

Springer Proceedings in Business and Economics

Veland Ramadani ·
Abdylmenaf Bexheti ·
Hyrije Abazi-Alili · Carmem Leal ·
Carlos Peixeira Marques *Editors*

Navigating Economic Uncertainty - Vol. 1

Proceedings of the 7th International
Scientific Conference on Business and
Economics (ISCBE), Portugal, June 2024

 Springer

**Springer Proceedings in Business
and Economics**

Springer Proceedings in Business and Economics brings the most current research presented at conferences and workshops to a global readership. The series features volumes (in electronic and print formats) of selected contributions from conferences in all areas of economics, business, management, and finance. In addition to an overall evaluation by the publisher of the topical interest, scientific quality, and timeliness of each volume, each contribution is refereed to standards comparable to those of leading journals, resulting in authoritative contributions to the respective fields. Springer's production and distribution infrastructure ensures rapid publication and wide circulation of the latest developments in the most compelling and promising areas of research today.

The editorial development of volumes may be managed using Springer Nature's innovative EquinOCS, a proven online conference proceedings submission, management and review system. This system is designed to ensure an efficient timeline for your publication, making Springer Proceedings in Business and Economics the premier series to publish your workshop or conference volume.

This book series is indexed in SCOPUS.


Veland Ramadani • Abdylmenaf Bexheti
Hyrije Abazi-Alili • Carmem Leal
Carlos Peixeira Marques
Editors

Navigating Economic Uncertainty - Vol. 1

Proceedings of the 7th International Scientific
Conference on Business and Economics
(ISCBE), Portugal, June 2024


 Springer


Editors

Veland Ramadani 
Faculty of Business and Economics
South East European University
Tetovo, North Macedonia

Abdylmenaf Bexheti
Faculty of Business and Economics
South East European University
Tetovo, North Macedonia

Hyrije Abazi-Alili 
Faculty of Business and Economics
South East European University
Tetovo, North Macedonia

Carmem Leal 
CETRAD
University of Trás-os-Montes
and Alto Douro
Vila Real, Portugal

Carlos Peixeira Marques 
CETRAD
University of Trás-os-Montes
and Alto Douro
Vila Real, Portugal

International Scientific Conference on Business and Economics, iscbe, iscbe2024,
ISCBE 7 Vila Real Portugal, 20240624-20240626

ISSN 2198-7246

ISSN 2198-7254 (electronic)

Springer Proceedings in Business and Economics

ISBN 978-3-031-73505-9

ISBN 978-3-031-73506-6 (eBook)

<https://doi.org/10.1007/978-3-031-73506-6>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2025

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

If disposing of this product, please recycle the paper.

Preface

This volume comprises the papers presented at the 7th International Scientific Conference on Business and Economics (ISCBE 2024), which took place from June 24 to 26, 2024, in Vila Real, Portugal. The conference theme, “Navigating Economic Uncertainty: Adaptation, Innovation, and Resilience in a World of Crisis,” was carefully chosen to reflect the profound shifts in global economic dynamics and character stemming from events such as the pandemic, the Ukraine conflict, energy crises, and inflation.

The ISCBE conference has seen significant growth and evolution, building on the success of its previous editions. This year, the conference received an overwhelming response, with over 50 submissions. Each submission underwent rigorous review by at least two reviewers and an average of one program committee member, resulting in a diverse program featuring 109 authors from 15 countries, who participated both online and onsite.

The call for papers was announced in January 2024, and ongoing communication with authors ensured a robust application process. The conference program included insightful keynote addresses delivered by internationally renowned professors:

- Prof. Dr. Andreas Kallmuenzer, Excelesia Business School, France
- Prof. Dr. Francesco Calabrò, Mediterranea University of Reggio Calabria, Italy

The conference commenced with opening remarks from Prof. Dr. Eduardo Augusto dos Santos Rosa, Vice-Rector of the University of Trás-os-Montes and Alto Douro (UTAD), and continued with contributions from Acad. Prof. Dr. Abdylmenaf Bexheti, Rector of South East European University (SEEU), alongside conference co-chairs Prof. Dr. Carmem Leal and Prof. Dr. Hyrije Abazi-Alili.

We would like to extend our heartfelt gratitude to UTAD and the Centre for Transdisciplinary Development Studies (CETRAD) for their exceptional hospitality, unwavering support, and invaluable insights throughout the conference. Special thanks go to our esteemed keynote speakers for accepting our invitation to share their expertise. We also acknowledge the dedication of the organizing committee and the contributions of the Public Relations Offices of SEEU and CETRAD, as

well as all staff members, whose efforts ensured the success of this event at our magnificent venue.

We are deeply appreciative of the preparation invested by all speakers, panelists, and participants and eagerly anticipate their contributions to the 8th ISCBE in 2025. We look forward to collaborating with you all again in the future.

