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Article

Impact of bank financial technology on the performance of banks in the European Union

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Abstract: This article examines how financial technology determines bank performance in different EU countries. The answer to that question would allow banks to choose their development policy. The paper focuses on the main and most popular bank services that are linked to financial technology. A SWOT analysis of FinTech is also presented to show the benefits and drawbacks of FinTech. FinTech-based services are very diverse and are provided by financial firms and banks alike. This paper looks at the financial technology provided by banks: internet usage (internet banking), number of ATMs, credit transfers in a country, percentage of the population in a country holding a debit or credit card and whether that population has received or made a digital payment. Using the multi-criteria assessment methods of CRITIC and EDAS, the authors analysed and compared the countries of the European Union and the financial technology used in them. As a result of the application of these methods, the EU countries under consideration were ranked in terms of the use of financial technology. Subsequently, three banks from different countries with different levels of the use of financial technology were selected for the study. For these banks, financial ratios of profitability were calculated to characterise their performance. Correlation and pairwise regression analyses between the banks' profitability ratios and financial technology were used to assess the relationship and influence between these ratios. The main conclusion of the study focuses on the extent to which financial technology influences the performance of banks in the selected countries. It is likely that further research will try to take into account the size of the country's population when analysing all financial technologies. Researchers also needed to find out what influence financial technologies have on the such financial indicators as operational efficiency (costs), financial stability, and capital adequacy.

Keywords: EU countries; financial technology; multi-criteria assessment methods; CRITIC; EDAS; correlation; regression; profitability ratios

1. Introduction

Technology has a major impact on the development of financial services. It would be hard to find a single firm or bank that does not use financial technology services. In recent years, rapid advances in financial technology (FinTech) have attracted considerable attention in the financial industry. A number of authors argue that emerging technology has the potential to fundamentally change financial services, as FinTech innovations make transactions cheaper, more convenient and safer (Chen et al., 2019; Fakunle and Ajani, 2021; Haurovi and Chilunjika, 2024; Wang and Zhang, 2021).

The term 'FinTech' is applied and used in a variety of contexts. The term is often used ambiguously, as there is no precise, strict definition of the concept. In order to understand what FinTech is, it is useful to compare how the term is defined by different

authors. Schueffel (2016) argues that financial technology is a new financial industry that uses technology to improve financial performance. Other authors (Gimpel et al., 2018; Huis et al., 2019; Katina and Komarova, 2024; Thakoris, 2020) define FinTech as digital technology that is used to create and expand new financial services and to improve them. It can be observed that the definition of FinTech has remained largely unchanged over the years. Thus, summarising the opinions of various authors, it can be said that FinTech is a new, innovative technology whose main purpose is to improve financial services.

When looking at financial technology at national level, each country uses at least a minimum amount of financial technology in the provision of services. The development of the sector in the EU countries has intensified, reflecting the fact that increasing numbers of individuals, firms or banks are choosing to manage their finances through more efficient and innovative alternatives. Financial technology has become a routine in banks, with their services making work easier. For every bank, one of the most important aspects is their financial and operating performance. Therefore, when introducing innovations such as financial technology, the main criterion for banks is whether they will contribute to improving their performance. Unfortunately, no accurate information is available on the use of financial technology in different countries, and it is not clear in which countries the use of financial technology is more widespread and in which it is less. Therefore, this article will attempt to identify the countries which use financial technology to a greater extent and the countries which use FinTech-based services to a lesser extent. It would also be interesting to examine whether financial technology determines the performance of banks.

The main aim of this article is therefore to investigate the use of financial technology in EU countries and to assess the impact of financial technology on the performance of banks.

This work is organised as follows. In order to achieve the set aim, the first section analyses financial technology, identifying the strengths and weaknesses of financial technology, as well as models. The second section presents the methodology developed. The third section presents the studies carried out according to the methods selected. The last section includes conclusions, and directions for future study.

The methods used in the article include generalisation, systematisation, comparison, multi-criteria methods, such as CRITIC, EDAS, analysis of ratios, correlation analysis, pairwise regression analysis.

Unfortunately, the study had limitations, i.e., the lack of data on Sweden, Luxembourg and Poland on the chosen topic.

Methodological origins of financial technology

Understanding the business environment is crucial to the strategic planning process (Somogyi and Nagy, 2022). One of the most important tools to facilitate this understanding is a SWOT analysis (Vučinić, 2020). Analysing strengths, weaknesses, opportunities and threats (SWOT) is one of the most popular types of analysis among firms and investors (Namugenyi et al., 2019).

Strengths should reduce threats and make the system less vulnerable, sensitive and more resilient to risks. While simpler, cheaper and faster services are more

attractive and convenient for consumers, they have some drawbacks. FinTech-based services are prone to privacy breaches and misuse of available information. The issues of consumer protection and data privacy can pose a threat, i.e., a growth in financial crime (Štitilis et al., 2023; Vučinić, 2020). A significant technological breakdown can disrupt, or even disable, the provision and use of services (Katina et al., 2023).

After assessing all the pros, cons and risks associated with FinTech, a SWOT analysis of FinTech can be carried out (Morales et al., 2022; Pi et al., 2022), which is presented in **Figure 1**.

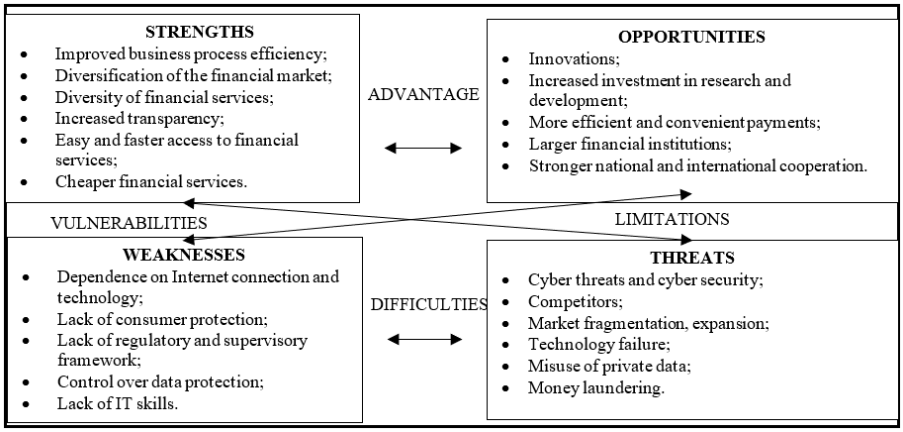

Figure 1. SWOT analysis of financial technology.
Source: Morales Et Al., 2022; Namugenyi Et Al., 2019; Vučinić, 2020.

The SWOT analysis shows the advantages and difficulties of using financial technology. Each firm that uses FinTech services faces different challenges and gains different benefits. In this case, the focus is more on the difficulties and advantages of financial technology used in banks (Adeniran et al., 2020).

As far as banking is concerned, the nature of services and institutions in financial markets is changing due to new market entrants (Anagnostopoulos, 2018; Tobisova et al., 2023). The situation in the financial services sector is also gradually changing as a result of reforming of financial regulation, as well as major advances in terms of financial technology innovations (Moralesas et al., 2022; Pi et al., 2022; Shava and Vyas-Doorgapersad, 2023).

FinTech is developing rapidly also at the present time and has passed through several evolutionary stages (Khalatur et al., 2022a, 2022b; Thakor, 2020; Wang et al., 2021). At the initial stage, financial technology played an important role in delivering information across borders, including financial information (Prawirasasra, 2018). Later, digitisation was introduced, which led to the invention of SWIFT (Society for Worldwide Interbank Financial Telecommunication) (Setiawan and Maulisa, 2020). Modern banking encompasses a large number of technological aspects, such as mobile banking, internet banking and ATMs (Leong, 2018; Legowo et al., 2021; Quyet,. 2024).

A study by Shy (2019) considers the types of FinTech innovations that are expected to change the future of the finance and banking industry. Blockchain, or Distributed Ledgers, is an example of modern development systems that could lead to

a banking revolution through related technology (Chilunjika and Uwizeyimana, 2024; Dimitrov et al., 2022).

Artificial intelligence and machine learning are other important new technologies that have had a major impact on banking in recent years (Fichter, and Anguelov, 2024; Krulický et al., 2024; Pechová et al.,2024; Samašonok and Išoraitė, 2023).

Each firm offers different services to consumers. These services are usually distributed according to existing FinTech models. Most authors (Anagnostopoulos, 2018; Lee and Shin, 2018; Laidroo et al., 2021) distinguish five main models:

1) payments;
2) wealth management;
3) crowdfunding;
4) lending;
5) capital markets.

The payments model is the simplest and most popular model among FinTech firms. FinTech firms that offer payment services attract customers by offering lower costs than competitors (Pizzi et al., 2021). Rupeika-Apoga and Thalassinos (2020) list some of the services that belong to this group of models: mobile payments, integrated billing, etc. (Lavrinenko et al., 2024).

One of the most prominent FinTech business models for wealth management is automated wealth managers that provide advice (robo-advisors). These advisors provide suggestions on various investments (Giglio, 2021) based on the client's preferences (Koman et al., 2022; Nazaritehrani and Mashali, 2020).

The crowdfunding model for financial technology allows the exploration of new product development prospects. Crowdfunding involves three parties. The first party is a project promoter or an entrepreneur who seeks funding from other parties. The second party is investors who may be interested in supporting a goal or a project by providing funds. The third party is intermediaries, who facilitate cooperation between entrepreneurs and investors, enabling faster and more accurate access to the information they need. Intermediaries or a representative organisation allow everyone to access information on different initiatives and funding opportunities for product/service development (Giglio, 2021).

P2P commercial lending is a major trend among FinTech firms. Online peer-to-peer lending is thriving as e-finances are becoming increasingly popular. P2P lending allows individuals and businesses to lend and borrow with each other. Due to their effective structure, P2P lending FinTech firms can offer low interest rates and an improved lending process to lenders and borrowers (Siddiqui and Rivera, 2022; Wang et al., 2015).

