRENT_{i,t} + \beta_7 LUN_{i,t} + \beta_8 LPOP_{i,t} + \beta_9 LEDU_{i,t} + \beta_{10} LTR_{i,t} + \delta_i + \varepsilon_{i,t} \quad (2)$$

This study conducted an analysis using data from 21 emerging countries[1], spanning the period from 2008 to 2020. The selection of countries was based on specific criteria aimed at capturing a diverse representation of emerging economies. We considered factors such as geographical distribution, economic development stage, and cultural diversity to ensure a comprehensive analysis of the relationship between financial development, corruption, and entrepreneurship. The data on entrepreneurship were obtained from the Global Entrepreneurship Monitor (GEM), which provided valuable insights into entrepreneurial activities. Other relevant data for the analysis were sourced from the World Development Indicators (WDI) database, maintained by the World Bank.

3.2 Rationale for variable selection

Lagged entrepreneurship is included to capture the persistence and dynamic nature of entrepreneurial activities. Past entrepreneurship levels can significantly influence current levels, aligning with the notion that nascent entrepreneurship is path-dependent (e.g., Davidsson, 2015; Audretsch et al., 2012).

The Corruption Control index is integral to understanding the impact of governance on entrepreneurship. It reflects the extent of public sector power abuse, providing insights into the regulatory environment and its influence on entrepreneurial activities (Kaufmann et al., 2006).

Financial development is crucial for entrepreneurship as it represents the percentage of GDP allocated by banks to the private sector. Adequate financial development is expected to positively influence

1 The selected countries are: Algeria, Angola, Argentina, Azerbaijan, Belarus, Brazil, Chile, China, Colombia, Croatia, Dominican Republic, Egypt, Hungary, Iran, Kuwait, Libya, Mexico, Morocco, Oman, Pakistan, Peru, Philippines, Netherlands, Qatar, Romania, Russia, Saudi Arabia, South Africa, Sri Lanka, Thailand, Turkey, Ukraine, United Arab Emirates, Uruguay, Venezuela, India, Indonesia, Kazakhstan, and Malaysia.

entrepreneurial activities by facilitating access to credit (e.g., Beck & Demirgüç-Kunt, 2006).

The interactive effect of corruption and financial development explores whether corruption mitigates the negative impact of limited financial development on entrepreneurship. This interaction acknowledges the potential compensatory role of corruption in certain contexts (Aidis et al., 2012).

Control variables account for broader economic, demographic, and educational factors influencing entrepreneurship. For example, GDP, natural resource rent, and trade openness reflect economic conditions, while education and the population growth rate capture demographic and human capital dimensions (e.g., Wennekers & Thurik, 1999; Audretsch & Keilbach, 2004). Country-fixed effects control for unobserved heterogeneity among emerging economies, recognizing that unique country-specific characteristics may affect entrepreneurship independently of the measured variables.

3.3 Econometric methodologies

From an econometric perspective, the inclusion of a lagged dependent variable on the right-hand side of equations (1) and (2) raises concerns about endogeneity and a potential correlation between the independent variables and the error term. To address endogeneity issues and a potential correlation between the independent variables and the error term in equations (1) and (2), the study employs the generalized method of moments (GMM) approach for estimation. The inclusion of a lagged dependent variable on the right-hand side of the equations necessitates the use of GMM to obtain consistent estimation results.

The GMM approach is particularly suitable for the specified form of the model where the dependent variable, entrepreneurship, exhibits a break. It offers several advantages over other estimation methods. Firstly, GMM allows for the use of breaks as instrumental variables to control for endogeneity. This helps address potential biases arising from the interplay between the dependent variable and the independent variables. Secondly, GMM incorporates the dynamics present in the model by incorporating lagged values, thereby capturing time-dependent relationships. Lastly, GMM can be applied to various types of data, including time series, cross-sectional, and panel data, making it a flexible and widely applicable estimation technique.

Empirical analysis in our study employs the dynamic panel generalized method of moments (GMM) approach, a sophisticated econometric method well-suited for handling endogeneity issues and capturing the dynamic relationships inherent in panel data. The GMM methodology, as applied to dynamic panels, was initially proposed by Arellano and Bond (1991), and it has since become a cornerstone in addressing various econometric challenges associated with panel data analysis.

The dynamic panel GMM estimation equation, building on the foundational work of Arellano and Bond (1991), Blundell and Bond (1998), and Arellano and Bover (1995), can be expressed as follows:

$$Yit = \alpha + \rho Yit - 1 + Xit\beta + Zit\gamma + \varepsilon it, \quad (1)$$

where Yit represents the dependent variable for unit i at time t, α is the intercept term, ρ captures the autoregressive parameter reflecting the lagged dependent variable, Xit is a matrix of time-varying independent variables, β is the vector of coefficients associated with the time-varying independent variables, Zit is a matrix of predetermined instruments, γ is the vector of coefficients associated with the predetermined instruments, and εit is the error term. The inclusion of lagged dependent variables and predetermined instruments addresses endogeneity concerns and enhances the efficiency of parameter estimates in the presence of unobserved heterogeneity and serial correlation.

By employing the GMM approach, the study aims to obtain consistent and efficient estimates of the relationships between the variables of interest. This helps mitigate the endogeneity concerns associated with the lagged dependent variable and provides a robust framework for the analysis of the impact of corruption control, financial development, and other factors on entrepreneurship (Munemo, 2018). The GMM methodology allows for rigorous inference and enhances the validity of the study findings.

Data analysis in our study was conducted using STATA version 16 software. Analysis commands in STATA, particularly for dynamic panel GMM, align with established methodologies outlined by researchers such as Roodman (2009).

4. Empirical results

4.1 Descriptive statistics

Table 1 encapsulates crucial descriptive statistics for nine variables derived from an extensive dataset of 130 observations for each variable based on the availability of data.

Table 1 Summary statistics of variables

Variable	Observations	Mean	Std. Dev.	Min	Max
Natural Resources Rent	130	7.129768	8.168906	0.2295636	30.81602
Unemployment Rate	130	7.324538	5.078499	0.11	27.04
Education Index	130	51.21416	21.78649	8.83833	113.2171
Population Growth	130	1.054496	0.9351613	-1.20061	5.114902
Corruption	130	-0.0606155	0.4926059	-1.060013	0.8783809
Total Trade	130	74.32311	36.9461	22.1059	176.6683
Financial Development Index	130	60.86398	36.89161	13.22519	165.3904
Gross Domestic Per Capita Growth	130	3.138249	2.741693	-7.444557	13.39624
Total Early Stage Entrepreneurship	130	12.99308	5.813606	2.9	27.4

Source: Research calculations

Within the realm of "Natural Resources", the mean score of 7.13 is accompanied by a notable standard deviation of 8.17, underscoring the pronounced variability within this metric. The "Unemployment Rate" manifests an average of 7.32%, exhibiting a moderate standard deviation of 5.08. The "Education Index" reveals a mean of 51.21, with a substantial standard deviation of 21.79 indicative of a diverse educational landscape. Scaled to normalize, "Population Growth" boasts a mean of 1.05, reflecting varied population sizes, while the "Corruption Index" exhibits a slightly negative mean (-0.06) and a moderate standard deviation of 0.49. The "Financial Development Index" registers an average of 60.86, coupled with a noteworthy standard deviation of 36.89, indicating pronounced variability. "Gross Domestic Product Growth" showcases an average growth rate of 3.14%, with a moderate standard deviation of 2.74. Lastly, "Total Early Stage Entrepreneurship" yields an average value of 12.99, suggesting moderate entrepreneurial activities, accompanied by a standard deviation of 5.81. These meticulously delineated statistics not only provide a panoramic view of the dataset but also furnish nuanced insights into the central tendencies, variabilities, and ranges inherent to each variable, thereby enriching the descriptive statistics section of this research paper.

Table 2 Bivariate correlations between the study variables

	TEA	GDPP	FD	TR	CC	POP	EDU	UN	RENT
TEA	1.0000								
GDPP	0.3300	1.0000							
FD	-0.1954	0.2597	1.0000						
TR	0.2666	-0.1427	0.3045	1.0000					
CC	0.3676	-0.2095	0.3058	0.2875	1.0000				
POP	0.2647	0.3881	-0.1244	-0.3535	-0.3241	1.0000			
EDU	0.2035	-0.2936	0.3304	0.2550	0.2842	-0.4340	1.0000		
UN	-0.2024	-0.2590	-0.1824	-0.2874	-0.2647	-0.1391	-0.1874	1.0000	
RENT	-0.1968	-0.2885	-0.1499	-0.1427	-0.1890	0.3898	-0.1711	-0.1276	1.0000

Source: Research calculations

4.2 Unit root test

Before proceeding with the analysis of the estimated model and examining the panel data, it is essential to assess the correlation between the time periods. This consideration is crucial because the presence of correlation between periods can lead to inconsistent and biased results. To test the correlation between the periods, we have employed the CD statistic introduced by Pesaran (2004). The CD statistic allows us to assess whether there is cross-sectional dependence among the variables over time.

The CD test results indicate that we reject the null hypothesis of no correlation between the time periods. This implies that the examined countries exhibit interdependence among the variables under investigation. The rejection of the null hypothesis suggests that the presence of correlation should be taken into account to obtain reliable and accurate results in the subsequent analysis.

Given the presence of correlation between periods, traditional unit root tests such as the Levin, Lin, and Chu (LLC) and Im, Pesaran, and Shin (IPS) tests may yield spurious results. This is because these tests assume no correlation among the observations. To address this issue, we employ the Cross-sectional augmented IPS (CIPS) unit root test proposed by Pesaran (2007). The CIPS test takes into account the presence of cross-sectional dependence and provides more robust results in the presence of such correlation.

By using the CIPS unit root test, we aim to mitigate the potential bias introduced by the correlated nature of the data and ensure the validity of our findings. This approach allows us to obtain reliable estimates and draw accurate conclusions about the unit root properties of the variables in the panel dataset.

Table 3 Results of the unit root tests

Variable	CIPS (Level)	CIPS (First Difference)
Entrepreneurship	-2/65	-3/68***
Financial Development	-2/52	-3/92***
Corruption Control Index	-2/93	-2/47**
Per Capita GDP	-2/08	-3/61***
Natural Resource Rent	-2/77	-2/53**
Unemployment Rate	-2/19	-3/48***
Population Growth Rate	-2/23	-2/39**
Education	-2/96	-3/84***
Trade Openness	-2/59	-2/74**
(Corruption Control* Financial Development)	-2/97	-3/88***

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Source: Research calculations

The unit root tests conducted on the variables in the panel dataset provide valuable insights into their stationarity properties. The results presented in Table 3 indicate that all variables are either stationary at the level or after differencing.

The CIPS statistic values obtained from the unit root tests are compared against the critical values to determine the rejection or acceptance of the null hypothesis of non-stationarity. If the CIPS statistic exceeds the critical values, it implies that we reject the null hypothesis, indicating that the variable is stationary.

In our analysis, all variables in the panel dataset exhibit stationary behavior. This finding is crucial as it enables us to reliably estimate the model parameters and draw meaningful conclusions from the empirical results. Having stationary variables ensures that the mean and variance of the variables remain constant over time, allowing for more accurate analysis of their relationships and dynamics.

Table 3 provides a comprehensive overview of the unit root test results, including the CIPS statistic values and the corresponding critical values at various significance levels. Based on these results, we can confidently state that all variables in the analysis demonstrate stationarity, either in their original form or after differencing.

4.3 Results and discussion

Table 4 presents the estimation results obtained using the dynamic panel GMM approach, which helps address the issue of spurious regression and endogeneity among the model variables. This table provides valuable information on various aspects of the estimation, including the number of observations, instruments used, autocorrelation tests, and instrument validity tests.

The number of observations reported in Table 4 indicates the sample size utilized in the estimation, reflecting the data points available for analysis. A larger sample size generally enhances statistical power and reliability of the results.

Instruments play a crucial role in addressing endogeneity concerns in the model. The table provides details about the instruments employed, which carefully selected variables are used to control for potential biases and omitted variable problems. These instruments are crucial for obtaining consistent and unbiased estimates of the model coefficients.

Autocorrelation tests (AR (1) and AR (2)) are conducted to examine the presence of serial correlation in the model errors. Serial correlation violates the assumption of independently distributed errors, and its presence can affect the efficiency and validity of the estimation results. The table includes information on the autocorrelation tests conducted, allowing for an assessment of the robustness of the estimated model.

The instrument validity test (Sargan test) is performed to evaluate the suitability and effectiveness of the instruments used in the estimation. These tests assess whether the instruments satisfy the necessary conditions and are valid for addressing endogeneity concerns. The results of these tests provide evidence of the reliability of the chosen instruments.

Table 4 Estimation of the impact of economic complexity on competitiveness

Variables	Model 1	Model 2
Entrepreneurship Lag	0.131*** (0.137)	0.125*** (0.124)
Financial Development Index	0.0017 (0.061)	0.0021 (0.048)
Corruption (WGI)	0.178*** (0.143)	0.154*** (0.129)
(Corruption * Financial Development)	0.193*** (0.021)	0.186*** (0.019)
Economic Growth	0.0348** (0.0163)	0.0286** (0.0119)
Natural Resource Rent	0.0318** (0.0159)	0.0308** (0.0137)
Unemployment Rate	0.0565** (0.0218)	0.0491** (0.0183)
Population Growth Rate	0.0376*** (0.0112)	0.0334*** (0.0108)
Education	0.0331** (0.0119)	0.0319*** (0.0102)
Trade Openness	0.0428*** (0.0113)	0.0451*** (0.0145)
Observation	1070	1300
Dummy Year	yes	yes
AR (1)	-3/31***	-3/48***
AR (2)	-1/75	-1/25
Sargan	26/56	24/63
Instruments for first differences equation	D.(TEA, CC, FD, GDP, RENT, UN, POP, EDU, TR, i.YEAR)	
Instruments for levels equation	(TEA, CC, FD, GDP, RENT, UN, POP, EDU, TR, i.YEAR)	

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. The numbers in parentheses represent standard errors of the correlation coefficients.

Source: Research calculations

The assessment of instrumental variables used to address endogeneity is an important step in ensuring the validity of the estimation results. In this case, a highly significant coefficient of ***-3.48*** (***p < 0.01***) for AR (1) suggests a strong negative autocorrelation in the first lag of the model residuals. The coefficient of ***-1.25*** for AR (2) with a non-significant result suggests a weaker negative autocorrelation in the second lag. The Sargan test serves as a crucial diagnostic tool to evaluate the validity of the instruments employed in the model. A non-significant result of ***24.63*** (***p > 0.05***) indicates that the instruments used are valid for addressing endogeneity concerns in the model. This implies that the chosen instrumental variables effectively satisfy the necessary conditions and do not exhibit correlation with the model residuals.

The estimation results in Table 4 reveal a positive and significant impact of past entrepreneurial activity on current entrepreneurial activity. This finding aligns with existing empirical literature that underscores the persistence and influence of historical entrepreneurial trends on contemporary entrepreneurial actions (Davidsson & Honig, 2003; Hessels et al., 2011). This is consistent with the notion that entrepreneurial ecosystems tend to foster a culture of innovation and risk-taking, leading to a continuous cycle of entrepreneurial initiatives (Shane & Venkataraman, 2000).

The analysis of the relationship between financial development and entrepreneurship reveals a positive but statistically insignificant association. This finding is consistent with some previous empirical studies that have reported mixed or insignificant effects of financial development on entrepreneurship (Beck et al., 2005; Klapper et al., 2006). In addition, this finding can be attributed to several factors that help explain this result. Firstly, limited access to credit and challenges in obtaining bank financing can be significant obstacles to the formation and growth of entrepreneurship in developing countries. Entrepreneurial ventures often require substantial financial resources to start and expand, and the lack of available credit can hinder entrepreneurial activities. Inadequate financial infrastructure, including the absence of supportive financial institutions and mechanisms, may contribute to the limited access to credit faced by entrepreneurs in these countries. Secondly, variations in institutional structures across countries can also influence the relationship between financial development and entrepreneurship. Each country has its own unique financial system and regulatory environment, which affects the availability and effectiveness of financial services for entrepreneurs. In some cases, underdeveloped financial and monetary markets may not generate positive outcomes for entrepreneurship due to the absence of well-functioning financial institutions and supportive policies. The finding aligns with prior research conducted by Gaies et al. (2021) and Aparicio et al. (2016), which also emphasized the challenges faced by entrepreneurs in developing countries regarding limited access to credit and variations in financial systems.

The analysis provides compelling evidence of a positive and significant impact of the corruption index on entrepreneurial activities. These findings reinforce the conclusions drawn by Dreher and Gassebner (2013) and Bologna and Ross (2015), suggesting that corruption can serve as the "only way" for potential entrepreneurs to initiate businesses in countries with corrupt business environments and weak institutions. One possible explanation for this finding is that in developing countries with a high prevalence of corruption, bribery and other corrupt practices have become deeply entrenched and normalized. In such environments, individuals may feel compelled to engage in corrupt activities as a means to overcome bureaucratic barriers and gain access to necessary resources and opportunities for starting or expanding their businesses. This normalization of corruption can create a distorted business landscape where unethical practices are widespread and accepted as the norm. However, it is crucial to emphasize that the positive impact of corruption on entrepreneurial activities does not justify or endorse corrupt behavior. Rather, it highlights the unfortunate reality that corruption can be deeply embedded in certain societies, making it difficult for entrepreneurs to operate in an environment that upholds integrity and fairness. Addressing corruption is of paramount importance to foster a healthy entrepreneurial ecosystem and promote sustainable economic development. Efforts should be directed towards strengthening institutions, enhancing transparency, and promoting ethical business practices. By combating corruption and improving the overall business environment, countries can create conditions that encourage genuine entrepreneurship, innovation, and long-term economic growth.

The analysis uncovers an intriguing interactive effect between controlling corruption and financial development, revealing a positive impact on the level of entrepreneurial activities. This finding is consistent with and extends the research conducted by Liu et al. (2019) and Aparicio et al. (2016). Additionally, this finding suggests that in countries with underdeveloped financial institutions and complex bureaucracies, where small and new businesses face significant challenges in accessing financial credit due to factors like the lack of collateral and higher levels of corruption, corruption can potentially facilitate easier access to financial resources and increase credit availability for entrepreneurs. The underlying mechanism behind this phenomenon can be explained by the presence of corrupt practices, such as bribery, that have become normalized and ingrained in these contexts. In such environments, where corruption is pervasive and financial institutions may be unreliable or inaccessible to small businesses, entrepreneurs may resort to engaging in corrupt activities as a means to bypass financial constraints and secure the necessary resources for their ventures. By leveraging corrupt networks and practices, entrepreneurs may gain increased access to credit and financial resources that would otherwise be unavailable to them. However, it is essential to emphasize that this finding should not be interpreted as a justification or endorsement of corruption. Corruption undermines transparency, fairness, and the rule of law, leading to distortions in the business environment and adverse long-term consequences for economic development. Addressing corruption remains a critical priority, and countries should focus on implementing robust anti-corruption measures, enhancing institutional frameworks, and promoting a culture of integrity and ethical business practices. However, it is essential to emphasize that this finding should not be interpreted as a justification or endorsement of corruption. While corruption may seemingly offer a temporary solution for entrepreneurs in underdeveloped financial markets, it is essential to prioritize anti-corruption efforts and simultaneously work towards improving financial institutions. By doing so, countries can foster an environment that promotes ethical entrepreneurship, transparency, and long-term economic growth.

Regarding the control variables, the analysis reveals a positive and statistically significant impact of education on entrepreneurship, which is in line with Korosteleva and Belitski (2017) and Sobel (2008), a positive and significant impact of natural resource rent, which is in line with studies by Korsgaard et al. (2016) and Chowdhury et al. (2019), a positive impact of population growth rate, which is supported by Florida (2003) and Lévesque and Minniti (2011), a positive impact of unemployment, which is in line with the results of Fuentelsaz et al. (2015) and Dvouletý (2017), a positive impact of GDP growth consistent with the results of Stel et al. (2005) and Thurik et al. (2008), and finally, a positive impact of trade openness on entrepreneurship, which is in line with the results of Sobel (2008) and Keupp and Gassmann (2009).

When comparing the results between Model 1 and Model 2 presented in the table, distinct patterns emerge in the estimated coefficients. Model 1, which focuses on the direct effect of entrepreneurship on economic growth, reveals specific insights into the relationship between these variables. Meanwhile, Model 2 introduces the dynamic threshold model, considering the potential nonlinear nature of this relationship and incorporating the impact of macroeconomic factors. The coefficients in Model 2 showcase how the threshold effect, indicated by the introduction of the binary variable and its associated parameters, influences the relationship between entrepreneurship and economic growth. The contrast between the two models elucidates not only the direct impact of entrepreneurship but also the nuanced dynamics revealed by the threshold model, offering a more comprehensive understanding of the complex interplay between entrepreneurship and economic growth, especially within the context of emerging economies.

5. Conclusion

The present study delves into the influence of financial development and corruption on entrepreneurship, focusing specifically on emerging economies. Through the application of the generalized method of moments (GMM) econometric approach and panel data analysis, we aim to provide valuable insights into these dynamics. Our research explores the direct and indirect effects of financial development and corruption on entrepreneurial activity, with a particular emphasis on investigating whether corruption can mitigate the adverse impact of limited financial development on entrepreneurship in emerging economies.

The findings of our study shed light on two key aspects. Firstly, we identify that underdeveloped financial accessibility poses a significant hurdle for aspiring entrepreneurs, limiting their entry into the market. Secondly, our analysis uncovers a noteworthy interactive effect, revealing that corruption has the potential to counterbalance the negative consequences of inadequate financial development on entrepreneurship, particularly in situations where financial resources and access to them are scarce. In the sample of emerging economies examined, higher levels of corruption, manifested as bribery or other illicit practices to navigate complex bureaucracies, can serve as a catalyst for entrepreneurial activity by facilitating greater access to financial resources. Consequently, in these contexts, corruption may be perceived as a means of enhancing entrepreneurship rather than hindering it.

It is crucial to acknowledge the contextual factors underlying these findings. In emerging and low-income countries, the availability of financial resources is often limited, and novice entrepreneurs encounter challenges in accessing external funding due to heightened business risks and a lack of collateral. In such circumstances, corruption can play a role in "greasing the wheels of businesses", enabling entrepreneurs to bypass bureaucratic obstacles and gain access to essential financial resources. However, it is essential to note that corruption carries additional costs for entrepreneurs and introduces uncertainties into their business transactions. Therefore, while our findings highlight the potential positive impact of corruption in the context of underdeveloped financial systems, it is imperative to maintain a broader perspective on the detrimental consequences of corruption. Transparency, fairness, and the rule of law remain crucial pillars for sustainable economic development.

In conclusion, this study provides valuable insights into the intricate relationship between financial accessibility, corruption, and entrepreneurship in emerging economies. By comprehending these dynamics, policymakers and stakeholders can gain a deeper understanding of the challenges and opportunities associated with fostering an entrepreneurial ecosystem. It is imperative for countries to address corruption, strengthen financial systems, and create an enabling environment that promotes ethical entrepreneurship, transparency, and sustainable economic growth.

In concluding our research into the interplay between financial accessibility, corruption, and entrepreneurship in emerging economies, it is essential to acknowledge certain limitations that require consideration. These limitations, in turn, pave the way for potential avenues of future research.

Limitations:

1. **Generalization constraints:** While our study provides valuable insights into specific emerging economies, the generalization of findings may be constrained by the inherent diversity across these nations. Cultural, institutional, and economic variations could influence the observed relationships, warranting caution in extrapolating our results universally.
2. **Temporal dynamics:** The focus of the study on the period from 2008 to 2020 may limit its ability to capture nuanced changes over time. Economic, political, and institutional shifts beyond this timeframe might influence the dynamics between financial development, corruption, and entrepreneurship.
3. **Variable selection:** Despite our comprehensive analysis, the scope of the study may be extended by considering additional variables that could further elucidate the intricate relationship between corruption, financial accessibility, and entrepreneurship.

Guidelines for further research:

1. **Cross-cultural analysis:** Future research endeavors could delve into cross-cultural analyses, exploring how the identified relationships differ or remain consistent across various cultural contexts. This could contribute to a more nuanced understanding of the interplay between corruption, financial development, and entrepreneurship.
2. **Longitudinal studies:** To address temporal limitations, longitudinal studies tracking the evolution of entrepreneurship in response to changes in corruption and financial accessibility over more extended periods could enhance our understanding of these dynamics.
3. **Macro- and micro-level factors:** Further research may explore the interconnection between macro-level factors (such as national policies) and micro-level factors (individual

entrepreneurial decisions). This could provide a more holistic view of the mechanisms influencing entrepreneurship in emerging economies.

4. **Qualitative dimensions:** Integrating qualitative methodologies, such as interviews and case studies, can add depth to our quantitative findings. Understanding entrepreneur perspectives and experiences in the context of corruption and financial constraints would enrich the analysis.

By recognizing these limitations and proposing future research guidelines, our study aims to contribute not only to the existing body of knowledge but also to inspire and guide scholars in advancing our comprehension of the intricate dynamics shaping entrepreneurship in emerging economies.

References

1. Acemoglu, D. & Verdier, T. (2000). The choice between market failures and corruption. *American Economic Review*, *91*(1), 194-211. https://doi.org/10.1257/aer.90.1.194
2. Ahlin, C. & Pang, J. (2008). Are financial development and corruption control substitutes in promoting growth?. *Journal of Development Economics*, *86*(2), 414-433. https://doi.org/10.1016/j.jdeveco.2007.07.002
3. Aidis, R., Estrin, S. & Mickiewicz, T. (2008). Institutions and entrepreneurship development in Russia: A comparative perspective. *Journal of Business Venturing*, *23*(6), 656-672. https://doi.org/10.1016/j.jbusvent.2008.01.005
4. Aidis, R., Estrin, S. & Mickiewicz, T. M. (2012). Size matters: entrepreneurial entry and government. *Small Business Economics*, *39*, 119-139. https://doi.org/10.1007/s11187-010-9299-y
5. Ajide, F. M. (2020). Can financial inclusion reduce the presence of corruption? Evidence from selected countries in Africa. *International Journal of Social Economics*, *47*(11), 1345-1362. https://doi.org/10.1108/IJSE-03-2020-0145
6. Anokhin, S. & Schulze, W. S. (2009). Entrepreneurship, innovation, and corruption. *Journal of Business Venturing*, *24*(5), 465-476. https://doi.org/10.1016/j.jbusvent.2008.06.001
7. Aparicio, S., Urbano, D. & Audretsch, D. (2016). Institutional factors, opportunity entrepreneurship and economic growth: Panel data evidence. *Technological Forecasting and Social Change*, *102*, 45-61. https://doi.org/10.1016/j.techfore.2015.04.006
8. Arellano, M. & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277-297. https://doi.org/10.2307/2297968
9. Arellano, M. & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29-51. https://doi.org/10.1016/0304-4076(94)01642-D
10. Audretsch, D. B., Hülsbeck, M. & Lehmann, E. E. (2012). Regional competitiveness, university spillovers, and entrepreneurial activity. *Small Business Economics*, *39*, 587-601. https://doi.org/10.1007/s11187-011-9332-9
11. Audretsch, D. & Keilbach, M. (2004). Entrepreneurship capital and economic performance. *Regional Studies*, *38*(8), 949-959. https://doi.org/10.1080/0034340042000280956
12. Avnimelech, G., Zelekha, Y. & Sharabi, E. (2014). The effect of corruption on entrepreneurship in developed vs non-developed countries. *International Journal of Entrepreneurial Behavior & Research*, *20*(3), 237-262. https://doi.org/10.1108/IJEBR-10-2012-0121
13. Beck, T. & Demirguc-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & Finance*, *30*(11), 2931-2943. https://doi.org/10.1016/j.jbankfin.2006.05.009
14. Beck, T., Demirguc-Kunt, A. & Levine, R. (2005). SMEs, growth, and poverty: Cross-country evidence. *Journal of Economic Growth*, *10*, 199-229. https://doi.org/10.1007/s10887-005-3533-5
15. Blundell, R. & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115-143. https://doi.org/10.1016/S0304-4076(98)00009-8
16. Bologna, J. & Ross, A. (2015). Corruption and entrepreneurship: evidence from Brazilian municipalities. *Public Choice*, *165*(1), 59-77. https://doi.org/10.1007/s11127-015-0292-5
17. Chen, C. & Cheng, S. (2019). The Effects of Corruption and Regulation on Business Entrepreneurship: Evidence from American States. *Public Performance & Management Review*, *42*(6), 1481-1506. https://doi.org/10.1080/15309576.2019.1574593
18. Chowdhury, F. & Audretsch, D. B. (2020). Do corruption and regulations matter for home country nascent international entrepreneurship? *The Journal of Technology Transfer*, *46*, 720-759. https://doi.org/10.1007/s10961-020-09797-3

19. Chowdhury, F., Audretsch, D. B. & Belitski, M. (2019). Institutions and entrepreneurship quality. *Entrepreneurship Theory and Practice*, *43*(1), 51-81. https://doi.org/10.1177/1042258718780431
20. Chowdhury, F., Desai, S. & Audretsch, D. B. (2018). Corruption, entrepreneurship, and social welfare. In Chowdhury, F. et al. (Eds.), *Corruption, Entrepreneurship, and Social Welfare: A Global Perspective* (pp. 67-94). Springer International Publishing. https://doi.org/10.1007/978-3-319-64916-0
21. Cooray, A. & Schneider, F. (2018). Does corruption throw sand into or grease the wheels of financial sector development?. *Public Choice*, *177*(1-2), 111-133. https://doi.org/10.1007/s11127-018-0592-7
22. Cumming, D. J., Grilli, L. & Murtinu, S. (2017). Governmental and independent venture capital investments in Europe: A firm-level performance analysis. *Journal of Corporate Finance*, *42*, 439-459. https://doi.org/10.1016/j.jcorpfin.2014.10.016
23. Cumming, D., Johan, S. & Zhang, Y. (2018). Public policy towards entrepreneurial finance: spillovers and the scale-up gap. *Oxford Review of Economic Policy*, *34*(4), 652-675. https://doi.org/10.1093/oxrep/gry012
24. Davidsson, P. (2015). Entrepreneurial opportunities and the entrepreneurship nexus: A re-conceptualization. *Journal of Business Venturing*, *30*(5), 674-695. https://doi.org/10.1016/j.jbusvent.2015.01.002
25. Davidsson, P. & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing*, *18*(3), 301-331. https://doi.org/10.1016/S0883-9026(02)00097-6
26. Dhahri, S. & Omri, A. (2018). Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say?. *World Development*, *106*, 64-77. https://doi.org/10.1016/j.worlddev.2018.01.008
27. Dreher, A. & Gassebner, M. (2013). Greasing the wheels? The impact of regulations and corruption on firm entry. *Public Choice*, *155*(3-4), 413-432. https://doi.org/10.1007/s11127-011-9871-2
28. Dutta, N. & Meierrieks, D. (2021). Financial development and entrepreneurship. *International Review of Economics & Finance*, *73*, 114-126. https://doi.org/10.1016/j.iref.2021.01.002
29. Dutta, N. & Sobel, R. S. (2018). Entrepreneurship and human capital: The role of financial development. *International Review of Economics & Finance*, *57*, 319-332 https://doi.org/10.1016/j.iref.2018.01.020
30. Dvouletý, O. (2017). Determinants of Nordic entrepreneurship. *Journal of Small Business and Enterprise Development*, *24*(1), 12-33. https://doi.org/10.1108/JSBED-07-2016-0104
31. Fan, Z. & Zhang, R. (2017). Financial Inclusion, Entry Barriers, and Entrepreneurship: Evidence from China. *Sustainability*, *9*(2), 203. https://doi.org/10.3390/su9020203
32. Fisman, R. & Svensson, J. (2007). Are corruption and taxation really harmful to growth? Firm level evidence. *Journal of Development Economics*, *83*(1), 63-75. https://doi.org/10.1016/j.jdeveco.2005.09.009
33. Florida, R. (2003). Entrepreneurship, Creativity, and Regional Economic Growth. In Hart, D. M. (Ed.), *The Emergence of Entrepreneurship Policy: Governance, Start-Ups, and Growth* (pp. 39-58). Cambridge University Press. https://doi.org/10.1017/CBO9780511610134.003
34. Fuentelsaz, L., González, C., Maícas, J. P. & Montero, J. (2015). How different formal institutions affect opportunity and necessity entrepreneurship. *BRQ Business Research Quarterly*, *18*(4), 246-258. https://doi.org/10.1016/j.brq.2015.02.001
35. Gaies, B., Najar, D., Maalaoui, A., Kraus, S. & El Tarabishy, A. (2021). Does financial development really spur nascent entrepreneurship in Europe? A panel data analysis. *Journal of Small Business Management*, *61*(6), 2440-2487. https://doi.org/10.1080/00472778.2021.1896722
36. Gu, W. & Qian, X. (2019). Does venture capital foster entrepreneurship in an emerging market?. *Journal of Business Research*, *101*, 803-810. https://doi.org/10.1016/j.jbusres.2018.12.011
37. Hannafey, F. T. (2003). Entrepreneurship and ethics: A literature review. *Journal of Business Ethics*, *46*, 99-110. https://doi.org/10.1023/A:1025054220365
38. Hessels, J., Van Gelderen, M. & Thurik, R. (2008). Entrepreneurial aspirations, motivations, and their drivers. *Small Business Economics*, *31*, 323-339. https://doi.org/10.1007/s11187-008-9134-x

39. Kakeh Baraie, E., Delangizan, S. & Sohaili, K. (2017). Administrative corruption and its impact on entrepreneurship development: Evidence From Global Entrepreneurship Monitor Institute. *Quarterly Journal of Public Organizations Management*, *6*(1), 131-142.