Sincerely,

Tetovo, North Macedonia
Tetovo, North Macedonia
Tetovo, North Macedonia
Vila Real, Portugal
Vila Real, Portugal

Veland Ramadani
Abdylmenaf Bexheti
Hyrije Abazi-Alili
Carmem Leal
Carlos Peixeira Marques

Contents

The Nexus of Knowledge Management (KM) Enablers, Knowledge Management Processes (KMPs), Innovation Speed, and Entrepreneurial Performance: A Conceptual Framework	1
Florinda Zegullaj, Veland Ramadani, Teuta Veseli-Kurtishi, and Viktorija Atanasovska Noveski	
Unlocking Innovation: Exploring the Determinants of Research and Development Using Panel Data Analysis	19
Elisabete Neves, Beatriz Neves, and Lara Tavares	
Skills Management and Employee Training Influence on Motivation and Job Performance	35
Rui Jorge Rodrigues da Silva, Manuel Preza, Carla Marques, and Mari Cruz Sánchez-Escobedo	
From Startup to Scaleup Through Digital Entrepreneurship: The Case of SEEUTechPark Tenants	55
Neroida Selimi, Anita Dina, and Driton Asani	
The Effect of Brand Image, Omni-Channel Marketing Strategies, and Organizational Culture on Customer Commitment in the Banking Sector in North Macedonia	73
Lutfije Ademi, Shpresa Sylja, and Selajdin Abduli	
Fiscal Sustainability of Pension Fund from the Perspective of Second Pillar: Case of North Macedonia	87
Nebi Xhemali, Abdylmenaf Bexheti, and Andrej Pulejkov	
The Relationship Between Wealth Distribution and Family Business Performance	119
Sara Muça-Mustafa, Gadaf Rexhepi, Hyrije Abazi-Alili, and Alhamzah Alnoor	

Evolving Business Landscape: Job Satisfaction Through the Lenses of Financial Compensation and Work-Life Balance	137
Ensar Mekic, Gordana Banovic, Ramo Palalic, and Armina Hubana	
Unveiling the Influence of Green Marketing on Consumer Behavior in North Macedonia: A Comprehensive Analysis	153
Teuta Veseli-Kurtishi and Haxhere Dervishi	
The Role of Customer Segmentation and Personalization Strategies in Data-Driven Marketing for Enhancing Sales Performance and Customer Retention in the E-Commerce Industry	169
Valbona Arifi, Veland Ramadani, Jusuf Zeqiri, and Rasim Zuferi	
The Influence of Operational Management on Financial Performance of Portuguese SMEs	183
Ruben Nunes, Rogério Bessa, and Carmem Leal	
The Impact of Mergers and Acquisitions on Efficiency and Performance in Banking: Empirical Evidence from Croatia	199
Katerina Fotova Čiković, Mila Mitreva, and Damira Keček	
The Role of Education on Economic Growth: An Empirical Analysis of Central and Eastern European Countries	223
Yvesa Jusaj, Valmir Zogaj, Gadaf Rexhepi, and Hyrije Abazi-Alili	
Half a Century of Enterprise Systems: From MRP to Artificial Intelligence ERPs	239
Blerta Abazi Chaushi and Agron Chaushi	
Practical Application of Knowledge in Business Studies for More Successful Student Integration in the Challenging Economic Reality	255
Lulzime Nuredini-Mehmedi, Veronika Kareva, and Abdylmenaf Bexheti	
Macroeconomic Dynamics and FDI Inflows: A Case Study of North Macedonia	271
Merita Zulfu Alili and Nevila Mehmetaj	
Recent Techniques and Algorithms for Cryptocurrencies' Price Prediction: A Literature Review	291
Haris Haxhimehmeti and Adrian Besimi	
Impact of Public Spending on North Macedonia's GDP: A Functional Classification Analysis	305
Arlinda Idrizi and Blerta Abazi Chaushi	
Application of Trade-Off Analysis in the Context of Agroecological Transitions: Reflections and Assumptions	323
Sofia Neto and Livia Madureira	

The Impact of Mergers and Acquisitions on Efficiency and Performance in Banking: Empirical Evidence from Croatia



Katerina Fotova Čiković, Mila Mitreva, and Damira Keček

Abstract The research field of the impact and effects of M&A in the banking sector is one of the most controversial fields with very inconsistent findings. Such research would provide a developing Southeastern European country with new insights and valuable feedback for potential bank investors, bank management, M&A analysts, academic members, and regulatory and government bodies. The main objective of this two-stage study is to evaluate the impact M&A transactions had on banks' efficiencies in Croatia. The main hypothesis argues that larger banks are more efficient than small-sized banks and, thus, consolidation of the small-sized banks would bring higher efficiency to each individual bank involved in the M&A process and the entire Croatian banking market, equally. Moreover, another goal of this study is to present the DEA methodology and its dynamic window technique, along with its strengths, limitations, and its lesser-known application in the evaluation of banking M&A transactions. In the first stage, the BCC Data Envelopment Analysis (DEA) window technique model was implemented to assess the relative efficiency of both the entire Croatian banking sector and each individual bank from the sample of 20 banks in the period 2011–2020, with two inputs (interest expenses and noninterest expenses) and two outputs (interest revenues and noninterest revenues). In the second stage, a closer analysis on the impact and efficiency gains or losses from a few case studies of merger and acquisition (M&A) transactions occurred in the Croatian banking sector during the observed period was conducted. The obtained results reveal new insights in the M&A field and indicate that the observed M&A transactions in Croatia's banking sector led to enhanced efficiency in the merged banks. Moreover, the consolidation of the Croatian banking sector has

K. Fotova Čiković (✉) · D. Keček
University North, Koprivnica, Koprivnica, Croatia
e-mail: kcikovic@unin.hr; dkecek@unin.hr

M. Mitreva
Faculty of Economics, Goce Delcev University, Stip, North Macedonia
e-mail: mila.mitreva@ugd.edu.mk

increased the relative efficiency of the overall banking sector, except for the last analyzed year of 2020.