New FinTech business models draw inspiration from a wide range of capital markets in such areas as investment, foreign exchange, trading, risk management and research. A promising area of the FinTech capital market is trading. FinTech trading allows investors and traders to connect and discuss and share knowledge, place orders, buy and sell commodities and shares, and monitor risks in real time (Siddiqui and Rivera, 2022).

Looking at FinTech from the perspective of banks, the main objective is to improve the automation of banks' financial services (Legowo et al., 2021). The global economy, the growing importance of innovations and the widespread use of

technologies have transformed the business of banks around the world. FinTech-based services have become an integral part of banking (Nassar and Strielkowski, 2022; Romanova and Kudinska, 2016).

As regards the FinTech services provided by banks, it can be observed that their amount is much smaller. The main authors (Nazaritehrani and Mashali, 2020; Romanova and Kudinska, 2016; Scott et al., 2017) distinguish the following key FinTech services provided by banks:

1) ATMs (automated teller machines);
2) internet banking;
3) mobile banking;
4) telephone banking;
5) electronic funds transfer at the point of sale terminal;
6) SWIFT (Society for Worldwide Interbank Financial Telecommunication);
7) debit and credit bank cards.

Most of the financial technology services provided by these banks are used by the majority of consumers. Access to ATMs, internet banking, mobile banking is available and provided to every bank client, therefore, the use of these services is widespread across countries.

There emerge authors who explore the impact of FinTech on banks. An empirical analysis by Sheng (2021) demonstrates that FinTech can stimulate banks' overall credit supply. This article examines one of the most important areas of profitability of banks in various countries, which is characterized by certain indicators. This area is related to the financial technology of banks - is there a relationship, whether the use of financial technology affects the profitability of banks. Such detailed studies of this topic have not been observed in the research of other authors.

According to Rome (2018), technological innovations can be exceptional tools for achieving progress. A study by Wang et al. (2021) concludes that the development of FinTech increases bank profitability, stimulates innovation and improves risk control for commercial banks. Some authors (Hu et al., 2019; Morales, Gray and Rajmill, 2022) advance the hypothesis that the growth of FinTech hinders bank performance. According to Zhao et al. (2022), the growth of FinTech has a significant impact on various aspects of bank performance: capital adequacy, asset quality, management efficiency, profitability and liquidity ratios. The study by Ullah et al. (2023) seeks to identify the role of FinTech regarding bank stability. The findings reveal a significant impact on bank stability, which supports a resource-based theory suggesting that an increase in FinTech leads to improved bank profitability and financial stability. There is a gap in the literature, since relationship between financial technology and performace of banks still is not estimated.

Research hypothesis: there is a different relationship between financial technology and profitability indicators in banks of various countries.

2. Research methodology

2.1. Multi-criteria decision analysis

The article uses such methods as generalization, systematization, comparison, multicriteria methods: CRITIC, EDAS, analysis of relative indicators, correlation

analysis, pairwise regression analysis. Using multi-criteria assessment methods: CRITIC and EDAS, European Union countries and the financial technologies used in them are analyzed and compared. As a consequence of the application of these methods, the studied EU countries were organized in terms of the use of financial technologies.

A multi-criteria decision analysis (MCDA) is widely used in research. Many of the evaluation methods introduced within the MCDA help to construct alternative series. Due to rapid and extensive advances in digital technology, information-based systems are becoming an increasingly important element in various fields. The increasing amount of available information increases the importance of the decision-making factor. Complex decision-making problems, considering many conflicting criteria, require a decision support system to operate with appropriate methods to solve such problems (Paradowski et al., 2021).

The first step in all MCDA methods is determination of the structure of the problem under consideration. This determination is elaborated by means of a matrix with evaluated alternatives and evaluation criteria. Equation (1) shows how the matrix should look like (Paradowski et al., 2021).

$$X = \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{13} & \dots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \dots & x_{mn} \end{bmatrix}_{m*n} \quad (1)$$

In order to understand what MCDA evaluation methods are and how they work, it is first useful to present a general scheme of structure and execution for the MCDA methods. A scheme of execution of an MCDA method can be seen in **Figure 2**.

Figure 2. Procedure for MCDA methods.
Source: Paradowski, et al. (2021).

Depending on the method selected, differences in the problem-solving procedure may involve various additional steps (Paradowski et al., 2021).

CRITIC method. The CRiteria Importance Through Intercriteria Correlation (CRITIC) method is of particular interest because its analytical approach allows the use of all the information included in evaluation criteria. This method provides a broader view of the decision matrix, as other criteria are taken into account in order to give each of them a more pronounced weight. The CRITIC method provides objective weights, taking into account the intensity of contrast and conflict included in the decision problem. Thus, this method is used in the latest procedures designed to measure the effectiveness of decisions. The weights are obtained by quantifying the internal information of each evaluation criterion. This technique uses standard deviations of the criteria and correlations measured between the criteria. The sequence of steps in the CRITIC method can be seen in **Figure 3** (Krishnan et al., 2021; Paradowski et al., 2021).

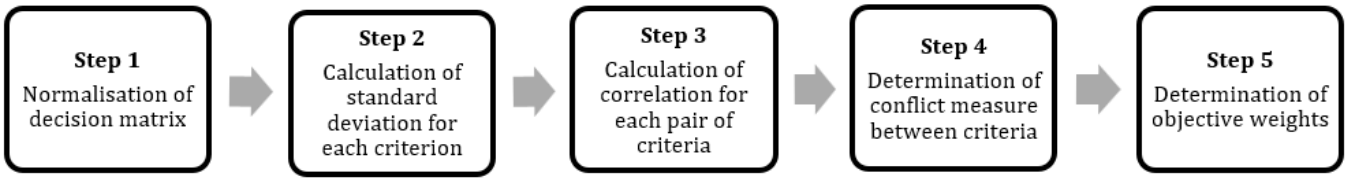

Figure 3. Procedure for the CRITIC method.
Source: Krishnan Et Al., 2021; Skvarciany And Astike, 2022.

The first step in the CRITIC method is the normalisation of decisions. Each value is converted into a number with a range of [0, 1]. In this procedure, criteria are not separated into profit and cost types. In this method, normalisation is done by using the minimum and maximum of the criteria, and the normalisation formula can be seen in Equation (2) (Krishnan et al., 2021; Skvarciany and Astike, 2022):

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \; i \in \{1,2,\dots,m\} \; j \in \{1,2,\dots,n\} \tag{2}$$

where: r_{ij}—the normalised number; m—the number of alternatives; n—the number of criteria.

The second step is the calculation of the standard deviation (σ_j). The standard deviation is calculated on the basis of the previously obtained normalised criterion values (r_j) (Skvarciany and Astike, 2022).

In the third step, the correlation is calculated for each pair's criterion (Skvarciany and Astike, 2022).

In the fourth step, a resultant vector is obtained using the resulting matrix and the standard deviation score. This step is calculated according to the formula presented in Equation (3) (Skvarciany and Astike, 2022):

$$C_j = \sigma_j \sum_{k=1}^{m} (1 - R_{jk}) \tag{3}$$

where: σ_j—the standard deviation; R_{jk}—the number obtained from the correlation.

In the last step, the weights of the criteria are calculated using the results of the normalisation of the vector sum as calculated previously (see Equation (4)) (Skvarciany and Astike, 2022):

$$w_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \tag{4}$$

In the last step, with the weights of each criterion being known and the fourth step having been completed, we can proceed to the selection of the multi-criteria method.

EDAS method. One of the most recent multi-criteria methods is the Evaluation based on Distance from Average Solution (EDAS) method. This method was invented by Keshavarz Ghorabaee, Zavadskas, Olfat and Turskis in 2015. It is distinguished by the fact that it is based on finding the best solution by looking for the distance from the average (Ghorabaee et al., 2015; Kahraman et al., 2017).

In applying the EDAS method, the following sequence of steps can be followed (Skvarciany et al., 2020).

Step 1. First, a decision matrix is created (Ghorabaee et al., 2015; Kahraman et al., 2017; Skvarciany et al., 2020):

$$X = [x_{ij}]_{m\times n} = \begin{matrix} X_{11} & \dots & X_{1m} \\ \vdots & \ddots & \vdots \\ X_{n1} & \dots & X_{nm} \end{matrix} \quad (5)$$

where: X_{ij}—the value of the *i*-th alternative; *n*—the number of alternatives; *m*—the number of criteria.

In the second step, the average solution for each criterion is calculated. The average solution is calculated using Equation (6) below (Kahraman et al., 2017):

$$AV_j = \frac{\sum_{i=1}^{n} x_{ij}}{n} \quad (6)$$

In the third step, the positive distance from the average matrix (*PDA*) and negative distance from the average matrix (*NDA*) are calculated according to the type of the criteria. If the criterion is maximising, it is calculated according to the following formulae (see Equation (7) and (8)) ((Ghorabaee et al., 2015; Skvarciany et al., 2020):

$$PDA_{ij} = \frac{max(0, (X_{ij} - AV_j))}{AV_j} \quad (7)$$

$$NDA_{ij} = \frac{max(0, (AVj - X_{ij}))}{AV_j} \quad (8)$$

where: PDA_{ij}—the positive distance from the average; NDA_{ij}—the negative distance from the average.

If the criterion is minimising, the *PDA* and *NDA* are calculated using the following formulae (see Equation (9) and (10)):

$$PDA_{ij} = \frac{max(0, (AV_j - X_{ij}))}{AV_j} \quad (9)$$

$$NDA_{ij} = \frac{max(0, (X_{ij} - AV_j))}{AV_j} \quad (10)$$

where: PDA_{ij}—the positive distance from the average; NDA_{ij}—the negative distance from the average.

In the fourth step, the weighted sums of the positive distance from the average (PDA_{ij}) and the negative distance from the average (NDA_{ij}) are calculated (see Equation (11) and (12)):

$$SP_i = \sum_{j=1}^{m} w_j PDA_{ij} \quad (11)$$

$$SN_i = \sum_{j=1}^{m} w_j NDA_{ij} \quad (12)$$

where: SP_i—the weighted sum of $PDAi_j$; SN_i—the weighted sum of NDA_{ij}.