40. Kar, M. & Özsahin, S. (2016). Role of financial development on entrepreneurship in the emerging market economies. *Eskisehir Osmangazi Üniversitesi IIBF Dergisi*, *11*, 131-152. https://doi.org/10.17153/oguiibf.272723

41. Kaufmann, D. (2007). *Governance matters VI: Aggregate and individual governance indicators, 1996-2006* (Vol. 4280). World Bank Publications. https://doi.org/10.1596/1813-9450-4012

42. Kaufmann, D., Kraay, A. & Mastruzzi, M. (2006). *Governance Matters V: Governance Indicators for 1996–2005* (World Bank Policy Research Working Paper No. 4012). Washington, DC: World Bank. https://doi.org/10.1596/1813-9450-3630

43. Keupp, M. M. & Gassmann, O. (2009). The Past and the Future of International Entrepreneurship: A Review and Suggestions for Developing the Field. *Journal of Management*, *35*(3), 600-633. https://doi.org/10.1177/0149206308330558

44. Klapper, L., Laeven, L. & Rajan, R. (2006). Entry regulation as a barrier to entrepreneurship. *Journal of Financial Economics*, *82*(3), 591-629. https://doi.org/10.1016/j.jfineco.2005.09.006

45. Korosteleva, J. & Belitski, M. (2017). Entrepreneurial dynamics and higher education institutions in the post-Communist world. *Regional Studies*, *51*(3), 439-453. https://doi.org/10.1080/00343404.2015.1103370

46. Korsgaard, S., Anderson, A. & Gaddefors, J. (2016). Entrepreneurship as re-sourcing: Towards a new image of entrepreneurship in a time of financial, economic, and socio-spatial crisis. *Journal of Enterprising Communities: People and Places in the Global Economy*, *10*(2), 178-202. https://doi.org/10.1108/JEC-03-2014-0002

47. Lévesque, M. & Minniti, M. (2011). Demographic structure and entrepreneurial activity. *Strategic Entrepreneurship Journal*, *5*(3), 269-284. https://doi.org/10.1002/sej.117

48. Liu, J., Hu, M., Zhang, H. & Carrick, J. (2019). Corruption and entrepreneurship in emerging markets. *Emerging Markets Finance and Trade*, *55*(5), 1051-1068. https://doi.org/10.1080/1540496X.2018.1531242

49. Liu, P., Li, H. & Guo, H. (2020). The impact of corruption on firms' access to bank loans: evidence from China. *Economic Research-Ekonomska Istraživanja*, *33*(1), 1963-1984 https://doi.org/10.1080/1331677X.2020.1768427

50. Méon, P. G. & Weill, L. (2010). Is corruption an efficient grease?. *World Development*, *38*(3), 244-259. https://doi.org/10.1016/j.worlddev.2009.06.004

51. Mohammadi Khyareh, M. (2017). Institutions and entrepreneurship: the mediating role of corruption. *World Journal of Entrepreneurship, Management and Sustainable Development*, *13*(3), 262-282. https://doi.org/10.1108/WJEMSD-09-2016-0045

52. Munemo, J. (2018). Entrepreneurial success in Africa: How relevant are foreign direct investment and financial development?. *African Development Review*, *30*(4), 372-385. https://doi.org/10.1111/1467-8268.12345

53. Omri, A. (2020). Formal versus informal entrepreneurship in emerging economies: The roles of governance and the financial sector. *Journal of Business Research*, *108*, 277-290. https://doi.org/10.1016/j.jbusres.2019.11.027

54. Omri, A. & Mabrouk, N. B. (2020). Good governance for sustainable development goals: Getting ahead of the pack or falling behind?. *Environmental Impact Assessment Review*, *83*, 106388. https://doi.org/10.1016/j.eiar.2020.106388

55. Pesaran, M. H. (2004). *General diagnostic tests for cross section dependence in panels* (Cambridge Working Paper in Economics No. 0435). Cambridge: Faculty of Economics, University of Cambridge. https://doi.org/10.2139/ssrn.572504

56. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265-312. https://doi.org/10.1002/jae.951

57. Rashid, A., Ahmad, F., Din, S. U. & Zaman, S. (2021). Exploring the relationship between corruption, income inequality and informal sector in developing countries: a panel quantile approach. *Journal of Economic and Administrative Sciences*, (ahead-of-print). https://doi.org/10.1108/JEAS-03-2021-0043

58. Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86-136. https://doi.org/10.1177/1536867X0900900106

59. Sayılır, O., Dogan, M. & Soud, N. S. (2018). Financial development and governance relationships. *Applied Economics Letters*, *25*(20), 1466-1470. https://doi.org/10.1080/13504851.2018.1430311

60. Schumpeter, J. A. (1912). *The Theory of Economic Development*, tenth printing 2004. Transaction Publishers.

61. Shane, S. & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, *25*(1), 217-226. https://doi.org/10.5465/amr.2000.2791611

62. Sharma, C. & Paramati, S. R. (2020). Does financial development reduce the level of corruption? Evidence from a global sample of 140 countries. *International Journal of Finance & Economics*, *26*(4), 5093-5109. https://doi.org/10.1002/ijfe.2056

63. Sobel, R. S. (2008). Testing Baumol: Institutional quality and the productivity of entrepreneurship. *Journal of Business Venturing*, *23*(6), 641-655. https://doi.org/10.1016/j.jbusvent.2008.01.004

64. Son, T. H., Liem, N. T. & Khuong, N. V. (2020). Corruption, nonperforming loans, and economic growth: International evidence. *Cogent Business & Management*, *7*(1), 1735691. https://doi.org/10.1080/23311975.2020.1735691

65. Song, C. Q., Chang, C. P. & Gong, Q. (2020). Economic growth, corruption, and financial development: Global evidence. *Economic Modelling*, *94*, 822-830. https://doi.org/10.1016/j.econmod.2020.02.022

66. Stel, A. V., Carree, M. & Thurik, R. (2005). The effect of entrepreneurial activity on national economic growth. *Small Business Economics*, *24*(3), 311-321. https://doi.org/10.1007/s11187-005-1996-6

67. Svensson, J. (2003). Who must pay bribes and how much? Evidence from a cross section of firms. *The Quarterly Journal of Economics*, *118*(1), 207-230. https://doi.org/10.1162/00335530360535180

68. Szyliowicz, D. & Wadhwani, R. D. (2007). The effects of corruption on entrepreneurial activity: A cross-country study (Summary). *Frontiers of Entrepreneurship Research*, *27*(20), 7.

69. Thai, M. T. T. & Turkina, E. (2014). Macro-level determinants of formal entrepreneurship versus informal entrepreneurship. *Journal of Business Venturing*, *29*(4), 490-510. https://doi.org/10.1016/j.jbusvent.2013.07.005

70. Thurik, A. R., Carree, M. A., Van Stel, A. & Audretsch, D. B. (2008). Does self-employment reduce unemployment?. *Journal of Business Venturing*, *23*(6), 673-686. https://doi.org/10.1016/j.jbusvent.2008.01.007

71. Tran, V. T., Walle, Y. M. & Herwartz, H. (2020). The impact of local financial development on firm growth in Vietnam: Does the level of corruption matter?. *European Journal of Political Economy*, *62*, 101858. https://doi.org/10.1016/j.ejpoleco.2020.101858

72. Urbano, D., Aparicio, S. & Audretsch, D. (2019). Twenty-five years of research on institutions, entrepreneurship, and economic growth: what has been learned?. *Small Business Economics*, *53*, 21-49. https://doi.org/10.1007/s11187-018-0038-0

73. Uribe-Toril, J., Ruiz-Real, J. L., Ceresia, F. & Valenciano, J. D. P. (2019). Corruption and entrepreneurship: A bibliometric analysis. *Journal of Legal, Ethical and Regulatory Issues*, *22*(4), 1-11.

74. Wennekers, S. & Thurik, R. (1999). Linking entrepreneurship and economic growth. *Small Business Economics*, *13*, 27-56. https://doi.org/10.1023/A:1008063200484

75. Williams, C. C. & Shahid, S. (2016). Informal entrepreneurship and institutional theory: Explaining the varying degrees of (in) formalization of entrepreneurs in Pakistan. *Entrepreneurship & Regional Development*, *28*(1-2), 1-25. https://doi.org/10.1080/08985626.2014.963889

76. Wilson, N., Wright, M. & Kacer, M. (2018). The equity gap and knowledge-based firms. *Journal of Corporate Finance*, *50*, 626-649. https://doi.org/10.1016/j.jcorpfin.2017.12.008

77. Wiseman, T. (2015). Entrepreneurship, corruption, and the size of US underground economies. *Journal of Entrepreneurship and Public Policy*, *4*(3), 313-330. https://doi.org/10.1108/JEPP-04-2014-0018

78. Zivari, A., Mohammadi Khyareh, M. & Mazhari, R. (2020). Impact of Access to Finance on Entrepreneurial Activities: Comparison of Selected Developed and Developing Countries. *Journal of Entrepreneurship Development*, *12*(4), 561-580.

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THE MEDIATING ROLE OF ORGANIZATIONAL IDENTIFICATION IN THE EFFECT OF COMPULSORY CITIZENSHIP BEHAVIOR ON EMPLOYEE SILENCE: THE CASE OF TURKISH (KONYA PROVINCE) MANUFACTURING INDUSTRY[1]

Abstract

Purpose: This study discusses the concept of compulsory citizenship behavior (CCB) and identifies the relationships between CCB, organizational identification, and employee silence bearing in mind the Conservation of Resources Theory (COR). In other words, the study examines CCB's effect on employee silence as well as whether organizational identification has a mediating role in this effect.

Methodology: Data were obtained by means of surveys from the employees of the manufacturing sector in a province in Turkey. Data were analyzed using the IBM SPSS, PROCESS Macro, and Amos package software in line with the purpose of the study.

Results: The findings show that CCB negatively affects organizational identification and positively affects employee silence. Furthermore, organizational identification was found to negatively affect employee silence. The findings regarding mediation indicate that organizational identification has a mediating role in CCB's effect on employee silence.

Conclusion: As a result, it was determined that CCB would have negative consequences. The perception of CCB increased employee silence behavior both directly and indirectly (by reducing identification).

Keywords: Compulsory citizenship behavior, organizational identification, employee silence, manufacturing sector

1 The present article was obtained from the first author's master's thesis in Turkey under the supervision of the second author.

1. Introduction

In today's competitive environment, a way for organizations to achieve their goals and continue their existence is for employees to engage in beneficial behaviors beyond their job descriptions (Sajuyigbe et al., 2022). These behaviors, which are expressed as organizational citizenship behaviors and which include behaviors such as helping the adaptation process of the new employees joining the organization and the work they do, being friendly to the customers and trying to complete the assigned tasks without complaining, have constructive effects on the performance of the employees and ultimately on the effectiveness of the organization (Podsakoff et al., 2000). For this reason, it is important for employees to exhibit these behaviors that are beyond their job descriptions for the continuity of their organization. However, employees sometimes move away from exhibiting these beneficial behaviors and limit themselves to the extent of their job descriptions. In these cases, there may be attempts to achieve these behaviors through social pressure. This obligatory citizenship is referred to as compulsory citizenship behavior (CCB) (Vigoda-Gadot, 2006) and can lead to negative reactions and situations among employees. This study discusses this type of citizenship and examines its relationship with positive and negative organizational outcomes. In other words, the present study discusses the relationship between CCB and organizational identification (a positive output) and employee silence (a negative output).

Organizational identification refers to an employee who see themselves as part of their organization and embrace it (Kerse & Karabey, 2019). Although organizational identification, which is perceived to be the same as organizational commitment in terms of this definition, is similar to organizational commitment in terms of attitude, it differs in terms of behavior and affects organizational commitment and other positive attitudes and behaviors (Danışmaz et al., 2019). The emergence of identification makes the employee's work life more meaningful and increases their performance (Mael & Ashforth, 1992). Thanks to identification, employees strive to achieve organizational goals and try to perform at a high level even when there is no supervision (Miller et al., 2000). Therefore, the more they identify and integrate with the organization, the more they contribute to the activities of the organization and ultimately provide a competitive advantage (Christ et al., 2003). For this reason, it is important to ensure identification in organizations.

Employee silence, which is another variable in the focus of the study, refers to refraining from expressing opinions and ideas about situations that will benefit the organization and organizational goals (van Dyne et al., 2003). This conscious employee behavior hinders the functioning of the organization and its development (Alparslan & Kayalar, 2012). In addition, it increases stress at the employee level, and leads to dissatisfaction and resignation; at the organizational level, it prevents change and innovation and decreases performance (John & Manikandan, 2019). For this reason, taking measures to reduce employee silence in organizations is important for organizations to continue their existence. The present study examines the CCB and organizational identification variables, which are likely to reduce silence behavior. In other words, the study attempts to determine whether CCB affects employee silence both directly and indirectly through organizational identification.

The study is expected to contribute to the literature for the following reasons. First of all, the study addresses employee silence behavior, which is quite common in countries with high power distances (Kerse & Karabey, 2018), alongside two important variables that affect it (CCB and organizational identification). Power distance is the level at which individuals in a society accept that power is not equally distributed and value and respect individuals with authority (Hofstede, 1980). In societies with high power distances, such as Turkey (Hofstede, 1980), employees rarely express their thoughts and concerns openly in both private and business life (Kerse & Karabey, 2018). As stated by Kerse and Karabey (2018), in these societies, silence is culturally supported, which is evident in sayings such as 'speech is silver, silence is gold'. Therefore, the present study is important in that it determines the variables that affect employee silence. Furthermore, since employee extra-role behaviors are not clearly defined in high power distance cultures, employees are forced to exhibit citizenship behavior (Chen et al., 2021). The study examines whether this citizenship behavior (i.e., CCB) achieved through this coercion achieves its purpose, that is, whether it provides organizational benefits specific to organizational identification and employee silence. Therefore, the present study is the first to examine CCB's effect on employee silence through organizational identification.

2. Conceptual frame and hypotheses

2.1 Compulsory citizenship behavior (CCB) and organizational identification

Compulsory citizenship behavior (CCB) emphasizes that, in general, beneficial behaviors to be exhibited by employees arise compulsorily as a result of organizational pressures (Danışmaz et al., 2019). CCB is defined as citizenship behaviors such as helping other employees, continuing to work outside the official working time, etc., which are compulsorily put forward as a result of pressures arising from other employees or managers (Vigoda-Gadot, 2006). Although citizenship behavior is included in the definition and citizenship behaviors inherently include beneficial behaviors beyond the job description, these beneficial behaviors include behaviors exhibited with some personal concerns (exclusion, wage cut, excessive workload, etc.) in CCB rather than behaviors exhibited willingly.

Although it is desirable to have citizenship behaviors exhibited voluntarily in organizations, employees sometimes refrain from exhibiting these behaviors (Zhou et al., 2014). This leads managers who want to respond to increasing competition and market pressures to adopt an autocratic management approach and ultimately to pressure employees to go beyond their job descriptions (Vigoda-Gadot, 2006). Although this oppression and the compulsory display of citizenship behavior originates from wanting to achieve organizational benefit and ultimately ensure the continuity of organizational life, this situation (CCB) leads to some negative outcomes. As a matter of fact, studies (Aslan & Yağcı Özen, 2019; Kerse et al., 2019; Doğan, 2019) have found that CCB leads to job stress, conflict between employees, an increase in turnover intention, and a decrease in job satisfaction, organizational commitment and performance. Another negative outcome of CCB is that it reduces organizational identification.

Organizational identification emerges with the presence of employees who embrace their organization and see themselves as an integral part of the organization (Çimen Fedai, 2022). Organizational identification reflects an employee's level of commitment to organizational membership. Accordingly, employees emphasizing their organizational identity when defining themselves, that is, referring to the organization and its characteristics when expressing themselves, show that the level of identification is high (Dutton et al., 1994). In short, organizational identification is the phenomenon of individuals feeling that their own values are one and the same with the values that make the organization an organization (Timur & Behram, 2021).

Employees identifying with their organization is very important for organizations, because employees who identify with their organizations tend to make sacrifices for their organizations. These employee behaviors are more supportive of their organizations and much more consistent with organizational goals (Smidts et al., 2001). Organizational identification not only reduces the differences that arise between the individual interests of the employee and organizational interests, but also reveals a strong convergence between the employees and the organization. This increases employees' interest in their jobs and leads them to be more present in cognitive processes (Brammer et al., 2015).

It is possible to explain the relationship between CCB and organizational identification in a theoretical context with the Conservation of Resources Theory (COR) (Hobfoll, 1989). The conservation of resources theory argues that individuals make efforts to gain, protect and increase resources that they deem valuable (Yürür, 2011). The conservation of resources theory states that employees may consume other resources in line with demands, which may in turn lead to the loss of their available resources (Grandey & Cropanzano, 1999). The employee is negatively affected if they lose their available resources and fail to obtain the sufficient level of resources they want (Hobfoll & Shirom, 2001). In other words, these feelings of stress and psychological insecurity caused by resource loss (Jin et al., 2020) enable them to move away from some attitudes and behaviors in order not to lose resources, even if they would bring organizational benefit. Considering this situation in the context of CCB, employees experience a loss of resources because they exhibit behaviors that are beyond their job descriptions. This loss of resources is undesirable and stressful for employees (Hobfoll, 1989). In the end, employee levels of identification decrease against this organization, causing a loss of resources. Indeed, Zhao et al. (2014) and He et al. (2018) suggested that there is a negative relationship between CCB and organizational identification. Considering the COR theory and research findings, the following hypothesis was developed for the sample on which the research was conducted:

H_1: CCB negatively effects organizational identification.

2.2 CCB and employee silence

Employees voluntarily or involuntarily hiding their knowledge and opinions that may be of benefit to the organization, i.e. remaining silent, is one of the important problems that need to be addressed in today's organizations (Bagheri et al., 2012). Employee silence means that employees hide their real opinions about organizational issues from other employees, including managers (Pinder & Harlos, 2001). Coined by Hirschman (1970), this concept refers to not sharing opinions and ideas that may benefit the organization and provide organizational improvement with the organization and its employees, remaining passive in situations and problems that arise (even if one has opinions and ideas about the issue) (Pinder & Harlos, 2001; van Dyne et al., 2003).

Employee silence is a behavior that starts individually and leads to organizational silence by affecting the organization's other employees (Erdoğan, 2011). This employee behavior hinders creativity, preventing the emergence of new ideas and opinions within the organization (Gül & Özcan, 2011). Therefore, although this behavior involves an individual decision, it is a problem that spreads to the organizational environment and affects the organization completely. For this reason, it is important to determine the reasons behind employee silence. Studies in the literature have suggested that employees prefer to be silent due to fear and worries (Uçar, 2016). Employee silence also has many individual and organizational sources. One of these sources is the perception of CCB.

The COR theory can explain the relationship between CCB and employee silence. In the context of this theory, employees will use time, a resource, to turn to beneficial extra-role behaviors, leading to a loss of resources (Chen et al., 2021). This will cause the employee to refrain from expressing beneficial ideas in order to avoid further losses of resources. This relationship appeared in empirical study findings. He et al. (2019) determined in their study that employees who perceive CCB prefer silence, which is a counterproductive work behavior. In another study, He et al. (2018) indicated that there was a significant positive relationship between CCB and employee silence. Therefore, the following hypothesis was developed for the research sample regarding CCB and employee silence:

H_2: CCB has a positive effect on employee silence.

2.3 Organizational identification and employee silence

Organizational identification occurs when employees accept the basic and important values of their organization together with their own personal values (Ashforth & Mael, 1989). An employee who identifies with the organization develops such a bond that they see the organization's success and failure as their own, which enables them to internalize the organization's goals and make more efforts to achieve these goals (Kerse & Karabey, 2019). Therefore, such an employee is less likely to keep beneficial information and ideas, that is, to engage in silence behavior. There are findings that support this relationship in the literature. Vakola and Bouradas (2005) suggested in their study that employees exhibit less silence behavior with increased levels of organizational identification. In their study, Knoll and van Dick (2013) determined the existence of a negative relationship between organizational identification and types of silence. Considering these findings, the following hypothesis was developed for the research sample:

H_3: Organizational identification has a negative effect on employee silence.

2.4 Organizational identification as a mediator

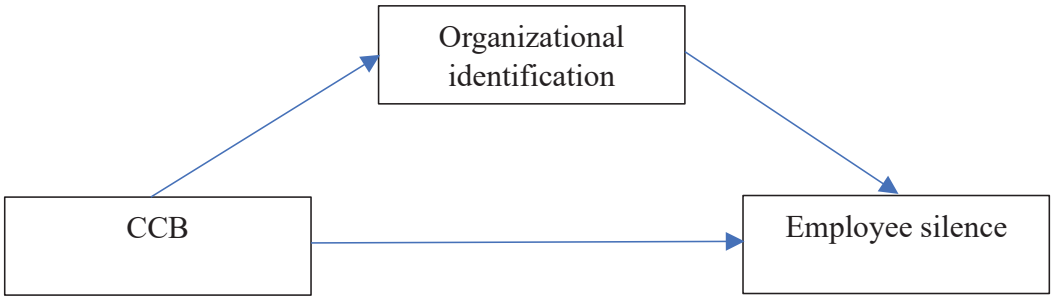
As explained above, employee perception of CCB reduces organizational identification (Ahmadian et al., 2017; Zhao et al., 2014) and leads to silence within the organization (He et al., 2018). However, while organizational identification reduces employee silence, a decrease in identification increases silence behavior (Knoll & van Dick, 2013). This relationship is also in line with the viewpoint of the COR theory. Employees who have to spend time to go beyond their job descriptions due to CCB have reduced organizational identification due to the loss of resources (time and effort) and hesitate to share beneficial opinions and ideas in order to conserve their resources. Therefore, they exhibit silence behavior instead of voice behavior, which is an extra-role behavior.

The above theoretical explanations and empirical findings show that the effect of CCB on employee silence is likely to be through organizational identification. For this reason, the following mediation hypothesis was developed for the research sample:

H_4: Organizational identification has a mediating role in the effect of CCB on employee silence.

The research model was created in line with the above hypotheses. The hypotheses were tested with reference to the said model.

Figure 1 Research model



Source: Authors

3. Method

Karamanoğlu Mehmetbey University Scientific Research Publication Ethical Committee produced ethics committee approval for this study dated 22 November 2021 under number 197-206.

3.1 The research sample

This study attempted to determine the relationships of CCB with employee silence and organizational identification. In other words, the effect of CCB on employee silence was examined both directly and indirectly (through organizational identification). The bulk of the study was formed by the manufacturing sector of Konya province in Turkey. Two businesses operating in this province were selected for the sample. It was determined that there were approximately 250 employees in these businesses. Data were obtained from these employees using simple random sampling. Survey data of 159 employees were evaluated. Considering that the research population is approximately 250 people, the sample size of 159 participants was sufficient, with a 95% reliability level for studies using quantitative methods in social sciences (Gürbüz & Şahin, 2016, p. 132). The majority of the employees were female (57.9%) and single (61%). Additionally, 88% of the employees were aged 36 and under, and 70% of the employees had a high school education or a lower level of education. Only 17.6% of employees worked for the company for more than 6 years, so the participants did not work in their businesses for very long.

3.2 Scales used in the research

Research data were obtained using surveys. The first part of the survey aims at measuring demographic characteristics and consists of 5 items. Other sections include the compulsive citizenship behavior, employee silence, and organizational identification scales, each consisting of 16 items. These scales were obtained from scales previously proven to be reliable and valid. The 5-point Likert-type scales include cross-sectional answers (from 1 - *Strongly disagree* to 5 - *Strongly agree*).

Compulsory citizenship behavior: A 5-item scale developed by Vigoda-Gadot (2007) and adapted into Turkish by Harmancı Seren and Ünaldı Baydun (2017) was used to determine the perception of CCB. The Cronbach alpha value was examined for validity and reliability. The Cronbach alpha coefficient obtained from the scale was 0.782, which meets the criteria and makes it reliably acceptable.

Organizational identification: A 6-item scale developed by Mael and Ashforth (1992) and adapted into Turkish by Başar and Basım (2015) was used to measure organizational identification. The Cronbach alpha coefficient of the scale was found to be 0.859, which makes it reliable.

Employee silence: A 5-item scale developed by Tangirala and Ramanujam (2008) was used to measure employee silence. There is no Turkish adaptation of this scale. Therefore, experts in the relevant fields were consulted for the translations from English into Turkish. The scale was finalized after consulting an expert in the relevant field. The Cronbach alpha coefficient of the scale was 0.879, which makes it reliable.

4. Findings

4.1 Statistical methods used in the research

Data were analyzed using the IBM SPSS, PROCESS Macro and Amos software packages. Reliability analysis, exploratory and confirmatory factor analyses, and correlation analysis were performed using these programs. The data were checked for the general conditions before undergoing the basic analyses. In order to test the validity of the scales used in the study, confirmatory factor analysis was performed for the scales with a Turkish adaptation, and exploratory and confirmatory factor analyses were performed for those without an adaptation. The Cronbach alpha value was examined to test scale reliability levels. Normality analysis was performed to determine whether the data had a normal distribution. The skewness and kurtosis values of the scales were examined for this. Skewness and kurtosis values are between -1.5 and +1.5 in a normal distribution (Tabachnick & Fidell, 2013). The skewness and kurtosis values for each scale were between -1.5 and +1.5 (see Table 1). Therefore, the assumption of normality was met.

4.2 Factor analysis of scales

Confirmatory factor analysis was performed to analyze the construct validity of the CCB, organizational identification and employee silence scales used in the study. Explanatory factor analysis was also performed for the employee silence scale, since it had not been adapted for Turkey. Explanatory factor analysis was carried out in the first stage of scale development and adaptation to determine which factors are formed by the observed variables (Gürbüz & Şahin, 2016).

Care was taken to ensure that the item factor loadings were above 0.40 for factor analysis (Hair et al. 2017). Explanatory factor analysis for the employee silence scale revealed a one-dimensional structure with all item factor loadings scoring above 0.40. The KMO value was 0.842. Barlett's test of sphericity was p = 0.00. The items in the scale explained 67.57% of the total variance. Confirmatory factor analysis was then performed to verify the scale factor structures. Scale item factor loadings and model fit index values provided the reference values, therefore, the construct validity of the scales was confirmed.

Table 1 Scale fit index and normal distribution results

Indexes	Reference value	CCB	Organizational identification	Employee silence
X^2/df	≤5	.673	1.887	1.539
CFI	≥.90	1.000	.992	.995
RMR	<.10	.008	.030	.019
IFI	≥.90	1.001	.992	.995
TLI	≥.90	1.011	.969	.987
RMSEA	≤.08	.000	.075	.058
Skewness		.116	-.740	.766
Kurtosis		-.480	-.082	.210

Source: Authors' calculations

4.3 Hypothesis testing

Before analyzing the study hypotheses, correlation analysis was performed to determine the magnitude and direction of the relationship between CCB, organizational identification and employee silence. The results are presented in the table below.

Table 2 Correlation analysis

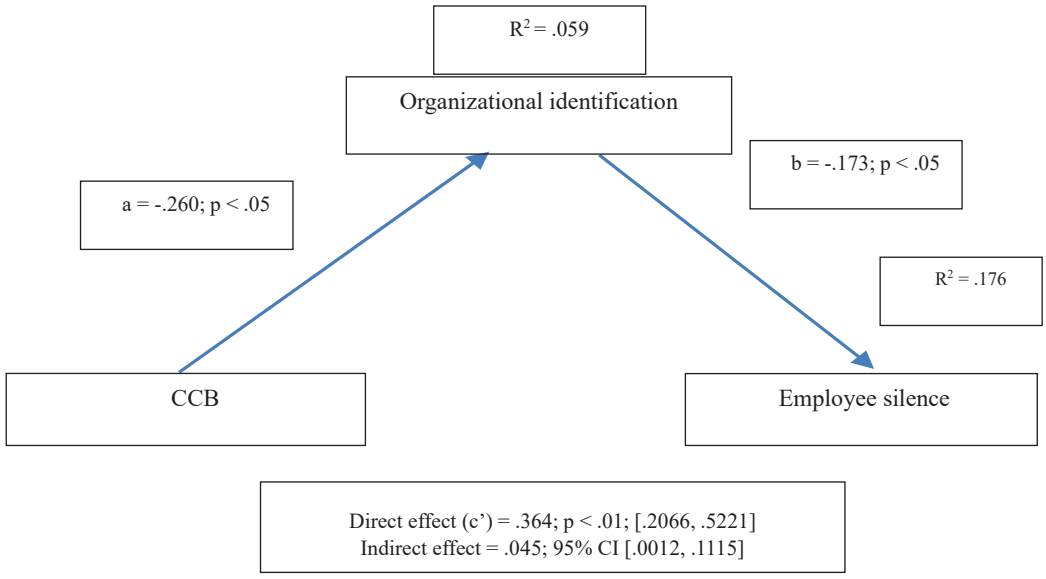
		CCB	OI	ES	Mean	S.D.
CCB	r	1			2.56	.86
	Sig.					
OI	r	-.243**	1		3.62	.92
	Sig.	.002				
ES	r	.384**	-.257**	1	2.17	.92
	Sig.	.000	.001			
CCB: Compulsory citizenship behavior; OI: Organizational identification; ES: Employee silence						

Source: Authors' calculations

In terms of the correlation coefficients, a coefficient value between 0.20 and 0.30 indicates a low-level relationship, whereas a value between 0.30 and 0.70 indicates a moderate relationship (Büyüköztürk, 2016). With this information in mind, examining the correlation analysis table of the variables reveals that there is a negative and low-level relationship between CCB and organizational identification (r = .243). A moderate and positive (r = .384) relationship was identified between CCB and employee silence. The relationship between organizational identification and employee silence was negative and low (r = .257).

Direct hypotheses and mediation hypotheses were analyzed using the Process Macro software developed by Hayes. The analyses were performed using the bootstrap technique. This contemporary technique makes it possible to calculate the indirect effect and make inferences from the calculated values (Gürbüz, 2019). Mediation analysis was carried out in Process Macro with reference to Model 4. The dependent variable was "employee silence", the independent variable was "CCB", and the mediating variable was "organizational identification". The findings regarding Model 4 are presented in Figure 2.