Keywords DEA · Data envelopment analysis · Banking sector · Bank efficiency · Mergers and acquisitions · Croatia · Window analysis

JEL Classification G21 · G34 · N24

1 Introduction

Financial markets are the “brain” of the overall economic system and, banks, as major financial institutions in developing countries around the world, play a very important role in maintaining economic stability and promoting growth, as well as a crucial role in stimulating economic development (Sugiyanto & Yolanda, 2020). Bank loans are crucial for both developed and developing economies because they represent a high percentage of their GDP (Santiso, 2008). Banks, through their daily operations, ensure financial stability in the global financial markets. Nowadays, financial institutions that are well built and efficient are not bound only to the domestic area—instead, many of them expand their activities abroad, mainly through foreign direct investments in the form of M&A (Nazim & Junaidah, 2018). In their paper, Ullah and Seman (2018) showed that, during a financial crisis, mergers and acquisitions start to grow rapidly. In the context of the banking sector, the efficiency theory and resource dependency theory are commonly used in understanding M&A. According to Wadhwa and Syamala (2015), the main motive of M&A in the banking sector is to gain operating and financial synergy, which can be in form of an increase in revenue or a cost reduction. Neto et al. (2010) stated that M&A can boost competition and lead to enhanced growth. However, Focarelli and Pozzolo (2001) claimed that the bank’s decision to expand its activities abroad should be mostly based on the size of the bank, among other factors.

In the context of mergers and acquisitions (M&As), two combined companies are considered to be more valuable and effective than two separate ones. Increased competition in the global financial markets, deregulation, and liberalization in the financial services sector have triggered the banking sector to improve its efficiency and increase its profitability in almost every country in the world. The recent financial crisis and the pressure from nonbank institutions, such as institutional investors, have affected the priorities of the banks. Nowadays, “value creation,” profitability, and performance are the main targets, as opposed to growth and size, which used to be dominant factors (Hahn, 2007). Achieving economies of scale in the banking sector is mostly done through mergers and acquisitions. Croatia has also made structural reforms in its banking sector, considering the fact that it is a country that went through a process of transition. During the late nineties of the previous century, there were two merger waves, the second of which led to the privatization of the largest national Croatian banks. Overcapacity, slow growth, and the need for

technological upgrade were the main motives behind this process (Kaštelan Mrak & Dimitrić, 2004). These reforms that occurred in the late 1990s created consolidated banking systems with a significant presence of foreign banks. European banks took part in the local state-owned and private banks through the process of acquisition. For these international transactions, the size of the institution and the number of clients served were very important factors. During the 1990s, these factors occurred mainly because of the intense competitive pressures and the opportunities for new technological developments and upgrades that required risky investments and the search for new areas of expanding the banks' operations (Kaštelan Mrak & Dimitrić, 2004).

The main objective of the banking business is to create "considerable profit" and to ensure the stability of the overall financial system. Moreover, the efficiency and profitability of the banking sector positively impacts the economic development and can lead to the "amortization" of various damaging effects, providing full support to the overall stability of the financial system of a country (Rebić et al., 2022). Thus, due to the banks' vital importance for financial stability and economic development, it becomes evident that their consistent efficiency and performance evaluation would be of primary interest to many stakeholders, especially regulatory bodies, governments, and policymakers. Notwithstanding, banks' efficiency impacts their ability to extend loans and to ensure the financial stability of the whole banking sector (Kozak & Wierzbowska, 2021). The DEA methodology, in this context, is one of the most frequently applied nonparametric linear programming methodologies that has been used extensively ever since its introduction in 1978. The BCC DEA model, a key component of data envelopment analysis (DEA), is a method for evaluating the relative efficiency of decision-making units (DMUs) by comparing their input and output levels. In this study, the window DEA (WDEA) has been applied to a sample of 20 Croatian commercial banks in the period from 2011 to 2020 in order to not only investigate the overall efficiency trends but also look into four M&A case study transactions as a means to evaluate the impact of M&A on banks' efficiency and performance. The main hypothesis is that larger banks (and especially banks from the group of large banks) are more efficient than small-sized banks. This has been mirrored in many published papers thus far: Micajkova and Poposka (2013), Pavković et al. (2018), Davidović et al. (2019), Altunbas et al. (2001), and Učkar and Petrović (2021). The overall average efficiency of the whole Croatian banking sector, as well as the efficiency results of each individual bank, will all be looked into. In the second stage, a deeper analysis of the four M&A transactions will take place in order to establish if the consolidated banks (i.e., banks after the M&A) experienced better performance and efficiency. As stated in Fotova Čiković et al. (2022a), there are "mixed and inconsistent results regarding the benefits of mergers of banks and M&A's impact on banks' performance and efficiency." The scientific contribution of this paper is based on the scarcity of empirical research papers published in this area in the Western Balkans region. Therefore, the empirical evidence on the impact of M&A transactions in Southeastern European banking is limited as opposed to the many scholarly studies employing the DEA methodology thus far in the evaluation of M&A in banking in other parts of the world, such as China (Li et al., 2018),

Mozambique (Wanke et al., 2016), Vietnam (Hang et al., 2016), and Malaysia (Sufian et al., 2012). Moreover, the managerial contribution provides a deeper insight regarding the real impact of M&A transactions on bank's management, regulatory bodies, and the government, as well as on potential investors, analysts, and the interested public. This study provides a solid scientific and managerial contribution since it is the first empirical study analyzing the impact of banks' M&A on bank efficiency in Croatia with the application of DEA methodology in the past decade.

The paper is arranged as follows: In Sect. 2, the literature review is presented with a few subsections regarding the importance of mergers and acquisitions and the efficiency gains of M&A in the banking sector. Section 3 unveils the used methodology and data. Section 4 reveals the obtained results. Section 5 opens up a discussion regarding the results, their implications, and the scientific contribution of this paper, concludes the paper, and provides guidelines for future research.