In the fifth step, we determine the normalised values of SP_i and SN_i. The normalisation of the values follows the following formulae (see Equation (13) and (14)) (Ghorabaee et al., 2015; Kahraman et al., 2017; Skvarciany et al., 2020):

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (13)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (14)$$

where: *NSP*i—the normalised value of SP_i; NSN_i—the normalised value of SN_i.

In the sixth step, the evaluation score of all alternatives is calculated according to the formula presented in Equation (15) (Ghorabaee et al., 2015; Kahraman et al., 2017; Skvarciany et al., 2020):

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \tag{15}$$

where: AS_i—the evaluation score of all alternatives.

If all the steps are correct, the *AS* result must be in the range ($0 \leq AS_i \leq 1$). Finally, the alternatives are ranked according to decreasing AS_i values, i.e., the alternative with the highest *AS* is the best choice among the candidates.

2.2. Profitability ratios of banks

Using the balance sheets and profit and loss statements provided by banks, it is possible to calculate the following profitability ratios, which after carrying out a critical analysis were selected as key and relevant for the banks under consideration.

Upon calculation of the profitability ratios, it is possible to analyse and compare both the return on assets and return on equity ratios as well as net profit and other ratios. As a result of the critical analysis, key profitability ratios were selected and presented in **Table 1** (Abdullah et al., 2017; Brigham and Houston, 2012; Felicia et al., 2023; Hasanaj and Kuqi, 2019; Ogbeide et al., 2021; Randey, 2016; Sabauri and Kvatashidze, 2023; Világi et al., 2022; Víghová et al., 2023).

Table 1. Key profitability ratios.

Ratio	Definition	Formula	Evaluation of indicator
Return on assets ratio	Return on assets shows whether a bank's assets are used efficiently.	$\frac{Net\ profit}{Average\ assets}$	The higher the score for the ratio, the more efficiently the bank's assets are used.
Return on equity ratio	The ratio shows how much net profit is generated per euro of equity. This ratio is very important for shareholders as it shows whether their invested assets are used efficiently.	$\frac{Net\ profit}{Average\ equity}$	The higher the score for the ratio, the better.
Net interest income margin	The ratio shows the profitability of a bank's financial activities in relation to lending of the bank and the funds on which interest is paid.	$\frac{Net\ interest\ income}{Assets}$	A low score for the ratio indicates that in financing its activities, the bank is over-using deposits and existing sources of funding which are subject to high interest rates.
Net profit margin	The ratio shows how much net profit is generated per euro of income.	$\frac{Net\ profit}{Operating\ income}$	A higher score for the ratio shows that a bank is able to control its expenses.

Source: Brigham And Houston, 2012; Hasanaj And Kuqi, 2019.

An analysis of profitability ratios of banks in three different countries provides an opportunity to assess the performance of the banks in question and to compare their situations with each other. The profitability ratios will also be used to determine the impact of FinTech on the banks.

2.3. Correlation and pairwise regression analyses

The study of the impact of FinTech on the financial performance of the banks is carried out by applying the theoretical and practical aspects of correlation and

regression analyses (Cohen et al., 2013; DeCoster and Claypool, 2004; Hoyt et al., 2008; Kafle, 2019).

The first step in correlation is a data outlier analysis, which shows whether there are skewed data in a data table. Failure to remove them may result in inaccurate or inappropriate results for further analysis. Cook's Distance (see Equation (16)) is used to detect and remove outliers (Cohen et al., 2013; DeCoster and Claypool, 2004).

$$D_i = \frac{(SR)^2 h_i}{2(1-h_i)} \tag{16}$$

where: D_i—Cook's Distance; SR—the standardised residual; h_i—the observation's influence index.

With the calculated results, the decision on the existence of outliers is made on the basis of the available requirements (**Table 2**) (Cohen et al., 2013; DeCoster and Claypool, 2004).

Table 2. Cook's distance decision making.

Di > 1	Outlier exists
Di < 1	Outlier does not exist

Source: developed by the authors.

Once the outliers have been removed, the next step is to calculate the correlation coefficient. This step determines whether there is a correlation between the available samples. The strength and direction of the correlation can also be determined (Cohen et al., 2013; DeCoster and Claypool, 2004; Hoyt et al., 2008; Kafle, 2019). The first step in the calculation of the correlation coefficient is the formulation of a hypothesis, which is developed using the method presented:

$$\begin{cases} H_0: \rho = 0 \\ H_1: \rho \neq 0 \end{cases}$$

where: ρ—the population correlation coefficient.

The null hypothesis indicates that the correlation coefficient is equal to zero and there is no correlation, while the alternative hypothesis indicates that the correlation exists and that further examination is possible. Once the hypothesis has been raised, the correlation coefficient (r) can be calculated according to Equation (17):

$$r = \frac{n\Sigma x_i y_i - \Sigma x_i \Sigma y_i}{\sqrt{n\Sigma x_i^2 - (\Sigma x_i)^2} \times \sqrt{n\Sigma y_i^2 - (\Sigma y_i)^2}} \tag{17}$$

where: $\Sigma x_i y_i$—sums of statistical values; $\Sigma x_i^2 - (\Sigma x_i)^2$—:sums of statistical values; r—the correlation coefficient.

The correlation coefficient can take values in the range [−1,1]. The interpretation of the strength of the correlation coefficient is presented in **Table 3**.

Table 3. Qualitative characteristics of the correlation coefficient.

Negative values	**Description**	**Positive values**
0.00	"none"	0.00
−0.19~−0.01	"very weak"	0.19–0.01
−0.39~−0.20	"weak"	0.39–0.20

Table 3. (*Continued*).

Negative values	Description	Positive values
−0.69~−0.40	"moderate"	0.69–0.40
−0.89~−0.70	"strong"	0.89–0.70
−0.99~−0.90	"very strong"	0.99–0.90
−1.00	"absolutely accurate"	1.00

Source: Cohen Et Al., 2013; Decoster And Claypool, 2004; Hoyt et al., 2008; Kafle, 2019.

For further calculations, we use the obtained p-value. This value is treated as the significance level in statistical analysis. The decision is made by comparing the obtained value against the obtained alpha value (Cohen et al., 2013):

1) If the p-value $\geq \alpha$, H_0 is not rejected.
2) If the p-value $< \alpha$, H_0 is rejected.

If the answer is that there is a correlation between the dependent factor and independent factors, it is possible to proceed to pairwise testing. In this analysis, an attempt is made to identify and determine a linear expression that will show the influence of the independent variables on the dependent variable (Cohen et al., 2013; DeCoster and Claypool, 2004; Hoyt et al., 2008; Kafle, 2019):

$$y = ax + b + e \tag{18}$$

where: a and b—unknown constants; e—a random error.

For the calculation of the coefficients, Equation (19) and (20) are used:

$$\mathrm{a} = \frac{\mathrm{n}\Sigma x_{\mathrm{i}}\mathrm{y}_{\mathrm{i}} - \Sigma x_{\mathrm{i}}\Sigma \mathrm{y}_{\mathrm{i}}}{\mathrm{n}\Sigma x_{\mathrm{i}}^2 - (\Sigma x_{\mathrm{i}})^2} \tag{19}$$

$$\mathrm{b} = \frac{\Sigma \mathrm{y}_{\mathrm{i}}}{\mathrm{n}} - \mathrm{a} \times \frac{\Sigma \mathrm{x}_{\mathrm{i}}}{\mathrm{n}} \tag{20}$$

Given the values of the coefficients, it is possible to determine the coefficient of determination, which indicates the proportion of the variation in the dependent variable that can be explained by independent variables. The coefficient of determination R is calculated using (21):

$$R = r^2 \tag{21}$$

where: r—the correlation coefficient.

The line has no value if the coefficient of determination is less than 0.25.

A correlation analysis will be carried out between the financial ratios of the three banks under consideration and financial technology. Firstly, a correlation coefficient will be calculated, which can indicate whether a correlation between variables exists. Alternatively, it is possible that the correlation does not exist, in which case no further analysis is possible. If the result shows that the correlation exists, a pairwise regression analysis will be carried out.

3. Study on the use of financial technology by banks and its impact on financial performance

3.1. Study on the use of financial technology by banks in the EU

The aim of the study is to examine and compare the European Union countries in terms of financial technology used by banks which exist and operate in these countries.

Due to lack of information, Luxembourg, Poland and Sweden did not participate in the follow-up study, and the study was carried out with 24 alternatives. In terms of the criteria selected, the financial instruments selected for examination were those offered and provided by the banks. The first criterion is Internet usage: Internet banking (Statistics | Eurostat, no data available), the second criterion is the number of ATMs (per 100000 adults) (European Union | Data, no data available), and the third criterion is credit transfers in the countries (SEPA Payment Statistics | European Payments Council, no data available). The fourth and fifth criteria are the percentage of the population in a country holding a debit or credit card and whether that population has received or made a digital payment (The Global Findex Database 2021, no data available). For the study summarized data for 2020–2022 were used.

In this study, two multi-criteria methods were selected. The first is the CRITIC method, which was employed to find out the weights of the criteria. The second method (EDAS) was used to construct an alternative series.

CRITIC method. After calculations were carried out using the formulae presented in the methodology section, the final results can be seen in **Table 4**.

Table 4. Results determined from the CRITIC method.

	Internet usage: Internet banking	**Number of ATMs (per 100000 adults)**	**Credit transfers (SEPA)**	**Holders of a debit or credit card (%, 15+)**	**Making or receiving a digital payment (%, 15+)**
C_j	0.700	1.196	0.730	0.483	0.437
Weights	0.20	0.34	0.21	0.14	0.12

Source: developed by the authors.

After performing all the calculations, the following results were obtained: the weight of the first criterion is 0.2; the weight of the second criterion is 0.34; the weight of the third criterion is 0.21; the weight of the fourth criterion is 0.14; the weight of the fifth criterion is 0.12.

EDAS method. The aim of this method was to rank European Union countries according to the financial technology provided by banks. The final scores on the basis of which the EU countries are ranked were obtained using the formulae presented in the methodology section. The final results can be seen in **Table 5**.

Table 5. EDAS method: NSP_i, NSN_i and AS_i scores.