Figure 2 Hypothesis test results



Source: Authors' calculations

The findings revealed that CCB and organizational identification accounted for approximately 18% (R^2 = .176) of the total change in employee silence. CCB was found to account for approximately 6% of the change in organizational identification (R^2 = .059). Findings regarding the effect of CCB on organizational identification (a pathway) indicate that this effect is significant and negative (b = -.260; p < .05). Based on this finding, "H1: It can be said that compulsory citizenship behavior has a negative effect on organizational identification" is accepted. The direct effect of CCB on employee silence (c' pathway) is positive and significant (b = .364; p < .01). Based on this finding, "H2: Compulsory citizenship behavior has a positive effect on employee silence" is accepted. Findings regarding the effect of organizational identification on employee silence (b = -.173; p < .05) indicate that the effect is negative and significant. Based on this, "H3: Organizational identification has a negative effect on employee silence" is accepted. The finding on the indirect effect regarding the mediation hypothesis indicates that CCB has an indirect effect on employee silence (b = .045), and this effect is significant (95% CI [.0012, .1115]). Moreover, the confidence interval values did not include zero (0), indicating that this relationship is significant. Based on these findings; "H4: Organizational identification has a mediating role in the effect of compulsory citizenship behavior on employee silence" is accepted.

5. Evaluation and conclusion

This study examined the effect of CCB on organizational identification and employee silence, obtaining findings that would make contributions to the literature. The first finding indicates that CCB negatively and significantly affects organizational identification, therefore supporting previous findings in the literature (Zhao et al., 2014; He et al., 2018). Additionally, in parallel with findings in the literature (He, et al., 2018; He et al., 2019), the findings of this study indicate that CCB directly and positively affects employee silence. The effect of organizational identification on employee silence was also negative, supporting the findings from other studies (Vakola & Bouradas, 2005; Knoll & van Dick, 2013). On the other hand, the analysis findings indicated that CCB affects employee silence not only directly, but also indirectly (through organizational identification). Therefore, CCB decreases employee identification levels, leading them to refrain from sharing beneficial information with the organization, therefore leading to silence behavior.

It would be beneficial to point out certain theoretical and practical implications based on these findings. The present study addresses the concept of CCB, which is common in high power distance societies (Chen et al., 2021), as well as its direct and indirect effects on silence behavior, which is also common in high power distance societies. The findings revealed that CCB (Vigoda-Gadot, 2006), which is incentivized for employees to provide organizational benefit, led to negative organizational outcomes. In other words, CCB increased employee silence behavior, which is a negative organizational outcome. Additionally, decreases in the level of organizational identification were found to lead to this increase. CCB reduced employee identification, ultimately leading to employee silence behavior. Therefore, the direct and indirect relationships between CCB and employee silence confirmed the perspective of the COR theory.

Moreover, the present study made contributions to the literature by evaluating CCB, organizational identification and employee silence together as variables. In their study, He et al. (2019) called for the relationship between CCB and employee silence to be addressed with different variables. The present study is the first in the literature to determine that organizational identification plays a mediating role in the relationship between CCB and employee silence, therefore revealing the mechanism driving these three variables and answering the call made by He et al. (2019).

All these findings have clearly shown that citizenship behavior should be voluntary and that making it compulsory can lead to negative outcomes. For this reason, organization managers are advised not to pressure employees to exhibit extra-role behaviors. It should also be noted that pressure regarding citizenship behavior is not applied only by managers. Coworkers may also apply this pressure on others. Therefore, organizations should strive to create organizational climates that do not pressure employees in such a way to create this citizenship.

Finally, one of the main duties of managers is to openly express beneficial ideas about work and the organization, ultimately maintaining organizational life. In high power distance societies such as Turkey, silence in private life is also reflected on organizational life. For this reason, although it is possible

to keep silence behavior to a minimum, it cannot be completely eliminated. One way to achieve this is to ensure that the employee identifies with the organization. As our findings indicate, the employee can get rid of silence behavior if they identify with their organization and embrace it as their own. Therefore, it may be beneficial to determine the factors that can enable identification and an organizational life that will make this possible.

6. Limitations and recommendations

The study has certain limitations alongside its above-mentioned contributions. Firstly, the study was conducted using a manufacturing sector sample from a single province in Turkey and used a cross-sectional design. This situation prevented a generalization encompassing the manufacturing sector as a whole. Therefore, it is useful to make the research findings and the inferences made above by taking this sample limitation into consideration because the effect of CCB on employee silence (through organizational identification) is specific to the sample in this study (Konya province). Secondly, the data were collected in November 2021, i.e. during the COVID-19 pandemic. Therefore, it is possible that the employees did not answer the survey questions with necessary care. For these reasons, it may be recommended to test the research model in the post-pandemic period. In fact, adding moderator variables to the research model in question and testing it in different sectors can benefit the relevant literature and practitioners. In addition, it should be studied how CCB affects employee silence in different cultures, trying to determine other moderating variables.

References

1. Ahmadian, S., Sesen, H. & Soran, S. (2017). Expanding the boundaries of compulsory citizenship behavior: Its impact on some organizational outputs. *Business and Economic Horizons*, *13*(1), 110-118. https://doi.org/10.15208/beh.2017.08
2. Alparslan, A. M. & Kayalar, M. (2012). Örgütsel sessizlik: Sessizlik davranışları ve örgütsel ve bireysel etkileri. *Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *4*(6), 136-147.
3. Ashforth, B. E. & Mael, F. (1989). Social identity theory and the organization. *Academy of Management Review*, *14*(1), 20-39. https://doi.org/10.2307/258189
4. Aslan, Ş. & Yağcı Özen, M. (2019). *Örgütsel vatandaşlık davranışından zorunlu vatandaşlık davranışına.* In *Proceedings of the 2nd International Congress on New Horizons in Education and Social Sciences (ICES-2019)* (pp. 682-689). https://doi.org/10.21733/ibadjournal.584469
5. Bagheri, G., Zarei R. & Aeen, M. N. (2012). Organizational silence (basic concepts and its development factors). *Ideal Type of Management*, *1*(1), 47-58.
6. Başar, U. & Basım, N. (2015). Effects of organizational identification on job satisfaction: Moderating role of organizational politics. *Yönetim ve Ekonomi Dergisi*, *22*(2), 663-683. https://doi.org/10.18657/yecbu.61175
7. Brammer, S., He, H. & Mellahi, K. (2015). Corporate social responsibility, employee organizational identification, and creative effort: The moderating impact of corporate ability. *Group and Organization Management*, *40*(3), 323-352. https://doi.org/10.1177/1059601114562246
8. Büyüköztürk, Ş. (2016). *Bilimsel araştırma yöntemleri.* Pegem Akademi Publishing. https://doi.org/10.14527/9789944919289
9. Chen, P., Xu, Y., Sparrow, P. & Cooper, C. (2021). Compulsory citizenship behaviour and work-family conflict: A moderated mediation model. *Current Psychology*, *42*(8), 6641-6652. https://doi.org/10.1007/s12144-021-01973-4
10. Christ, O., Van Dick, R., Wagner, U. & Stellmacher, J. (2003). When teachers go the extra mile: foci of organisational identification as determinants of different forms of organisational citizenship behaviour among schoolteachers. *British Journal of Educational Psychology*, *73*(3), 329-341. https://doi.org/10.1348/000709903322275867
11. Çimen Fedai, G. (2022). *Örgütsel yıldırmanın örgütsel özdeşleşme ve işten ayrılma niyeti üzerine etkisi – bankacılık sektöründe bir uygulama* [Master thesis, Necmettin Erbakan University]. Necmettin Erbakan University.
12. Danışmaz, A. T., Bozkurt, S. & Bal, Y. (2019). Zorunlu vatandaşlık davranışı ile örgütsel bağlılık arasındaki ilişkide başarma ihtiyacının rolünün kurumsal ve kavramsal açıdan incelenmesi. *The Journal of Social Science*, *6*(38), 259-275. https://doi.org/10.16990/SOBIDER.5092
13. Doğan, E. (2019) *İstismarcı yönetim algısının zorunlu vatandaşlık davranışlarına etkisinde kariyerizmin moderatör etkisi* [Master thesis, Gebze Technical University]. Gebze Technical University.
14. Dutton, E. J., Dukerich, M. J. & Harquail, V. C. (1994). Organizational images and member identification. *Administrative Science Quarterly*, *39*(2), 239-263. https://doi.org/10.2307/2393235
15. Erdoğan, E. (2011). *Etkili liderlik örgütsel sessizlik ve performans ilişkisi* [Master thesis, Gebze Technical University]. Gebze Technical University.
16. Grandey, A. A. & R. Cropanzano (1999). The conservation of resources model applied to work-family conflict and strain. *Journal of Vocational Behavior*, *54*(2), 350-370. https://doi.org/10.1006/jvbe.1998.1666
17. Gül, H. & Özcan N. (2011). Mobbing ve örgütsel sessizlik arasındaki ilişkiler: Karaman İl Özel İdaresi'nde görgül bir çalışma. *KSÜ İİBF Dergisi*, *1*(2), 107-135.
18. Gürbüz, S. (2019). *Sosyal bilimlerde aracı, düzenleyici ve durumsal etki analizleri*. Seçkin Publishing.
19. Gürbüz, S. & Şahin, F. (2016). *Sosyal bilimlerde araştırma yöntemleri.* Seçkin Publishing.

20. Hair Jr, J. F., Hult, G. T. M., Ringle, C. M. & Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM).* Sage Publications.
21. Harmancı Seren, A. K. & Ünaldı Baydın, N. (2017). Zorunlu vatandaşlık davranışı ölçeği'nin Türkçede geçerlik ve güvenirlik çalışması: Hemşireler üzerinde bir araştırma. *Sağlık ve Hemşirelik Yönetimi Dergisi*, *4*(2), 43-49.
22. He, P., Peng, Z., Zhao, H. & Estay, C. (2019). How and when compulsory citizenship behavior leads to employee silence: A moderated mediation model based on moral disengagement and supervisor–subordinate guanxi views. *Journal of Business Ethics*, *155*, 259-274. https://doi.org/10.1007/s10551-017-3550-2
23. He, P., Wang, X., Li, Z., Wu, M. & Estay, C. (2018). Compulsory citizenship behavior and employee silence: The roles of emotional exhaustion and organizational identification. *Social Behavior and Personality*, *46*(12), 2025-2048. https://doi.org/10.2224/sbp.7452
24. Hirschman, A. O. (1970). *Exit, Voice and Loyalty. Responses to Decline in Firms, Organizations and States.* Harvard University Press.
25. Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, *44*(3), 513-524. https://doi.org/10.1037/0003-066X.44.3.513
26. Hobfoll, S. E. & Shirom, A. (2001). *Conservation of Resources Theory: Applications to stress and management in the workplace.* In Golembiewski, R. T. (Ed.), *Handbook of Organizational Behavior* (pp. 57-80). Marcel Dekker.
27. Hofstede, G. (1980). Culture and organizations. *International Studies of Management & Organization*, *10*(4), 15-41. https://doi.org/10.1080/00208825.1980.11656300
28. Jin, X., Jiang, J., Li, P. & Li, B. (2020). LMX and voice: A test in the Chinese hospitality industry. *Anatolia*, *31*(1), 131-141. https://doi.org/10.1080/13032917.2020.1716259
29. John, S. P. & Manikandan, K. (2019). Employee silence: A meta-analytic review. *International Journal of Indian Psychology*, *7*(1), 354366.
30. Kerse, G. & Karabey, C. N. (2018). Is the voice gold or silence? The relationship political behaviour perceptions, leader-member exchange and employee voice. In Çankaya, F. & Kayıkçı, S. (Eds.), *Sosyal, Beşeri ve İdari Bilimler'de Akademik Araştırmalar-IV* (pp. 487-506). Gece Publishing.
31. Kerse, G. & Karabey, C. N. (2019). Örgütsel sinizm ve özdeşleşme bağlamında algılanan örgütsel desteğin işe bağlanma ve politik davranış algısına etkisi. *Eskişehir Osmangazi Üniversitesi İİBF Dergisi*, *14*(1), 83-108. https://doi.org/10.17153/oguiibf.439835
32. Kerse, G., Koçak, D. & Yücel, İ. (2019). Örgütsel vatandaşlığın zorunlu olması iş tatminini etkiler mi? iş stresi bağlamında bir inceleme. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*, *21*(2), 547-560. https://doi.org/10.32709/akusosbil.505213
33. Knoll, M. & van Dick, R. (2013). Authenticity, employee silence, prohibitive voice, and the moderating effect of organizational identification. *The Journal of Positive Psychology*, *8*(4), 346-360. https://doi.org/10.1080/17439760.2013.804113
34. Mael, F. A. & Ashforth, B. E. (1992). Alumni and their alma mater: A partial test of the reformulated model of organizational identification. *Journal of Organizational Behaviour*, *13*(2), 103-123. https://doi.org/10.1002/job.4030130202
35. Miller, V. D., Allen, M., Casey, M. K. & Johnson, J. R. (2000). Reconsidering the organizational identification questionnaire. *Management Communication Quarterly*, *13*(4), 626-658. https://doi.org/10.1177/0893318900134003
36. Pinder, C. & Harlos, K. (2001). Employee silence: Quiescence and acquiescence as responses to perceived injustice. *Research in Personnel and Human Resources Management*, *20*, 331-369. https://doi.org/10.1016/S0742-7301(01)20007-3
37. Podsakoff, P. M., MacKenzie, S. B., Paine, J. B. & Bachrach, D. G. (2000). Organizational citizenship behaviors: A critical review of the theoretical and empirical literature and suggestions for future research. *Journal of Management*, *26*(3), 513-563. https://doi.org/10.1177/014920630002600307

38. Sajuyigbe, A. S., Inegbedion, H. E., Adebanji, A. & Ighomereho, S. O. (2022). Compulsory citizenship behavior, work-life balance, and turnover intention in Academia: Mediating effects of emotional intelligence. *The Journal of Behavioral Science*, *17*(2), 58-72.

39. Smidts, A., Pruyn, Ad. T. H. H. & van Riel, C. B. M. (2001). The impact of employee communication and perceived external prestige on organizational identification. *Academy of Management Journal*, *44*(5), 1051-1062. https://doi.org/10.2307/3069448

40. Tabachnick, B. G. & Fidell, L. S. (2013). *Using Multivariate Statistics*. Pearson.

41. Tangirala, S. & Ramanujam, R. (2008). Employee silence on critical work issues: The cross level effects of procedural justice climate. *Personnel Psychology*, *61*(1), 37-68. https://doi.org/10.1111/j.1744-6570.2008.00105.x

42. Timur, A. & Behram, N. (2021). İşveren markası ve örgütsel bağlılık ilişkisinde örgütsel özdeşleşmenin aracı rolü: Sosyal Kimlik Kuramı bağlamında bir araştırma. *Finans Ekonomi ve Sosyal Araştırmalar Dergisi*, *6*(1), 135-150. https://doi.org/10.29106/fesa.857470

43. Uçar, Z. (2016). Örgütsel (Işgören) sessizlik olgusunun kişisel ve demografik özellikler bağlamında araştırılması: Nitel bir çalışma. *Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *31*(1), 311-342. https://doi.org/10.24988/deuiibf.2016311511

44. Vakola, M. & Bouradas, D. (2005). Antecedents and consequences of organisational silence: An empirical investigation. *Employee Relations*, *27*(5), 441-458. https://doi.org/10.1108/01425450510611997

45. van Dyne, L., Ang, S. & Botero, I. C. (2003). Conceptualizing employee silence and employee voice as multidimensional constructs. *Journal of Management Studies*, *40*(6), 1359-1392. https://doi.org/10.1111/1467-6486.00384

46. Vigoda-Gadot, E. (2006). Compulsory citizenship behavior: Theorizing some dark sides of the good soldier syndrome in organizations. *Journal for the Theory of Social Behaviour*, *36*(1), 77-93. https://doi.org/10.1111/j.1468-5914.2006.00297.x

47. Vigoda-Gadot, E. (2007). Redrawing the boundaries of OCB? An empirical examination of compulsory extra-role behavior in the workplace. *Journal of Business and Psychology*, *21*(3), 377-405. https://doi.org/10.1007/s10869-006-9034-5

48. Yürür, Ş. (2011). Öğrenilmiş güçlülük, kıdem ve medeni durumun duygusal tükenmedeki rolü: Kaynakların Korunması Teorisi kapsamında bir analiz. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *25*(1), 107-126.

49. Zhao, H., Peng, Z. & Chen, H. K. (2014). Compulsory citizenship behavior and organizational citizenship behavior: The role of organizational identification and perceived interactional justice. *The Journal of Psychology*, *148*(2), 177-196. https://doi.org/10.1080/00223980.2013.768591

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FINDING AN OPTIMAL DISTRIBUTION STRATEGY PATH IN AN UNPREDICTABLE ENVIRONMENT

Abstract

Purpose: This article introduces an innovative method designed to optimize distribution strategies with respect to future uncertainty. It goes beyond the limitations of traditional scenario-based planning that often leads to suboptimal strategies due to the unpredictability of future developments and the challenge of accurately assigning probabilities to these scenarios. Consequently, the method allows selection of the most economically viable future strategy.

Methodology: Our methodology diverges from conventional approaches by refraining from making rigid assumptions about the probabilities of future scenarios. Instead, it comprehensively explores the entire allowable probability space to identify an optimal strategy that works well in possible future developments. We employed this method in the case study of a real-world company based in Czechia, where we devised three viable distribution strategies and four model development scenarios.

Results: The application of our method demonstrated its effectiveness in selecting the most advantageous strategy, as evidenced by the results of our case study. However, the applicability of the method is contingent upon the accurate definition of potential future scenarios and the evaluation of the performance of different strategies within these scenarios.

Conclusion: Our findings suggest that this approach significantly enhances strategic planning under uncertainty. Future research will seek to refine this method further by integrating causal relationships to convey additional information across different model periods, thereby improving the robustness and applicability of the strategy selection process.

Keywords: Supply chain optimization, probabilistic modelling, economic resilience, cost-benefit analysis

1. *Introduction*

This paper presents a robust and reliable approach to the difficult task of distribution strategy decision-making in an environment prone to significant volatility and uncertainty. Distribution strategy planning is a process that each company with a larger volume transported in their network should do. This large volume indirectly affects a company's profit and provides considerable savings even though it is inefficient. Specifically, companies categorized as medium-sized enterprises and larger[1] should already start to consider their network on a strategic long-term level. Whether it is a key topic

1 Lex-Europa

for the company depends on its segment and the efficiency of its current logistics solution. For example, based on an analysis performed by Bain and Co.[2] in the segment of consumer-packed goods, the share of distribution cost on the total revenue is 6-10%. The higher the ratio, the greater the optimization space it provides. These numbers differ in other segments but should always be critically revised and considered.

The task of distribution strategy planning itself is very complex. Distribution network design aims to plan the most cost-efficient manner of product movement through the whole supply chain (Ambrosino & Grazia Scutellà, 2005). To stress the importance, Ballou (2001) estimated that operation costs can be reduced by up to 15% through an efficient distribution network and effective facility management, making a difference between higher and lower shares in the above-mentioned analysis. Mangiaracina et al. (2015) composed a highly comprehensive review of the distribution network optimization methods in contemporary literature. However, there is a significant gap in the rigid process of handling uncertainties during planning.

From a very high level, we can divide the distribution strategy into two groups: outsourced to a partner (3PL or 4PL or other) and insourced; for a more detailed description, see e.g. Panicker et al. (2009). In the first case, there is not enough room for large distribution questions and optimization. This kind of solution fits better smaller companies than those defined above, and the current trend on the market is to regain control of the company's logistics and abandon X-PL schemes. Further, in this article, we will consider only insourced logistics solutions.[3]

When a distribution strategy is to be designed, it cannot be performed with the outlook for a small period. A distribution network is a structure that requires time to change. It consists of logistics nodes, distribution fleets, and accompanying processes; for more details, refer to Ambrosino and Grazia Scutella (2005). Logistics nodes need to be either constructed or rented. Even in the case of renting, it takes at least six months to get a logistics node fully operational. The fleet is usually leased or outsourced without losing control over the operations, and changes can be performed faster. For larger companies, the fleet agreement preparation and signing processes again demand a substantial amount of time.

These aspects create an apparent necessity to plan and optimize a distribution strategy in advance. At the same time, future effects such as market changes, new customers, drops in demand, external influences such as legislation and petrol costs, and much more, play a significant role in the process. These effects are difficult to evaluate precisely as they carry a high degree of uncertainty.

Therefore, we propose the following research question:

Given several possible development scenarios, how do we select the best long-term distribution strategy without making rigid assumptions regarding their probability?

Consequently, this article aims to propose and test a method for evaluating distribution strategies that avoids rigid assumptions about future development, thereby providing a tool for management to make informed, economically sound decisions over multi-year perspectives.

The article is structured as follows. First, we introduce the underlying model in Section 1.1, provide a literature review in Section 2, and establish the notation used in Section 3. Next, we propose a method for modeling the optimal distribution strategy and evaluating its share in the whole space of available strategies in Section 4, which is the main contribution of this article. The model is then tested in Section 5 on a business case of an electronics merchant, where we use it to plan an optimum long-term distribution strategy. Section 6 provides an overview of results and the last section concludes the whole article.

1.1 Model background

This article builds on a novel Concurrent Optimization Model (COM) (Petřík & Plajner, 2023), which allows the selection of the best long-term distribution strategy based on various development scenarios, their respective likelihoods, and the values of several potential distribution strategies. Using the COM, the authors evaluated different possible expansion strategies of a real-world company.

In the COM, the effectiveness of each strategy is measured using a key performance indicator (KPI), such as the distribution network operating costs. The COM incorporates the principles of Bayes-

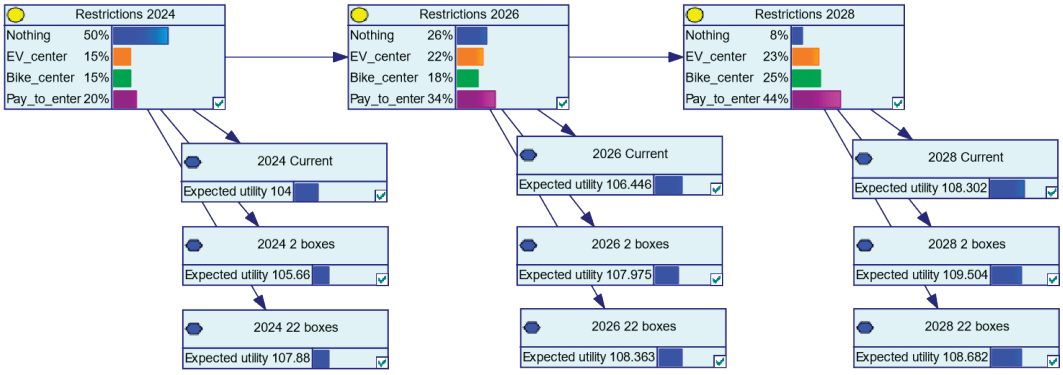
2 Bain & Co.

3 Nevertheless, specific parts of this solution can be rented or leased from 3rd parties.

ian networks (Jensen & Nielsen, 2007; Kjaerulff & Madsen, 2013) to encompass the complete system of values and beliefs. Bayesian networks are probabilistic graphical models that visually depict knowledge about a system under uncertainty. In these networks, each node represents a random variable, and each connecting arc represents a conditional probability relationship. An example structure of such a network can be seen in Figure 1. The chance nodes represent the model company each year. Each chance node has a set of states. In this particular case, there are traffic restrictions that could be adopted by the city that the company operates in. The connecting arcs between the nodes represent the conditional relationships. The variable at the beginning of an arc is called the parent of the variable at its end. A conditional relationship is specified by a conditional probability table (CPT), which specifies the probabilities of states of the child, given all states of the parent node. The three nodes dependent on each chance node in Figure 1 are called utility nodes. Their purpose is to measure the expected value of each considered distribution strategy, given the conditional probability of each scenario of the given chance node they depend on.

However, specifying precise conditional relationships usually requires a lot of work in real-world strategic planning. To address this issue, the approach described in this article assumes only limited or no knowledge of the likelihood of each modeled scenario and no knowledge of the conditional dependencies. Therefore, the model presented in this article assumes no dependent relationships between variables, and hence, we do not apply the BN framework in its entirety as Petřík and Plajner (2023) did. However, in our more general approach, we employ a similar optimization procedure to select the best option for each potential development scenario when searching through the entire probabilistic space. We subsequently measure the share of cases where each distribution strategy is optimal. A significant advantage of the method presented here lies in its ability to provide valuable insights without placing precise, potentially biased assumptions regarding future business scenario development.

Figure 1 Example of the network structure used



Source: Output from the GeNIe 3.0 academic software produced by the authors

2. Literature review

The presented article deals with distribution strategy planning under uncertainty, which broadly consists of distribution network design and planning. Distribution network design is not the primary focus of this article; the reader is referred to other sources, such as Chopra (2003) or Mangiaracina et al. (2015). The branch of literature related to supply chain planning under uncertainty, in line with the topic of this article, is discussed in this literature review. There are a wide range of approaches to planning and risk management in unpredictable environments of supply chains. Trend impact analysis (Gordon & Stover, 1976) and cross-impact analysis (Gordon & Stover, 2003) comprise a foundational class of scenario planning approaches, which utilize historical data and expert opinions to formulate possible future development scenarios. Both approaches were introduced mainly by the same authors and have many applications, for example, developing resilient scenarios for hospital supply chains (Nejad et al., 2021). Research in the field is ongoing, and new methods and applications are being developed; for example, the concept of VUCA

(volatility, uncertainty, complexity, and ambiguity) has been explored to identify the challenges and internal barriers in realizing a resilient supply chain (Grzybowska & Tubis, 2022). Mathematical models have also been developed for recovery planning in three-tier manufacturing supply chains facing sudden disturbances (Paul et al., 2019). A common aspect of these studies is the emphasis on the need for robust planning mechanisms to navigate the complexities of modern supply chains. Bayesian networks (Jensen & Nielsen, 2007; Kjaerulff & Madsen, 2013), a class of probabilistic graphical models, have been used to deploy a probabilistic approach to risk management. Examples of specific use cases are a risk propagation model (Garvey et al., 2015), supply-side risk modeling (Sharma et al., 2022), or a resilience assessment on a deep water port (Hossain et al., 2019).

Further studies have explored predictive sales and operations planning based on statistical treatment of demand to increase a manufacturer's efficiency (Gallego-García & García-García, 2021), as well as, for example, sustainable closed-loop supply chain synergy in the forestry industry (Wang & Tian, 2022). Optimal inventory control using stochastic optimization models has also been discussed, focusing on multi-echelon supply chains with uncertain demand (Crevecoeur et al., 2019). These studies indicate the growing interest in employing probabilistic and statistical methods for planning and risk management in domains of a company's operations. Such models considering uncertainty have not been heavily utilized so far.

Despite extensive research in these areas, the specific topic of distribution strategy planning in unpredictable environments still needs to be explored. The following section presents the notation used later in our model. The main contribution of this article, our method to find an optimal distribution strategy path in an unpredictable environment, is then developed in Section 4.

3. Notation

Our model searches for the optimum long-term distribution strategy given a set of business scenarios and a set of feasible potential distribution strategies. Business scenarios can be, for example, different sales growth trajectories, shifts in consumer behavior, or a black swan event (Taleb, 2007). Distribution strategies are different configurations of the company distribution network. For the optimization procedure from the COM, they must be evaluated across all considered business scenarios. Therefore, if we, for example, consider four business scenarios and two distribution strategy setups, there must be eight estimates in total.

For clarity, we use the same basic notation (Petřík & Plajner, 2023) when appropriate.

The distribution strategy is designed for n consecutive time periods. Variable $A^i,\ i \in 1 \dots n$, is the modeled company in the period i and its states $a^i_j, j \in 1 \dots m^i$ are the possible business scenarios where the company can be in that period. $A = \{A^1, \dots, A^n\}$ is the set of all company nodes at all time periods. The company must then design a number d of feasible distribution networks **Z,** which could accommodate the needs of company A. Symbol $Z^i_f, i \in \{1, \dots, n\}, f \in \{1, \dots, d\}$ then refers to a strategy Z_f implemented during a specific period i.

Next, it is necessary to choose a KPI which will be used to evaluate each business scenario – a distribution network combination. We define distribution network operating costs as the one most frequently used in practice from our experience. Distribution network operating costs[4] for a company are costs related to network operations. $c^i_{j,f}, i \in \{1, \dots, n\}, j \in \{1, \dots, m^i\}, f \in \{1, \dots, d\}$ stands for distribution network operating costs in a state a^i_j while operating a distribution network Z_f. The tool to obtain all estimates c^i_j can be chosen freely, but it must be possible for every Z_f at every state a^i_j included in the model.

4. Methodology for modeling the share of cases when a distribution strategy is optimal

While facing the long-term planning task and creating a robust strategy, expectations of future development are required. This can be obtained using data and mathematical forecasting methods (such as regressions, neural networks, and the like) or experts and their opinions and educated guesses. Having worked on various distribution strategy design projects, we discovered that acquiring conditional probability tables, as described in Subsection 1.1, is challenging using either data or expert

4 The exact estimation of the distribution network operation costs is always case-specific. However, the costs usually contain fleet operating costs, warehousing costs, external pallet carrier costs, and overhead costs.

knowledge, especially with a long horizon of several years. Underlying data are usually too sparse for robust predictions, prone to unforeseen events, and expert knowledge is difficult to obtain in a precise form. The causal transitions among states between company nodes are difficult to capture and notoriously prone to misspecification. To address this difficulty, we design a process that helps experts fill their expectations into the model and calculation even though they are very imprecise. We propose to limit the possible future scenarios to a smaller area (viable options). In this area of potential future development, we estimate the percentage share when a distribution strategy is optimal. This gives strategists and planners an answer to the possibility that the selected path will be correct, which is important information in the planning process. The advantage of this approach lies in its robustness to user misperceptions about the likelihood of future development scenarios. On the other hand, even with this approach, evaluating the future distribution network scenario is necessary as it is an essential input for calculations. We use proprietary software, Distribution Wizard, which allows us to do such calculations.

The computations in the presented model are conducted separately for each company node A^i, $i \in 1...n$, from the network. Accordingly, we assume independence of different company nodes. However, the users have demonstrated a far better ability to accurately describe the probability of a_j^i by an interval than by an exact CPT. Therefore, we allow the user to restrict the probability of each state a_j^i in the network, to model their assumptions about the probability of state a_j^i.

The user-restricted probability space **P** can be defined as:

$$\boldsymbol{P} = P\left(A^i = a_j^i\right) \in \left[\overline{w_j^i}, \widehat{w_j^i}\right], i \in \{1,2,\dots,n\},$$
$$j \in \{1,2,\dots,m^i\}, \overline{w_j^i} \in [0,1], \widehat{w_j^i} \in [0,1],$$

where $\overline{w_j^i}$ and $\widehat{w_j^i}$ are the lower and the upper limit for the probability that state a_j^i can have. In the application presented in this article, we model business scenarios in which the modeled company is assumed to shift part of its wholesale from Czechia to Poland. The user-restricted probability space **P** allows us to model the situation when, for example, the scenario in mind has a probability of at least 10% and a maximum of 60% to happen in the future.

Now, let us define a subspace $\mathbf{W}_f \subseteq \mathbf{P}$, which represents all probability combinations for which a strategy $f \in \{1,\dots,d\}$ is optimal. Probabilities $p_j^i, i \in \{1,\dots,n\}, j \in \{1,\dots,m^i\}$ create the subspace W_f, where the following condition is satisfied for a given *f*:

$$f = \arg\min_d \left\{\sum_{j=1}^{m^i} p_j^i \, c_{j,d}^i\right\}. \quad (1)$$

The condition given by Equation 1 is based on the COM (Petřík & Plajner, 2023) and states that a distribution strategy Z_f yields the lowest expected distribution network operating costs at the company node A^i given the probability combination p_j^i and the costs $c_{j,d}^i$ associated to each business scenario a_j^i and each distribution strategy Z_d.