2 Literature Review

While there is a plethora of literature on banking efficiency in Europe (Vincova, 2005; Jemrić & Vujčić, 2002; Cvetkoska et al., 2021; Kurtishi-Kastrati et al., 2016; Milenković et al., 2022), there is a paucity of studies on the impact of mergers and acquisitions on banks' efficiencies and few to none studies on the impact of M&A transactions on banks' efficiencies in Southeastern Europe.

The application of DEA in the banking industry could be focused on (a) an analysis of banks operating within one national economy, (b) an analysis of bank branches of a bank, (c) an analysis of banks in two or more national economies, (d) the efficiency of bank mergers, and (e) the banking branch development strategies (Paradi et al., 2004; Cvetkoska & Fotova Čiković, 2020). This study fills the gap in the existing literature by exploiting the efficiency of bank mergers and the impact of M&A transactions on individual banks, as well as the effect of the concentration of the banking sector on the efficiency of the Croatian banking sector as a whole. This section has been divided into two subsections, one covering the literature regarding the importance of mergers and acquisitions and one discussing the effects of mergers and acquisitions in the banking sector (in the form of efficiency gains or losses).

2.1 Importance of Mergers and Acquisitions

The term "merger" can be defined as "any transaction that results in a new organizational entity from two or more prior companies," and the new business combination, i.e., entity is an independent one (Pazarskis et al., 2022). Mergers and acquisitions are very popular corporate restructuring activities that are undertaken by many companies whose main objective is to strengthen their current positions, gain competitive advantage, and achieve long-term success (Osuma et al., 2021).

Financial markets and financial institutions are constantly evolving. In order to adapt to the changing business environment, M&A is a proper strategy to be implemented due to its purpose of synergy. Moreover, globalization has affected how today's businesses operate—they expand their activities in international markets mainly through FDI in the form of M&A (Rodrigues et al., 2024; Ullah & Seman, 2018). M&A is, undoubtedly, a part of the financial activities of many companies, organizations, and institutions in various sectors. The financial gains or failures cannot be completely predicted; thus, a profound understanding of this concept is required. Many papers have been published and many studies conducted to explain the logic and purpose of M&A. According to the existing theory, the main benefits of M&A include expansion of scale, cost savings, and rich resources (Shi & Wang, 2020). Ullah and Seman (2018) have defined M&A processes as “one of the most renowned strategies to make adoption with those changing businesses.”

Godswill et al. (2021) conducted a systematic literature review on mergers and acquisitions and found that almost half of the analyzed studies prove that the processes of M&A lead to “synergy gains.” Ullah and Seman (2018) reviewed over 30 M&A transactions in the period from 1993 to 2017. They have found significant differences between M&A in conventional and Islamic banking, which they explain through “different approaches in handling M&A (i.e., domestic or cross border) and various factors contributing to the decision of conducting the M&A activity.”

2.2 Mergers and Acquisitions in the Banking Sector (Efficiency Gains)

According to Fotova Čiković and Fotov (2015), M&A are a largely debated subject and a topic of interest for government officials, academicians, and researchers. As presented in their paper, the main advantages of M&A include stronger competition, lower cost of capital, change in business models, and higher profitability and efficiency. Nevertheless, the process of M&A requires deep knowledge of the matter, good corporate culture, and, most importantly, a lot of time and dedication (Fotova Čiković et al., 2022b). Li et al. (2018) have also highlighted the importance of mergers and acquisitions—in today's economic life, mergers and acquisitions strengthen the advantages of firms and contribute to their better performance. In this context, Aljadani and Toumi (2019) in their paper examined the causal effect of mergers and acquisitions on bank productivity in 23 European Union countries and the short- and long-term relationship between fixed assets, liquid assets, and labor for the period 1990–2013. The results showed that M&A have the potential to create long-term productivity improvement in the banking sector. According to Reztis (2008), the effect of M&A on Greek banks is negative, contrary to the finding of Vennet (1996), who estimated that M&A have a positive effect on the performance of banking entities. Additionally, Toumi et al. (2016) in their paper analyzed the effects of M&A on the performance of credit institutions in the EU for the period 2005–2013. The results showed that M&A have a positive effect on bank

performance but a negative effect on efficiency gains. Moreover, Nnadi and Tanna (2014) have published a paper on the SCAR technique and the 61-day window used to capture the wealth effects of the domestic and cross-border acquiring banks. Their results showed that the wealth effects of both types of mergers are negative and that there is a significant loss in the shareholder value for the acquiring banks. However, the study proved that capital strength and the cost efficiency of the acquiring banks are the main factors influencing the profitability of cross-border mergers. Sindi et al. (2017) in their paper analyzed the effect of M&A for the period 2000–2012 in the MENA region and concluded that M&A do not have a significant effect on the profit, revenue, and cost efficiency of the 39 acquirer banks. However, Al-Sharkas et al. (2008), through the implementation of SFA and DEA methodology, concluded that M&A improve the cost and profit efficiencies of US banks. Ikpefan (2012) focused on the post-consolidation effects of M&A on the Nigerian deposit money banks and found that the performance of the banks is positively affected by M&A. Jayadev and Sensarma (2007) took into consideration the managers and the shareholders in the Indian banking system. They concluded that forced M&A is not beneficial to both the shareholders of the acquiring bank and the shareholders of the acquired bank. Contrary to this, during a voluntary process of M&A, the shareholders of the acquiring bank gain more compared to the shareholders of the acquired bank. According to Caiazza and Pozzolo (2014), in different countries, efficiency gains are not a guarantee that a bank merger will create value for the banks' shareholders. Internationalization is not as common in the banking sector as in other industries, such as manufacturing companies. Thus, when it comes to international M&A, banks usually expand to countries that have strong economic stability and are culturally and legally linked to their country of origin (Buch & DeLong, 2004). The main motives behind M&A in the banking sector are profit maximization, power building by managers, and larger size. Andries et al. (2021) have used a database of 200 M&A transactions in Southeastern Europe in the period 2000–2018 and have found that “the most important promoters of mergers and acquisitions are size, profitability (ROAE), and liquidity as well as interbank interest rates.”