	SP_i	**SN_i**	**NSP_i**	**NSN_i**	**AS_i**	**Ranking**
Austria	0.599	0.072	0.34825	0.85702	0.603	5
Belgium	0.462	0.011	0.26871	0.97802	0.623	4
Bulgaria	0.121	0.402	0.07061	0.19702	0.134	22
Croatia	0.339	0.259	0.19727	0.48196	0.340	10
Cyprus	0.005	0.376	0.00294	0.24822	0.126	23
Czechia	0.030	0.292	0.01743	0.41598	0.217	17
Denmark	0.098	0.358	0.05728	0.28548	0.171	20
Estonia	0.086	0.227	0.05006	0.54616	0.298	14
Iceland	0.312	0.175	0.18128	0.64976	0.416	9
France	1.119	0.000	0.65104	1.00000	0.826	2

Table 5. (*Continued*).

	SP_i	SN_i	NSP_i	NSN_i	AS_i	Ranking
Germany	1.720	0.042	1.00000	0.91676	0.958	1
Greece	0.086	0.243	0.05030	0.51440	0.282	15
Hungary	0.000	0.325	0.00000	0.35141	0.176	19
Ireland	0.114	0.199	0.06620	0.60270	0.334	11
Italy	0.355	0.057	0.20670	0.88564	0.546	6
Latvia	0.079	0.253	0.04621	0.49348	0.270	16
Lithuania	0.073	0.342	0.04231	0.31584	0.179	18
Malta	0.000	0.349	0.00000	0.30322	0.152	21
Netherlands	0.749	0.181	0.43577	0.63849	0.537	7
Portugal	0.500	0.173	0.29077	0.65472	0.473	8
Romania	0.000	0.500	0.00000	0.00000	0.000	24
Slovakia	0.074	0.199	0.04291	0.60194	0.322	13
Slovenia	0.084	0.196	0.04878	0.60788	0.328	12
Spain	0.470	0.000	0.27318	1.00000	0.637	3

Source: developed by the authors.

After the steps of the EDAS method were completed, ranking can be performed. The ranking was done with the help of the Excel RANK function. The rank assigned to each alternative can be seen in **Table 3**. Thus, Germany is ranked first in terms of the use of financial technology, France is ranked second and Spain is ranked third. According to the EDAS method, Lithuania is ranked 18th.

3.2. Evaluation of the banks' profitability ratios

The calculation and evaluation of profitability ratios are carried out on the basis of a balance sheet and a profit and loss statement, accordingly indicated in the list of literature, for three banks from different European Union countries. The first bank selected is Germany's Deutsche Bank (Deutsche Bank—Annual report, 2013–2022). The second bank selected is Landsbankinn, which operates in Italy (Landsbankinn—Annual Financial Statement, 2013–2022). The third bank is Swedbank, which operates in Lithuania (Swedbank, AB—Annual Report, 2013–2022).

Profitability ratios primarily show whether a bank is profitable. Scores for the profitability ratios for the banks in question are shown in **Table 6**.

Table 6. Scores for profitability ratios.

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Return on assets ratio	Deutsche Bank	0.0004	0.0010	−0.0042	−0.0009	−0.0005	0.0003	−0.0041	0.0005	0.0019	0.0042
	Landsbankinn	0.0250	0.0271	0.0326	0.0150	0.0166	0.0145	0.0128	0.0067	0.0167	0.0095
	Swedbank	0.0290	0.0185	0.0170	0.0123	0.0130	0.0114	0.0103	0.0064	0.0045	0.0075
Return on equity ratio	Deutsche Bank	0.0124	0.0247	−0.1080	−0.0227	−0.0116	0.0055	−0.0943	0.0114	0.0433	0.0913
	Landsbankinn	0.1192	0.1186	0.1378	0.0663	0.0803	0.0804	0.0736	0.0407	0.1023	0.0609
	Swedbank	0.1720	0.1083	0.1009	0.1248	0.1329	0.1311	0.1277	0.0955	0.0742	0.1282

Table 6. (*Continued*).

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Net interest income margin	Deutsche Bank	0.0092	0.0084	0.0097	0.0092	0.0084	0.0099	0.0106	0.0087	0.0084	0.0102
	Landsbankinn	0.0298	0.0256	0.0452	0.0309	0.0304	0.0308	0.0278	0.0243	0.0225	0.0260
	Swedbank	0.0156	0.0159	0.0130	0.0134	0.0138	0.1311	0.1277	0.0955	0.0742	0.1282
Net profit margin	Deutsche Bank	0.0399	0.0957	−0.3838	−0.0886	−0.0522	0.4173	0.1761	0.0499	−0.5592	0.0284
	Landsbankinn	0.4385	0.4709	0.5038	0.3452	0.3694	0.3573	0.3540	0.2750	0.4640	0.3192
	Swedbank	0.9268	0.5853	0.6575	0.4879	0.4891	0.4830	0.4462	0.3726	0.3237	0.4034

Source: developed by the authors.

The return on assets ratio shows whether banks' assets are used efficiently. A higher score indicates that a bank is managing its assets efficiently. If the banks have interest or commission fee income as one of their main sources of income, the scores for this ratio are much lower and may be as low as 1%.

Banks' return on assets ratios have been quite low over the last decade, even below 1%. This may indicate that the main activity of the banks analysed is commission fee and/or interest income. These scores are therefore acceptable and do not indicate poor asset management by the banks. The highest score is with the Italian bank, although the bank has experienced difficulties over the last few years. Meanwhile, the scores of the German and Lithuanian banks have increased in the recent period.

The return on equity is a key ratio that summarises the measure of return to shareholders. The score of the ratio is dependent on the profits earned and losses suffered by the bank.

Looking at the return on equity ratio, it can be seen that the Lithuanian bank has the highest score for the ratio, which indicates that the bank is managed efficiently. Its initiative of attracting deposits and other borrowed resources is quite good. In contrast, the German bank has experienced several downturns over the last decade, in the course of which it has achieved a negative score.

The net interest income margin ratio shows a bank's financial activity which is related to the income that earns interest. The lowest score for the ratio is observed in the German bank, which indicates that the bank finances its activities by using deposits for which high interest rates have been fixed. In both the Italian and German banks, the score for the ratio is quite low, suggesting that the loans held by the banks are not earning sufficient interest (see **Table 6**).

The net profit ratio reflects a bank's ability to manage its expenditure. The best score has been achieved by Swedbank from Lithuania (see **Table 6**). In 2022, it was as high as 40%, which shows that the bank is able to control its expenditure. In contrast, the German bank's performance shows that it is not successful in managing its expenditure.

3.3. Study of the impact of the banks' financial technology on their performance

3.3.1. Correlation and regression analyses of the profitability ratios of German

bank Deutsche bank

In a correlation analysis of Deutsche Bank, the dependent factor is the respective profitability ratio under consideration. The independent factor in the analysis of the German bank is financial technology. The following five financial technologies have been selected for Germany:

1) Number of ATMs (Germany: ATMs per Capita | Statista, 2022).
2) Internet banking (Statistics | Eurostat, 2022).
3) Credit cards (Germany: Number of Credit and Debit Cards, Statista, 2022).
4) Debit cards (Germany: Number of Credit and Debit Cards, Statista, 2022).
5) SEPA (Single Euro Payment Area) payments (Germany: Credit Transfer Volume, Statista, 2022).

The results of a correlation analysis between the German bank's return on assets (ROA) ratio and independent variables are shown in **Table 7**.

Table 7. Results of the correlation analysis between the German bank's return on assets and independent variables.

Number of ATMs in the country	*p*–0.713
Internet usage: Internet banking	*p*–0.206
Number of credit cards	*p*–0.851
Number of debit cards	*p*–0.852
Digital payments	*p*–0.855

Source: developed by the authors.

For all the ratios considered, the resulting *p*-value is greater than 0.05, suggesting that no financial technology has an impact on the return on assets ratio of the German bank.

The results of a correlation analysis between the German bank's return on equity ratio and independent variables are presented in **Table 8**.

Table 8. Results of the correlation and regression analyses between the German bank's return on equity ratio and independent variables.

	Number of ATMs in the country	**Internet usage: Internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
	p–0.482	*p*–0.353	*p*–0.400	*p*–0.072	*p*–0.02
p-value	These *p-value*s are greater than 0.05, suggesting that a correlation does not exist.				This *p*-value is less than 0.05, suggesting that a correlation exists.
Equation	-	-	-	-	$y = 9.747 \times 10^{-5}x_1 - 0.625$
Interpretation of the equation	-	-	-	-	The ratio will increase as digital payments increase.
Coefficients of correlation, determination	-	-	-	-	$r = 0.716$; Adjusted R Square = 0.452.

Source: developed by the authors.

Looking at the correlation analysis between the return on equity ratio and the independent variables, it can be said that most financial technologies have no impact on the ratio except the number of digital payments. The result shows that there is a strong and positive correlation. As digital payments increase, the equity ratio will also increase. This is because, as the number of payments made by consumers increases, the bank receives a fixed fee for such transfers. This leads to an increase in profit, which in turn leads to an increase in the ratio.

The results of a correlation analysis between the German bank's net interest income margin ratio, the profit margin ratio and the interest expense to assets ratio, on the one part, and independent variables, on the other part, are shown in **Table 9**.

Table 9. Results of the correlation analysis between the German bank's net interest income margin, net profit margin ratios and independent variables.

	Net interest income margin ratio	**Net profit ratio**
Number of ATMs in the country	*p*–0.695	*p*–0.637
Internet usage: Internet banking	*p*–0.679	*p*–0.262
Number of credit cards	*p*–0.708	*p*–0.488
Number of debit cards	*p*–0.761	*p*–0.119
Digital payments	*p*–0.898	*p*–0.059

Source: developed by the authors.

The performed correlation analysis shows that no financial technology has a statistically significant correlation with the ratios considered. Therefore, no further analysis was carried out.