Finally, we want to estimate the size of the subspace W_f. Let us first denote the size as $S \in [0,1]$, $S(W_f) = 0$ implies that the strategy is never optimal in the subspace. The size *S* of the strategy *f* is then the integral of the $(r-1)$th order over this subspace. *r* is the number of states a_j^i which a company node A^i can have. One integral dimension is subtracted due to the logical restriction $\sum_j p(a_j^i) = 1$.

$$S(\boldsymbol{W_f}) = \int_{W_f}^{(r-1)} 1 dW_f \quad (2)$$

In case there are user-defined restrictions placed on the probability space **P**, $\sum_{f=1}^{d} S(W_f) \neq 1$. Therefore, the values $S(W_f)$ are normalized to

$$S'(\mathbf{W}_f) = 1 \quad (3)$$

for better interpretation. The resulting $S'(\mathbf{W}_f)$ then represents the percentage share of the cases when the strategy *f* is optimal in the user-restricted probability space **P**.

5. Case study: choosing the optimal distribution strategy in an unpredictable environment

In a case study involving a consumer electronics wholesale company[5] operating primarily in Czechia, we applied the methodology presented in Section 4 to explore the probability of three distinct

5 At the company's request, the name will remain undisclosed, as will any other fact by which it could be decisively identified. Consequently, all prices are always quoted in units corresponding to the CZK* coefficient and therefore the conclusions are expressed in relative values that remain accurate.

distribution networks being optimal under the impact of four considered scenarios of future business development. The prospective analysis extended to six years, divided into three separate time frames: 2024, 2026, and 2028. As it takes time to implement changes to the distribution network, it is reasonable to use two-year intervals. These intervals can be modified to any necessary length if needed. For this analysis, we project a steady wholesale volume relative to the outlook. The case study is structured as follows: Initially, we present the logistics operations and an overview of the modeled traffic restrictions. After that, we implement our method and examine the findings.

5.1 Description of logistics operations

The company's operations comprise two major channels and one minor channel. The first is a chain of retail electronics stores with branches in most Czech cities. The second is wholesale to a vast network of other customers. The company's last channel is an e-commerce platform, which nowadays represents only a minor portion of sales. Currently, wholesale deliveries and deliveries to the retail chain are conducted from one distribution center on the outskirts of Prague. Two main channels facilitate distribution. A network of privately operated trucks is used to deliver bulk amounts to the retail chain and to those customers whose orders are large enough. Outsourced logistics service providers are then used to deliver goods to the remaining clients. Providing shipments to these clients with 22-ton trucks is not economically viable. However, the storage and throughput capacity of the distribution centers currently in use is constantly under pressure, so part of the portfolio consisting of large consumer electronics will be moved to the new distribution center.

5.2 Business development scenarios

We modeled several business development scenarios that could significantly influence the choice of the optimal distribution strategy. In addition to the current status quo, which assumes no changes in the current state, we present three distinct scenarios.

- **Sales shift:** In this scenario, we assume that 30% of the sales, in terms of volume in m^3, nowadays conducted in retail stores would shift to e-commerce. Such a shift would reduce the overall amount transported by the fleet to the retail branches. The goods would be shipped directly to the consumers via outsourced services.
- **Wholesale shift small:** We model a wholesale shift from Czechia (-90% of the total existing sales volume in m^3) to Poland (+15,000 m^3 of the sales volume). In this scenario, the major wholesale customers in the Czech market signal the option of diverting and purchasing the goods directly from overseas manufacturers. At the same time, there are advanced negotiations with a significant online e-commerce company from the fast-emerging Polish market, which could soon become a major customer. In this scenario, most shipments to the Czech wholesale customers, whose warehouses are primarily located in the Central Bohemian Region, would stop. However, a significant amount of goods would be newly delivered to the distribution center of the Polish company situated on the outskirts of the capital, Warsaw.
- **Wholesale shift large:** We model a wholesale shift from Czechia (-90% of the total existing sales volume in m^3) to Poland (+25,000 m^3 of the sales volume). This scenario is identical to everything else except for the amount newly delivered to the Polish company.

5.3 Distribution strategies

We propose three alternative strategies with different network topologies. The network topology is defined by the distribution nodes (warehouses, cross-docks) and the vehicles operating them. Each strategy corresponds to a different choice of location for the new distribution center:

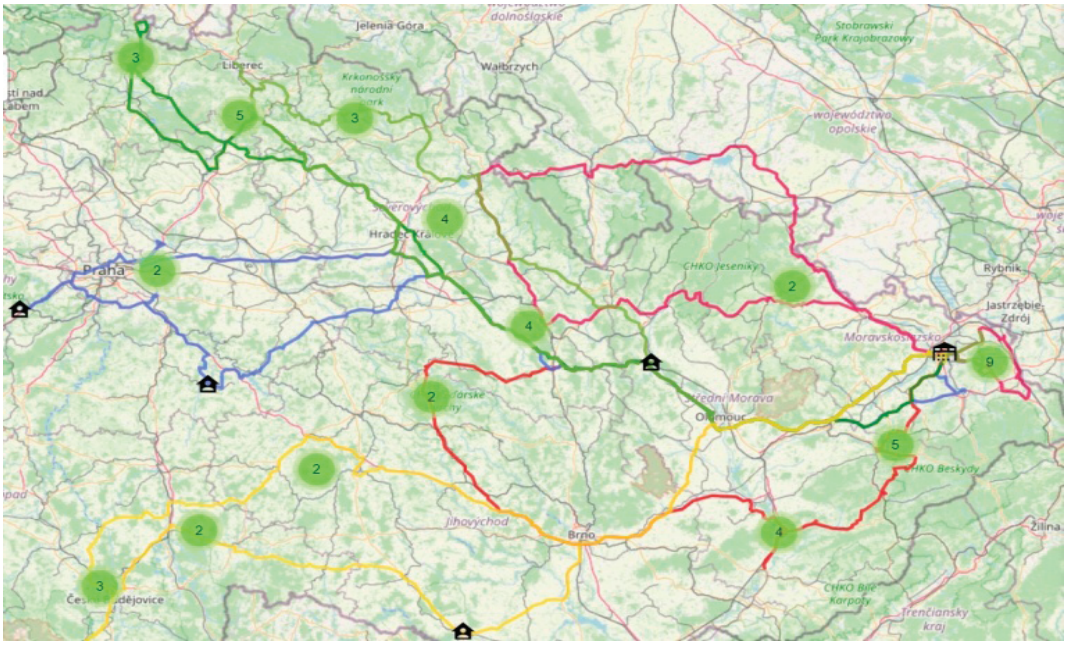
- **Praha:** A new distribution center near Prague,
- **Brno:** A new distribution center near Brno,
- **Ostrava:** A new distribution center near Ostrava.

5.4 Modeling

We model one year of operations of each network as described in Subsection 5.3 under each scenario from Subsection 5.2 using actual data of historical orders provided by the company. The data includes details about precise delivery time and date, order

size, the delivery channel used, and customer location addresses. To model each scenario as realistically as possible, we deployed proprietary simulation software, Distribution Wizard, from Logio, a Czech consultancy and technological company providing supply chain management services to major retailers and manufacturers worldwide since 2004. Distribution Wizard's engine[6] can solve large vehicle routing problems and integrate a wide range of parameters, enabling us to accurately model a wide range of network configurations. Next, we simulated the modeled scenarios and fine-tuned model parameters where necessary. An example of graphical output provided by DW can be seen in Figure 2. Each colored line represents a route designed by DW to deliver a given set of orders to customers on a given day. The color bears no other meaning than to visually distinguish different routes. The figure explicitly shows one of the simulations for the distribution scenario when the new distribution center is near Ostrava. The warehouse in Ostrava is represented by the synonymous pictogram on the right edge of the figure. A smaller pictogram shows customer locations. Those that are close to each another are represented by green circles, which represent their number in the area.

Figure 2 Distribution routes from the Ostrava warehouse



Source: Output from the Distribution Wizard software model done by the authors

Table 1 provides an overview of the calculated costs of each distribution strategy under each business scenario. Each figure is a combination of the expenses for one's own fleet of trucks, as estimated by DW, and the costs of outsourced pallet delivery providers. The cost of one's own fleet of trucks consists of two main parts:

- Cost per distance driven – given a specific vehicle type, the price per distance is directly related to several factors, the most influential ones are fuel consumption, maintenance, lease payment, and insurance.
- Cost per time driven – price per time is derived from the driver costs.

In our computations, we applied the cost model used by the company to estimate the distribution network operating costs as accurately as possible. In line with the non-disclosure request, the exact specifics of the cost model will remain undisclosed. Furthermore, pallet delivery costs were estimated using our knowledge of the industry standard deliv-

6 jsprit

ery prices for a given distance from the origin and the pallet weight. Since we focus on relative rather than absolute differences between the results, the final estimates were scaled for the **Praha** distribution strategy in the current state business scenario to equal 1,000,000 units. Scaling preserves the relative ratios and enhances the readability of the results for the reader.

The results suggest that building a new distribution center in Praha under the current scenario yields the lowest operating costs. Moreover, the same distribution strategy is also the most cost-efficient under the **Sales shift** scenario when we modeled a sales shift from the retail store shelves to e-commerce. Under both business scenarios, Ostrava's distribution strategy is the most expensive one. On the other hand, in the case of a wholesale shift to Poland, as modeled in the third and the fourth scenarios, **Ostrava** and **Praha** correspond to the lowest and the highest estimated costs, respectively. That is an expected outcome because the wholesale shift is much more favorable to **Ostrava** than **Praha** as it lies much closer to the Polish capital, Warsaw. The operating cost of the **Brno** strategy always lies between **Praha** and **Ostrava**.

Table 1 Comparison of the operating cost of each scenario and each strategy

Strategy	Scenario			
	Current	Sales shift	Wholesale shift small	Wholesale shift large
Praha	1,000,000	1,136,622	1,196,659	1,335,497
Brno	1,048,860	1,163,901	1,165,068	1,279,688
Ostrava	1,114,696	1,184,497	1,159,403	1,239,946

Source: Authors' computations

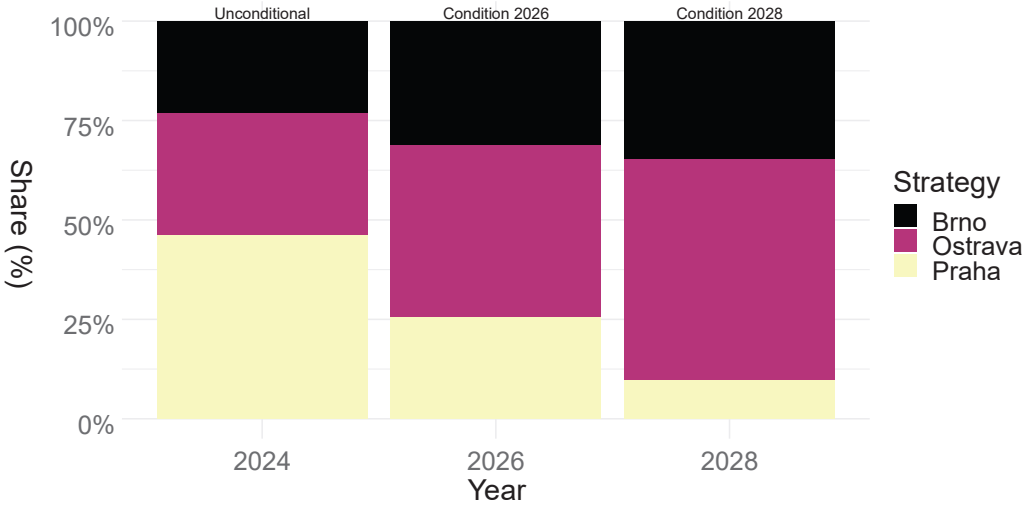
5.5 Case study results: Finding the probabilistically optimal strategy for each year

Having obtained the expected costs of each strategy under each scenario, we approached the application of the methodology presented in this paper in Section 3. In line with the proposed method, we first restrict the probability space. We limit the **Wholesale shift small** and the **Wholesale shift large**. The first restriction assumes that the probability of the **Wholesale shift small** scenario in 2026 is at least 10% and in 2028 at least 20%. The second restriction assumes that the probability of **Wholesale shift large** in 2026 is at least 5% and in 2028 at least 10%. According to condition 1, we identified the subspace for each of the three distribution strategies considered, where each strategy yields the lowest expected operating costs. The respective subspaces were approximated by discretization of the entire probability space. The tests have shown that the granularity of multiples less than or equal to 10% for each $P(a^i_j)$ quickly converges to a stable result. We have chosen a sufficient granularity of 5% to proceed with the method. Consequently, we obtained the percentage share of the cases when each given strategy is optimal. This calculation[7] was done in line with Equation 2. Finally, the shares were normalized according to Equation 3 to make the total sum equal to 1.

Figure 3 depicts the results of our model application. The stacked bars represent the shares of cases where each considered strategy is optimal in each modeled year, given the user-placed assumptions referenced in the figure caption. In 2024, the distribution strategy in Praha holds the majority share. Yet, as we explore scenarios with a higher probability of shifting wholesale operations to Poland, we observe a transition of shares from **Praha** to the strategies in **Ostrava** and **Brno**. **Ostrava** emerges as a practical alternative due to its proximity to Warsaw, making it an attractive location for a new distribution center. However, an interesting movement is seen in the shares towards the **Brno** strategy. Although the data in Table 1 suggest that placing a new warehouse in Brno is not optimal in any given scenario, this strategy still boasts the highest expected value for a considerable range of probability distributions across various scenarios. This might have been overlooked if we had relied only on traditional scenario analysis methods.

7 Since we discretized the probability space, the percentage share was not obtained by integration but by summation.

Figure 3 Shares of optimal distribution strategies each year



Condition 2026: P(Wholesale shift small), P(Wholesale shift large) > 0.05,
Condition 2028: P(Wholesale shift small), P(Wholesale shift large) > 0.10

Source: Authors' computations

The appeal of the **Brno** strategy lies in its resilience to changes across different scenarios. It might not be the best choice under any circumstance, but it is never the worst-performing one either. Hence, it embodies a safe choice. Furthermore, even when we impose user-defined probability limits on specific scenarios, as illustrated in Figure 3, the share of **Brno** changes minimally compared to **Praha** and **Ostrava** strategies. This highlights **Brno's** strategy as a steady and reliable choice. From a planning and risk management standpoint, a strategy offering the most consistent outcome can be more valuable than riskier ones, promising higher rewards. Thus, **Brno's** strategy may be compelling due to its predictability and stability.

6. Results

The method of finding the optimal distribution strategy path, as introduced in Section 4, was successfully deployed on a real company case study in Section 5. The application enabled us to identify the most fitting distribution strategy under the modeled development scenarios in three time periods. As the modeled shift to Poland becomes increasingly likely, the Ostrava strategy is probably optimal. However, Brno was found to be the most stable strategy under different development scenarios.

7. Conclusion

This article was focused on the complex topic of distribution strategy planning. First, we have described the problem and explained our motivation and connection with previous research in this area. There are some gaps in practical economic decision-making within strategic distribution network planning and current best practices. We proposed a methodology to overcome one of these problems. The key is to circumvent the problem of defining expectations about future economic conditions or potential scenarios.We replaced such expectations with probability intervals, which are much easier for users to provide. From the user's perspective, this represents a significant reduction in complexity. Furthermore, despite simplification, our method maintains a high level of information value, ensuring no loss in the quality of insights obtained. However, the presented method still assumes accurately defined and estimated development scenarios. Therefore, the proposed method is not applicable when planners cannot determine the development scenarios and assess the distribution network costs under these scenarios.

In this article, we presented a business case of a Czechia-based company looking for a potential storage location and working with many uncertain-

ties during its decision-making process. It is a real-world example where we empirically present the usefulness and usage of the proposed method. In our example, the company can take three different potential directions. One is currently the best, and the other is the best in specific future scenarios. The last scenario is never the best-performing one when evaluating things in this straightforward way. While utilizing our method, it becomes clear that the third network is the best for over 30% of cases. It is still not the best result compared to other networks, but it shows that a methodical approach such as the one proposed helps to identify real potential. Using different probability intervals or introducing the KPI volatility in the evaluation could provide an even more strict mean variant of positive results.

We have created an approach to utilize uncertain future expectations for model-based informed management decisions. This is a crucial takeaway for distribution network planners to work with their long-term plans and uncertain events to achieve robust and reliable network designs.

What we presented in this article exhibits significant potential, and we intend to explore this field further. One of the main topics is how to introduce causal relationships between individual company states. This article removed these relationships, and we would like to introduce them back. Causal relationships add a new layer of complexity but also provide considerable potential for more complex model design, which covers more potential situations.

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References

1. Ambrosino, D. & Grazia Scutellà, M. (2005). Distribution network design: New problems and related models. *European Journal of Operational Research*, *165*(3), 610-624. https://doi.org/10.1016/j.ejor.2003.04.009
2. Ballou, R. H. (2001). Unresolved Issues in Supply Chain Network Design. *Information Systems Frontiers*, *3*(4), 417-426. https://doi.org/10.1023/A:1012872704057
3. Chopra, S. (2003). Designing the distribution network in a supply chain. *Transportation Research*, *39*, 123-140. https://doi.org/10.1016/S1366-5545(02)00044-3
4. Crevecoeur, J., Antonio, K. & Verbelen, R. (2019). Modeling the number of hidden events subject to observation delay. *European Journal of Operational Research*, *277*(3), 930-944. https://doi.org/10.1016/j.ejor.2019.02.044
5. Gallego-García, S. & García-García, M. (2021). Predictive Sales and Operations Planning Based on a Statistical Treatment of Demand to Increase Efficiency: A Supply Chain Simulation Case Study. *Applied Sciences*, *11*(1), 233. https://doi.org/10.3390/app11010233
6. Garvey, M. D., Carnovale, S. & Yeniyurt, S. (2015). An analytical framework for supply network risk propagation: A Bayesian network approach. *European Journal of Operational Research*, *243*(2), 618-627. https://doi.org/10.1016/j.ejor.2014.10.034
7. Gordon, T. J. & Stover, J. (1976). Using perceptions and data about the future to improve the simulation of complex systems. *Technological Forecasting and Social Change*, *9*(1-2), 191-211. https://doi.org/10.1016/0040-1625(76)90049-4
8. Gordon, T. J. & Stover, J. G. (2003). Cross-Impact Analysis. In Glenn, J. C. & Gordon, T. J. (Eds.), *Futures Research Methodology*. American Council for the United Nations University.
9. Grzybowska, K. & Tubis, A. A. (2022). Supply Chain Resilience in Reality VUCA—An International Delphi Study. *Sustainability*, *14*(17), 10711. https://doi.org/10.3390/su141710711
10. Hossain, N. U. I., Nur, F., Hosseini, S., Jaradat, R., Marufuzzaman, M. & Puryear, S. M. (2019). A Bayesian network based approach for modeling and assessing resilience: A case study of a full service deep water port. *Reliability Engineering & System Safety*, *189*, 378-396. https://doi.org/10.1016/j.ress.2019.04.037
11. Jensen, F. V. & Nielsen, T. D. (2007). *Bayesian Networks and Decision Graphs* (2nd ed). Springer. https://doi.org/10.1007/978-0-387-68282-2
12. Kjaerulff, U. B. & Madsen, A. L. (2013). *Bayesian Networks and Influence Diagrams: A Guide to Construction and Analysis* (2nd ed). Springer. https://doi.org/10.1007/978-1-4614-5104-4
13. Mangiaracina, R., Song, G. & Perego, A. (2015). Distribution network design: A literature review and a research agenda. *International Journal of Physical Distribution & Logistics Management*, *45*(5), 506-531. https://doi.org/10.1108/IJPDLM-02-2014-0035
14. Nejad, A. K. J., Kahnali, R. A. & Heyrani, A. (2021). Developing Hospital Resilient Supply Chain Scenario through Cross-Impact Analysis Method. *Depiction of Health*, *12*(4), 310-319. https://doi.org/10.34172/doh.2021.30
15. Panicker, V., Govindan, K. & Sasikumar, P. (2009). Conceptual study on 3PL/4PL/ new trends for service industry. *International Journal of Services Technology and Management*, *12*(1), 3-22. https://doi.org/10.1504/IJSTM.2009.025033
16. Paul, S. K., Sarker, R., Essam, D. & Lee, P. T.-W. (2019). A mathematical modelling approach for managing sudden disturbances in a three-tier manufacturing supply chain. *Annals of Operations Research*, *280*(1), 299-335. https://doi.org/10.1007/s10479-019-03251-w
17. Petřík, T. & Plajner, M. (2023). *Concurrent Business and Distribution Strategy Planning Using Bayesian Networks* (IES Working Paper No. 3/2023). Prague: Charles University Prague, Faculty of Social Sciences, Institute of Economic Studies.

18. Sharma, S. K., Routroy, S. & Chanda, U. (2022). Supply-side risk modelling using Bayesian network approach. *Supply Chain Forum: An International Journal*, *23*(2), 158-180. https://doi.org/10.1080/16258312.2021.1988697

19. Taleb, N. N. (2007). *The Black Swan: The Impact of the Highly Improbable (Vol. 2)*. Random House.

20. Wang, S. & Tian, X. (2022). Research on Sustainable Closed-Loop Supply Chain Synergy in Forest Industry Based on High-Quality Development: A Case Study in Northeast China. *Forests*, *13*(10), 1587. https://doi.org/10.3390/f13101587

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THE IMPACT OF ELECTRONIC DESPATCH ADVICE ON THE SERVICE TIME OF A MEANS OF TRANSPORT IN A DISTRIBUTION CENTER

Abstract

Purpose: The aim of the article is to verify the impact of the use of electronic notification of deliveries on the service time of a means of transport in a distribution center.

Methodology: The study used electronic notification in the form of EDI DESADV messages. The research was carried out in one of the distribution centers of a retail company operating in Poland. The study used the method of recording the time of logistics operations. The study was conducted in two stages (each lasting a week), in which the time of logistics operations was recorded in conditions without and with the DESADV message implemented.

Results: The results of the conducted research show that the use of electronic despatch advice allows you to reduce the time of handling the means of transport in the distribution center.

Conclusion: Reducing the time of handling the means of transport in the distribution center brings numerous additional benefits, such as faster release of the means of transport and enabling it to carry out subsequent transport tasks, handling a larger number of unloadings with the same number of resources (e.g. warehouse ramps), accelerating the internal process and enabling faster reloading to other means of transport performing the distribution process.

Keywords: Despatch advice, supply chain digitization, logistics operations

1. Introduction

Nowadays, there is a strong trend towards digitization of supply chains. This is the result of the implementation of the Industry 4.0 concept. Industry 4.0 can be understood as "development of production and value creation systems by linking the real and the digital world" (Hetterscheid & Schlüter, 2019). One of the guidelines of Industry 4.0 is to create links between organizations in the supply chain. These links were traditionally associated with the exchange of goods. Currently, they are increasingly associated with the exchange of data and information (Galati & Bigliardi, 2019). Digitization gives new opportunities to supply chains, primarily related to the availability of information, the ease of its exchange between companies in the supply chain, which may affect more effective inventory manage-

ment, more efficient use of resources, or the ability to react faster to changes in the environment (Bigliardi et al., 2022).

Digitization of supply chains is observed in many dimensions. It may be related to the technologies used in the acquisition, collection, processing and transfer of data, data security and the impact of data availability on the implementation of supply chain processes in the real layer.

The aim of the article is to analyze the impact of the use of electronic data exchange in the field of delivery notification (DESADV message) on the time of accepting the delivery to the warehouse. The study is a case study due to the fact that it was carried out only in one logistics center of a selected retail chain. The study used quantitative data collection and analysis methods.

2. Supply chain digitization

The digitization of the supply chain is related to the concept of Logistics 4.0. Logistics 4.0 is defined as a set of technical and organizational solutions aimed at improving the flow of materials and information enabling the implementation of the postulates of the Industry 4.0 concept (Saturno et al., 2018).

Logistics 4.0 and the digitization of supply chains use various technologies that allow data manipulation. Among these technologies, the most frequently mentioned are the Internet of Things (IoT), Artificial Intelligence (AI) or Machine Learning (ML), Augmented Reality (AR) and Virtual Reality (VR), robots, 3D printing and drones (Eckert et al., 2016). Thanks to the availability of data and AI algorithms, it is possible to communicate between machines and solve emerging problems (Dirican, 2015). The dissemination of technologies included in Industry 4.0 may even lead to the creation of digital supply chains. Supply chains carry out independent communication between enterprises, which will give completely new possibilities for production or service creation (MacCarthy & Ivanov, 2022).

Supply chain digitization also raises issues of data security and the ability to share it (in a secure way) with partners in the supply chain (Jagtap et al., 2021). Related to this issue is blockchain technology that allows data to be shared and protected in the event of an attack or failure of storage devices (Krajka et al., 2022). Blockchain technology makes it possible to track different transactions along the whole supply chain in a secure and traceable manner. The documented transactions and data are irrevocably stored in the blockchain and cannot be used or read without consensus. Every time a consignment is transported or handled, the transaction can be documented, creating a permanent history from the manufacturer to the trader or consumer (Aritua et al., 2021).

Although the practical applications of blockchain solutions in logistics are still in their nascent phase, several papers and studies have been published on blockchain in supply chains (Gurtu, 2019). A comprehensive literature review of positive impacts and challenges/barriers in maritime transport was given in Jović et al. (2020). The authors identified and described 20 positive impacts and 20 challenges (Jović et al., 2020).

Digitization brings many benefits to supply chains. Thanks to the availability of data and the possibility of their rapid exchange, the resilience of the organization and supply chains increases, i.e., "…companies can access many open datasets, and collecting and aggregating these data can improve their preparedness for future disruptive events" (Nagy & Foltin, 2022). The digitization of supply chains can also have a positive impact on the environmental performance of an organization (Hashmi et al., 2023). Many authors point out that technologies connected with Industry 4.0 and supply chain digitization enable the effective implementation of sustainable development goals (Chauhan et al., 2023).

Summing up the considerations on supply chain digitization, it should be noted that it is difficult to clearly define what a digital supply chain is and what it is not. The set of tools used under this concept is very wide and not precisely defined, which makes it much more difficult in practice to measure the effectiveness of the use of individual tools in the supply chain digitization (Mugurusi et al., 2021).

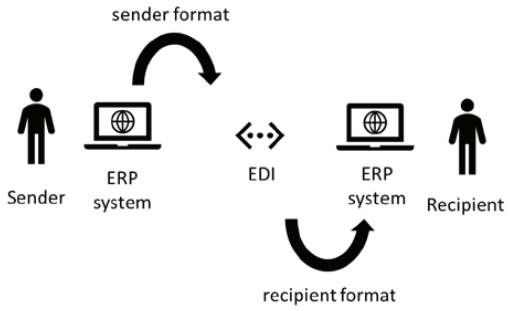
3. The role of electronic data interchange in the digitization of the supply chain

3.1 Electronic Data Interchange

Electronic Data Interchange (EDI) is the exchange of data in formats described by international standards, between IT systems of business partners, with minimal human intervention. EDI combines the possibilities of IT and telecommunications. It enables the elimination of paper documents, increas-

ing the efficiency of all activities related to the flow of goods and information. EDI is the simplest way to carry out business transactions, omitting the tedious work of creating, copying and sending paper documents. EDI directly connects IT systems of cooperating companies. EDI enables an immediate transfer of information that is contained in typical business documents. The use of standard and internationally accepted data formats ensures that all exchange participants use the same language. An EDI document is the equivalent of a paper business document in an internationally established form that has been adapted for electronic data transmission. EDI functions independently of the type of user software. The use of EDI is not limited by differences in software that business partners use in their enterprises. EDI is about exchanging data in a fixed format between IT systems, not between people. These data can be automatically processed by a computer[1].

Figure 1 Exchange of documents using Electronic Data Interchange (EDI)



Source: Authors' own study

The introduction of EDI, i.e., an exchange of documents by electronic means, solves problems related to errors and significantly reduces the time of document processing, also contributing to saving resources. The procedure is as follows (Figure 1):

1. the seller creates, for example, a notice in its IT system (Enterprise Resource Planning - ERP) and sends it in its own internal format;
2. advice, without human intermediation, is sent quickly and automatically via the EDI network to the buyer, being instantly translated from the supplier's format to the recipient's format;
3. the recipient receives the advice in its own internal format directly to its own IT system (ERP).

In this way, both companies have an advice note - each in the format of their internal system. In the same way, you can automate the transfer of other documents and data exchanged between companies. Eliminating the need for a human to rewrite documents makes data exchange quick and error-free[2].

3.2 Despatch advice in EDI

The message EDI – despatch advice (DESADV) is of key importance for this article. This message contains a specification of goods sent to the buyer. One document describes one load that can be delivered to one or more destinations - it allows the buyer to prepare for the collection of goods. The use of a reader for scanning labels with a bar code placed on shipping packaging allows you to automatically check the compliance of delivery with the previously sent shipping notification-Despatch Advice (DESADV)[3]. Large-scale retailers are increasingly demanding the use of the ASN or DESADV message from their suppliers to enhance the traceability of their trading operations and optimize the logistics chain. ASN stands for Advanced Shipping Notice, otherwise known as a shipping note. ASN is also known by the abbreviation DESADV or the term Despatch Advice when working with the EDIFACT standard, and it is widely used in other regions of the world and mainly in Europe[4].

A literature review was conducted in June 2023 based on the Scopus database, because it is the largest database of scientific publications in the world. The selection consisted in searching for selected phrases in the title, keywords and abstract. Only 3 publications were selected as part of the systematic literature search conducted in this way ("despatch advice" and "DESADV"). The first article deals with the monitoring of the Key Performance Indicators (KPI) and of the efficiency of the stock processes. The areas described in the article are some aspects of modern stock management by using the Warehouse Management System (WMS) with a focus on the processes of receiving and picking of goods.

1 https://gs1pl.org/standardy/gs1-edi, https://www.edi.pl

2 https://www.edi.pl/abc-edi, https://gs1pl.org/standardy/gs1-edi

3 https://www.gs1.org/standards/edi-xml-gs1-eancom/eancom-desadv-s4/syntax-4

4 https://edicomgroup.com/blog/asn-or-desadv-a-key-edi-message-in-the-supply-chain

In terms of goods reception, the article deals with the utilization of the Electronic Data Interchange for the Despatch Advice (EDI DESADV) in combination with the exploitation of the Serial Shipping Container Code (SSCC) during goods reception (Klabusayova, 2013). The second article describes the technique and prospects for the development of medication traceability information management. This article assesses the situation regarding regulatory and technical aspects of medication traceability – analyzing the modalities of handling traceability data, their internal and external flow organization (using e.g. DESADV) (Aiguillon et al., 2010). The third article deals with economic dispatch advice for the NETA balancing mechanism. The requirement is to define power injections and response levels to maintain a viable and economic system over the balancing period (Dyer et al., 2002).

The literature review results are so surprising, because within the phrases "electronic data interchange" and "EDI", the Scopus database shows as many as 1,315 publications. The juxtaposition of the above-mentioned phrases with a more popular science notation of the keyword in the form of "advice note" in each of the two combinations does not lead to showing any publications as the result of such a literature search.