Ullah and Seman (2018) analyzed the efficiency theory in the context of M&A in the banking sector. The basis of this theory is the purpose of synergy. However, it is worth mentioning that acquiring synergy is not always a necessity, especially if the bank is facing financial distress or is unable to maintain the requirement of common equity of risk-weighted assets. Hence, in the case of an infant bank, the initial and required step is for the bank to be merged or acquired by a stable financial institution. Afterward, the target should experience a synergy.

2.3 An Overview of the Croatian Banking Sector

The socialist era in Croatia “was marked by simple and shallow financial markets, serviced primarily by banks extending credit lines to business and individual citizens,” where banks served as “regional financial services” to primarily “serve the

local economy, to distribute credit to the business and organize retail banking” (Kaštelan Mrak & Dimitrić, 2004).

At the beginning of the transition process in the late nineties of the previous century, a two-tier banking system already existed in Croatia. However, the new circumstances required upgrading and updating of the Croatian banking system and market-based practices had to be incorporated. Croatia did not go under direct bank privatization, but considering that state-owned enterprises owned the banks, with their privatization, the Croatian banks were transferred into private ownership (Reininger & Walko, 2004). It is worth mentioning that the Croatian financial system is a bank-based continental system, and the banking sector is one of the largest industries in Croatia (Tomičić et al., 2012). However, the Croatian banking sector was profoundly affected by the transformation process that occurred in the late 1990s. During that period, merger and acquisition trends were starting to occur, and some of those banks went through the process of bankruptcy, and this caused the number of banks to start to decrease over the following years. In comparison, in the early 1990s, there were around 50–60 banks in Croatia, while in 2010, there were only 32 (Tomičić et al., 2012). Although the number of banks showed a decreasing trend, the concentration was increasing. Thus, the bank profits experienced an increase during that period, and the competition started to increase as well. To adjust to the new market circumstances, the Croatian bank started orienting more toward offering new products, boosting their advertising activities, and decreasing the interest rates (Kraft et al., 2006). Furthermore, Ružić (2006) in his paper analyzed the role of the Croatian National Bank in the monitoring of the concentration of the system and highlighted its importance. An interesting analysis was conducted in the paper of Tipurić et al. (2003), where they estimated that the Croatian banking industry is highly concentrated as its structure is composed of two big market players, many small banks, and several medium-sized banks. Stojanović et al. (2016) in their paper stated that the profitability problems of the smaller banks in Croatia caused the decreasing trend in the number of Croatian banks. Mandac and Krišto (2016) concluded that the decline in lending activity within the Croatian banking system since 2011 can be attributed to the negative impact of the 2007/2008 financial crisis. In their research on metrics such as Theil entropy, the Gini coefficient, the Pietra index, the Atkinson index, and the coefficient of variation, Delalic et al. (2018) estimated that there is heterogeneity in the system and inequalities among Croatian banks, particularly in terms of their asset sizes. Moreover, prior to Croatia’s accession to the EU in 2013, several new banking laws were introduced in 1999, 2002, 2008, and 2013. The most recent legislation enabled European banks to provide services directly without prior approval by Croatian authorities, thereby impacting market competition (Kraft & Huljak, 2018). Kraft and Tirtiroglu (1998) identified a statistically weak relationship between profitability and efficiency among Croatian banks. According to Kraft et al. (2006), they found that during the period from 1994 to 2000, newly privatized banks in Croatia were not the most efficient, suggesting that the process of privatization did not necessarily lead to improved cost efficiency in the banks. Additionally, Jemrić and Vujčić (2002) showed that foreign-owned banks are more efficient than domestic banks, and new banks tend to be more

efficient than older ones. Huljak (2014) estimated that, in terms of managing administrative costs, domestic and smaller banks are more efficient compared to foreign banks, while both foreign and larger banks, as well as smaller domestic banks, exhibit similar levels of efficiency in managing total costs.

The Croatian economy experienced a recession that spanned from 2008 till 2014 (Fotova Čiković et al., 2022a). Despite this recession, the Croatian banking sector consolidated and allocated the majority of assets and market share to a few large banks. Consequently, this resulted in the creation of “large and efficient banks” (Učkar & Petrović, 2021), while the number of small banks in the Croatian banking market decreased (Visković et al., 2022). The regulatory legislation remained unchanged, and the monetary policy remained relatively consistent during this period. However, Croatia’s accession to the EU in 2013 introduced a new period of international and fierce competition for small domestic Croatian banks, enforcing them to find ways to operate more efficiently and, if possible and necessary, consider consolidation.