3.3.2. Correlation and regression analyses of the profitability ratios of Italian bank Landsbankinn

Just as in the previous study, in a correlation analysis of the Italian bank, the dependent factor is the respective profitability ratio. Independent factors are the following five financial technologies in Italy:

1) Number of ATMs in Italy (Italy: ATMs per Capita | Statista, 2022).
2) Internet banking (Statistics | Eurostat, 2022).
3) Credit cards (Italy: Payment Cards per Capita | Statista, 2022).
4) Debit cards (Italy: Payment Cards per Capita | Statista, 2022).
5) SEPA (Single Euro Payment Area) payments (Italy: Credit Transfer Volume 2000–2022 | Statista, 2022).

Table 10. Results of the correlation and regression analyses between the Italian bank's return on assets ratio and independent variables.

	Number of ATMs	**Internet usage: Internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
p-value	*p*–0.025 This *p*-value is less than 0.05, suggesting that a correlation exists.	*p*–0.024	*p*–0.493 This *p*-value is greater than 0.05, suggesting that there is no correlation.	*p*–0.007 This *p*-value is less than 0.05, suggesting that a correlation does not exist.	*p*–0.012
Equation	$y = 0.002x_1 - 0.200$	$y = -0.001x_2 + 0.040$	-	$y = -0.049x_3 + 0.067$	$y = -4.008\times10^{-5}x_4 + 0.74$

Table 10. (*Continued*).

	Number of ATMs	Internet usage: Internet banking	Number of credit cards	Number of debit cards	Digital payments
Interpretation of the equation	The return on assets ratio will increase as the number of ATMs increases.	The profitability ratio will decrease as the Internet usage increases.	-	The profitability ratio will decrease as the number of debit cards increases.	The profitability ratio will decrease as the number of digital payments increases.
Coefficients of correlation, determination	$r = 0.697$; Adjusted R Square = 0.421	$r = -0.700$; Adjusted R Square = 0.426	-	$r = -0.790$; Adjusted R Square = 0.577	$r = -0.752$; Adjusted R Square = 0.511
	The equations have a value.			The equations have a value.	

Source: developed by the authors.

For each of the bank's profitability ratios, a correlation analysis is carried out to show whether financial technology has an impact on the bank's performance.

The results of a correlation analysis between the Italian bank's return on assets (ROA) ratio and independent variables are presented in **Table 10**.

The results show that the return on assets ratio is determined by the majority of the independent factors under consideration. Only the number of ATMs in the country has a positive impact, and the ratio increases as this independent factor increases. This suggests that assets are managed more efficiently. The remaining independent factors have a negative impact on the return on assets ratio. This may be because the assets remain unchanged as these financial technologies grow.

The results of a correlation analysis between the Italian's bank return on equity ratio and independent variables are presented in **Table 11**.

Table 11. Results of the correlation and regression analyses between the Italian bank's return on equity ratio and independent variables.

	Number of ATMs in the country	Internet usage: Internet banking	Number of credit cards	Number of debit cards	Digital payments
	p–0.137	*p*–0.092	*p*–0.425	*p*–0.032	*p*–0.56
p-value	This *p*-value is greater than 0.05, suggesting that a correlation does not exist.			This *p*-value is less than 0.05, suggesting that a correlation exists.	This *p*-value is greater than 0.05, suggesting that a correlation does not exist.
Equation	-	-	-	$y = -0.159x_1 + 0.247$	-
Interpretation of the equation	-	-	-	The ratio will decrease as the number of debit cards increases.	-
Coefficients of correlation, determination	-	-	-	$r = -0.676$; Adjusted R Square = 0.390	-
	-	-		The equations have a value.	-

Source: developed by the authors.

The return on equity ratio correlates only with the number of debit cards. The correlation is negative but strong enough. In contrast, other independent factors have no impact on this ratio.

The results of a correlation analysis between the Italian bank's net interest income margin ratio and independent variables are presented in **Table 12**.

Table 12. Results of the correlation and regression analyses between the Italian bank's net interest income margin ratio and independent variables.

	Number of ATMs in the country	**Internet usage: Internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
	p–0.003	p–0.150	p–0.536	p–0.185	p–0.099
p-value	This p-value is less than 0.05, suggesting that a correlation exists.	This p-value is greater than 0.05, suggesting that a correlation does not exist.			
Equation	$y = 0.002x_1 - 0.173$	-	-	-	-
Interpretation of the equation	The ratio will increase as the number of ATMs increases.	-	-	-	-
Coefficients of correlation, determination	$r = -0.837$; Adjusted R Square = 0.663	-	-	-	-
	The equation has a value.	-	-	-	-

Source: developed by the authors

The Italian bank's net income margin ratio correlates only with the number of ATMs in the country. This is a quite realistic scenario as the bank's assets increase.

The results of a correlation analysis between the Italian bank's profit margin ratio and the interest expense to assets ratio, on the one part, and independent variables, on the other part, are presented in **Table 13**.

Table 13. Results of the correlation analysis between the Italian bank's net profit ratio and independent variables.

	Net profit ratio
Number of ATMs in the country	p–0.230
Internet usage: Internet banking	p–0.203
Number of credit cards in Italy	p–0.395
Number of debit cards in Italy	p–0.095
Digital payments	p–0.121

Source: developed by the authors.

The net profit ratio shows that none of the independent factors (financial technology) has an impact on the bank's performance.

3.3.3. Correlation and regression analyses of the profitability ratios of bank Swedbank operating in Lithuania

The following analysis is carried out using data from bank Swedbank operating in Lithuania and data from five financial technologies in Lithuania. Just as in the correlation analyses carried out earlier, the dependent factor is the respective financial

profitability ratio. The following five financial technologies have been selected for Lithuania:

1) Number of ATMs in Lithuania (Lithuania ATMs per 100,000 Adults-Data, Chart | TheGlobalEconomy.Com, 2022).
2) Internet banking (Statistics | Eurostat, 2022).
3) Credit cards (Lithuania: Payment Cards per Capita | Statista, 2022).
4) Debit cards (Lithuania: Payment Cards per Capita | Statista, 2022).
5) SEPA (Single Euro Payment Area) payments (Europe: Credit Transfers per Country 2000–2022 | Statista, 2022).

For each of the bank's profitability ratios, a correlation analysis is carried out to show whether financial technology has an impact on the bank's performance.

The results of a correlation analysis between the Lithuanian bank's return on assets ratio and independent variables are presented in **Table 14**.

Table 14. Results of the correlation and regression analyses between the Lithuanian bank's return on assets ratio and independent variables.

	Number of ATMs in the country	**Internet usage: Internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
p-value	*p*–0.010	*p* < 0.001	*p*–0.163	*p*–0.232	*p*–0.074
	These *p*-values are less than 0.05, suggesting that a correlation exists.		These *p*-values are greater than 0.05, suggesting that a correlation does not exist.		
Equation	$y = 0.001x_1 - 0.016$	$y = -0.001x_2 + 0.052$	-	-	-
Interpretation of the equation	The ratio will increase as the number of ATMs increases.	The ratio will decrease as the Internet usage increases.	-	-	-
Coefficients of correlation, determination	$r = 0.763$; Adjusted R Square = 0.530. The equations have a value.	$r = -0.876$; Adjusted R Square = 0.738	-	-	-

Source: developed by the authors.

Looking at the correlation of the bank's return on assets (ROA) ratio with independent variables, it can be concluded that there is a correlation between the ratio and the number of ATMs and the Internet usage. There is a positive correlation between the number of ATMs and the dependent variable and a negative correlation between the Internet usage and the dependent variable.

The results of a correlation analysis between the Lithuanian bank's return on equity ratio and independent variables are presented in **Table 15**.

Table 15. Results of the correlation analysis between the Lithuanian bank's return on equity ratio and independent variables.

Number of ATMs in the country	*p*–0.208
Internet usage: Internet banking	*p*–0.156
Number of credit cards in Lithuania	*p*–0.871
Number of debit cards in Lithuania	*p*–0.765
Digital payments	*p*–0.150

Source: developed by the authors.

The return on equity ratio for the Lithuanian bank does not correlate with any of the financial technologies considered, so no further analysis was carried out.

The results of a correlation analysis between the Lithuanian bank's net interest income margin and independent variables are presented in **Table 16**.

Table 16. Results of the correlation and regression analyses of the Lithuanian bank's net interest income margin ratio and independent variables.

	Number of ATMs in the country	**Internet usage: internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
p-value	*p*–0.002	*p*–0.004	*p*–0.099	*p*–0.277	*p*–0.011
	These *p*-values are less than 0.05, suggesting that a correlation exists.		These *p*-values are greater than 0.05, suggesting that a correlation does not exist.		This *p*-value is less than 0.05, suggesting that a correlation exists.
Equation	$y = 0.000x_1 - 0.001$	$y = 0.000x_2 + 0.027$	-		$y = -7.832\times10^{-5}x_2 + 0.027$
Interpretation of the equation	The ratio will remain unchanged as the number of ATMs increases.	The ratio will remain unchanged as the Internet usage increases.	-		The ratio will decrease as the number of digital payments increases.
Coefficients of correlation, determination	$r = 0.839$; Adjusted R Square = 0.667	$r = 0.817$; Adjusted R Square = 0.625	-		$r = -0.759$; Adjusted R Square = 0.523
	The equations have a value.		-		The equation has a value.

Source: developed by the authors.

Looking at the correlation of the net interest income margin ratio with independent variables, it can be seen that it correlates with three financial technologies. With the increase in the number of ATMs in the country and the increase in the Internet usage, the net interest income margin ratio under consideration should remain unchanged. Meanwhile, a negative correlation exists between the net interest income margin ratio and the number of digital payments. The number of digital payments has the greatest impact on the ratio under consideration.

The results of a correlation analysis between the Lithuanian bank's net profit margin ratio and independent variables are presented in **Table 17**.

Table 17. Results of the correlation and regression analyses of the Lithuanian bank's net profit margin ratio and independent variables.

	Number of ATMs in the country	**Internet usage: Internet banking**	**Number of credit cards**	**Number of debit cards**	**Digital payments**
p-value	*p*–0.024	*p*–0.002	*p*–0.179	*p*–0.295	*p*–0.123
	These *p*-values are less than 0.05, suggesting that a correlation exists.		These *p*-values are greater than 0.05, suggesting that correlation does not exist.		
Equation	$y = 0.015x_1 - 0.126$	$y = -0.015x_2 - 1.439$	-	-	-
Interpretation of the equation	The ratio will increase as the number of ATMs increases.	The ratio will decrease as the Internet usage increases.	-	-	-
Coefficients of correlation, determination	$r = 0.702$; Adjusted R Square = 0.429	$r = -0.846$; Adjusted R Square = 0.679	-	-	-
	The equations have a value.		-	-	-

Source: developed by the authors.