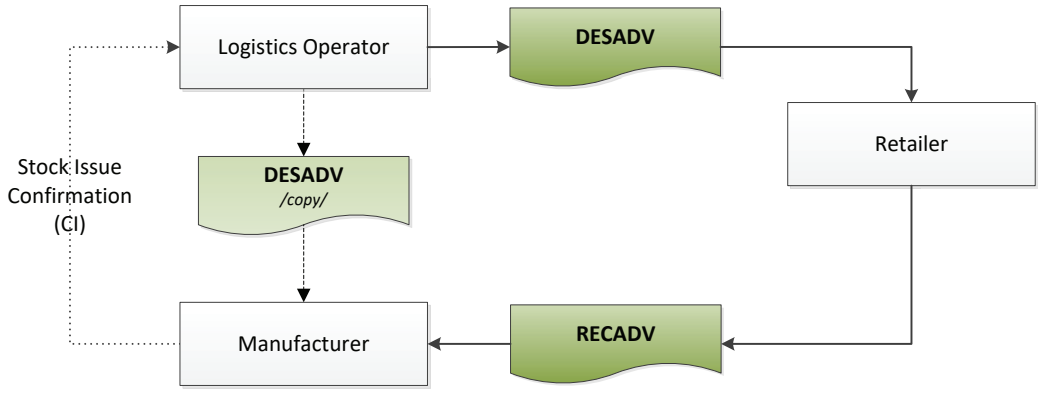
Therefore, an additional literature search was conducted ("advanced shipping notice" and "ASN"), which yielded 5 additional publications. The first article points to the need for the ASN capability concerning mixed pallets (Chiappinelli, 2008). The second article deals with supply chain integration and specifically concentrates on the importance of information distribution among various parties in the chain to make the chain visible (Marufuzzaman & Halim, 2006). The third article evaluates the benefit of a strategy of sharing shipment information, where one stage in a supply chain shares shipment quantity information with its immediate downstream customers - a practice also known as advanced shipping notice (Zhang et al., 2006). The fourth article discusses the development of documents that prescribe the organization and labeling of shipments to the receiving docks. The people on the receiving docks that suppliers order from prefer some features like receipt of an electronic advanced shipping notice (ASN) (Apple, 2003). The fifth article identifies the areas within purchasing where costs have been reduced through direct electronic transmission of standard business forms (purchase orders, advanced shipping notices, invoices, etc.) between two organizations and provides estimates of the size of these reductions. Reduction of workload for purchasing professionals resulting from EDI implementation is also documented (Carter & Fredendall, 1990).

4. Analysis of research results

4.1 Methodology

The research methodology is based on the diagram shown in Figure 2. This diagram follows the methodology of the pilot implementation of the paperless concept presented in the paper (Cudzilo & Kolinski, 2022).

Figure 2 Relationships in the flow of messages in the supply chain



Source: Ł-PIT research, (Cudzilo & Kolinski, 2022)

The research methodology proposed in the paper (Cudzilo & Kolinski, 2022) is the basis for conducting analyses of the impact of using the paperless concept on logistics process efficiency in the supply chain. Benefit analysis by comparing the pre-implementation state and the post-implementation state in the same period allowed minimizing the risk of comparing different current states, caused, for example, by the seasonality of supplies from a given manufacturer, or sales peaks. The proposed benefit analysis methodology makes it possible to multiply this method of analysis to further partners in the supply chain. However, as indicated, the results of the analysis of the benefits of the pilot implementation proved insufficient to conduct detailed research.

During the pilot study, an additional indicator was defined in the supply chain which is, from the perspective of the supply chain under study, important to demonstrate the benefits of implementing electronic documents (DESADV, RECADV). The indicator of the time taken to receive a delivery in the warehouse (pallet counting time) is the main indicator conditioned by the use of DESADV and, at the same time, an indicator that influences the parameter related to the driver's time in the DC, which is why the counting time was analyzed first. It is important to note that during the ongoing study, the counting time was only measured for the pallets from the manufacturer - the company involved in the implementation of the paperless concept.

The first step is to establish the objectives of the complementary research carried out. It was agreed to measure the times over the course of two weeks, i.e.:

- Week 1: /21 June - 27 June 2022/ - DESADV for all manufacturer deliveries to DC.
- Week 2: /28 June - 4 July 2022/ - no DESADV for manufacturer deliveries to DC.

Two exactly the same (in terms of duration) time segments (7 days) were intentionally defined to ensure relevance of measurements.

4.2 Result analysis

All deliveries in the first week were to be advised by the logistics operator electronically (using DESADV) in line with the standard for this supply chain.

For the test in the second week, advice of delivery was to be deactivated, meaning deliveries were to be made over the following 7 calendar days without electronic advice (without DESADV).

The overall result in terms of the counting time is shown in Table 1.

Table 1 Overall result of the study in terms of time taken to receive pallets into the warehouse (pallet counting time) during the examined weeks

Week	Average pallet counting time [minutes]	Average number of pallets per reception	Number of orders
Week 1 (with DESADV)	6.9	18.4	18.0
Week 2 (without DESADV)	9.9	21.3	13.0

Source: Authors' own study

As shown in Table 1, the time taken to count pallets from the manufacturer, or the time taken to receive a delivery (of Lactalis pallets) in the warehouse, was 3 minutes (or 31%) shorter in week 1, i.e., the week when the DESADV message was used (in relation to week 2 - without DESADV).

In addition, the average number of manufacturer pallets per reception, i.e. per order, was checked and once again the number of orders was quoted for both weeks under study. This information is presented in the last two columns in Table 1, respectively. It turns out that the average number of pallets per admission process was lower in week 1, but more orders were handled in this week.

The average number of pallets per acceptance (per order) was lower in week 1 (averaging 18 pallets per order in week 1 and 21 pallets in week 2), but more orders were handled in that week (18 orders in week 1 and 13 orders in week 2). A smaller number of pallets per reception (order) recorded in week 1 may have an impact on the achieved result regarding a shorter counting time in week 1; nevertheless, the pallet counting time per pallet still remains shorter in week 1.

The average number of pallets per reception (reception in relation to 1 order) can affect the result in terms of the counting time, especially in the first week. The point is that if reception is done with reference to DESADV, then each pallet has to be scanned separately, even if there are exactly the same goods on each pallet (and in the entire delivery). If, on the other hand, in a manually accepted delivery (week 2 - without DESADV) all pallets are identical (1 good in the delivery), the warehouse worker does not check all pallets but manually enters the total number of pallets (scans only the first pallet of a given index and manually enters multiples of pallets).

Continuing this topic, it was examined how the manufacturer's pallet counting time developed as a function of the number of pallets in reception (resulting from the order). The results are shown in Table 2.

Table 2 Average counting time per interval determined by the number of pallets received

	Counting time [minutes] per order				
Pallets in delivery	0-5	6-10	11-15	16-20	26-33
Week 1 (with DESADV)	7.7	4.0	5.3	-	8.5
Week 2 (without DESADV)	3.0	8.5	20	8.0	11.1

Source: Authors' own study

As can be seen in Table 2, in most of the intervals conditioned by the number of pallets in reception, the counting time is clearly longer in week 2 (without DESADV). An exception is the interval characterizing receptions with a maximum of 5 pallets. In week 1, there were 3 such receptions, in week 2, there were two. It appears that these smallest orders are most often homogeneous, i.e. they refer to one product in the delivery. As a result, in the case of week 1 - all pallets have to be scanned separately, which takes longer than in the case of week 2, where in this situation (1 good in the delivery) only one pallet is scanned (without reference to DESADV) and the total number of pallets in the delivery is entered (without scanning them). Larger deliveries (more than 5 pallets) generally contain a larger number of goods, including mix pallets, and in this type of situation, the counting time is much shorter if the counting is done with reference to DESADV (according to Table 2):

- 2.1 times shorter (113% shorter) for deliveries containing 6 to 10 pallets,
- 3.8 times (281% reduction) for deliveries containing 11 to 15 pallets,
- 1.3 times (31% reduction) for deliveries containing 26 to 33 pallets.

From the analysis presented, it can therefore be concluded that the counting time, i.e. the time it takes to receive a delivery at the recipient's warehouse, is reduced as a result of the DESADV message, regardless of the number of manufacturer's pallets in the delivery.

This confirms the conclusion reached during the pilot study: Delivery acceptance efficiency on the recipient's side is improved due to the reduction in delivery acceptance lead times.

Accordingly, in the additional study described in this paper, as a result of DESADV, the acceptance time was reduced by 31%; during the pilot study, a result of 44% was achieved in this regard.

Discussing the preliminary results of the survey with DC, the staff also identified that there are a number of additional factors that may affect counting times. On the one hand, it could be the fact that smaller deliveries generally have a smaller number of indexes - this factor has already been discussed above. On the other hand, another factor that the staff paid attention to was the organization of work in the process of receiving goods into the warehouse. In fact, for the measurement to be meaningful in this context, deliveries would always have to be counted by the same employee (throughout the test). In practice, however, this is not possible, and in the counting process over the two weeks when the test took place, different employees were involved and their approach to carrying out the admissions process may be different (e.g., a different pace of work), which in turn may affect the pallet counting time.

5. Conclusion

The conducted research shows that the use of EDI messages (in this particular case, DESADV) allows to reduce the time of unloading the means of transport in the distribution center. The use of electronic data interchange allowed, on average, to reduce the service time of the means of transport by 31%.

The use of the DESADV message therefore allows for a better use of resources of both the supplier and the customer. Reducing the execution time of the acceptance process allows for the implementation of a larger number of acceptances using the same resources. This is particularly important in food supply chains, and in particular temperature-controlled chains. In the case of these chains, on the one hand, the time factor is decisive for the freshness of the products (the possibility of their quick reloading for downstream transport), and on the other hand, the resources used to accept these goods into the warehouse are more expensive. Therefore, the impact of implementing DESADV messages on reducing logistics costs is much greater.

According to the authors, the described research is a significant addition to the research gap in the form of a lack of quantitative research on the impact of the use of electronic data exchange in the field of advice notes on the course of the delivery acceptance process. A literature search did not yield any publications that would present such research results. This publication, therefore, opens a new area of research with a high practical implication.

The presented research, although carried out on the case study, allows the claim that the use of electronic data exchange in the field of advice notes allows shortening the process of receiving goods to the warehouse. It is interesting that the impact of electronic notification is not uniform and depends on many factors. In the conducted research, only two factors were distinguished, i.e., the number of pallets accepted in the delivery and the variety of the assortment included in the delivery. The less complicated the delivery (the fewer assortment items and the smaller number of pallet load units), the smaller the impact of electronic notification on the shortening of the acceptance time. This observation should be confirmed in subsequent studies.

Conducting the study in only one distribution center is a serious limitation of the possibility of interpreting the results. Therefore, in the next step of research, it is necessary to increase the number of enterprises and industries, and thus the characteristics of the adoption processes they implement. Taking action will allow you to collect more data and show more relationships between the implementation of DESADV and the time of delivery acceptance. It will be necessary to determine the variables affecting the shortening of time and to verify this effect on the basis of the observations made.

References

1. Aiguillon, P., Caire-Maurisier, F., Cassagneres, F., Desme, N., Gache, L., Gruau, P., Koenig, C., Lictevout, L., Machet, G., Tatot, S., Vabois, A. & Vincent, G. (2010). Traceability of drugs. *STP Pharma Pratiques*, *20*(5), 327-356.
2. Apple, J. (2003). With a little help from your friends. *Modern Materials Handling*, *58*(3).
3. Aritua, B., Wagener, C., Wagener, N. & Adamczak, M. (2021). Blockchain Solutions for International Logistics Networks along the New Silk Road between Europe and Asia. *Logistics*, *5*(55). https://doi.org/10.3390/logistics5030055
4. Bigliardi, B., Filippelli, S., Petroni, A. & Tagliente L. (2022). The digitalization of supply chain: a review. *Procedia Computer Science*, *200*, 1806-1815. https://doi.org/10.1016/j.procs.2022.01.381
5. Carter, J. R. & Fredendall, L. D. (1990). Dollars and sense of electronic data interchange. *Production and Inventory Management*, *31*(2), 22-26.
6. Chauhan, S., Singh, R., Gehlot, A., Akram, S. V., Twala, B. & Priyadarshi, N. (2023). Digitalization of Supply Chain Management with Industry 4.0 Enabling Technologies: A Sustainable Perspective. *Processes*, *11*(1), 96. https://doi.org/10.3390/pr11010096
7. Chiappinelli, C. (2008). Driving RFID. *Managing Automation*, *23*(5), 41-43.
8. Cudzilo, M. & Kolinski, A. (2022). Digitalization model of information and documents flows in goods movement processes in supply chains-determinants of implementation and measurement efficiency. *Business Logistics in Modern Management*, *22*, 91-102.
9. Dirican, C. (2015). The impacts of robotics, artificial intelligence on business and economics. *Procedia-Social and Behavioral Sciences, 195*, 564-573. https://doi.org/10.1016/j.sbspro.2015.06.134
10. Dyer, J. R., Williams, T. G. & Dunnett, R. M. (2002). Economic dispatch advice for the NETA balancing mechanism. *IEE Conference Publication*, (488), 1-6. https://doi.org/10.1049/cp:20020001
11. Eckert, V. H., Curran, C. & Bhardwaj, S. C. (2016). *Tech breakthroughs megatrend: how to prepare for its impact*. PricewaterhouseCoopers. www.pwc.com/techmegatrend
12. Gurtu, J. J. (2019). Potential of blockchain technology in supply chain management: a literature review. *International Journal of Physical Distribution & Logistics Management*, *49*(9), 881-900. https://doi.org/10.1108/IJPDLM-11-2018-0371
13. Hashmi, S. D., Naz, I., Waqas, M. A. & Sahar, N. (2023). Impact of Information Technology Resources on Environmental Performance: Mediating Role of Green Supply Chain Integration. *LogForum*, *19*(2), 211-223. https://doi.org/10.17270/J.LOG.2023.843
14. Jović, M., Tijan, E., Žgaljić, D. & Aksentijević, S. (2020). Improving Maritime Transport Sustainability Using Blockchain-Based Information Exchange. *Sustainability*, *12*(21), 8866. https://doi.org/10.3390/su12218866
15. Klabusayova, N. (2013). Support of logistic processes in modern retail chain warehouse. *Applied Mechanics and Materials*, *309*, 274-279. https://doi.org/10.4028/www.scientific.net/AMM.309.274
16. Krajka, M., Cyplik, P. & Adamczak, M. (2022). The impact of blockchain technology on operational and strategic risks in the supply chain - a systematic literature review. *LogForum*, *18*(3), 365-377. https://doi.org/10.17270/J.LOG.2022.741
17. Galati, F. & Bigliardi, B. (2019). Industry 4.0: Emerging themes and future research avenues using a text mining approach. *Computers in Industry*, *109*, 100-113. https://doi.org/10.1016/j.compind.2019.04.018
18. Hetterscheid, E. & Schlüter, F. (2019). Morphology for Designing Cyber-Physical Systems in Supply Chain Planning and Control Processes. *Logistics Journal: Not Reviewed*, (3).
19. Jagtap, S., Bader, F., Garcia-Garcia, G., Trollman, H., Fadiji, T. & Salonitis, K. (2021). Food Logistics 4.0: Opportunities and Challenges. *Logistics*, *5*(1), 2. https://doi.org/10.3390/logistics5010002

20. MacCarthy, B. L. & Ivanov, D. (2022). The Digital Supply Chain—emergence, concepts, definitions, and technologies. *The Digital Supply Chain*, 3-24. https://doi.org/10.1016/B978-0-323-91614-1.00001-0

21. Marufuzzaman, Md. & Halim, Z. I. (2006). Effective information transfer to shirk delays in supply chain management. In *Managing Information in the Digital Economy: Issues and Solutions – Proceedings of the 6th International Business Information Management Association Conference* (pp. 657-662). Bonn: IBIMA.

22. Mugurusi, G., Korsen, E. B. H. & Eshaghzadeh, A. (2021). Defining and measuring supply chain digitalization: A systematic literature review. In *Proceedings of 2021 IEEE Technology and Engineering Management Conference - Europe (TEMSCON-EUR)* (pp. 1-6). Dubrovnik: IEEE. http://doi.org/10.1109/TEMSCON-EUR52034.2021.9488646

23. Nagy, J. & Foltin, P. (2022). Increase supply chain resilience by applying early warning signals within big-data analysis. *Ekonomski vjesnik/Econviews - Review of Contemporary Business, Entrepreneurship and Economic Issues*, *35*(2), 467-481. https://doi.org/10.51680/ev.35.2.17

24. Saturno, M., Pertel, V. M., Deschamps, F. & Loures, E. F. R. (2018). Proposal for new automation architecture solutions for industry 4.0. *LogForum*, *14*, 185-195. https://doi.org/10.17270/J.LOG.266

25. Zhang, C., Tan, G.-W., Robb, D. J. & Zheng, X. (2006). Sharing shipment quantity information in the supply chain. *Omega*, *34*(5), 427-438. https://doi.org/10.1016/j.omega.2004.12.005

Review papers

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DIGITALIZATION IN SMALL AND MEDIUM ENTERPRISES: A REVIEW AND RESEARCH AGENDA

Abstract

Purpose: The main goal of the paper is to thematically cluster, identify, and present the most significant topics in the field of digitalization within small and medium enterprises. Additionally, the paper aims to propose guidelines for future research in this area.

Methodology: In the paper, a bibliometric analysis of the literature was carried out on a sample of 285 articles with a special focus on keyword analysis, co-occurrence network analysis and trend topics analysis.

Results: There has been a noticeable increase in interest in this topic since 2019, accompanied by a significant rise in the number of published articles and citations**.** Based on the analysis, five key thematic clusters were identified, which are related to the most frequently researched topics, and they are defined as follows: Digital technologies and Industry 4.0, Digital marketing and social media, COVID-19 and Innovation, Digital transformation, and Business models.

Conclusion: The topic of digitalization in small and medium enterprises is gaining significant importance within the academic environment. This paper provides comprehensive guidelines covering methodological, practical, and thematic aspects, along with proposed research questions for future studies in this field.

Keywords: Digitalization, digital technology, small and medium enterprises, Industry 4.0, review

1. Introduction

The modern business environment is characterized by numerous challenges. Rapid changes in technology and consumer habits, as well as unexpected events, such as the COVID-19 pandemic and the war in Ukraine, have caused many companies to reorganize their operations and change their approach to shaping a business strategy. With the onset of the COVID-19 pandemic and its consequences, almost overnight, companies were faced with disruptions in the supply chain, restrictions on movements and the inability to conduct regular business operations, and digitalization of business was imposed as a necessary solution to avoid a complete collapse of business (Interreg Europe, 2022).

Digitalization is often identified with the concepts of digitization and digital transformation, but in essence, these are not identical concepts. For this reason, it is necessary to highlight their differences. Digitization is a technical process of dematerialization of information and its conversion into digital form. Digitalization is described as a wider socio-techno-

logical phenomenon and the process of adopting digital technologies in a wider individual, organizational and social context (Legner et al., 2017). Autio (2017) defined digitalization in a similar way, pointing out that it represents the application of digital technologies and infrastructure in business, economy and society. It can be concluded that digitization is a tool supporting digitalization. Digitization can contribute to operational efficiency and reduce errors, but it does not change by itself the business or implement new business models and strategies, since that is the domain of digitalization (Gobble, 2018). Digital transformation refers to changes in the way companies operate and create new value, products and services using digital technologies (Gašperlin et al., 2021). In other words, digital transformation is a process in which organizations use digital technologies to change the value creation process and thus respond to changes in the environment (Vial, 2021).

Small and medium enterprises (SMEs) are key players in the business environment of numerous national economies, and their importance is reflected in the creation of new jobs and contribution to the gross national product. However, SMEs are lagging behind in the application of digital technologies. According to OECD (2021) data, small enterprises are less digitalized than medium-sized enterprises, while medium-sized enterprises are less digitalized than large enterprises. In 2021, only 55% of SMEs in the European Union have reached at least the basic level of adoption of digital technologies (European Commission, 2022). Although there is a positive trend in the digitalization of companies, the level of use of advanced digital technologies is still low. The importance of the development of digitalization in economic recovery, but also in new opportunities for business growth, was recognized by the European Union, which supports companies throughout the European Union in their adaptation to the digital world through various initiatives, policies and support schemes. Finally, within the framework of the Digital Decade policy programme, digital goals were defined according to which at least 90% of SMEs should achieve a basic level of digital intensity by 2030, while at least 75% should implement AI, cloud and big data technologies by 2030 (European Commission, 2023).

In addition to the real sector, industry and society, digitalization has been an important topic in the academic environment for the past several years. Previous literature reviews covering SMEs have been exclusively devoted to the following topics: digital innovation in the SME sector (Ramdani et al., 2022), digital transformation (Egodawele et al., 2022; Gašperlin et al., 2021), digital transformation and sustainable development (Philbin et al., 2022), digital transformation and internationalization (Feliciano-Cestero et al., 2023), and technological transformation in SMEs and business model innovation (de Mattos et al., 2023). This paper joins previous research, and places special emphasis on the sector of SMEs, taking into account the wider spectrum of digitalization and related topics, such as digital technologies, innovation and transformation. The main goal of the paper is to thematically cluster, identify and present the most important topics in this research area, and to propose guidelines for future research. Furthermore, to support the achievement of the defined goal, the following research questions are defined:

Q1: What is the global trend in scientific publications in the field of digitalization in SMEs?

Q2: What are the main research topics and findings in this field?

Q3: What are the future avenues of research in this field?

A bibliometric analysis of literature on a sample of 285 articles was performed in the paper, using the software packages VOSViewer and R with Bibliometrix and Biblioshiny. The conducted analysis brings to light previously unexplored topics that could be of interest for future research and have potential implications. By employing quantitative bibliometric methods in conjunction with comprehensive reading and assessment of specific articles, a more comprehensive understanding of the existing literature endeavors is achieved. The paper follows a structured format. Section 2 provides a comprehensive explanation of the methodology used to identify pertinent articles. In Section 3, a bibliometric analysis of the co-occurrence of author keywords is presented, as well as a systematic review of identified thematic clusters. In Section 4, potential future research directions in the field of digitalization in SMEs are discussed and suggested. Lastly, the paper concludes with a summary and conclusions in the final section.

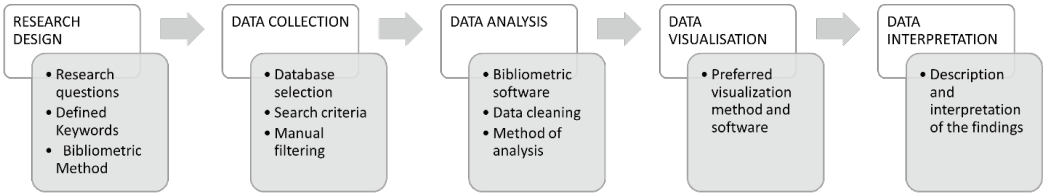
2. Methodology

Science mapping based on a bibliometric analysis of literature was applied in the paper. According

to Cobo et al. (2011), the purpose of science mapping is to create bibliometric maps that illustrate the conceptual, intellectual, and social organization of particular disciplines, scientific domains, or research fields. Using bibliometric methods, it is possible to investigate the connection between scientific disciplines, areas, certain specificities and individual articles.

This paper adopted the science mapping workflow method, considering the five steps followed by Zupic and Čater (2015). According to the authors, the five main phases of science mapping with bibliometric methods are as follows: research design, compilation of bibliometric data, data analysis, data visualization and data interpretation. Figure 1 shows the adopted methodology and its phases with the main activities.

Figure 1 Main phases of the methodology



Source: Adapted from Zupic and Čater (2015)

As suggested in the workflow, the research questions were defined in the first step. The main keywords were defined based on the research aim and research questions. The search query was defined based on two main words – small and medium enterprise and digitalization, but it also includes all possible combinations of lexemes used in the papers, as well as Boolean operators "AND" and "OR" in paper titles, abstracts, and keywords. Thus, the search query was defined in the following way: "small and medium enterprise*" OR "SME*" OR "small and medium business*" OR "small and medium companie*" AND digitalisation OR digitalization OR "digital orientation" OR "digital technolog*" OR "digital capabilit*".

The data collection process was defined in the second phase of the methodology. The Scopus database was selected for the analysis because it includes a larger number of journals than the ISI Web of Science database (Anand et al., 2021; Casprini et al., 2020; Rovelli et al., 2021).

In the first phase, the analysis yielded 1,092 documents. The second phase included specific search criteria based on relevance to the topic. The criteria used in the search are a type of paper, a language and a scientific field. In terms of the type of paper, further search was based only on peer-reviewed scientific articles written in English, since the peer review process facilitates reliable scientific communication, stimulates meaningful research questions, and provides accurate conclusions (Kelly et al., 2014; Secinaro et al., 2020). Based on the application of this criterion, 497 articles were obtained through the search. Finally, in the last step of the data search, criteria related to the scientific field were applied in which the articles were published. The following scientific fields were included in the data set: Business, Management and Accounting, Social Sciences, Computer Sciences, Engineering, Economics, Econometrics and Finance, Decision Sciences, Environmental Sciences, Energy, Psychology, and Multidisciplinary. Based on these search criteria, 419 papers were identified. Subsequent and deeper content analysis of titles, abstracts, keywords, and if necessary, complete papers, identified a total of 285 articles relevant to bibliometric analysis.

The database was extracted on January 21, 2023, and included documents published in the period from 2009 to 2022. To ensure a high-quality and methodologically correct analysis, it underwent a thorough cleaning process to address inconsistencies. These inconsistencies primarily pertained to abbreviated journal titles, incomplete references lacking journal issue numbers, and variations in the initials used to represent the authors of the articles. Table 1 presents the main figures related to descriptive statistics of the sample.

Table 1 Descriptive statistics of the sample

Timespan	2009:2022
Documents	285
Sources	177
Authors	877
Countries	73
Author keywords	908
Cited references	18,707

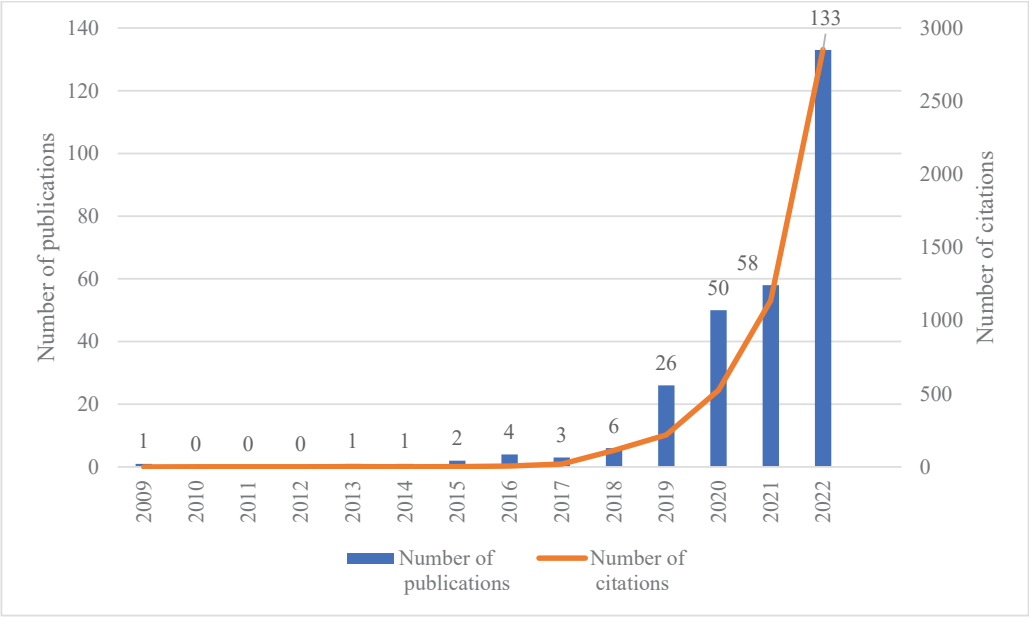
Source: Authors' elaboration based on Scopus

The sample included 285 articles written by 877 authors from 73 countries. The articles were published in 177 journals and cited 18,707 references. As previously mentioned, data analysis and data visualization were conducted by using two software packages – VOSViewer and R with Bibliometrix codes. In terms of data analysis, keyword analysis, co-occurrence network analysis, and trend topics analysis were applied.

3. Keyword analysis, trend topics and co-occurrence network analysis

In the analyzed sample, it is possible to identify that the earliest paper was published in 2009. More significant interest in this topic begins after 2019, and in the mentioned period, in addition to a significant increase in the number of published papers, a significant increase in the number of citations can also be observed (Figure 2).

Figure 2 Annual scientific production and the number of citations



Source: Authors' elaboration based on Scopus

The largest number of papers was published in 2022, as much as 47% of the total number of papers in the analyzed sample. Considering the growing number of papers published in the last five years, it can be concluded that there is interest in this topic and the trend of increasing the number of published papers can be expected to continue.

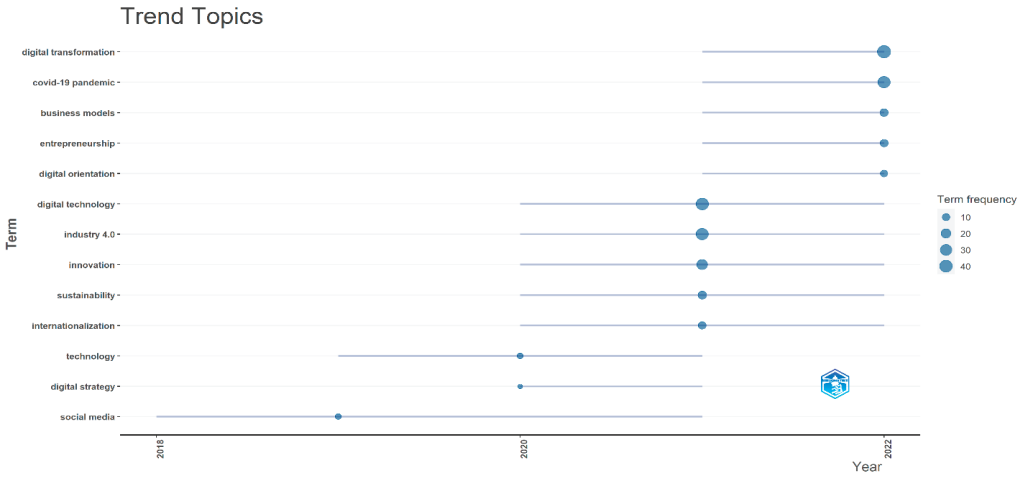
To gain a comprehensive understanding of field development, a keyword co-occurrence analysis was conducted, resulting in the identification of the main thematic clusters and the most relevant research topics. Analyzing the keywords used by authors in their publications is a crucial method for exploring current research topics and the focus of scholars in a particular field (Song et al., 2019). Figure 3 presents 50 frequently used author keywords in the data set. The total number of author keywords in the sample was 908. The most frequently used ten words and related occurrences were: small and medium enterprises (146), digitalization (92), digital transformation (42), digital technology (37), industry 4.0 (33), COVID-19 pandemic (28), innovation (24), sustainability (15), business models (13), and entrepreneurship (11).

Figure 3 Tree map and author keyword occurrences

Source: Authors' elaboration based on Biblioshiny

Furthermore, based on author keywords from the data set, the trending topics were also analyzed. This analysis gives further insight into the trending topics in terms of keyword occurrences in digitalization in small and medium enterprises over the years. While conducting the analysis, the following parameters were applied: timespan was set at 2018 to 2022, the word minimum frequency was set to 5, the number of words per year was set to 5, and the word label size was also set to 5. Within this analysis, words small and medium enterprises and digitalization were excluded. The filtering parameters used were applied with the aim of identifying more precisely the growing topics in the last five years in the observed period. Based on the analysis, it can be observed that the leading topics in the last two years were related to digital technology, Industry 4.0, digital transformation and the COVID-19 pandemic (Figure 4).