3 Methodology and Data

The evaluation of the efficiency of commercial bank utilities has been traditionally carried out using econometric methods or linear programming techniques. However, in this study, the primary methodology used is the leading nonparametric methodology DEA, utilizing two inputs and two outputs. When applying DEA, the results are largely determined and driven by the selection of the input and output variables. In other words, one of the main challenges in DEA is the selection of appropriate input and output indicators (Luo et al., 2012). Moreover, the selection of inputs and outputs in DEA models in banking M&A is a crucial and anything but a simple process. Avkiran (2006) highlights the importance of grounding this selection in finance and banking theories, while Floros et al. (2020) emphasized the significance of this selection in the context of European banking efficiency, particularly in relation to the role of deposits. These studies collectively underscore the need for a systematic and theory-driven approach to input and output selection in DEA models in the banking M&A context. Notwithstanding, the chosen approach to the DEA model plays a major role in the selection process of the input and output variables as well. The intermediation approach adopted in this study is considered a more appropriate approach in efficiency evaluation in banking in general as banks are considered intermediaries that collect deposits and transform them into loans and other earning assets (Mokhtar et al., 2008; Holod & Lewis, 2011). Furthermore, banks are considered “intermediaries” between savers and investors (Mostafa, 2011). Most importantly, the intermediation approach “assumes that the main aim of a commercial bank is to create output, defined as loans and investment, whilst using liabilities (including deposits), labour, and capital as inputs” (Boda & Piklova, 2018). Therefore, in this study, interest expenses and noninterest expenses are chosen as inputs and can be mapped into the output variables of interest revenue and

Table 1 Input and output variables

Character of variable	Label of the variables	Elements of the variables
Input	Interest expenses (I1)	
	Noninterest expenses (I2)	Expenses on fees and commissions
		General administrative expenses and depreciation
		Expenses on value adjustments and provisions
		Other operating expenses
Output	Interest revenues (O1)	
	Noninterest revenues (O2)	Income from fees and commissions
		Other operating income

Source: Personal elaboration

noninterest revenue. The specific variables chosen and the details regarding the variables and their definitions are outlined in Table 1.

The used data has been extracted from the official and publicly available financial statements for the selected inputs and outputs for each commercial bank in the 2011–2020 period.

Data envelopment analysis (DEA) is the leading nonparametric linear programming method which was first developed and introduced by Charnes, Cooper, and Rhodes in a seminal paper published in 1978. In their work, they built upon “Farrell’s idea and used this approach (which derives from the concept of productivity, i.e., the ratio of individual output to a single input) in multidimensional situations” (Miszczynska & Miszczynski, 2021).

The DEA methodology has two basic models, i.e., the CCR (Charnes, Cooper, Rhodes) and BCC (Banker et al., 1984) models, and all the extensions and modifications that have emerged since 1978 are based on these models. The main difference between these two basic models is the applied return to scale. Namely, the CCR model is also known as CRS (constant returns to scale) and the BCC DEA model as VRS (variable returns to scale). As a “classic economic concept, the returns to scale describe the change in the output after a proportional change in the inputs.” Thus, a constant return to scale assumes a “directly proportional change in the number of outputs based on the change in the number of inputs” (Vankova & Vrabkova, 2022). The variable return to scale assumes that the increase or change in the inputs does not necessarily lead to a proportional increase or change in the outputs (Fotova Čiković et al., 2022b). Moreover, each DEA model can have an input, output, or non-orientation.

The obtained efficiency result from the DEA methodology is usually presented either as a percentage (0–100%) or a number between 0 and 1, with 100% or 1 being relatively efficient, while values below 100% or 1 indicate relative inefficiency.

The envelopment form of the output-oriented BCC DEA model is presented in (1)–(5) (Cooper et al., 2007):

$$(BCC - O_o) \quad \max_{\eta_B, \lambda} \eta_B \quad (1)$$

$$\text{subject to} \quad X\lambda \leq x_0 \quad (2)$$

$$\eta_B y_0 - Y\lambda \leq 0 \quad (3)$$

$$e\lambda = 1 \quad (4)$$

$$\lambda \geq 0 \quad (5)$$

where η_B is a scalar. The input data for DMU j ($j = 1, \dots, n$) are $(x_{1j}, x_{2j}, \dots, x_{mj})$, and the output data are $(y_{1j}, y_{2j}, \dots, y_{mj})$; the data set is given by two matrices X and Y , where X is the input data matrix, Y is the output data matrix, λ is a column vector and all its elements are nonnegative, and e is a row vector and all its elements are equal to 1 (Cooper et al., 2007, p. 22, 91–92; Cvetkoska & Barišić, 2017, pp. 33–34).

For the purposes of this study, the “popular, effective and applicable method for dynamic performance assessment of peer decision-making units,” i.e., the DEA window technique was applied (Peykani et al., 2021). The window analysis is considered “a dynamic DEA method based on moving averages suitable for detecting the trends in efficiency” (Vankova & Vrabkova, 2022). Moreover, they claimed that the window technique is a more incisive method used for evaluating and observing the overall trend in performance and efficiency.

The window DEA technique was introduced to terminology by Charnes et al. (1984) and Klopp (1985) as a method for “evaluation of perennial data, and trend determination.” The specific characteristic of window DEA is that it “treats each decision-making unit as a different unit, so data on DMUs in different time zones are included in the model, treating them as separate DMUs” (Özsoy & Pehlivanli, 2022). Al-Delaimi and Al-Ani (2006) claimed that the main objective of the window DEA is to “capture the variations of efficiency over time.” Peykani et al. (2021) stated that the main perk of the WDEA method is its ability to “describe the horizontal and vertical changes in the efficiency of DMUs.”