Looking at the net profit margin ratio, there are two financial technologies that correlate with the financial ratio under consideration. There is a positive and statistically significant correlation between the net profit margin ratio and the number of ATMs. Meanwhile, a negative correlation exists between the net profit margin ratio and Internet banking, which means that the profit margin ratio will decrease with the growth of the Internet usage.

4. Discussion

A correlation analysis of profitability ratios of each bank shows which ones are statistically significant. However, before making an overall judgement on the impact of financial technology on banks' performance, it is worth comparing and evaluating the correlations found between all banks' profitability ratios. A comparison of results of the correlation analysis of the banks' profitability ratios is presented in **Table 18**.

Table 18. Comparison of results of the correlation analysis of the banks' profitability ratios.

Ratio	Financial technology	Deutsche Bank	Landsbankinn	Swedbank
Return on assets ratio	Number of ATMs	No correlation	Moderate positive correlation	Strong positive correlation
	Internet banking	No correlation	Strong negative correlation	Strong negative correlation
	Credit cards	No correlation	No correlation	No correlation
	Debit cards	No correlation	Strong negative correlation	No correlation
	Digital payments	No correlation	Strong negative correlation	No correlation
Return on equity ratio	Number of ATMs	No correlation	No correlation	No correlation
	Internet banking	No correlation	No correlation	No correlation
	Credit cards	No correlation	No correlation	No correlation
	Debit cards	No correlation	Moderate negative correlation	No correlation
	Digital payments	Strong positive correlation	No correlation	No correlation
Net interest income margin	Number of ATMs	No correlation	Strong positive correlation	Strong positive correlation
	Internet banking	No correlation	No correlation	Strong positive correlation
	Credit cards	No correlation	No correlation	No correlation
	Debit cards	No correlation	No correlation	No correlation
	Digital payments	No correlation	No correlation	Strong negative correlation
Net profit margin	Number of ATMs	No correlation	No correlation	Strong positive correlation s
	Internet banking	No correlation	No correlation	Strong negative correlation
	Credit cards	No correlation	No correlation	No correlation
	Debit cards	No correlation	No correlation	No correlation
	Digital payments	No correlation	No correlation	No correlation

Source: developed by the authors

An analysis of the return on assets of the banks in question shows that the results obtained vary between the banks under examination. Looking at the return on assets ratio, two financial technologies stand out the most, namely, the number of ATMs and Internet banking. The number of ATMs has a positive impact on the financial performance of the banks, because ATMs are treated as an asset, which increases the value of the bank. The other financial technology is the Internet usage, namely,

Internet banking, which has a negative impact on the return on assets ratio. It is rather difficult to give a reason why this factor has a negative impact on the ratio, since it does not directly determine either the size of the assets or the profit. It can also be observed that debit cards and digital payments have a negative impact on the ratio, however this result is only obtained when looking at the Italian bank. In contrast, other banks report that there is no correlation between these independent factors and the return on assets ratio.

Looking at the return on equity ratio, it is observed that there is no financial technology that affects the ratio in at least two banks, which shows that this ratio is not directly dependent on financial technology.

The net interest income margin ratio is most strongly influenced by the number of ATMs. This financial technology has a positive impact on the scores of two banks, suggesting that there is indeed a correlation between this financial technology and the ratio.

The net profit ratio did not demonstrate a strong correlation. The results show that only a few financial technologies correlate with the ratios of one bank, which leads to the final conclusion that the dependence of this ratio is not high.

This study focused on establishing the correlation between financial technology and the main ratios of bank profitability. There are also other studies being carried out which provide equally interesting findings. That is to say, the aim is to investigate the impact of financial technology not only on the return on assets ratios of banks in different countries, but also on other areas/groups of financial ratios, such as operational efficiency/costs, financial stability, capital adequacy ratios.

5. Conclusions

Examination of scientific literature on banks' financial technology and financial performance provides a number of insights. Financial technology is a very popular phenomenon among the general public and is increasingly gaining market share. Meanwhile, banks are losing quite a few clients to new applications and innovations. In order to become more competitive and win back the clients, the banks are integrating financial technology into their operations in the hope of improving their financial performance. Most of the authors reviewed argue that financial technology determines the financial performance of banks, though there is still no unanimity as regards the magnitude and direction of this influence.

The authors of the present study first used a multi-criteria decision analysis to analyse the situation in the EU countries and the use of financial technology in banks operating in these countries. The results determined from the CRITIC evaluation method showed that the most influential financial technology of banks is ATMs and the number of ATMs in a country. This is because cash is still a relatively popular payment method. Such criteria as the Internet usage (Internet banking) and credit transfers (SEPA) yielded very similar results, which shows that these financial technologies are sufficiently significant factors. Meanwhile, the results show that the number of cards in the country and digital payments are of low significance. The results determined from the EDAS evaluation method show that the more developed and larger the country is, the greater and more widespread the use of financial

technology by the country's banks will be. The obtained alternative series shows that Germany, Spain and France are the leading countries in the European Union in terms of the amount of financial technology. The three states are slightly larger compared to the other EU countries, which is probably why the scores obtained are higher. Future studies are likely to attempt to apply the relative size of the amount of financial technology in relation to population.

The study carried out using the CRITIC and EDAS evaluation methods and the alternative series obtained helped not only rank the countries, but also identify and select three countries with different rankings and the banks operating in them for further analysis. The financial ratios of certain groups were calculated for them. This study revealed different results for the countries in question. The analysis of the financial ratios of the three banks leads to the conclusion that the German bank has the worst financial performance. Its scores of profitability and liquidity ratios are lower than those of the Lithuanian bank or the Italian bank. It experienced periods of losses over the last ten years, after which its financial recovery has been less successful. Looking at the Italian bank and its scores, it is the Italian bank that has the best profit scores due to high volume of lending, though at the same time it has problems in managing its expense. The Lithuanian bank manages its liabilities well, although it does not demonstrate the best scores for the profitability ratio in the last periods under consideration. It has a very high score for the liquidity ratio, which shows that the bank can cover its expense, though at the same time it is not managed very efficiently, as the bank's available funds are not used for its development and growth.

After analysing the banks' performance over a ten-year period, correlation and pairwise regression analyses were carried out to assess the impact of financial technology on bank performance. Looking at scores for the profitability ratios, it was observed that the performance of the German bank has little dependence on the financial technology available in the country. In contrast, for the Italian and Lithuanian banks, the correlation between financial technology and profitability ratios is stronger, with both positive and negative correlations, which are quite significant.

In conclusion, it can be stated that financial technology has a lesser impact on the performance of German banks, which may be due to the fact that Germany as a country has a large amount of financial technology and changes in financial technology no longer produce any significant impact. In contrast, the performance of banks in Lithuania and Italy is more dependent on financial technology. Thus, it appears that the initial studies carried out demonstrate that the strength of the impact of financial technology may depend on the size of a bank's country and the spread of financial technology.

The obtained results of the research provides an opportunity to see the impact of financial technologies used by banks on the results of bank operations. In this way, it would be possible to further investigate whether, by using certain financial technologies in this way, their combinations can influence and regulate the performance of banks.

It is likely that future studies will attempt to take into account the size of a country's population when analysing all financial technologies. Studies are also being carried out in order to investigate the impact of financial technology not only on the profitability ratios of banks in different countries, but also on other areas/groups of

financial ratios, such as operational efficiency (costs), financial stability, capital adequacy ratios. It would be interesting to compare in studies the impact of financial technology on different areas of corporate activity.

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References

AB "Swedbank" Metinė ataskaita. (2013). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2013_metine_ataskaita.pdf (accessed on 2 April 2024).

AB "Swedbank" Metinė ataskaita. (2014). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2014_metine_ataskaita.pdf (accessed on 5 April 2024).

AB "Swedbank" Metinė ataskaita. (2015). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2015_metine_ataskaita.pdf (accessed on 11 April 2024).

AB "Swedbank" Metinė ataskaita. (2016). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2016_metine_ataskaita.pdf (accessed on 8 May 2024).

AB "Swedbank" Metinė ataskaita. (2017). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2017_metine_ataskaita.pdf (accessed on 17 April 2024).

AB "Swedbank" Metinė ataskaita. (2018). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2018_metine_ataskaita.pdf (accessed on 20 April 2024).

AB "Swedbank" Metinė ataskaita. (2019). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2019_metine_ataskaita.pdf (accessed on 23 April 2024).

AB "Swedbank" Metinė ataskaita. (2020). Available online:

AB "Swedbank" Metinė ataskaita. (2021). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2021_metine_ataskaita.pdf (accessed on 12 April 2024).

AB "Swedbank" Metinė ataskaita. (2022). Available online: https://www.swedbank.lt/static/pdf/about/finance/reports/2022_metine_ataskaita.pdf (accessed on 24 April 2024).

Abdullah, M. D. F., Ardiansah, M. N., & Hamidah, N. (2017). The Effect of Company Size, Company Age, Public Ownership and Audit Quality on Internet Financial Reporting. Sriwijaya international Journal of Dynamic Economics And Business, 1(2), 153. https://doi.org/10.29259/sijdeb.v1i2.153-166

Adeniran, A. O., Jadah, H. M., Mohammed, N. H. (2020). Impact of information technology on strategic management in the banking sector of Iraq. Insights into Regional Development, 2(2), 592-601. https://doi.org/10.9770/ird.2020.2.2(7)

Anagnostopoulos, I. (2018). FinTech" and regtech: Impact on regulators and banks. Journal of Economics and Business, 100, 7–25. https://doi.org/10.1016/J.JECONBUS.2018.07.003

Brigham, E.F., & Houston, J. F. (2012). Fundamentals of Financial Management, 13th ed. South-Western College Pub. p. 816.