Figure 4 Trend topics in the last five years

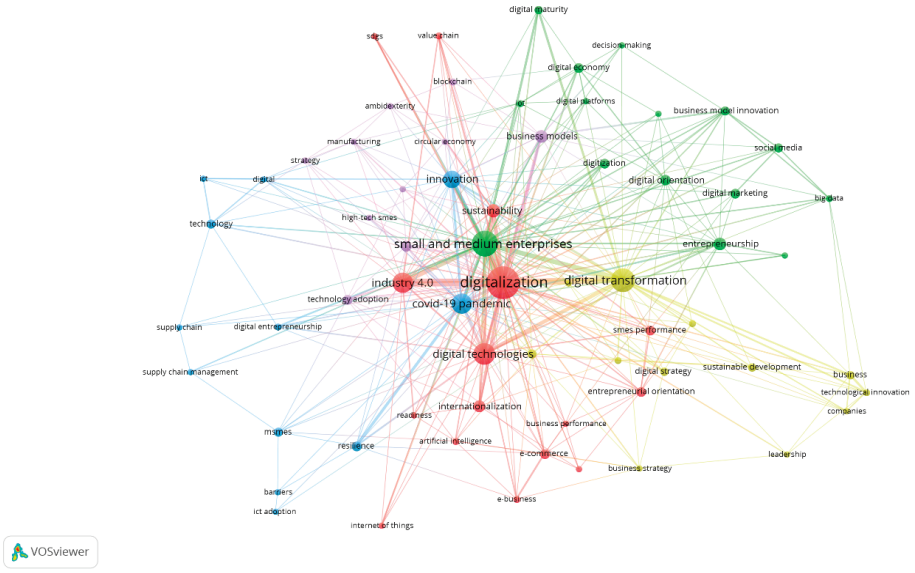


Source: Authors' elaboration based on Biblioshiny

Author keyword co-occurrence analysis was performed in VOSViewer. Co-occurrence means that two or more keywords are used in the same article. If the same keywords co-occur in the documents, their meaning is closely related (Zupic & Čater, 2015). Based on the analysis results, it is possible to identify five different clusters that express the visual thematic map of the field overview (Figure 5).

The purpose of creating a thematic map is to gain an understanding of the present state of a field and what its future prospects may be. This analysis is beneficial for providing researchers and stakeholders with information about the potential areas of future research and development within a particular field (Agbo et al., 2021).

Figure 5 Keyword co-occurrence analysis



Source: Authors' elaboration based on VOSViewer

3.1 Digital technologies and Industry 4.0

The papers in this cluster primarily deal with the implementation of digital technologies of Industry 4.0. Ghobakhloo and Iranmanesh (2021) state that digital transformation within Industry 4.0 is complex and requires a significant investment of resources. The authors identified 11 determinants key to successful implementation of digital transformation of SMEs (for example, external support for digitalization is the first step in ensuring success of digital transformation, while the readiness of operational technology is the least available determinant of digital transformation success). Based on a sample of 163 SMEs from Italy, Poland, Germany, Austria and Hungary, Agostini and Nosella (2020) concluded that companies with stronger internal and external social capital have a greater tendency to adopt Industry 4.0 technologies. Garbellano and Da Veiga (2019) investigated how leading Italian innovative SMEs implemented Industry 4.0 technology transfer, while Nwaiwu et al. (2020) pointed out that strategy, organizational capability, competitiveness, operations and human resources are relevant factors for achieving a sustainable process management model in the implementation of Industry 4.0 concepts. De Lucas Ancillo et al. (2022) investigated relevant obstacles that need to be overcome to enter Industry 4.0 on a sample of 22 SMEs that operate within industrial production activities and are already exporting or planning their internationalization toward LATAM regions, while on a sample of five Portuguese SMEs that implemented Industry 4.0 technologies, Santos et al. (2022) sought to investigate the resources and capabilities needed by SMEs to successfully implement Industry 4.0. Sharma et al. (2022) arrived at the result that high implementations costs, market competition and resistance to adoption are obstacles that hinder the adoption of technologies associated with Industry 4.0.

Muhamad et al. (2021) state that Industry 4.0 is a challenge for SMEs that need to adopt it, especially in developing countries, and that the process of adopting the digitalization of Industry 4.0 varies significantly. The authors emphasize that by using cloud computing, big data, artificial intelligence, and the Internet of Things (IoT), SMEs could secure a new competitive advantage. Tamvada et al. (2022) state that manufacturing organizations around the world are embracing Industry 4.0 and related technologies (such as the Internet of Things, advanced robotics, big data, and cyber security), but also that implementation involves significant financial, operational, business, technological and social risks. Kemendi et al. (2022) investigated the difference between Industry 4.0 and Industry 5.0, and the role of human resources management in the context of the necessary digital and computer competences of society for successful operation in Industries 4.0 and 5.0.

One part of papers within the cluster is thematically dedicated to digital technologies at the time of the COVID-19 pandemic. Papadopoulos et al. (2020) state that there is limited evidence of the use of digital technologies to address the consequences of extreme events such as the COVID-19 pandemic. In the paper, they defined potential research directions and considered the implications of using digital technologies within SMEs to address the consequences of COVID-19 and ensure business continuity. Based on a survey completed by 257 Italian SMEs and in-depth interviews with owners and/or managers of eight SMEs, Bettiol et al. (2022) came to the conclusion that increased use of information and communication technology during the pandemic had a direct positive impact on product innovation. Garcia et al. (2021) state that the COVID-19 pandemic encouraged manufacturing companies to adapt to dynamic and unpredictable circumstances in order to ensure the continuity of production. Khalil et al. (2022) concluded based on a sample of 96 SMEs in six countries that digital technology helped companies to survive the pandemic, become stronger, and ensure their survival. On a sample of six SMEs from southern Italy, Corvello et al. (2022) showed how all analyzed companies turned the crisis into a business opportunity by developing new products, investing in marketing and communications or establishing new collaborations.

3.2 Digital marketing and social media

In the modern business world characterized by increasing digitalization, social media as a marketing tool has an increasingly significant impact on business performance (Virglerová et al., 2022), bringing various advantages to businesses. David et al. (2018) state that social media has a positive effect on the sustainability of small enterprises because it helps create a brand image, loyal customers and customer satisfaction, and that effective use of social networks can help SMEs reach a wider audience, while

Khan et al. (2019) state that many successful SMEs have modernized their marketing tools by presenting their business through social networks with the aim of gaining greater attention from consumers.

Based on 8 semi-structured interviews, Othman et al. (2022) identified the main challenges of marketing on social networks faced by small traders of agricultural products in Malaysia. These include lack of knowledge required for the use of social networks within companies, agricultural products that are challenging to sell online due to maintaining quality and freshness, and human resources that still prioritize management and work on the farm over online communication with customers. Yousaf et al. (2021) conducted a quantitative study on a sample of 397 directors of SMEs in Pakistan with the aim of determining the impact of digital orientation, the Internet of Things and digital platforms on sustainable digital innovation. The authors concluded that digital orientation, the Internet of Things and digital platforms are precursors of digital innovation. On a sample of 338 respondents from SMEs in Indonesia, Sultoni et al. (2022) investigated the effect of digital marketing, digital orientation, marketing capability and information technology capability on marketing performance of Indonesian SMEs. The research results indicate a significant positive relationship between digital marketing and marketing performance, digital orientation and marketing performance, marketing capability and marketing performance, and information technology and marketing performance. David et al. (2018) investigated the advantages, disadvantages and integration of social media in small restaurants. Some of the research results are that small restaurants use email as the main promotional tool, that Facebook is the most popular promotional tool in social media, but also that social media has a significant impact on improving the image of restaurants. Based on research conducted on a sample of 150 respondents that include entrepreneurs, activists, students, consumers, bloggers and other professionals who are active on multiple social media (such as Facebook, Instagram, LinkedIn, YouTube, and Twitter), Khan et al. (2019) state that consumers are likely to perceive social media and pay attention to it if social media include specific cues (for example, visual, ethics, information, social and security).

3.3 COVID-19 and innovation

The first group of papers deals with the adaptation of SMEs to business changes brought about by the COVID-19 pandemic, as well as the impact of the COVID-19 pandemic on business results of SMEs. Iancu et al. (2022) investigated how SMEs cope with the disruptions caused by the COVID-19 pandemic. The authors indicate the importance of state measures to support SMEs during the COVID-19 crisis, and as the main obstacles to resilience of SMEs to the crisis, they cite limited access to liquidity, lack of strong state support, poorly prepared and motivated employees and low digitalization. On a sample of 11 Czech small and medium hotel enterprises, MacGregor Pelikanova et al. (2021) showed that the challenges faced by entrepreneurs in emerging economies at the time of the COVID-19 crisis are universal challenges that can serve as a basis for implementing digitalization and changing entrepreneurial strategies. According to Siahaan and Tan (2022), the institutional environment is a key driver of strengthening entrepreneurial orientation and developing digital capabilities of companies to adapt to disruptions caused by the pandemic. On the basis of research conducted on a sample of 48 restaurants in Baden-Wuertemberg, Ludin et al. (2022) state that the degree of digitalization is one of the factors of restaurant business success in the time of COVID-19, which is why restaurants should think about new and digitalized business models.

The second group of papers deals with innovative activities of SMEs during the COVID-19 pandemic, but also with innovative activities of companies in general. Using the example of SMEs in Kazakhstan, Bokayev and Issenova (2022) conclude that financial and administrative support measures by the state during the pandemic are emphasized, but insufficient attention is paid to encouraging innovation, including the use of digitalization in business. Based on secondary data collected in Romania in 2004-2018, Stanescu and Virjan (2020) analyzed the ability of Romanian SMEs to integrate elements of research, development and innovation within their usual activities. The results indicate that investing in innovation is a rather desirable direction for companies, and they state "customers and consumers, their own organization, and magazines and specialized magazines" as the main sources of information for innovative processes of companies. On a sample of 2,156,360 European SMEs, Scuotto et al. (2021) showed the importance of individual digital capabilities for growth and innovation of companies. Abudaqa et al. (2022) investigated how innovation affects the empirical relationship between digital facilitators, digital transformation

strategies and overall performance of manufacturing SMEs in the UAE. The results indicate a positive relationship between digital facilitators and overall performance of SMEs.

Based on the conducted research that included 102 SMEs from Indonesia, Astuti et al. (2020) indicated that organizational readiness, company characteristics, strategic orientation and conviction in innovation are determinants of digital technology for adoption of innovation. Furthermore, digital technology for the adoption of innovation has a significant impact on the performance of SMEs.

3.4 Digital transformation

Most of the papers in this cluster are focused on the topic of the process of implementing digital transformation in SMEs. On a sample of 510 Vietnamese SMEs, Hoa and Tuyen (2021) built a model for assessing the readiness of enterprises for digital transformation, while based on 421 respondents from 219 Turkish SMEs, Özşahin et al. (2022) developed and validated a scale for measuring the adoption of information and communication technology and digitalization for SMEs in the context of developing countries. Based on 53 responses from leading experts for SMEs as well as teachers and researchers, Sándor and Gubán (2022) developed a methodology that helps determine the position of SMEs in the life cycle of digital maturity. Based on a review of the existing literature on digital transformation and organizational competence as well as on interviews with six experts, González-Varona et al. (2021) developed a model of organizational competence for digital transformation that enables SMEs to identify and develop digital capabilities necessary for progress in digital transformation.

Omrani et al. (2022) used data collected from 15,346 SMEs from the European Union and outside the European Union to investigate the factors that determine the adoption of digital technologies in SMEs. The results show that the technological context (IT infrastructure and digital tools) together with the existing level of innovation are the main drivers of accelerating the process of digital technology adoption. Based on 127 semi-structured interviews with a sample of 15 family SMEs from Germany, Austria and Switzerland, Soluk and Kammerlander (2020) investigated how family SMEs deal with digital transformation of business. Based on the research, they propose three phases of digital transformation for family SMEs (digitalization of processes, digitalization of products and services, and digitalization of the business model). Bouncken and Schmitt (2022) conducted research on a sample of nineteen managers from eight family SMEs from Germany, Liechtenstein and Switzerland with the aim of understanding the challenges at the strategic level faced by family SMEs during digital transformation. The results show that the investigated enterprises have a low level of focus on digital strategy, the top management has little expertise in the field of digital technologies, and enterprises in the sample tend to follow a reactive digital transformation. On a sample of 106 manufacturing SMEs in Guangdong province, Chen et al. (2022) showed that digital transformation and information technology play a key role in the digital transformation of enterprises in the sample, and the digital process and digital innovation are the main problems faced by enterprises.

On a sample of 8 managers of SMEs from South Africa, Jeza and Mpele Lekhanya (2022) showed that digital transformation significantly affects building relationships with clients and ensuring easy access to business, as well as that online sales and digital marketing are leading digital platforms successfully implemented by most South African SMEs.

In this cluster, too, it is possible to identify papers that included the context of the COVID-19 pandemic in the research. The results of the authors Abilova and Alijeva (2022) indicate that the COVID-19 pandemic had a significant impact on the acceleration of digital transformation in SMEs in Azerbaijan. On a sample of 246 SMEs in Latvia during the COVID-19 pandemic, Rupeika-Apoga et al. (2022) proved the positive effect of digital orientation and digital capability on digital transformation. On a sample of seven manufacturing SMEs from Indonesia, Priyono et al. (2020) proved that SMEs adopt different degrees of digital transformation depending on the contextual factors of the enterprise (accelerating transition towards digitalized enterprises, digitalization of only the sales function, finding partners that possess excellent digital capabilities).

3.5 Business models

The fifth cluster defines two primary topics to which the papers are dedicated. The first topic is related to the impact of adapting business models to digital transformation on the performance of SMEs. Based on a sample of 338 European SMEs

that actively use social media and big data to innovate business models, Bouwman et al. (2018) came to the conclusion that business model innovations stimulated by social media and big data positively affect business results. In addition to the above, the authors also conducted 4 in-depth case studies of companies implementing business model innovation, which showed that the driving force behind business model innovation is big data, not social media. Bouwman et al. (2019), on the other hand, state that digital transformation requires SMEs to change and innovate business models, but also that SMEs do not have the capacity to implement business model innovations. The authors conducted empirical research on a sample of 321 SMEs from Europe that actively use social media, big data and information technologies in the innovation of business models with the aim of determining the impact of the amount of resources used by enterprises when adapting business models to digital transformation on business results. The authors concluded that enterprises from the sample that allocate more resources to the adaptation of business models to digital transformation indirectly achieve better business results. Savastano et al. (2022) conducted an online survey involving managers of 162 SMEs operating in the tourism sector on five different continents to assess the relationship between the maturity of the digital business model and the sustainability of business results over time. They arrived at the conclusion that there is a statistically significant positive relationship between maturity of the digital business model and sustainability of business success.

The second group of papers deals with innovative business models as sources of competitive advantage of SMEs. Andersen et al. (2022) believe that digitalization of business is essential for the development of competitive advantage and new business models of companies. North et al. (2020) developed a framework (based on dynamic capabilities and digital transformation studies) that provides guidance to SMEs on how to take advantage of the growth opportunities arising from digital transformation of business, so as to remain competitive in a dynamic business environment. Chaudhuri et al. (2021) conducted in-depth interviews with four SMEs whose business models are based on circular economy and which have adopted digital technologies such as 3D printing and blockchain. They came to the conclusion that in order to create a competitive advantage, SMEs should have the ability to exploit, research and adapt to new technologies.

4. Discussion and recommendations for future research

The identified clusters enable a better understanding and overview of topics that have been specifically researched in the field of digitalization of SMEs. In the context of Industry 4.0 and the implementation of digital technologies, research was especially devoted to assessing the readiness and capability of SMEs to face the challenges and risks that Industry 4.0 poses to them (De Lucas Ancillo et al., 2022; Muhamad et al., 2021), as well as determinants and resources crucial for the implementation of digital transformation (Ghobakhloo & Iranmanesh, 2021; Santos et al., 2022). In the modern business world characterized by increasing digitalization, social media as a marketing tool is becoming increasingly important in company operations (Virglerová et al., 2022). Therefore, a number of authors focused their research efforts on the identification of challenges faced by SMEs in the application of social networks and digital marketing, as well as their impact on business sustainability (David et al., 2018; Othman et al., 2022). Digitalization of business is essential for the development of competitive advantage and new business models of companies (Andersen et al., 2022), and innovations of business models have a positive effect on business results of companies (Bouwman et al., 2018; 2019) and sustainability of business success (Savastano et al., 2022). In the context of digital transformation, authors have developed models for assessing the readiness of companies for digital transformation (Hoa & Tuyen, 2021), and models for assessing digital capability (González-Varona et al., 2021), and a smaller number of authors is dedicated exclusively to the process of digital transformation in family SMEs (Soluk & Kammerlander, 2020; Bouncken & Schmitt, 2022). The trend of increasing the number of papers in the last several years can be explained by a greater number of papers that observe digitalization through the COVID-19 disease pandemic. The pandemic had a significant impact on the acceleration of digital transformation in the economy (Abilova & Alijeva, 2022). Furthermore, increased use of information and communication technology during the pandemic had a direct positive effect on product innovation (Bettiol et al., 2022), and digital technology helped SMEs to become stronger and more resilient (Khalil et al., 2022). Although these papers represent a significant contribution, recommendations for future research are aimed at conducting research in the post-pandemic time to identify the best crisis survival strategies (Abuhussein et al., 2023).

Based on the analyzed papers, the guidelines for future research are defined, which are shown in Table 2. In the context of the methodology, a significant number of papers suggest increasing the number of companies in research samples, as well as including different geographical areas and industries in which companies operate. Future research should be longitudinal research that monitors changes and the relationship between the investigated phenomena and variables over the years (Kemendi et al., 2022). In the context of methodology, it is important to mention that a certain number of authors propose conducting research based on mixed methodology, i.e., combining quantitative and qualitative research (Khalil et al., 2022; Bettiol et al., 2022; Rupeika-Apoga et al., 2022), as well as the implementation of more complex research models that include moderator and mediator variables that would examine the presumed direct relationships between the investigated variables (Muhamad et al., 2021). Based on the analyzed papers, research questions for future research were defined. Considering the variety of papers and researched topics, the questions are divided into two categories – internal environment of the company, which includes the company's resources and characteristics, internal culture and openness to digitalization, and external environment, which includes various market, environmental, regulatory, social and institutional factors. The research questions are shown in Table 2. With the aim of connecting science and industry and the real sector, it is proposed to involve regulators and collaborate with experts and partners from different industries in research processes in order to gain an understanding of the institutional context and further the development and validation of tools and methods for assessing digital maturity and readiness of companies for digitalization.

Table 2 Suggestions for future research

Methodological aspect	• Larger and more diverse samples of SMEs • Longitudinal research • Mixed methodology • More complex research models that include moderator and mediator variables	
Thematic aspect	Internal environment of the company and company specifics	• Is there a connection between technological and soft skills of employees and Industry 4.0? • Is there a connection between digital orientation and sustainable digital innovation? • What are the obstacles to digital transformation in family SMEs? • How does socio-emotional wealth affect digital transformation in family SMEs? • Is there a connection between investments in the field of design and the adoption of 4.0 technologies? • Is there a difference in the digital transformation process in companies managed by female entrepreneurs compared to companies managed by male entrepreneurs?
	External environment of the company	• What is the role of state support in encouraging digital transformation? • What is the influence of market factors on the adoption of digital technologies in SMEs? • What is the influence of regulatory factors on the adoption of digital technologies in SMEs? • What is the influence of technological and environmental factors on the level of adoption of ICT technologies? • How do the characteristics of the domestic market influence business model innovations for resilient international growth? • Are and to what extent are digital skills of consumers, distribution channels and socially responsible business models drivers of digital transformation? • What are the key challenges to the resilience of companies in the era after the COVID-19 disease pandemic? • What is the influence of digital facilitators of Industry 4.0 on reducing the impact of the COVID-19 disease pandemic?
Practical aspect	• Further development and validation of tools and methods for assessing digital maturity and readiness of companies for digitalization • Involving regulators and industry experts in research to gain an understanding of the institutional context	

Source: Authors' elaboration

5. Conclusion

Digitalization is a ubiquitous topic in today's business environment. The implementation of digital technology and tools provides companies with the opportunity for innovation, development of new products and services, and enables access to international markets and achievement of competitive advantage in a dynamic business environment. This paper joins the growing trend of research on the topic of digitalization in SMEs. The main goal of the paper was to thematically cluster, identify and present the most important topics in this research area and propose guidelines for future research. Based on the bibliometric analysis of literature conducted on a sample of 285 relevant articles, five key thematic clusters related to the most frequently researched topics were identified, and they are defined as follows: Digital technologies and Industry 4.0, Digital marketing and social media, COVID-19 and innovation, Digital transformation, and Business models. The largest number of papers is devoted to the identification of challenges and the analysis of key determinants for a successful implementation of digital technology and digital tools, and the implementation of digital transformation in SMEs. Furthermore, a significant number of papers focus on researching the impact of the pandemic on digitalization and innovative activities in SMEs, as well as on researching the impact of adapting business models to digital transformation on the business results of SMEs. Based on the analyzed papers, guidelines for future research were defined, which include methodological, practical and thematic aspects, with proposed future research questions. One of the main limitations of this paper is its restricted focus on a single database and its exclusive review of literature written in English. To overcome this limitation, future research should consider including multiple databases and exploring literature in various languages to ensure a comprehensive and more inclusive understanding of the topic.

References

1. Abilova, A. & Aliyeva, B. (2022). Impact of Covid-19 on Digital Transformation and Resilience of Small and Medium Enterprises: The Case of Azerbaijan. *WSEAS Transactions on Environment and Development*, *18,* 836-842. https://doi.org/10.1007/978-3-030-50454-0_48
2. Abudaqa, A., Alzahmi, R. A., Almujaini, H. & Ahmed, G. (2022). Does innovation moderate the relationship between digital facilitators, digital transformation strategies and overall performance of SMEs of UAE? *International Journal of Entrepreneurial Venturing*, *14(*3), 330-350. https://doi.org/10.1504/IJEV.2022.124964
3. Abuhussein, T., Barham, H. & Al-Jaghoub, S. (2023). The effects of COVID-19 on small and medium-sized enterprises: empirical evidence from Jordan. *Journal of Enterprising Communities: People and Places in the Global Economy*, *17*(2), 334-357. https://doi.org/10.1108/JEC-03-2021-0043
4. Agbo, F. J., Oyelere, S. S., Suhonen, J. & Tukiainen, M. (2021). Scientific production and thematic breakthroughs in smart learning environments: a bibliometric analysis. *Smart Learning Environments*, *8*(1), 1-25. https://doi.org/10.1186/s40561-020-00145-4
5. Agostini, L. & Nosella, A. (2020). The adoption of Industry 4.0 technologies in SMEs: results of an international study. *Management Decision*, *58*(4), 625-643. https://doi.org/10.1108/MD-09-2018-0973
6. Anand, A., Argade, P., Barkemeyer, R. & Salignac, F. (2021). Trends and patterns in sustainable entrepreneurship research: A bibliometric review and research agenda. *Journal of Business Venturing*, *36*(3), 106092. https://doi.org/10.1016/j.jbusvent.2021.106092
7. Andersen, T. C. K., Aagaard, A. & Magnusson, M. (2022). Exploring business model innovation in SMEs in a digital context: Organizing search behaviours, experimentation and decision-making. *Creativity and Innovation Management*, *31*(1), 19-34. https://doi.org/10.1111/caim.12474
8. Astuti, E. S., Sanawiri, B. & Iqba, M. (2020). Attributes of Innovation, Digital Technology and Their Impact on SME Performance in Indonesia. *International Journal of Entrepreneurship*, *24*(1), 1-14. https://doi.org/10.6084/m9.figshare.12228692.v1
9. Autio, E. (2017). *Digitalisation, Ecosystems, Entrepreneurship and Policy* (Policy Brief No. 20/2017) Helsinki: Finnish Government. https://www.researchgate.net/publication/321944724_Digitalisation_ecosystems_entrepreneurship_and_policy
10. Bettiol, M., Capestro, M., Di Maria, E. & Micelli, S. (2022). Overcoming pandemic challenges through product innovation: The role of digital technologies and servitization. *European Management Journal*, *40*(5), 707-717. https://doi.org/10.1016/j.emj.2022.05.003
11. Bokayev, B. & Issenova, A. (2022). Innovative Strategies of Development of Small and Medium-Sized Businesses in Kazakhstan: Examining State Policy during COVID-19. *The Innovation Journal*, *27*(1), 1-19.
12. Bouncken, R. & Schmitt, F. (2022). SME Family Firms and Strategic Digital Transformation: Inverting Dualisms Related to Overconfidence and Centralization. *Journal of Small Business Strategy*, *32*(3), 1-17.
13. Bouwman, H., Nikou, S. & de Reuver, M. (2019). Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?. *Telecommunications Policy*, *43*(9), 101828. https://doi.org/10.1016/j.telpol.2019.101828
14. Bouwman, H., Nikou, S., Molina-Castillo, F. J. & de Reuver, M. (2018). The Impact of Digitalization on Business Models. *Digital Policy, Regulation and Governance*, *20*(2), 105-124. https://doi.org/10.1108/DPRG-07-2017-0039
15. Casprini, E., Dabic, M., Kotlar, J. & Pucci, T. (2020). A bibliometric analysis of family firm internationalization research: Current themes, theoretical roots, and ways forward. *International Business Review*, *29*(5), 101715. https://doi.org/10.1016/j.ibusrev.2020.101715

16. Chaudhuri, A., Subramanian, N. & Dora, M. (2021). Circular economy and digital capabilities of SMEs for providing value to customers: Combined resource-based view and ambidexterity perspective. *Journal of Business Research*, *142*, 32-44. https://doi.org/10.1016/j.jbusres.2021.12.039

17. Chen, Q., Zhang, W., Jin, N., Wang, X. & Dai, P. (2022). Digital Transformation Evaluation for Small- and Medium-Sized Manufacturing Enterprises Using the Fuzzy Synthetic Method DEMATEL-ANP. *Sustainability*, *14*(20), 13038. http://dx.doi.org/10.3390/su142013038

18. Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E. & Herrera, F. (2011). Science mapping software tools: Review, analysis, and cooperative study among tools. *Journal of the American Society for Information Science and Technology*, *62*(7), 1382-1402. https://doi.org/10.1002/asi.21525

19. Corvello, V., Verteramo, S., Nocella, I. & Ammirato, S. (2022). Thrive during a crisis: the role of digital technologies in fostering antifragility in small and medium-sized enterprises. *Journal of Ambient Intelligence and Humanized Computing,* 1-13. https://doi.org/10.1007/s12652-022-03816-x

20. David, A., Sudhahar, J. C. & Varghese, J. (2018). Digital technology integration for small restaurant business in India. *International Journal of Civil Engineering and Technology*, *9*(6). 1593-1601.

21. De Lucas Ancillo, A., Gavrila, S., Fernández del Castillo Díez, J. R. & Corro Beseler, J. (2022). LATAM and Spanish SME barriers to Industry 4.0. *Academia Revista Latinoamericana de Administración*, *35*(2), 204-222. https://doi.org/10.1108/ARLA-07-2021-0137

22. de Mattos, C. S., Pellegrini, G., Hagelaar, G. & Dolfsma, W. (2023). Systematic literature review on technological transformation in SMEs: a transformation encompassing technology assimilation and business model innovation. *Management Review Quarterly*, 1-39. https://doi.org/10.1007/s11301-023-00327-7

23. Egodawele, M., Sedera, D. & Bui, V. (2022). A Systematic Review of Digital Transformation Literature (2013-2021) and the development of an overarching apriori model to guide future research. In *Proceedings of the Australasian Conference on Information Systems*. Melbourne: Australasian Association for Information Systems.

24. European Commission (2022). *Digital Economy and Society Index (DESI) 2022.* https://digital-strategy.ec.europa.eu/en/policies/desi

25. European Commission (2023). *Europe's Digital Decade: digital targets for 2030.* https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

26. Feliciano-Cestero, M. M., Ameen, N., Kotabe, M., Paul, J. & Signoret, M. (2023). Is digital transformation threatened? A systematic literature review of the factors influencing firms' digital transformation and internationalization. *Journal of Business Research*, *157*(December 2022), 113546. https://doi.org/10.1016/j.jbusres.2022.113546

27. Garbellano, S. & Da Veiga, M. d. R. (2019). Dynamic capabilities in Italian leading SMEs adopting industry 4.0. *Measuring Business Excellence*, *23*(4), 472-483. https://doi.org/10.1108/MBE-06-2019-0058

28. Garcia, A., Bregon, A. & Martínez-Prieto, M. A. (2021). A non-intrusive Industry 4.0 retrofitting approach for collaborative maintenance in traditional manufacturing. *Computers & Industrial Engineering, 16,* 107896. https://doi.org/10.1016/j.cie.2021.107896

29. Gašperlin, B., Pucihar, A. & Kljajić Borštnar, M. (2021). Influencing Factors of Digital Transformation in SMEs – Literature Review. In *Proceedings of the 40th International Conference on Organizational Science Development: Values, Competencies and Changes in Organizations* (pp. 231-244). Maribor: University of Maribor Press. https://doi.org/10.18690/978-961-286-442-2.17

30. Ghobakhloo, M. & Iranmanesh, M. (2021). Digital transformation success under Industry 4.0: a strategic guideline for manufacturing SMEs. *Journal of Manufacturing Technology Management*, *32*(8), 1533-1556. https://doi.org/10.1108/JMTM-11-2020-0455

31. Gobble, M. A. M. (2018). Digitalization, Digitization, and Innovation. *Research Technology Management*, *61*(4), 56-59. https://doi.org/10.1080/08956308.2018.1471280

32. González-Varona, J. M., López-Paredes, A., Poza, D. & Acebes, F. (2021). Building and Development of an Organizational Competence for Digital Transformation in SMEs. *Journal of Industrial Engineering and Management, 14*(1), 15-24. https://doi.org/10.3926/jiem.3279

33. Gupta, S., Prathipati, B., Dangayach, G. S., Rao, P. N. & Jagtap, S. (2022). Development of a structural model for the adoption of industry 4.0 enabled sustainable operations for operational excellence. *Sustainability*, *14*(17), 11103. https://doi.org/10.3390/su141711103

34. Hoa, N. T. X. & Tuyen, N. T. (2021). A model for assessing the digital transformation readiness for Vietnamese SMEs. *Journal of Eastern European and Central Asian Research (JEECAR)*, *8*(4), 541-555. https://doi.org/10.15549/jeecar.v8i4.848

35. Iancu, A., Popescu, L., Varzaru, A. A. & Avram, C. D. (2022). Impact of Covid-19 Crisis and Resilience of Small and Medium Enterprises. Evidence from Romania. *Eastern European Economics*, *60*(4), 352-374, https://doi.org/10.1080/00128775.2022.2032177

36. Interreg Europe (2022). *Fostering the digital transformation of SMEs. Focus: traditional sectors / SMEs with low digital maturity - A Policy Brief from the Policy Learning Platform on SME competitiveness.* https://www.interregeurope.eu/find-policy-solutions/policy-briefs/fostering-the-digital-transformation-of-smes

37. Jeza, S. & Mpele Lekhanya, L. (2022). The influence of digital transformation on the growth of small and medium enterprises in South Africa. *Problems and Perspectives in Management*, *20*(3), 297-309. https://doi.org/10.21511/ppm.20(3).2022.24

38. Kelly, J., Sadeghieh, T. & Adeli, K. (2014). Peer review in scientific publications: benefits, critiques, & a survival guide. *EJIFCC*, *25*(3), 227.