In this study, the practical application of the DEA window technique is explored in the investigation of the relative efficiencies of banks operating in Croatia as well as the impact of M&A transactions on banks’ efficiency. The main objective of the research is to empirically assess the impact of M&A transactions on banks’ efficiencies in Croatia and the main hypothesis that larger banks (and especially banks from the group of large banks) are more efficient than small-sized banks and, thus, consolidation of the small-sized banks would bring higher efficiency to each individual bank involved in the M&A process and the entire Croatian banking market, equally. The number of windows (w) in the solved problem can be expressed using the following relationship:

$$w = k - p + 1 \quad (6)$$

$$\text{the number of DMUs in each window : } np / 2 \tag{7}$$

$$\text{and the number of different DMUs : } npw \tag{8}$$

where: w = number of windows; n = number of DMUs; k = number of periods; p = duration of window ($p \leq k$) (Vankova & Vrabkova, 2022).

In the second phase of this study, a case study approach was applied following Le (2017) and Fotova Čiković et al. (2022a). Even though there is a plethora of DEA studies that investigate the efficiency of banking systems (as covered in Sect. 2), there are no DEA studies that revolve around and evaluate the impact of M&A in Croatia. Therefore, this is an original study that offers solid scientific contributions. Moreover, four case studies will be evaluated in detail as follows: the merger of Karlovačka Banka d.d. and Nava Banka d.d. in 2012, the acquisition of Banco Popolare Croatia by OTP Banka Hrvatska d.d. in 2014, the acquisition of Splitska Banka d.d. by OTP Banka Hrvatska d.d. in 2017, and the acquisition of Jadranska Banka d.d. by Hrvatska Poštanska Banka d.d. in 2018.

4 Empirical Results

The observed sample consists of 20 commercial banks ($n = 20$) over a period of 10 years ($k = 10$), where the length of the window is 5 years ($p = 5$) and the number of windows is 6 ($w = k - p + 1 = 10 - 5 + 1 = 6$). In each window, there are 100 banks ($n \times p$), and the number of “different” banks is 600 (100 banks \times 6 windows). Every window covers 5 years (e.g., window 1 covers the years 2011, 2012, 2013, 2014, and 2015; window 2 covers data for 2012, 2013, 2014, 2015, and 2016, and so on) as presented in Table 2 below. Considering the fundamental importance of the window duration in the window DEA method, a 5-year time window has been chosen; this is because the authors deemed it very important to address the Croatian economic timeline, considering that the year 2015 is the first Croatian postrecession year after a long recession of 7 years (ever since the Great Financial Crisis of 2008/2009). Namely, the Croatian economy experienced recession “since the last quarter of 2008 for almost 6 years continuously and it shrank 13% cumulatively”

Table 2 Windows in the DEA window analysis model

Window 1	2011	2012	2013	2014	2015					
Window 2		2012	2013	2014	2015	2016				
Window 3			2013	2014	2015	2016	2017			
Window 4				2014	2015	2016	2017	2018		
Window 5					2015	2016	2017	2018	2019	
Window 6						2016	2017	2018	2019	2020

Source: Authors’ construction

and 2014 is the year in which Croatia's recession was considered to be over (Pisarović et al., 2021).

The applied output-oriented BCC window DEA model (Window-O-V) used in this study has been solved using the DEA-Solver-LV software. Additional information about this software can be found in Cooper et al. (2007). The obtained results provide insights into the relative efficiency of the banks included in the sample. Therefore, banks that are deemed relatively efficient are assigned an efficiency score of 1 or 100%. On the other hand, banks that are relatively inefficient receive an efficiency score lower than 1 or 100%.

The obtained results reveal that the relative efficiency of the Croatian banking sector during the entire observed period (2011–2020) is 71.5%. As shown in Fig. 1, the average efficiency was highest in the initial year of observation (2011), with a result of 80.82%, but subsequently experienced a decrease until 2017 (65.90%). The efficiency results for 2018 and 2019 improved to 73.37% and 77.77%, respectively, but decreased significantly in 2020 to an efficiency score of 68.36%. This notable decline could be attributed to the COVID-19 pandemic's impact on banks' efficiencies, an issue requiring further investigation in future works. Furthermore, while it is important to note the impact of the COVID-19 pandemic on the overall Croatian banking sector, the focus should not be placed only on the first pandemic year of 2020. Instead, studies should include a rather longer time span that would include the latter years of the pandemic into their research in order to achieve a more comprehensive analysis. The decrease in efficiency in 2020 is undoubtedly a result of the pandemic, due to the "deteriorating macroeconomic environment that caused an increase in credit risk, which has adversely affected the profitability of banks" (Croatian National Bank, 2021), but this is not the research question at hand and will be the subject of future research of the authors. Nevertheless, the primary

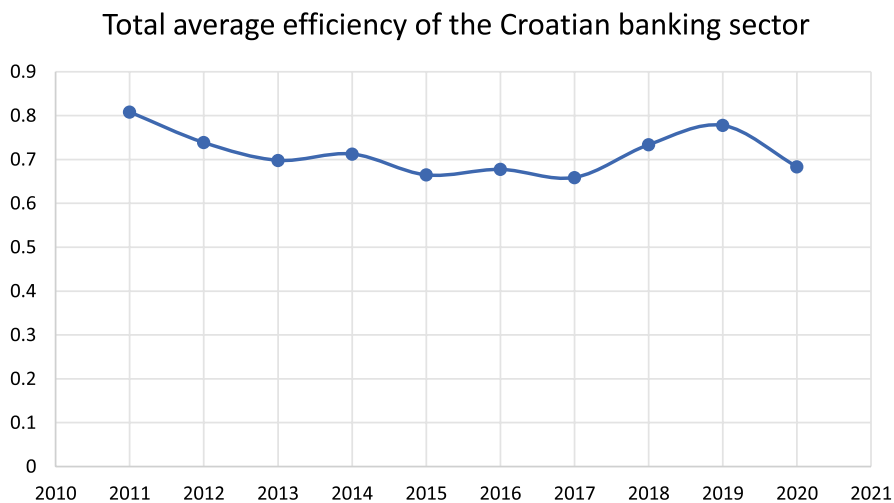


Fig. 1 The total average efficiency of the Croatian banking sector. Source: Authors' construction