Chen, M. A., Wu, Q., & Yang, B. (2019). How Valuable Is FinTech Innovation? The Review of Financial Studies, 32(5), 2062-2106. https://doi.org/10.1093/RFS/HHY130

Chilunjika, S. R., & Uwizeyimana, D. E. (2024). Blockchain technology for health information management: a case of Zimbabwe. Insights into Regional Development, 6(1), 59-73. https://doi.org/10.9770/ird.2024.6.1(5)

Cohen, J., Cohen, P., West, S. G., et al. (2013). Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. Routledge.

Crum, M., Nelson, T., de Borst, J., et al. (2020). The use of cluster analysis in entrepreneurship research: Review of past research and future directions. Journal of Small Business Management, 60(4), 961-1000. https://doi.org/10.1080/00472778.2020.1748475

DeCoster, J., & Claypool, H. M. (2004). Data Analysis in SPSS. Available online: http://www.stat-help.com/notes.htm (accessed on 2 April 2024).

Deutsche Bank—Annual report. (2013). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2013_entire.pdf?language_id=1 (accessed on 3 May 2024).

Deutsche Bank—Annual report. (2014). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2014_entire.pdf?language_id=1 (accessed on 1 April 2024).

Deutsche Bank—Annual report. (2015). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2015.pdf?language_id=1 (accessed on 10 June 2024).

Deutsche Bank—Annual report. (2016). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2016.pdf?language_id=1 (accessed on 11 June 2024).

Deutsche Bank—Annual report. (2017). Available online: https://investor-relations.db.com/files/documents/annual-reports/DB_Annual_Report_2017.pdf?language_id=1 (accessed on 15 May 2024).

Deutsche Bank—Annual report. (2018). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2018.pdf?language_id=1 (accessed on 12 June 2024).

Deutsche Bank—Annual report. (2019). Available online: https://investor-relations.db.com/files/documents/annual-reports/Deutsche_Bank_Annual_Report_2019.pdf?language_id=1 (accessed on 12 June 2024).

Deutsche Bank—Annual report. (2020). Available online: moz-extension://fdc63a3e-82b6-4e02-8cf8-706cb0e96ddb/enhanced-reader.html?openApp&pdf=https%3A%2F%2Finvestor-relations.db.com%2Ffiles%2Fdocuments%2Fannual-reports%2FAnnual_Report_2020.pdf%3Flanguage_id%3D1 (accessed on 16 June 2024).

Deutsche Bank—Annual report. (2021). Available online: https://investor-relations.db.com/files/documents/annual-reports/2022/Annual_Report_2021.pdf?language_id=1 (accessed on 29 April 2024).

Deutsche Bank—Annual report. (2022). Available online: https://investor-relations.db.com/files/documents/annual-reports/2023/Annual-Report-2022.pdf (accessed on 25 April 2024).

Dimitrov, I., Gigov, R., & Dimitrova, A. (2022). Leading factors for blockchain technology implementation in the business organisations in the Bulgarian context. Entrepreneurship and Sustainability Issues, 10(2), 255-273. https://doi.org/10.9770/jesi.2022.10.2(16)

Europe: credit transfers per country 2000-2022 | Statista. (n.d.) Available online: https://www.statista.com/statistics/443618/credit-transfer-payment-europe-by-country/ (accessed on 30 October 2023).

Fakunle, S. O., & Ajani, B. K. (2021). Peculiarities of ICT adoption in Nigeria. Insights into Regional Development, 3(4), 51-61. https://doi.org/10.9770/ird.2021.3.4(4)

Fichter, A., & Anguelov, K. (2024). Information communication promoting insurance sales: use of chatbot technologies. Entrepreneurship and Sustainability Issues, 11(4), 10-30. https://doi.org/10.9770/jesi.2024.11.4(1)

Fleacă, B., Fleacă, E., & Corocăescu, M. (2023). Sustainability information—analysis of current trends in sustainability monitoring & reporting. Entrepreneurship and Sustainability Issues, 10(3), 274-287. https://doi.org/10.9770/jesi.2023.10.3(18)

Germany: ATMs per capita | Statista. (n.d.) Available online: https://www.statista.com/statistics/562522/automated-teller-machines-per-100000-adults-germany-europe/ (accessed on 22 October 2023).

Germany: credit transfer volume 2000-2022 | Statista. (n.d.) Available online: https://www.statista.com/statistics/443055/cashless-transfer-payment-germany/ (accessed on 23 October 2023).

Germany: number of credit and debit cards | Statista. (n.d.) Available online: https://www.statista.com/statistics/1096803/credit-card-and-debit-card-number-in-germany/ (accessed on 23 October 2023).

Ghorabaee, M. K., Zavadskas, E. K., Olfat, L., et al. (2015). Multi-Criteria Inventory Classification Using a New Method of Evaluation Based on Distance from Average Solution (EDAS). Informatica, 26, 435-451. http://dx.doi.org/10.15388/Informatica.2015.57

Giglio, F. (2021). Fintech: A Literature Review. International Business Research, 15(1), 80. https://doi.org/10.5539/ibr.v15n1p80

Gimpel, H., Rau, D., & Röglinger, M. (2018). Understanding FinTech start-ups—a taxonomy of consumer-oriented service offerings. Electronic Markets, 28(3), 245–264. https://doi.org/10.1007/S12525-017-0275-0/TABLES/7

Hasanaj, P., & Kuqi, B. (2019). Analysis of Financial Statements. Humanities and Social Science Research, 2(2), 17. https://doi.org/10.30560/hssr.v2n2p17

Haurovi, M., & Chilunjika, A. (2024). Fourth industrial revolution and social innovation dynamics in South Africa: a review. Insights into Regional Development, 6(2), 103-116. https://doi.org/10.9770/IRD.2024.6.2(7)

Hoyt, W. T., Imel, Z. E., & Chan, F. (2008). Multiple regression and correlation techniques: Recent controversies and best practices. Rehabilitation Psychology, 53(3), 321–339. https://doi.org/10.1037/a0013021

https://www.swedbank.lt/static/pdf/about/finance/reports/202020_metine_ataskaita.pdf (accessed on 9 May 2024).

Hu, Z., Ding, S., Li, S., et al. (2019). Adoption Intention of Fintech Services for Bank Users: An Empirical Examination with an Extended Technology Acceptance Model. Symmetry, 11(3), 340. https://doi.org/10.3390/SYM11030340

Italy: ATMs per capita | Statista. (n.d.) Available online: https://www.statista.com/statistics/564041/automated-teller-machines-per-adults-italy-europe/ (accessed on 28 October 2023).

Italy: credit transfer volume 2000-2022 | Statista. (n.d.) Available online: https://www.statista.com/statistics/443072/cashless-transfer-payment-italy/ (accessed on 28 October 2023).

Italy: payment cards per capita | Statista. (n.d.) Available online: https://www.statista.com/statistics/1098155/credit-cards-and-debit-cards-per-capita-in-italy/ (accessed on 28 October 2023).

Kafle, S. C. (2019). Correlation and regression analysis using SPSS. The OCEM Journal of Management, Technology & Social Sciences, 1(1), 126-132.

Kahraman, A. C., Keshavarz G. M., Zavadskas E. K., et al. (2017). Intuitionistic fuzzy EDAS method: an application to sold wasta disposal site selection. Journal of Environmental Engineering and Landscape Management, 25(1), 1-12. https://doi.org/10.3846/16486897.2017.1281139

Katina, J., Katin, I. & Komarova, V. (2024). Cryptocurrency price forecasting: a comparative analysis of autoregressive and recurrent neural network models. Entrepreneurship and Sustainability Issues, 11(4), 425-436. https://doi.org/10.9770/jesi.2024.11.4(26)

Katina, J., Plėta, T., Petkevičius, R., et al. (2023). Industrial Control Systems (ICS) cyber prediction model. Insights into Regional Development, 5(1), 86-96. https://doi.org/10.9770/ird.2023.5.1(6)

Khalatur, S., Pavlova, H., Vasilieva, L., et al. (2022a). Innovation management as basis of digitalization trends and security of financial sector. Entrepreneurship and Sustainability Issues, 9(4), 56-76. https://doi.org/10.9770/jesi.2022.9.4(3)

Khalatur, S., Tvaronavičienė, M., Dovgal, O., et al. (2022b). Impact of selected factors on digitalization of financial sector. Entrepreneurship and Sustainability Issues, 10(1), 358-377. https://doi.org/10.9770/jesi.2022.10.1(19)

Koman, G., Tumová, D., Jankal, R., et al. (2022). Business-making supported via the application of big data to achieve economic sustainability. Entrepreneurship and Sustainability Issues, 9(4), 336-358. https://doi.org/10.9770/jesi.2022.9.4(18)

Krishnan, A. R., Kasim, M. M., Hamid, R., et al. (2021). A Modified CRITIC Method to Estimate the Objective Weights of Decision Criteria. Symmetry, 13(6), 973. https://doi.org/10.3390/sym13060973

Krulický, T., Apanovych, Y., & Rodová, V. (2024). The impact of Industry 4.0 on business results. Entrepreneurship and Sustainability Issues, 11(4), 205-218. https://doi.org/10.9770/jesi.2024.11.4(13)

Laidroo, L., Koroleva, E., Kliber, A., et al. (2021). Business models of FinTechs—Difference in similarity? Electronic Commerce Research and Applications, 46, 101034. https://doi.org/10.1016/J.ELERAP.2021.101034

Landsbankinn - Annual Financial Statement. (2013-2022). Available online: https://www.landsbankinn.is (accessed on 28 October 2023).

Lavrinenko, O., Danileviča, A., Jermalonoka, I., et al. (2024). Use of mobile technologies by business companies in the context of digitalization of the Latvian economy, Entrepreneurship and Sustainability Issues, 11(4), 339-351. https://doi.org/10.9770/jesi.2024.11.4(21)

Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. Business Horizons, 61(1), 35–46. https://doi.org/10.1016/J.BUSHOR.2017.09.003

Legowo, M. B., Subanidja, S., & Sorongan, F. A. (2021). FinTech“ and Bank: Past, Present, and Future. Jurnal Teknik Komputer AMIK BSI, 7(1). https://doi.org/10.31294/jtk.v4i2

Leong, K. (2018). FinTech“ (Financial Technology): What is It and How to Use Technologies to Create Business Value in FinTech“ Way? International Journal of Innovation, Management and Technology, 74–78. https://doi.org/10.18178/ijimt.2018.9.2.791

Lithuania ATMs per 100,000 adults-data, chart | TheGlobalEconomy.com. (2022). Available online: https://www.theglobaleconomy.com/Lithuania/ATM_machines/ (accessed on 30 October 2023).