39. Kemendi, Á., Michelberger, P. & Mesjasz-Lech, A. (2022). Industry 4.0 and 5.0 – organizational and competency challenges of enterprises. *Polish Journal of Management Studies*, *26*(2), 209-232. https://doi.org/10.17512/pjms.2022.26.2.13

40. Khalil, A., Abdelli, M. E. A. & Mogaji, E. (2022). Do Digital Technologies Influence the Relationship between the COVID-19 Crisis and SMEs' Resilience in Developing Countries? *Journal of Open Innovation: Technology, Market and Complexity*, *8*(2), 100. https://doi.org/10.3390/joitmc8020100

41. Khan, A. A, Wang, M. Z., Ehsan, S., Nurunnabi, M. & Hashmi, M. H. (2019). Linking Sustainability-Oriented Marketing to Social Media and Web Atmospheric Cues. *Sustainability*, *11*(9), 2663. https://doi.org/10.3390/su11092663

42. Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., Mädche, A., Urbach, N. & Ahlemann, F. (2017). Digitalization: Opportunity and Challenge for the Business and Information Systems Engineering Community. *Business and Information Systems Engineering*, *59*(4), 301-308. https://doi.org/10.1007/s12599-017-0484-2

43. Ludin, D., Holler, M., Wellbrock, W. & Mueller, E. (2022). How COVID-19 Accelerates Business Model Innovation and Digital Technological Transformation in the Hospitality Industry: A Focus on Restaurants in Baden–Wuerttemberg. *International Journal of Innovation and Technology Management*, *19*(6), 1-23. https://doi.org/10.1142/S0219877022420020

44. MacGregor Pelikanova, R., Cvik, E. D. & MacGregor, R. K. (2021). Addressing the COVID-19 challenges by SMEs in the hotel industry – a Czech sustainability message for emerging economies. *Journal of Entrepreneurship in Emerging Economies*, *13*(4), 525-546. https://doi.org/10.1108/JEEE-07-2020-0245

45. Muhamad, M. Q. B., Mohamad, S. J. A. N. S. & Nor, N. M. (2021). Navigating the future of industry 4.0 in Malaysia: A proposed conceptual framework on SMEs' readiness. *International Journal of Advanced and Applied Sciences*, *8*(7), 41-49. https://doi.org/10.21833/ijaas.2021.07.006

46. North, K., Aramburu, N. & Lorenzo, O. J. (2020). Promoting digitally enabled growth in SMEs: a framework proposal. *Journal of Enterprise Information Management*, *33*(1), 238-262. https://doi.org/10.1108/JEIM-04-2019-0103

47. Nwaiwu, F., Duduci, M., Chromjakova, F. & Otekhile, C-A. F. (2020). Industry 4.0 concepts within the Czech SME manufacturing sector: an empirical assessment of critical success factors. *Business: Theory and Practice*, *21*(1), 58-70. https://doi.org/10.3846/btp.2020.10712

48. OECD (2021). *The Digital Transformation of SMEs*. https://www.oecd-ilibrary.org/industry-and-services/the-digital-transformation-of-smes_bdb9256a-en

49. Omrani, N., Rejeb, N., Maalaoui, A., Dabic, M. & Kraus, S. (2022). Drivers of Digital Transformation in SMEs. *IEEE Transactions on Engineering Management*, 1-14. https://doi.org/10.1109/TEM.2022.3215727

50. Othman, Z., Abu, N. H., Shafie, S., Nur, B. K. Z.. Alias, E. F. & Yahaya, W. A. J. W (2022). Challenges of Social Media Marketing in Digital Technology: A Case of Small Traders of Agricultural Products in Malaysia. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *28*(3), 312-339. https://doi.org/10.37934/araset.28.3.312319

51. Özşahin, M., Çallı, B. A. & Coşkun, E. (2022). ICT Adoption Scale Development for SMEs. *Sustainability*, *14*(22), 14897. https://doi.org/10.3390/su142214897

52. Papadopoulos, T., Baltas, K. N. & Balta, M. E. (2020). The use of digital technologies by small and medium enterprises during COVID-19: Implications for theory and practice. *International Journal of Information Management, 55*, 102192. https://doi.org/10.1016/j.ijinfomgt.2020.102192

53. Philbin, S., Viswanathan, R. & Telukdarie, A. (2022). Understanding how digital transformation can enable SMEs to achieve sustainable development: A systematic literature review. *Small Business International Review*, *6*(1). https://doi.org/10.26784/sbir.v6i1.473

54. Priyono, A., Moin, A. & Putri, V. N. A. O. (2020). Identifying Digital Transformation Paths in the Business Model of SMEs during the COVID-19 Pandemic. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(4), 104. http://dx.doi.org/10.3390/joitmc6040104

55. Ramdani, B., Raja, S. & Kayumova, M. (2022). Digital innovation in SMEs: a systematic review, synthesis and research agenda. *Information Technology for Development*, *28*(1), 56-80. https://doi.org/10.1080/02681102.2021.1893148

56. Rovelli, P., Ferasso, M., De Massis, A. & Kraus, S. (2021). Thirty years of research in family business journals: Status quo and future directions. *Journal of Family Business Strategy*, *13*(3), 100422. https://doi.org/10.1016/j.jfbs.2021.100422

57. Rupeika-Apoga, R., Petrovska, K. & Bule, L. (2022). The Effect of Digital Orientation and Digital Capability on Digital Transformation of SMEs during the COVID-19 Pandemic. *Journal of Theoretical and Applied Electronic Commerce Research*, *17*(2), 669-685. http://dx.doi.org/10.3390/jtaer17020035

58. Sándor, Á. & Gubán, Á. (2022). A multi-dimensional model to the digital maturity life-cycle for SMEs. *International Journal of Information Systems and Project Management*, *10*(3), 58-81. https://doi.org/10.12821/ijispm100303

59. Santos, B., Dieste, M., Orzes, G. & Charrua-Santos, F. (2022). Resources and capabilities for Industry 4.0 implementation: evidence from proactive Portuguese SMEs. *Journal of Manufacturing Technology Management, 34*(1), 25-43. https://doi.org/10.1108/JMTM-02-2022-0074

60. Savastano, M., Zentner, H., Spremic, M. & Cucari, N. (2022). Assessing the relationship between digital transformation and sustainable business excellence in a turbulent scenario. *Total Quality Management & Business Excellence*, *1*(1), 1-22. https://doi.org/10.1080/14783363.2022.2063717

61. Scuotto, V., Nicotra, M., Del Giudice, M., Krueger, N. & Gregori, G. L. (2021). A microfoundational perspective on SMEs' growth in the digital transformation era. *Journal of Business Research*, *129,* 382-392. https://doi.org/10.1016/j.jbusres.2021.01.045

62. Secinaro, S., Brescia, V., Calandra, D. & Biancone, P. (2020). Employing bibliometric analysis to identify suitable business models for electric cars. *Journal of Cleaner Production*, *264*, 121503.

63. Sharma, M, Raut, R. Sehrawat, R. & Ishizaka, A. (2022). Digitalisation of manufacturing operations: The influential role of organisational, social, environmental, and technological impediments. *Expert Systems with Applications*, *211*, 118501. https://doi.org/10.1016/j.eswa.2022.118501

64. Siahaan, D. T. & Tan, C. S. L. (2022). What Drives the Adaptive Capability of Indonesian SMEs during the Covid-19 Pandemic: The Interplay between Perceived Institutional Environment, Entrepreneurial Orientation, and Digital Capability. *Asian Journal of Business Research*, *12*(2), 8-27. https://doi.org/10.14707/ajbr.220125

65. Soluk, J. & Kammerlander, N. (2020). Digital Transformation in Family-Owned Mittelstand Firms: A Dynamic Capabilities Perspective. *European Journal of Information Systems*, *30*(6), 676-711. https://doi.org/10.1080/0960085X.2020.1857666

66. Sommer, L. (2015). Industrial revolution - Industry 4.0: Are German manufacturing SMEs the first victims of this revolution?. *Journal of Industrial Engineering and Management*, *8*(5), 1512-1532. https://doi.org/10.3926/jiem.1470

67. Song, Y. et al. (2019). Exploring two decades of research on classroom dialogue by using bibliometric analysis. *Computers in Education*, *137*, 12-31. https://doi.org/10.1016/j.compedu.2019.04.002

68. Stanescu, S. M. & Virjan, D. (2020). Research-development and innovation in small and medium-sized enterprises in Romania. *Review of Applied Socio-Economic Research*, *20*(2), 72-85.

69. Sultoni, M. H., Sudarmiatin, S., Hermawan, A. & Sopiah, S. (2022). Digital marketing, digital orientation, marketing capability, and information technology capability on marketing performance of Indonesian SMEs. *International Journal of Data and Network Science*, *6*(4), 1381-1388. https://doi.org/10.5267/j.ijdns.2022.5.013

70. Tamvada, J. P., Narula, S., Audretsch, D., Puppala, H. & Kumar, A. (2022). Adopting New Technology is a Distant Dream? The Risks of Implementing Industry 4.0 in Emerging Economy SMEs. *Technological Forecasting and Social Change*, *185*, 122088. https://doi.org/10.1016/j.techfore.2022.122088

71. Vial, G. (2021). Understanding digital transformation. In Hinterhuber, A. et al. (Eds.), *Managing Digital Transformation* (pp. 13-66). Routledge. https://doi.org/10.4324/9781003008637-4

72. Virglerová, Z., Kramoliš, J. & Capolupo, N. (2022). The impact of social media use on the internationalisation of SMEs. *Economics and Sociology*, *15*(1), 268-283. https://doi.org/10.14254/2071-789X.2022/15-1/17

73. Yousaf, Z., Radulescu, M., Sinisi, C. I., Serbanescu, L. & Păunescu, L. M. (2021). Towards Sustainable Digital Innovation of SMEs from the Developing Countries in the Context of the Digital Economy and Frugal Environment. *Sustainability*, *13*(10), 5715. http://dx.doi.org/10.3390/su13105715

74. Zupic, I. & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, *18*(3), 429-472. https://doi.org/10.1177/1094428114562629

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MAPPING GASTRONOMY TOURISM RESEARCH: LITERATURE REVIEW

Abstract

Purpose: This paper provides a review of the existing literature on gastronomic tourism experiences, with a focus on underrepresented perspectives, research domains, and methodologies.

Methodology: Employing the PRISMA protocol, a systematic literature review was conducted, analyzing 50 relevant studies published between 2017 and 2023.

Results: The findings reveal a significant prevalence of consumer-oriented research within the domain of destination marketing, comprising 88% of the analyzed studies. Conversely, exploration of provider perspectives in the domain of facility marketing is limited, accounting for only 10% of the sample. Moreover, a mere 2% of the total research integrates both consumer and provider perspectives, highlighting a gap in the literature. Methodologically, consumer-centric studies exhibit a preference for quantitative (QUAN) methods, with a notable utilization of the PLS-SEM technique. In contrast, provider-focused studies tend to gravitate towards qualitative (QUAL) methods, such as content analysis.

Conclusion: This review underscores the importance of balanced exploration using both QUAL and QUAN methods while considering perspectives from both consumers and providers. Such an approach is essential to achieving a holistic understanding of gastronomic tourism experiences and addressing the current research gap in the field, particularly within the realm of destination and facility marketing.

Keywords: Gastronomy tourism experience, consumer perspective, provider perspective, literature review

1. Introduction

Gastronomy tourism has emerged as a distinctive form of travel, emphasizing the pursuit of novel and authentic culinary experiences, traditions, and connections with local food in visited destinations (Dixit & Prayag, 2022; Martín et al., 2020; Laškarin Ažić et al., 2024). This trend has evolved from a secondary interest for travelers to a primary motivator, which is crucial to enhancing the overall tourism experience (Folgado-Fernández et al., 2017). As gastronomy tourism becomes a primary motivator for travelers, understanding the dynamics between consumers seeking unique gastronomic experiences and the providers offering these experiences becomes essential.

Previous studies, as highlighted by Rašan and Laškarin Ažić (2023), have predominantly focused on the consumer perspective, leaving a noticeable gap in understanding the role of providers. This research aims to address this gap by adopting a more

comprehensive approach that encompasses both consumer and provider perspectives. Therefore, the purpose of this study is to synthesize existing literature on gastronomic tourism experiences, considering perspectives of both consumers and providers. In doing so, it seeks to offer a comprehensive understanding of the current state of research in the field.

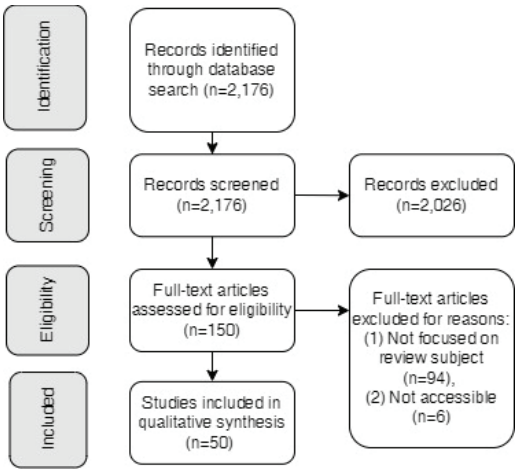
In accordance with this overarching purpose, the specific goal of this review is to identify research gaps in understanding gastronomic tourism experiences. This will be achieved through a thorough examination of underrepresented perspectives, research domains, and methodologies employed, thereby shedding light on areas requiring further exploration.

By identifying underrepresented perspectives and areas necessitating further exploration, this research aims to contribute to the advancement of knowledge in gastronomic tourism. By highlighting research gaps, it provides direction for future research endeavors and helps prioritize areas for research.

2. Research design

For this purpose, the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was applied in this research. The authors created a flow diagram to illustrate the study selection process (Figure 1).

Figure 1 PRISMA protocol



Source: Authors' research

For literature review, many previous tourism scholars have selected Scopus as an online scientific database due to its simplicity and fast search capabilities (Magano et al., 2023). For this reason, Scopus was selected as the most appropriate online search engine for the collection of relevant studies. The keyword "gastronomic tourism experience" was chosen for the search. Despite Google Trending indicating more interest in the term "restaurant experience", the authors justified the selection based on a wider scope of gastronomic tourism, covering experiences beyond just restaurants. Using the selected keyword, 2,176 studies were found. Further selection from the sample was based on the scope of the data including subject field, language, period of publication, and type of document, as recommended by Aguinis et al. (2018). The data selected as inclusion criteria for the final sample were: (a) only complete studies, (b) written in English, (c) published between 2017 and 2023, and (d) journal studies in the final publication stage. Following the listed criteria, 150 studies were obtained. Next, the authors performed manual cleaning of 150 studies by reading their titles and abstracts. Manual cleaning identified 94 studies not focused on review subjects, which were then excluded from the sample. Furthermore, another 6 studies were removed from the preliminary sample as they were not accessible. A total of 50 studies on gastronomic tourism experiences were included in the final sample.

Then, the authors of this study applied the modified categorization system provided by Le et al. (2019) in the process of their data analysis. For each study, notes were taken about (a) the authors and the year of publication, (b) a perspective, (c) a research domain, (d) a research approach, (e) a collection site, (f) a collection strategy/technique, (g) a research tool, (h) a sample size, (i) a data analysis method, and (j) limitations. After completing the categorization process, the research findings were reported. This step is used to extract meaningful insights from the reviewed studies in the sample.

3. Findings and discussion

This section presents the results of trends in the research on the perspectives of gastronomic tourism experiences. To delve deeper into the findings, the authors will discuss each perspective individually.

Table 1 Literature review

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
1	Rodrigues et al. (2023)	Consumer	Destination marketing	QUAN	Online and onsite by trained interviewers	Survey	Questionnaire survey	PLS-SEM	By using longitudinal design, researchers can track participant experiences and well-being over time, offering insights into the dynamics and causal relationships that may not be apparent in cross-sectional or one-time studies.
2	Şahin & Kılıçlar (2023)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey	PLS-SEM	This empirical study recognizes the uniqueness of Istanbul as a gastronomic destination and suggests that future research should consider different destinations and researcher models to enhance the generalizability and depth of insights into tourist gastronomic experiences.
3	Bonfanti et al. (2023)	Provider (managers)	Facility marketing	QUAL	Via a phone call or with the support of online communication programs such as Zoom or Google Meet	Interview	In-depth interview	Lexical and reflexive thematic analysis	This study acknowledges the limitation of a small sample size of managers and proposes a future research proposal. By including a larger and more diverse sample of managers and staff, as well as adopting a longitudinal approach, future studies can enhance the robustness and generalizability of findings in the context of restaurant management.
4	Soonsan & Somakai (2023)	Consumer	Destination marketing	QUAN	Online by researchers	Interview	Questionnaire survey	Factor analysis (CFA)	Research recommendations underscore the importance of a multifaceted approach to researching gastronomic tourism. By employing longitudinal studies, exploring destination characteristics, and utilizing qualitative methodologies, future research can contribute significantly to the planning, management, and promotion of gastronomic tourism destinations, ultimately enhancing the overall tourist experience and destination competitiveness.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
5	Kovalenko et al. (2023)	Consumer	Destination marketing	QUAN	Online by researchers	Survey	Questionnaire survey	PLS-SEM	The study has a methodological limitation due to the purposive sampling procedure which limits the generalization of the results. This research was mainly focused on demand, which makes it difficult to convey the results to other subjects of gastronomy activity such as stakeholders, local communities, or businesses.
6	Myrnes-Hansen & Skeiseid (2022)	Consumer	Facility marketing	QUAL	Onsite by researchers	Focus groups	Cartoon style illustration	-	The method employed in this study necessitates additional testing across varied contexts to gain a more comprehensive understanding of the functions and constraints of visual stimuli, particularly cartoons, as catalysts for focus group dynamics.
7	Pappas et al. (2022)	Consumer	Destination marketing	QUAL	Onsite by researchers	Delphi technique	Questionnaires	Fuzzy set qualitative comparative analysis (fsQCA)	The study initially focuses on a specific context, namely Greece, and targets tourist segments from the UK and Germany, each of which possessing distinct cultural attributes. Additionally, the research study was conducted amidst the COVID-19 pandemic, potentially influencing tourist perceptions. Further research is necessary to furnish empirical evidence elucidating the interplay between factors such as culture, income, education, and their correlation with food-related personality traits.
8	Sharma et al. (2022)	Consumer	Facility marketing	QUAN	Online by researchers	Survey	Questionnaire survey	PLS-SEM	This study depended on self-reported data, which carries inherent limitations due to biases stemming from retrospective recall or social desirability. Therefore, future studies could employ a mixed-methods approach incorporating real-time and objective data collection methods.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
9	Batat (2020)	Provider (chefs)	Facility marketing	QUAL	Onsite by a researcher	Interview and netnography	In-depth interview, archival data, and researcher's observational notes	Content analysis	The limitation of this study is intricately tied to research methodology, which relies on in-depth interviews exclusively conducted with Michelin-starred chefs. This specificity poses a challenge in terms of generalizability. Additionally, the participant pool is confined to a single cultural setting, specifically the French context. This deliberate choice is in line with the focus of our research, emphasizing the significance of the French gastronomic heritage and its global impact. For future research, scholars may explore and contrast sustainable food practices not only within Michelin-starred chef-owned restaurants but also extend their inquiry to encompass luxury gastronomic establishments affiliated with upscale hotels and multinational corporations.
10	Galiñanes Plaza et al. (2022)	Consumer	Facility marketing	QUAL	Onsite	Focus groups	Semi-structured group discussion / iRaMuTeQ software / XLSTAT Addinsoft 2019	Text mining analysis	Future research endeavors could delve into investigating the potential shifts in consumer expectations regarding dining out in light of the COVID-19 crisis. Employing a quantitative survey methodology would be particularly valuable in substantiating and extrapolating the discernible differences brought to light.
11	Stone et al. (2022)	Consumer	Destination marketing	QUAN	Onsite by a panel research company	Survey	Questionnaire survey	T-test significant	The analysis has so far been limited exclusively to quantitative data. In future research, it would be beneficial to incorporate qualitative methodologies to provide a more comprehensive understanding of the phenomenon under study. Qualitative insights could offer nuanced perspectives, capturing the intricacies and contextual nuances that quantitative data alone may overlook.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
12	Park & Widyanta (2022)	Consumers and providers	Destination marketing	QUAL	Onsite by researchers	Exploratory qualitative study	Suppliers → in-depth interviews, Consumers → focus groups	Multiple analysis process to enable concepts and categories to emerge	The constraints of this study are inherent in its exploratory nature. Future research efforts could build on these preliminary findings by employing more targeted methodologies to validate and expand on the insights gleaned from this exploratory study. By so doing, researchers can enhance the depth and reliability of their findings, moving towards a more conclusive understanding of the subject matter.
13	Seyitoğlu & Ivanov (2022)	Consumer	Facility marketing	QUAL	Online reviews from tripadvisor.com	Multiple case study	UGC platforms and websites	Thematic content analysis	This study is characterized by several limitations, including a relatively small sample size of robotic restaurants (13) and the exclusive evaluation of comments in English. To overcome these limitations, future research efforts might consider employing face-to-face interviews, a method that could provide richer and more in-depth insights into customer perceptions of robotic restaurants.
14	Kılıçhan et al. (2022)	Consumer	Facility marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey	Exploratory factor analysis (EFA) / Factor analyses (CFA)	This study has limitations based on its sampling technique and population. Future studies can be conducted in different cultures and different geographies.
15	Basnyat & Ho (2021)	Consumer	Destination marketing	QUAL	Onsite by researchers	Interview	In-depth semi-structured interviews	Content analysis	The limitations of this study are associated with a relatively small sample size consisting of only 20 interviews with tourists centered on Macau. Additionally, most participants were from Asian countries, potentially limiting the generalizability of the findings to a more diverse global context. To address these limitations, future research could undertake a similar study in other countries to assess the extent to which the identified findings can be generalized and whether cultural variations impact the outcomes.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
16	Badu-Baiden et al. (2022)	Consumer	Destination marketing	QUAN/ QUAL	Online by a panel survey company	Survey	Questionnaire survey / STATA software	Exploratory factor analysis (EFA) / Fuzzy-set qualitative comparative analysis (Fs/ QCA)	The limitations of this research arise from the exclusive focus on a sample comprising only US tourists who traveled to Europe and Asian countries. This narrow sample restricts the generalizability of the conceptual model to a more diverse population. To address this limitation and enhance the robustness of the model, a future study should aim to validate and refine the conceptual model using non-US samples with varied ethnic and cultural backgrounds and regions.
17	Valverde-Roda et al. (2022)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey / SPSS	K-means clustering	The limitation of this study is the confined time frame of data collection. Future research could enhance the scope of this research by examining gastronomic tourism in the city across various seasons and periods throughout the year.
18	Kattiyapornpong et al. (2022)	Consumer	Destination marketing	QUAL	Online reviews from different online platforms	Mixed purposeful sampling	NVivo software / User-generated content (UGC)	Sentiment analysis and thematic analysis / Duoethnographic reflections of researchers	The primary limitation in sampling and data collection for this research is the reliance on only five online gastronomic tourism platforms for gathering information on gastronomic tourism in Thailand. To address this limitation, future studies could incorporate quantitative data, capturing respondent profiles and their eating behaviors and preferences.
19	Lin et al. (2022)	Consumer	Destination marketing	QUAN	Online reviews from tripadvisor.com	Multiple case study	User-generated content (UGC)	Content analysis	In this study, one of the primary challenges posed by big data lies in the classification of key terms and the construction of categories. Future research could enhance our understanding of gastronomic experiences by delving into perspectives from both the supply and demand sides of the market.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
20	Mora et al. (2021)	Consumer	Destination marketing	QUAN	Online by researchers	Survey	Structured questionnaire / SPSS / SmartPLS software	PLS-SEM	A notable limitation of this research is the restricted time span of the fieldwork. To address this constraint, future research is recommended to undertake a more extensive and in-depth investigation concerning the gastronomic offerings tailored for tourists in Spain.
21	Cordova-Buiza et al. (2021)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey / SPSS software v. 24	K-means clustering	The primary limitation of this empirical study lies in the data collection time frame. Future researchers are encouraged to address this limitation by reinforcing research that emphasizes the significance of gastronomy from the supply perspective.
22	Hernández-Rojas & Alcocer (2021)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey / SPSS software / SmartPLS 3.3.3	PLS-SEM	Concerning the limitations of this study, it is noteworthy that additional variables could have been considered to explain satisfaction with the restaurant. Future research could explore the intersection of information between supply and demand, aiming to provide insights into achieving an appropriate balance in specific markets.
23	Hernández-Rojas et al. (2021)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire survey / Smart PLS 3.2.9	PLS-SEM	-
24	Ramírez-Gutiérrez et al. (2021)	Consumer	Destination marketing	QUAL	Online reviews from tripadvisor.com	Analysis of tourist social media communication	Specialized software and exploratory statistical treatment	Content analysis	The results of this study are influenced by the examination of a single case and the sample size. For future research, conducting content analyses of tourist comments and opinions could involve adding additional code categories. Exploring several non-emblematic case studies could also be considered, contributing to the development of a model that better represents the communicative activation of diner experiences.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
25	Hernández-Mogollón et al. (2020)	Consumer	Destination marketing	QUAN	Online and a paper-and-pencil method	Survey	Questionnaire / IBM-SPSS Statistics Version 21 / PLS-SEM	PLS-SEM	The primary limitation in this paper stems from the use of a non-probabilistic sampling strategy, impacting the generalizability of the results. Future research could consider adopting a qualitative approach to gain a deeper understanding of tourist assessments of the experiential variables considered.
26	Filimonau & Krivcova (2017)	Provider (restaurant managers)	Facility marketing	QUAL	Onsite by researchers	Interview	Semi-structured interviews	Content analysis	To bolster the representativeness and robustness of the findings, seeking managerial opinions on the topic in question through the application of a large-scale, quantitative survey could be beneficial.
27	Cherro Osorio et al. (2022)	Provider (chefs)	Facility marketing	QUAL	Onsite by researchers	Interview	In-depth face-to-face interviews	Content analysis	The main limitation of this paper stems from the absence of input from diners, as well as the lack of comparisons with other types of restaurants and a broader range of destinations. Future studies could address these limitations by including input from international tourists or local patrons who have experienced these restaurants, providing diverse insights into the effectiveness of the gastronomic elements employed.
28	Villagómez-Buele et al. (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaires	Multiple correlation and regression techniques	The primary limitation of this research lies in its temporality, conducted within a specific period (January to March), making its results potentially subject to variations in demand. As a future research direction, it would be valuable to explore the relationship between a gastronomic image and destination loyalty.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
29	Pratt et al. (2020)	Consumer	Facility marketing	QUAN	Onsite by researchers	Survey	Question-naires	IPA, IRPA and IAA analysis	Limitations of this study arise from a relatively small sample size of cooking schools considered. To address these constraints and broaden the scope of the study, future research could conduct a comparative analysis by including cooking classes from various destinations in the South-East Asian region.
30	Moral-Cuadra et al. (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Question-naire	PLS-SEM	When addressing the limitations, conducting a study over a more extended time frame and engaging a broader spectrum of stakeholders, including the local population, businesses, and public/private entities, could provide a more comprehensive understanding.
31	Crespi-Vallbona & Mascarilla-Miró (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Question-naire	Case study	This research would benefit from complementing its findings with in-depth interviews with wine enthusiasts to refine the wine tourism experience. Additionally, the scope of the study is limited to the Pla de Bages DO region. To ascertain the broader impact of wine tourism and its economic, social, and cultural development potential, similar studies should be conducted in other wine DO regions. This comparative approach would offer insights into the unique characteristics and challenges of different wine tourism destinations.
32	Gupta & Sajnani (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Question-naire	PLS-SEM	This study lacks research on the perception of authenticity among foreign tourists. Future research could be aimed at identifying this distinction, shedding light on how authenticity perceptions evolve with repeated visits and their subsequent influence on tourist overall experiences and intentions to recommend the destination.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
33	Rodríguez-López et al. (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire via the *Qualtrics* platform / LISREL software / PROCESS software	LS regression and bootstrap estimation	The scope of the study is limited by its focus on only two restaurants. Replicating the study by comparing restaurants with diverse characteristics could confirm whether the findings from these two types are applicable across different restaurant contexts. By extending the comparison to include different types of restaurants, researchers can explore the generalizability of the results and gain insights into how different restaurant characteristics influence the outcomes being investigated.
34	Rodríguez-Gutiérrez et al. (2020)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire	PLS-SEM	The main limitation of this research is the restricted time frame of the fieldwork (March and April 2018). Future studies should consider extending the research to include other months and seasons for a more comprehensive analysis. Additionally, exploring gastronomic tourism from the supply side and investigating the loyalty resulting from satisfaction with local cuisine could be valuable avenues for future research.
35	Kala & Barthwal (2020)	Consumer	Destination marketing	QUAN / QUAL	Onsite by researchers	Survey / Interview	Questionnaire / Semi-structured interviews	Regression analysis	The findings of the study are specific to tourists visiting Rishikesh and Badrinath, limiting their generalizability to other destinations. Additionally, a larger sample size is recommended to enhance generalizability. Future studies are advised to employ rigorous qualitative methods to gain a deeper understanding of visitor food experiences during holidays.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
36	Berbel-Pineda et al. (2019)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire / SPSS / SmartPLS 2.0	PLS-SEM	This research has several limitations. Firstly, it exclusively focuses on one city, Seville, potentially limiting the generalizability of the findings to other urban contexts. Secondly, the specific antecedents and outcomes in the model pose a limitation in extending the results to other conceptual frameworks. Thirdly, the cross-sectional design of the study may not fully capture variables associated with prolonged processes, potentially leading to a misrepresentation of effects that become apparent over longer periods. Future studies could enhance the robustness of the analysis by adopting a longitudinal approach, allowing for a more nuanced understanding of the relationships and outcomes over time.
37	Kiatkawsin & Han (2019)	Consumer	Facility marketing	QUAN	Online by a research agency	Survey	Questionnaire / IBM SPSS version 23 / AMOS software	SEM / Factor analysis (CFA) / Promax / Maximum likelihood rotation method	Regarding limitations, it is essential to note that the samples in this study may not fully represent the overall luxury restaurant customer population. Caution is needed when interpreting the results, as the influence of culture remains unknown. To enhance the robustness and generalizability of the findings, future researchers could explore opportunities to replicate the conceptual framework in other luxury restaurant markets.
38	González Santa Cruz et al. (2019)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire / SPSS v. 22	K-means clustering	The main limitation of this research is the specific time frame in which it was conducted, i.e. in February 2018. To enhance the applicability of the study, it would be beneficial to extend the research to encompass tourist demands of the city throughout the entire year.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
39	Nicoletti et al. (2019)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire / SPSS v23	K-means clustering	Expanding the study to focus on the supply side could identify potential gaps between tourist expectations and offerings in Trapani, providing valuable insights for the tourism sector. Exploring both demand and supply sides would contribute to a more comprehensive understanding of the dynamics shaping the tourism experience in Trapani.
40	Dressler et al. (2019)	Consumer	Facility marketing	QUAN	Onsite by researchers	Survey	Questionnaire / IBM SPSS Statistics 19	Descriptive statistics / PCA (principal component analysis)	Data collection in this study took place within a confined time frame, limited to two summer months, without active measures to ensure sample validity through quotas or similar techniques. By conducting similar research in diverse settings, researchers can broaden the scope of understanding and draw more robust conclusions about the factors influencing the phenomenon under investigation.
41	Sthapit (2019)	Consumer	Destination marketing	QUAL	Onsite by researchers	Interview	Semi-structured interviews	Thematic analysis	Reliance on a single destination imposes limitations on the broader applicability of the findings to other destinations. To address this constraint, future studies could employ a larger and more varied sample size in different destinations.
42	Vargas-Sánchez & López-Guzmán (2018)	Providers (chefs)	Facility marketing	QUAN	Online	Survey	Questionnaire / SPSS, version 20 / Warppls 6.0 software	SEM	The limitation of this research lies in its exclusive focus on distinguished chefs with Michelin stars from Spain. To enhance the breadth and generalizability of the findings, a promising avenue for future research could be to extend the study to include chefs from various countries.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
43	Ramón et al. (2018)	Consumer	Facility marketing	QUAN	Online through Facebook	Survey	Questionnaire	SEM	A primary limitation of this research is its exclusive focus on restaurants with Michelin stars, limiting its applicability to various types of culinary establishments. Future avenues of research could broaden the scope by including a diverse range of culinary settings to provide a more comprehensive understanding of the factors at play.
44	Lee et al. (2018)	Consumer	Destination marketing	QUAL	Onsite by researchers	Survey / Interview	Questionnaire / ZMET survey / In-depth interviews / Microsoft Visio / Photoshop	Kelly's repertory grid technique	The current study concentrated on tourist experiences of Hakka gourmet food and cultural heritage, acknowledging a potential limitation in capturing the entirety of tourist experiences. Future research could employ a confirmatory method to develop specific tools tailored for assessing 'experiencing tourism-inheriting cuisine'.
45	Brito & Vale (2018)	Consumer	Destination marketing	QUAN	Onsite by researchers	Survey	Questionnaire	Confirmatory factor analysis (CFA) / SEM	There are doubts regarding whether the predictive role of the nostalgic proneness construct would remain effective in relation to food nostalgia when the situation changes. To address these uncertainties and expand the research agenda, future studies could explore associations between food nostalgia measurements and specific details concerning the type of food or recipe.
46	Aaltojärvi et al. (2018)	Consumer	Destination marketing	QUAL	Onsite	Interviews	In-depth interviews	Case study / Framing theory	The dataset in this study is constrained in terms of both its size and its exclusive focus on the Finnish context. Given these limitations, caution should be exercised when generalizing findings to broader contexts or populations. Future research could consider expanding the dataset to encompass a more diverse sample size and incorporate multiple geographical contexts.