Lithuania: payment cards per capita | Statista. (n.d.). Available online: https://www.statista.com/statistics/1098547/credit-cards-and-debit-cards-per-capita-in-lithuania/ (accessed on 30 October 2023).

Morales, L., Gray, G., & Rajmill, D. (2022). Emerging Risks in the FinTech" Industry—Insights from Data Science and Financial Econometrics Analysis. Economics, Management, and Financial Markets, 17(2), 9. https://doi.org/10.22381/EMFM17220221

Namugenyi, C., Nimmagadda, S. L., & Reiners, T. (2019). SWOT analysis: a theoretical review. Procedia Computer Science, 159, 1145-1154. https://doi.org/10.1016/j.procs.2019.09.283

Nassar, N. & Strielkowski, W. (2022). Transition towards green financial sector for gaining newly perceived competitiveness by adopting a green management model. Insights into Regional Development, 4(1), 71-88. https://doi.org/10.9770/ird.2022.4.1(5)

Nazaritehrani, A., & Mashali, B. (2020). Development of E-banking channels and market share in developing countries. Financial Innovation, 6(1). https://doi.org/10.1186/S40854-020-0171-Z

Ogbeide, S. O., Ogiugo, H. U., & Adesuyi, I. O. (2021). Corporate governance mechanisms and financial reporting quality of commercial banks in Nigeria. Insights into Regional Development, 3(1), 136-146. https://doi.org/10.9770/ird.2021.3.1(8)

Paradowski, B., Shekhovtsov, A., Aczkiewicz, A. B., et al. (2021). Similarity Analysis of Methods for Objective Determination of Weights in Multi-Criteria Decision Support Systems. Symetry. https://doi.org/10.3390/sym13101874

Pechová, J., Volfová, H., & Jírová, A. (2024). From interaction to integration: leveraging AI in enhancing team communication and task efficiency. Entrepreneurship and Sustainability Issues, 11(4), 276-292. https://doi.org/10.9770/jesi.2024.11.4(17)

Pi, T., Hu, H., Lu, J., et al. (2022). The Analysis of „FinTech" Risks in China: Based on Fuzzy Models. Mathematics. https://doi.org/10.3390/math10091395

Pizzi, S., Corbo, L., & Caputo, A. (2021). Fintech and SMEs sustainable business models: Reflections and considerations for a circular economy. Journal of Cleaner Production, 281, 125217. https://doi.org/10.1016/J.JCLEPRO.2020.125217

Prawirasasra, K. P. (2018). Financial technology in Indonesia: disruptive or collaborative? Reports on Economics and Finance, 4(2), 83–90. https://doi.org/10.12988/ref.2018.818

Quyet, C. B. (2024). The acceptance of sustainable e-commerce by small and medium-sized enterprises: a case of Vietnam. Insights into Regional Development, 6(1), 46-58. https://doi.org/10.9770/ird.2024.6.1(4)

Randey, K. (2016). Financial management. Laxmi book publikation. p. 248.

Romanova, I., & Kudinska, M. (2016). Banking and FinTech": A challenge or opportunity? Contemporary Studies in Economic and Financial Analysis, 98, 21–35. https://doi.org/10.1108/S1569-375920160000098002/FULL/XML

Rome, F. P. (2018). FinTech and banking: today and tomorrow Speech by the Deputy Governor of the Bank of Italy.

Rupeika-Apoga, R., & Thalassinos, E. I. (2020). Ideas for a regulatory definition of FinTech. Available online: https://www.um.edu.mt/library/oar/handle/123456789/55195 (accessed on 30 October 2023).

Sabauri, L. & Kvatashidze, N. (2023). Sustainability reporting issues. Entrepreneurship and Sustainability Issues, 11(2), 282-289. https://doi.org/10.9770/jesi.2023.11.2(19)

Samašonok, K., & Išoraitė, M. (2023). The implementation of sustainable development goals through communication tools. Entrepreneurship and Sustainability Issues, 10(3), 102-122. https://doi.org/10.9770/jesi.2023.10.3(8)

Schueffel, P. (2016). Taming the Beast: A Scientific Definition of Fintech. Journal of Innovation Management, 4(4), 32-54. https://doi.org/10.24840/2183-0606_004.004_0004

Scott, S. V., Van Reenen, J., & Zachariadis, M. (2017). The long-term effect of digital innovation on bank performance: An empirical study of SWIFT adoption in financial services. Research Policy, 46(5), 984–1004. https://doi.org/10.1016/J.RESPOL.2017.03.010

SEPA Payment statistics | European Payments Council. (n.d.) Available online: https://www.europeanpaymentscouncil.eu/what-we-do/be-involved/sepa-payment-statistics (accessed on 30 October 2022).

Setiawan, K., & Maulisa, N. (2020). The Evolution of FinTech": A Regulatory Approach Perspective. Atlantis Press. https://doi.org/10.2991/AEBMR.K.200321.029

Shava, E., & Vyas-Doorgapersad, S. (2023). Inclusive participation in information and communication technologies (ICTs) processes for smart services in the city of Johannesburg, Insights into Regional Development, 5(1), 26-40. https://doi.org/10.9770/ird.2023.5.1(2)

Sheng, T. (2021). The effect of FinTech“ on banks' credit provision to SMEs: Evidence from China. Finance Research Letters, 39, 101558. https://doi.org/10.1016/J.FRL.2020.101558

Shy, O. (2019). Technological Change and Financial Innovation in Banking: Some Implications for FinTech“. Federal Reserve Bank of Atlanta, Working Papers. https://doi.org/https://doi.org/10.29338/wp2018-11

Siddiqui, Z., & Rivera, C. A. (2022). FinTech“ and FinTech“ ecosystem: A review of literature. Risk Governance and Control: Financial Markets and Institutions, 12(1), 63–73. https://doi.org/10.22495/rgcv12i1p5

Skvarciany, V., & Astike, K. (2022). Decent work and economic growth case of EU. In: Proceedings of 12th International Scientific Conference Business and Management 2022.

Skvarciany, V., Jurevičienė, D., & Volskytė, G. (2020). Assessment of Sustainable Socioeconomic Development in European Union Countries. Sustainability, 12(5), 1986. https://doi.org/10.3390/su12051986

Somogyi, T., & Nagy, R. (2022). Some impacts of global warming on critical infrastructure protection - heat waves and the European financial sector. Insights into Regional Development, 4(4), 11-20. https://doi.org/10.9770/ird.2022.4.4(1)

Statistics | Eurostat. (n.d.). Available online: https://ec.europa.eu/eurostat/databrowser/view/tin00099/default/table?lang=en (accessed on 30 October 2022).

Štitilis, D., Laurinaitis, M., & Verenius, E. (2023). The use of biometric technologies in ensuring critical infrastructure security: the context of protecting personal data. Entrepreneurship and Sustainability Issues, 10(3). 133-150. https://doi.org/10.9770/jesi.2023.10.3(10)

Thakor, A. V. (2020). Fintech and banking: What do we know? Journal of Financial Intermediation, 41, 100833. https://doi.org/10.1016/J.JFI.2019.100833

The Fintech Landscape in Lithuania 2021–2022—Invest Lithuania. Available online: https://investlithuania.com/report/fintech-report-2021-2022/ (accessed on 19 September 2022).

The Global Findex Database (2021). Available online: https://www.worldbank.org/en/publication/globalfindex (accessed on 30 October 2022).

Tobisova, A., Seňová, A. & Rozenberg, R. (2023). Risk factors' prediction model for the investment evaluation. Entrepreneurship and Sustainability Issues, 11(2), 153-168. https://doi.org/10.9770/jesi.2023.11.2(11)

Ullah, A., Pinglu, C., Ullah, S., et al. (2023). Impact of intellectual capital efficiency on financial stability in banks: Insights from an emerging economy. International Journal of Finance & Economics, 28(2), 1858-1871. https://doi.org/10.1002/IJFE.2512

Víghová, A., Košovská, I., & Hudáková, M. (2023). Analytical view of the profitability of commercial companies, Entrepreneurship and Sustainability Issues, 11(1), 353-364. https://doi.org/10.9770/jesi.2023.11.1(21)

Világi, R., Konečný, M., & Ruschak, M. (2022). Impact of selected financial indicators on a company's reputation. Entrepreneurship and Sustainability Issues, 10(2), 408-417. https://doi.org/10.9770/jesi.2022.10.2(25)

Vučinić, M. (2020). Fintech and Financial Stability Potential Influence of FinTech on Financial Stability Fintech and Financial Stability Potential Influence of FinTech on Financial Stability, Risks and Benefits. Journal of Central Banking Theory and Practice, 2, 43–66. https://doi.org/10.2478/jcbtp-2020-0013

Wang, H., Chen, K., Zhu, W., et al. (2015). A process model on P2P lending. Financial Innovation, 1(1), 1-8. https://doi.org/10.1186/S40854-015-0002-9/FIGURES/8

Wang, Y., Xiuping, S., & Zhang, Q. (2021). Can FinTech“ improve the efficiency of commercial banks? —An analysis based on big data. Research in International Business and Finance, 55, 101338. https://doi.org/10.1016/J.RIBAF.2020.101338

Yim, O., & Ramdeen, K. T. (2015). Hierarchical Cluster Analysis: Comparison of Three Linkage Measures and Application to Psychological Data, 11(1). https://doi.org/10.20982/tqmp.11.1.p008

Zhao, J., Li, X., Yu, C. H., et al. (2022). Riding the „FinTech“ innovation wave: „FinTech“, patents and bank performance. Journal of International Money and Finance, 122, 102552. https://doi.org/10.1016/J.JIMONFIN.2021.102552