No.	Authors and year	Perspective	Research domains	Research approach	Collection site	Data collection strategy/ technique	Research tool	Data analysis method/ technique	Limitations or future suggestions
47	Akdag et al. (2018)	Consumer	Destination marketing	QUAN	Onsite	Survey	Questionnaire	Sampling method / Frequency analysis / Multiple independent samples t-tests / χ^2 analysis/ Multiple regression analyses	The use of the convenience sampling method in this study imposes limitations on the generalizability of the findings to broader populations, in terms of both the gathered data and the associated constraints. To address this limitation, future research could undertake a more comprehensive investigation of gastronomic experiences and the factors influencing gastronomy satisfaction in diverse Mediterranean destinations.
48	Huang (2017)	Consumer	Facility marketing	QUAL	Online reviews	User-generated content	WORDij 3.0 software	Semantic network analysis (SNA)	This study adopted a case study approach, concentrating on a specific specialty food and a single restaurant brand. To broaden the scope and enhance the applicability of the study, future research could consider comparing the perceptions of local food not only between domestic residents and foreign customers.
49	Horng & Hsu (2021)	Consumer	Facility marketing	QUAN	Online	Survey through Amazon Mechanical Turk (MTurk)	Questionnaire / SmartPLS v.3.2.9 software	PLS-SEM	Future studies have the potential to delve deeper into the interactive relations among cognitive and affective components, along with esthetic stimulation.
50	Hsu et al. (2022)	Consumer	Facility marketing	QUAN/ QUAL	Online through the Wenjuanxing platform	Focus group	Open-ended questionnaire / NVivo software / Stata version 15 / Mplus version 8.4	Exploratory data analysis (EFA) / Item response theory (IRT) / CFA / SEM	The scale employed in this study reveals incompleteness when it comes to high-level affective gastronomy experiences. To address this limitation and ensure more comprehensive coverage of construct variance, it is recommended that future research incorporates additional items that specifically capture the nuances of higher-level affective gastronomy experiences.

Source: Authors' research

3.1 Consumer perspective

The data given in Table 1 indicate that most studies in the sample prioritize a consumer-centric approach (88%). This approach predominantly concentrates on investigating how tourists perceive and interact with gastronomic offerings of a destination. Despite considerable emphasis placed on destination marketing within these studies, there is a noticeable research gap concerning the exploration of gastronomic experiences within the realm of restaurant marketing. This suggests that fewer studies have specifically addressed the marketing dynamics of gastronomic facilities, particularly in terms of understanding and navigating the intricacies of restaurants situated within tourist destinations.

In studies focusing on destination marketing, the gastronomic experience is often examined alongside various factors such as tourist life satisfaction, quality of life, trip satisfaction, emotions, experience value, behavioral intentions, place attachment, and memorability. Understanding these interconnections is vital for destination management, as it enables stakeholders to bolster the destination's brand image by strategically developing and promoting its gastronomic offerings. Conversely, the limited number of studies in the domain of facility marketing may signal a potential opportunity for further research. Exploring gastronomic experiences within the facilities themselves could yield valuable insights into the intricacies of food-related services. Uncovering factors such as food preferences, overall satisfaction, identity, aesthetic stimulation, emotions, memorability, and behavioral intentions cannot only enrich understanding but also potentially pave the way for improvement and innovations in the business sphere. This deeper dive into the dynamics of gastronomic facilities could lead to the development of tailored strategies to enhance customer experiences and drive business success within the hospitality industry.

Moreover, the presented data suggest a clear preference for QUAN techniques in gastronomic research, with a higher frequency of use compared to QUAL and MIX methods approaches. This trend indicates that researchers in this field tend to rely more heavily on numerical data analysis to explore consumer perspectives on gastronomic tourism experiences. In QUAN studies, questionnaires are the primary research tool due to their perceived reliability and limited potential for researcher influence on respondent behavior. However, the application of analysis techniques varies, with PLS-SEM being the most popular, followed by other methods such as K-means clustering, EFA, PCA, ANOVA, CFA, regression, and CBBE.

Despite the prevalence of QUAN approaches, QUAL methods are also applied in consumer-centric studies. Content analysis is the most common qualitative analysis technique, along with other methods such as fuzzy set qualitative comparative analysis (fsQCA), Kelly's repertory grid technique, and framing theory. In-depth interviews are the preferred data collection technique, although other methods such as the Delphi technique and focus groups are also utilized.

While QUAN and QUAL methods dominate, there is a recognition of the value of integrating both approaches through MIX method designs. Sample studies which employed MIX methods typically utilize exploratory sequential design, where QUAL results inform the development of new survey instruments for subsequent QUAN analysis. This indicates a growing understanding of the complementary nature of QUAL and QUAN approaches in gastronomic research.

Moreover, scholars in QUAL studies acknowledge the relativistic nature of their findings due to contextual factors such as cultural settings, geographical context, data collection limitations, and sample characteristics. This recognition underscores the importance of considering diverse perspectives and contextual factors in gastronomic research methodologies and interpretations.

3.2 Provider perspective

Results also indicate that there is a noticeable imbalance in the reviewed literature, with most studies focusing on the consumer perspective and only a limited number on the provider perspective. Specifically, only 10% of the studies addressed the provider perspective, primarily examining the gastronomic experience in the domain of facility marketing, particularly in luxury restaurants. Research areas include sustainability, design and delivery, knowledge, post-COVID-19 crisis strategies, and the connection between menu design and responsible food selection. The absence of studies in the domain of destination marketing represents a gap in the literature, signaling an opportunity for future research to explore and address this aspect.

In provider-focused studies, QUAL research is more common, with interviews as the predominant data collection technique. Content analysis, lexical and reflexive thematic analysis are common in the analysis of QUAL data. Only one study in the provider sample applied the QUAN approach, utilizing SEM on a small sample size of 56 respondents for data analysis. This indicates a limited use of QUAN methods in provider-focused studies and suggests a potential avenue for future research.

Moreover, the QUAL authors in provider-focused studies state that the revitalization of the results and the difficulties of generalization were a limitation in their research. The lack of a common technical structure clearly poses a major challenge when it comes to describing unstructured data. Therefore, some QUAL scholars recommend that future research from the provider perspective should use QUAN techniques when examining the gastronomic tourism experience.

3.3 Both perspectives

Further, studies that consider both consumer and provider perspectives are rare, constituting only 2% of the examined literature on the gastronomic tourism experience. More precisely, only one study in the sample explores simultaneously both consumer and provider perspectives. For the purpose of gathering data, the study utilized QUAL methods, including in-depth interviews for providers and focus groups for consumers. Data analysis involved multiple processes to identify emerging concepts and categories. However, the study is acknowledged to have limitations, mainly due to its exploratory nature. It is essential to recognize that the findings may not be generalizable due to the specific focus and scope of the research.

4. Concluding remarks

Overall, this review underscores several critical gaps in existing research into the gastronomic tourism experience, shedding light on the limitations and biases present in the current literature. A significant shortcoming is the dearth of studies from the provider perspective, indicating a potential imbalance in understanding the industry. By emphasizing this gap, the review draws attention to the need for more research that explores gastronomic tourism experiences from the provider perspective. Moreover, the review highlights the underrepresentation of the domain of facility marketing within consumer studies. This suggests that the existing body of research may not fully capture the complexities of the business aspects of gastronomic tourism experiences. The call for more studies in this domain reflects the importance of a holistic approach that considers consumer perspectives within the business domain to provide a comprehensive understanding of gastronomic tourism experiences.

Another noteworthy finding relates to methodological preferences within the field. The review indicates a predominant use of QUAN methods, with PLS-SEM being particularly popular in consumer-centric studies. This insight into methodological trends is valuable for researchers and practitioners in the field, providing an understanding of the prevalent tools and techniques employed in gastronomic tourism research. In response to this identified gap, the review advocates for a more balanced research approach that incorporates both QUAL and QUAN methods. This recommendation emphasizes the importance of gaining a comprehensive understanding of gastronomic tourism experiences by considering diverse perspectives and employing a mix of research approaches.

Furthermore, this study contributes to the further development of the theoretical framework in gastronomic tourism by summarizing existing knowledge and identifying gaps. It provides a foundation for future scholars to build upon and refine theoretical constructs related to both consumer and provider perspectives. By emphasizing the need for studies considering both consumer and provider perspectives, the review encourages a more holistic theoretical approach. This integration can lead to the development of comprehensive models that capture the dynamics and interactions between tourists and gastronomic service providers. The recognition of methodological trends indicates a predominance of QUAN techniques. The review suggests a potential shift towards a more diverse methodological framework, incorporating both QUAN and QUAL methodologies to enhance the depth of theoretical understanding.

5. Limitations and future research

There are several limiting factors in this study. Firstly, only the Scopus online database was used

for data collection. Therefore, it is recommended for future research to include other scholarly databases such as WoS, Google Scholar and Emerald Insight. Another limitation relates to the inclusion of studies published in the last seven years (2017-2023). To achieve greater representativeness, future researchers are advised to include a longer period in data collection of the sample. Thirdly, as this research only considered studies that dealt with gastronomic tourism experiences, a proposal for further research would be to include a methodological discussion related to other tourism areas, such as ecotourism, event tourism, etc.

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References

1. Aaltojärvi, I., Kontukoski, M. & Hopia, A. (2018). Framing the local food experience: a case study of a Finnish pop-up restaurant. *British Food Journal*, *120*(1), 133-145. https://doi.org/10.1108/BFJ-12-2016-0613
2. Akdag, G., Guler, O., Dalgic, A., Benli, S. & Cakici, A. C. (2018). Do tourists' gastronomic experiences differ within the same geographical region? A comparative study of two Mediterranean destinations: Turkey and Spain. *British Food Journal*, *120*(1), 158-171. https://doi.org/10.1108/BFJ-01-2017-0017
3. Aguinis, H., Ramani, R. S. & Alabduljader, N. (2018). What you see is what you get? Enhancing methodological transparency in management research. *Academy of Management Annals*, *12*(1), 83-110. https://doi.org/10.5465/annals.2016.0011
4. Basnyat, S. & Ho, I. T. E. (2022). Food and tourist experiences: Insights from Macau. *Journal of Global Scholars of Marketing Science: Bridging Asia and the World*, *32*(1), 97-113. https://doi.org/10.1080/21639159.2020.1808835
5. Badu-Baiden, F., Correia, A. & Kim, S. (2022). How do tourists' memorable local gastronomy experiences and their personal gastronomic traits influence destination loyalty? A fuzzy set approach. *Journal of Travel & Tourism Marketing*, *39*(5), 501-515. https://doi.org/10.1080/10548408.2022.2148041
6. Batat, W. (2020). Pillars of sustainable food experiences in the luxury gastronomy sector: A qualitative exploration of Michelin-starred chefs' motivations. Journal of Retailing and Consumer Services, 57, 102255. https://doi.org/10.1016/j.jretconser.2020.102255
7. Berbel-Pineda, J. M., Palacios-Florencio, B., Ramírez-Hurtado, J. M. & Santos-Roldán, L. (2019). Gastronomic experience as a factor of motivation in the tourist movements. *International Journal of Gastronomy and Food Science*, *18*, 100171. https://doi.org/10.1016/j.ijgfs.2019.100171
8. Bonfanti, A., Vigolo, V., Yfantidou, G. & Gutuleac, R. (2023). Customer experience management strategies in upscale restaurants: Lessons from the Covid-19 pandemic. *International Journal of Hospitality Management*, *109*, 103416. https://doi.org/10.1016/j.ijhm.2022.103416
9. Brito, P. Q. & Vale, V. T. (2018). Toward an integrated model of visitor's food nostalgia and gender difference: A festival context. *Event Management*, *22*(4), 609-628. https://doi.org/10.3727/152599518X15300559276967
10. Cherro Osorio, S., Frew, E., Lade, C. & Williams, K. M. (2022). Blending tradition and modernity: gastronomic experiences in High Peruvian cuisine. *Tourism Recreation Research*, *47*(3), 332-346. https://doi.org/10.1080/02508281.2021.1940462
11. Cordova-Buiza, F., Gabriel-Campos, E., Castaño-Prieto, L. & García-García, L. (2021). The Gastronomic Experience: Motivation and Satisfaction of the Gastronomic Tourist—The Case of Puno City (Peru). *Sustainability (Switzerland)*, *13*(16), 9170. https://doi.org/10.3390/su13169170
12. Crespi-Vallbona, M. & Mascarilla-Miró, O. (2020). Wine lovers: their interests in tourist experiences. *International Journal of Culture, Tourism, and Hospitality Research*, *14*(2), 239-258. https://doi.org/10.1108/IJCTHR-05-2019-0095
13. Dixit, S. K. & Prayag, G. (2022). Gastronomic tourism experiences and experiential marketing. *Tourism Recreation Research,* 47(3), 217-220. https://doi.org/10.1080/02508281.2022.2065089
14. Dressler, M. & Paunovic, I. (2019). Customer-centric offer design: Meeting expectations for a wine bar and shop and the relevance of hybrid offering components. *International Journal of Wine Business Research*, *31*(1), 109-127. https://doi.org/10.1108/IJWBR-07-2018-0036
15. Filimonau, V. & Krivcova, M. (2017). Restaurant menu design and more responsible consumer food choice: An exploratory study of managerial perceptions. *Journal of Cleaner Production, 143*, 516-527. https://doi.org/10.1016/j.jclepro.2016.12.080
16. Folgado-Fernández, J. A., Hernández-Mogollón, J. M. & Duarte, P. (2017). Destination image and loyalty development: the impact of tourists' food experiences at gastronomic events. *Scandinavian Journal of Hospitality and Tourism*, *17*(1), 92-110. https://doi.org/10.1080/15022250.2016.1221181

17. Galiñanes Plaza, A., Saulais, L. & Delarue, J. (2022). What really matters when dining out? Insights into the role of context from a qualitative study with French consumers. *International Journal of Gastronomy and Food Science*, *28*, 100537. https://doi.org/10.1016/j.ijgfs.2022.100537

18. González Santa Cruz, F., Choque Tito, J., Pérez-Gálvez, J. C. & Medina-Viruel, M. J. (2019). Gastronomic experiences of foreign tourists in developing countries. The case in the city of Oruro (Bolivia). *Heliyon*, *5*(7), e02011. https://doi.org/10.1016/j.heliyon.2019.e02011

19. Gupta, V. & Sajnani, M. (2020). A study on the influence of street food authenticity and degree of their variations on the tourists' overall destination experiences. *British Food Journal*, *122*(3), 779-797. https://doi.org/10.1108/BFJ-08-2019-0598

20. Hernández-Mogollón, J. M., Di-Clemente, E. & Campón-Cerro, A. M. (2020). Culinary travel experiences, quality of life and loyalty. *Spanish Journal of Marketing - ESIC*, *24*(3), 425-446. https://doi.org/10.1108/SJME-11-2019-0094

21. Hernández-Rojas, R. D. & Alcocer, N. H. (2021). The role of traditional restaurants in tourist destination loyalty. *PLoS ONE*, *16*(6), e0253088. https://doi.org/10.1371/journal.pone.0253088

22. Hernandez-Rojas, R. D., Folgado-Fernandez, J. A. & Palos-Sanchez, P. R. (2021). Influence of the restaurant brand and gastronomy on tourist loyalty. A study in Córdoba (Spain). *International Journal of Gastronomy and Food Science*, *23,* 100305. https://doi.org/10.1016/j.ijgfs.2021.100305

23. Horng, J. S. & Hsu, H. (2021). Esthetic Dining Experience: The relations among aesthetic stimulation, pleasantness, memorable experience, and behavioral intentions. *Journal of Hospitality Marketing & Management*, *30*(4), 419-437. https://doi.org/10.1080/19368623.2021.1859425

24. Hsu, F. C., Liu, J. & Lin, H. (2022). Affective components of gastronomy tourism: measurement scale development and validation. *International Journal of Contemporary Hospitality Management*, *34*(9), 3278-3299. https://doi.org/10.1108/IJCHM-09-2021-1112

25. Huang, J. (2017). The dining experience of Beijing Roast Duck: A comparative study of the Chinese and English online consumer reviews. *International Journal of Hospitality Management*, *66*, 117-129. https://doi.org/10.1016/j.ijhm.2017.07.003

26. Kala, D. & Barthwal, S. (2020). Exploring tourist satisfaction on food and restaurant experience in mountainous religious destinations. *International Journal of Tourism Policy*, *10*(1), 1-22. https://doi.org/10.1504/IJTP.2020.107195

27. Kattiyapornpong, U., Ditta-Apichai, M. & Chuntamara, C. (2022). Exploring gastronomic tourism experiences through online platforms: evidence from Thai local communities. *Tourism Recreation Research*, *47*(3), 241-257. https://doi.org/10.1080/02508281.2021.1963920

28. Kiatkawsin, K. & Han, H. (2019). What drives customers' willingness to pay price premiums for luxury gastronomic experiences at Michelin-starred restaurants? *International Journal of Hospitality Management*, *82*, 209-219. https://doi.org/10.1016/j.ijhm.2019.04.024

29. Kılıçhan, R., Karamustafa, K. & Birdir, K. (2022). Gastronomic trends and tourists' food preferences: scale development and validation. *International Journal of Contemporary Hospitality Management*, *34*(1), 201-230. https://doi.org/10.1108/IJCHM-03-2021-0308

30. Kovalenko, A., Dias, Á., Pereira, L. & Simões, A. (2023). Gastronomic Experience and Consumer Behavior: Analyzing the Influence on Destination Image. *Foods*, *12*(2), 315. https://doi.org/10.3390/foods12020315

31. Laškarin Ažić, M., Rašan, D. & Mikinac, K. (2024). Memorable gastronomic experience in sustainable tourism destinations: evidence from Croatia. *European Journal of Tourism Research*, *36*, 3608. https://doi.org/10.54055/ejtr.v36i.3156.

32. Le, T. H., Arcodia, C., Novais, M. A. & Kralj, A. (2019). What we know and do not know about authenticity in dining experiences: A systematic literature review. *Tourism Management*, *74*, 258-275. https://doi.org/10.1016/j.tourman.2019.02.012

33. Lee, T. H., Chao, W. H. & Lin, H.-Y. (2018). Cultural inheritance of Hakka cuisine: A perspective from tourists' experiences. *Journal of Destination Marketing and Management*, *7*, 101-111. https://doi.org/10.1016/j.jdmm.2016.09.006

34. Lin, M.-P., Marine-Roig, E. & Llonch-Molina, N. (2022). Gastronomic experience (co)creation: evidence from Taiwan and Catalonia. *Tourism Recreation Research*, *47*(3), 277-292. https://doi.org/10.1080/02508281.2021.1948718

35. Magano, J., Fraiz-Brea, J. A. & Leite, Â. (2023). Dark tourism, the holocaust, and well-being: A systematic review. *Heliyon*, 9(1), e13064. https://doi.org/10.1016/j.heliyon.2023.e13064

36. Martín, J. C., Román, C., López-Guzmán Guzmán, T. & Moral-Cuadra, S. (2020). A fuzzy segmentation study of gastronomical experience. *International Journal of Gastronomy and Food Science*, *22*, 100248. https://doi.org/10.1016/j.ijgfs.2020.100248

37. Mora, D., Solano-Sánchez, M. Á., López-Guzmán, T. & Moral-Cuadra, S. (2021). Gastronomic experiences as a key element in the development of a tourist destination. *International Journal of Gastronomy and Food Science*, *25,* 100405. https://doi.org/10.1016/j.ijgfs.2021.100405

38. Moral-Cuadra, S., de la Cruz, R. A., López, R. R. & Cuadrado, E. S. (2020). Relationship between consumer motivation and the gastronomic experience of olive oil tourism in Spain. *Sustainability (Switzerland)*, *12*(10), 4178. https://doi.org/10.3390/su12104178

39. Myrnes-Hansen, K. V. & Skeiseid, H. V. (2022). How to start a Focus Group: Using cartoons in adult focus groups to discuss consumers feedback expectations in food service settings. *International Journal of Gastronomy and Food Science*, *29,* 100582. https://doi.org/10.1016/j.ijgfs.2022.100582

40. Nicoletti, S., Medina-Viruel, M. J., Di-Clemente, E. & Fruet-Cardozo, J. V. (2019). Motivations of the culinary tourist in the city of Trapani, Italy. *Sustainability (Switzerland)*, *11*(9), 2686. https://doi.org/10.3390/su11092686

41. Pappas, N., Michopoulou, E., Farmaki, A. & Leivadiotaki, E. (2022). Chaordic destination image formulation through gastronomy perspectives: evidence from Greece. *International Journal of Contemporary Hospitality Management*, *34*(9), 3459-3481. https://doi.org/10.1108/IJCHM-10-2021-1252

42. Park, E. & Widyanta, A. (2022). Food tourism experience and changing destination foodscape: An exploratory study of an emerging food destination. *Tourism Management Perspectives*, *42,* 100964. https://doi.org/10.1016/j.tmp.2022.100964

43. Pratt, S., Suntikul, W. & Agyeiwaah, E. (2020). Determining the attributes of gastronomic tourism experience: Applying impact-range performance and asymmetry analyses. *International Journal of Tourism Research*, *22*(5), 564-581. https://doi.org/10.1002/jtr.2356

44. Ramírez-Gutiérrez, D., Santana-Talavera, A. & Fernández-Betancort, H. (2021). Tasting experiences of a destination's local gastronomy on tourist communications. *Tourism Recreation Research*, *46*(3), 345-359. https://doi.org/10.1080/02508281.2020.1799293

45. Ramón, N. D., Rosell, B. F., Fransi, E. C. & Roig, E. M. (2018). Posturing or enjoying the gastronomic experience? Effects of reputation and experience in the recommendation of upscale restaurants. *Cuadernos de Turismo*, 42, 605-608.

46. Rašan, D. & Laškarin Ažić, M. (2023). Key dimensions of memorable gastronomic experience: application of Q-methodology. *Journal of Hospitality Marketing & Management*, *32*(5), 615-630. https://doi.org/10.1080/19368623.2023.2188625

47. Rodrigues, P., Borges, A. P. & Vieira, E. (2023). Gastronomic experiences on tourists' life satisfaction and happiness: The case of Porto. *European Journal of Tourism Research*, *34,* 3412. https://doi.org/10.54055/ejtr.v34i.3034

48. Rodríguez-Gutiérrez, P., Cruz, F. G. S., Gallo, L. S. P. & López-Guzmán, T. (2020). Gastronomic satisfaction of the tourist: Empirical study in the creative city of Popayán, Colombia. *Journal of Ethnic Foods*, *7*(1) 1-12. https://doi.org/10.1186/s42779-019-0044-0

49. Rodríguez-López, M. E., del Barrio-García, S. & Alcántara-Pilar, J. M. (2020). Formation of customer-based brand equity via authenticity: The mediating role of satisfaction and the moderating role of restaurant type. *International Journal of Contemporary Hospitality Management*, *32*(2), 815-834. https://doi.org/10.1108/IJCHM-05-2019-0473

50. Şahin, A. & Kılıçlar, A. (2023). The effect of tourists› gastronomic experience on emotional and cognitive evaluation: an application of SOR paradigm. *Journal of Hospitality and Tourism Insights, 6*(2), 595-612. https://doi.org/10.1108/JHTI-09-2021-0253

51. Seyitoğlu, F. & Ivanov, S. (2022). Understanding the robotic restaurant experience: a multiple case study. *Journal of Tourism Futures*, *8*(1), 55-72. https://doi.org/10.1108/JTF-04-2020-0070

52. Sharma, S., Singh, G., Ferraris, A. & Sharma, R. (2022). Exploring consumers' domestic gastronomy behaviour: a cross-national study of Italy and Fiji. *International Journal of Contemporary Hospitality Management, 34*(9), 3353-3375. https://doi.org/10.1108/IJCHM-10-2021-1251

53. Soonsan, N. & Somkai, U. (2023). Dimensions of gastronomic experience affecting on sharing experience: place attachment as a mediator and length of stay as a moderator. *Journal of Hospitality and Tourism Insights*, *6*(1), 344-361. https://doi.org/10.1108/JHTI-07-2021-0171

54. Sthapit, E. (2019). Memories of gastronomic experiences, savoured positive emotions and savouring processes. *Scandinavian Journal of Hospitality and Tourism*, *19*(2), 115-139. https://doi.org/10.1080/15022250.2017.1402702

55. Stone, M. J., Migacz, S. & Sthapit, E. (2022). Connections Between Culinary Tourism Experiences and Memory. *Journal of Hospitality and Tourism Research*, *46*(4), 797-807. https://doi.org/10.1177/1096348021994171

56. Valverde-Roda, J., Medina Viruel, M. J., Castaño Prieto, L. & Solano Sánchez, M. Á. (2022). Interests, motivations and gastronomic experiences in the world heritage site destination of Granada (Spain): satisfaction analysis. *British Food Journal*, *125*(13), 61-80. https://doi.org/10.1108/BFJ-07-2021-0830

57. Vargas-Sánchez, A. & López-Guzmán, T. (2018). Protection of culinary knowledge generation in Michelin-Starred Restaurants. The Spanish case. *International Journal of Gastronomy and Food Science*, *14*, 27-34. https://doi.org/10.1016/j.ijgfs.2018.09.001

58. Villagómez-Buele, C., Carvache-Franco, M., Carvache-Franco, O., Carvache-Franco, W. & Villavicencio-Párraga, M. (2020). Gastronomic Experience as a Factor of Motivation and Satisfaction in Coastal Destinations. *Journal of Environmental Management & Tourism, 11*(6), 1328-1337. https://doi.org/10.14505/jemt.v11.6(46).03

Book review

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BOOK REVIEW: “Brendiranje kulturom: glagoljica”

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Branding is a marketing activity by which a branded phenomenon (product, company, local or national community) is unambiguously identified with a meaning constructed in the consumer’s mind. Authors Horvat and Forjan published the book “Brendiranje kulturom: glagoljica” (Cultural Branding: Glagolitic Script) at the end of 2023. The book is accompanied by two reviews, and it was published by the increasingly reputable publisher Andizet Institute, under the financial support of the Ministry of Foreign and European Affairs. In the book “Brendiranje kulturom: glagoljica”, the authors systematically elaborate on the concept of cultural branding and exemplify it with the Glagolitic script. The Glagolitic script is a cultural phenomenon that was included on the list of intangible cultural heritage of the Republic of Croatia in 2014. The authors emphasize that the book is the result of nine years of work focused on scientific and professional research into the potential of the Glagolitic script in cultural branding. January 2023 is cited as the direct incentive and occasion for publishing the book “Brendiranje kulturom: glagoljica”, when the Republic of Croatia, after entering the European Monetary Union, marked euro coins in denominations of 5, 2, and 1 cent with the Glagolitic script.

The research study “Brendiranje kulturom: glagoljica” comprises four chapters: Glagolitic Script in the Circular Creativity Model, Novel Az – the Origin of the Circular Creativity Model, Sectoral Results, and Cultural Branding: Glagolitic Script in the Circular Creativity Model. The inclusion of keywords such as creative industry, methodology, fundamental cultural expression, Glagolitic script, and circular creativity, attests to its broad scope.

Presented and elaborated upon in the first chapter, the Circular Creativity Model is an original scientific contribution by the authors. It is important to note that this is a kind of novelty in the branding process, closely linked to the creative industry, which has not yet been formally institutionalized in the Republic of Croatia. The authors provide a detailed description of the Circular Creativity Model and then link it to the Glagolitic script, a traditional Croatian script, declared intangible cultural heritage of the Republic of Croatia. However, the Glagolitic script is examined in all chapters of the book from a theoretical and/or experimental point of view. As stated by the authors and confirmed by the reviewers, the established methodology of the Circular Creativity Model can be applied to other cultural goods of (in)tangible cultural heritage as a process for branding culture by circulating the core idea through the creative industry sectors. The concept of the Circular Creativity Model lies in the planned circulation of the fundamental cul-

tural template (literary text) through all sectors of the creative industry. Through such circulation, the underlying cultural template is interpreted in each of the creative industry media, resulting in a comprehensively branded conceptual origin (Horvat and Forjan, 2023: 5).

The second chapter of the book, titled "Novel Az – the Origin of the Circular Creativity Model", presents discussions between two scientists from humanistic studies. These two scientists elucidate the literary text by Jasna Horvat – The Novel Az, published by Naklada Ljevak in 2009 and later in its second edition in 2020. This literary text was awarded the Josip Juraj Strossmayer Literary Award by the Croatian Academy of Sciences and Arts in 2010. It also served as the conceptual template for applying the Circular Creativity Model to the phenomenon of the Croatian Glagolitic script in the book "Cultural Branding: Glagolitic Script".

Along with detailed discussions by Hrvojka Mihanović Salopek and Milica Lukić, the second chapter provides an explanation of the Croatian Academy of Sciences and Arts award given to this novel. It also provides selected excerpts from the novel, including the chapter "Slovarij: azbukividnjak", which succinctly explains all Glagolitic characters, and the chapter "Vector Reading of the Glagolitic script" with a matrix view of the Glagolitic script system.

The third chapter, "Sectoral Results", describes and critically analyzes sectoral circulation of the novel Az (Horvat 2009 and 2020) through sectors of the creative industry: architecture, audio-visual arts, heritage, design, music, performing arts, books and publishing, media, advertising and market communications, applied arts, computer games and new media, and visual arts. This chapter consists of sixteen subchapters dedicated to various products and creative industries named according to the key contribution of the described experiment: Sundial, Who Am I?, Glagolitic Hall, Meandering Glagolitic Murals, Glagolitic Game, Glagolitic Evening, Multimedia Guided Tour of the Glagolitic Hall, Millennium Competition in the Creative Industry, Millennium Stars, Ave Medallion, Sweet Az, Alkar Mural, Virtual Alkar, Alkar Computer Font, Glagolitic Chant, and Croatian Cultural Passport on the Silk Road.

In these 16 subchapters, the creation of each creative product (projects, services, or creative content) is explained based on the Glagolitic script and realized in one of the creative industry sectors.

Creation, connection to the fundamental cultural expression, conceptual initiators, media visibility, and market effectiveness, are described for each product. The subchapters are accompanied by illustrations, QR codes linking to online content, making the third chapter a multimedia manual and conceptual guide for future users of the Circular Creativity Model.

The fourth chapter, "Cultural Branding: Glagolitic Script in the Circular Creativity Model", consolidates previous chapters and divides key concepts into four subchapters: Branding and the Circular Creativity Model, Cultural Branding, Branding with the Glagolitic Script, Effects of Branding with the Glagolitic Script, and Continuation of Branding with the Glagolitic Script. The authors conclude that "culture is a resource multiplies by consumption". They also see the Circular Creativity Model as a template for "the process of comprehensive cultural branding with effects of global reach" (Horvat and Forjan, 2023: 114). Furthermore, the fourth chapter theoretically documents the analyzed phenomenon, and the subchapter on the Effects of Branding with the Glagolitic Script describes the spillover of cultural branding into education, tourism, and creative industry activities, as well as the enhancement of diplomatic and economic reputation.

The book "Brendiranje kulturom: glagoljica" expands knowledge in social sciences and other scientific studies related to knowledge about the Glagolitic script (humanities), communication (information sciences, sociology, and communication studies), and the production of creative products (artistic fields). Equipped with 6 tables, 68 images, one diagram, and a list of references, the book is intended for students of various scientific disciplines, scientists and researchers, policymakers, and entrepreneurs.

Literature:

1. Horvat, J. and Forjan, J. (2023). Brendiranje kulturom: glagoljica. Osijek: Andizet – Institut za znanstvena i umjetnička istraživanja u kreativnoj industriji.

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