Table 3 Overall efficiency for commercial banks in Croatia (2011–2020) and their classifications

Bank	Overall efficiency		Type of bank
	By windows	By years	
Addiko Bank d.d.	0.5507	0.5848	Middle-sized
Agram Banka d.d.	0.6877	0.6774	Middle-sized
Banka Kovanica d.d.	0.6885	0.6714	Small-sized
Croatia Banka d.d.	0.5609	0.5168	Small-sized
Erste & Steirnerische Bank d.d.	0.9324	0.8851	Large
Hrvatska poštanska Banka d.d.	0.6527	0.7031	Large
Imex Banka d.d.	0.6986	0.7776	Small-sized
Istarska Kreditna Banka Umag d.d.	0.7230	0.7699	Middle-sized
J&T Banka d.d.	0.4875	0.5227	Small-sized
Karlovačka Banka d.d.	0.6300	0.6390	Middle-sized
KentBank d.d.	0.6700	0.6728	Middle-sized
OTP Banka d.d.	0.7848	0.8167	Large
Partner Banka d.d.	0.6164	0.6368	Small-sized
Podravska Banka d.d.	0.6159	0.6427	Middle-sized
Privredna Banka Zagreb d.d.	0.9505	0.9623	Large
Reiffeisenbank Austria d.d.	0.6985	0.7298	Large
Samoborska Banka d.d.	0.8466	0.8971	Small-sized
Sberbank d.d. (Nova hrvatska Banka d.d.)	0.6079	0.6100	Middle-sized
Slatinska Banka d.d.	0.6550	0.6998	Small-sized
Zagrebačka Banka d.d.	0.9550	0.8930	Large

Source: Authors' work

objective of this study is to emphasize that M&A transactions in the Croatian banking market have indeed had a positive impact on the overall efficiency of the banking sector as a whole.

The total average efficiency (by windows and by term-years) for each observed Croatian bank, categorized as small-sized, middle-sized, or large, is presented in Table 3. Namely, the “Croatian National Bank classifies banks as small-sized banks (banks with a market share of less than 1%), middle-sized banks (banks with a market share between 1 and 5%), and large banks (banks with a market share above 5%)” (Cvetkoska et al., 2021). The average efficiency results from the five windows are given as the average efficiency by windows. These findings reveal that the most efficient Croatian banks in the period 2011–2020 belong to the group of large banks, specifically Erste & Steirnerische bank d.d. (0.9324 by windows and 0.8851 by years), Privredna Banka Zagreb d.d. (0.9505 by windows and 0.9623 by years), and Zagrebačka Banka d.d. (0.9550 by windows and 0.8930 by years). On the other hand, the least efficient banks are two small-sized commercial banks: Croatia banka d.d. (0.5609 by windows and 0.5168 by years) and J&T Banka d.d. (0.4875 by windows and 0.5227 by years), while Addiko Bank d.d. achieved an efficiency score of 0.5507 by windows and 0.5848 by years.

Table 4 The analyzed bank M&A case studies

Analyzed case studies		
Buyer	Target bank	Year
Karlovačka Banka d.d.	Nava Banka d.d.	2012
OTP Banka Hrvatska	Banco Popolare Croatia	2014
OTP Banka Hrvatska	Societe Generale Splitska Banka d.d.	2017
Hrvatska Poštanska Banka d.d.	Jadranska Banka d.d.	2018

Source: Authors' construction

The M&A activity in the markets of Central and Eastern Europe peaked in 2015 and has since declined due to “the stabilizing macroeconomic environment in the past 3 years, vivid lending activity, dismantling of non-performing exposure volumes and entailing profitability improvements” which decreased the pressure on banks and therefore removed the need for M&A (Deloitte, 2018). However, this was not completely mirrored in the case of Croatia. Namely, the largest and most observed M&A case studies in this paper are those written after 2015. The first M&A transaction occurred in 2012, when Karlovačka Banka d.d. took over Nava Banka d.d. The second one took place in 2014 while the remaining M&A transactions occurred in 2017 and 2018. These case studies and the second stage of the study, including their empirical results, are presented in Table 4. The details and analysis of these case studies are further elaborated in Sects. 4.1–4.3.

4.1 The Merger of Karlovačka Banka d.d. and Nava Banka d.d. (2012)

The merger agreement was signed on July 25, 2012, and the stated motive for the merger was the potential high compatibility and kinship of the banks based on the same activity and identical business mission, with a strategic orientation toward doing business with small and medium-sized entrepreneurs and the population.

The obtained results show that during the first observed year (2011), the bank achieved an efficiency score of 61.68%. The bank experienced a dramatic fall in efficiency in 2013 (i.e., the first year after the merger), leading to its lowest recorded efficiency of 0.3534 (35.34%). However, the bank's efficiency has since returned to its original high score, achieving 0.8567 or 85.67% in 2019. Therefore, the lowest efficiency result in 2013 cannot be considered a negative impact of the M&A transaction but rather a result of the changes in the bank's management, organizational structure, and restructuring process. The average efficiency for the whole observed period was 63.9%. In the case of Karlovačka Banka d.d., it is obvious that the consolidation of Karlovačka Banka d.d. and Nava Banka d.d. positively influenced their efficiency and performance (Fig. 2).

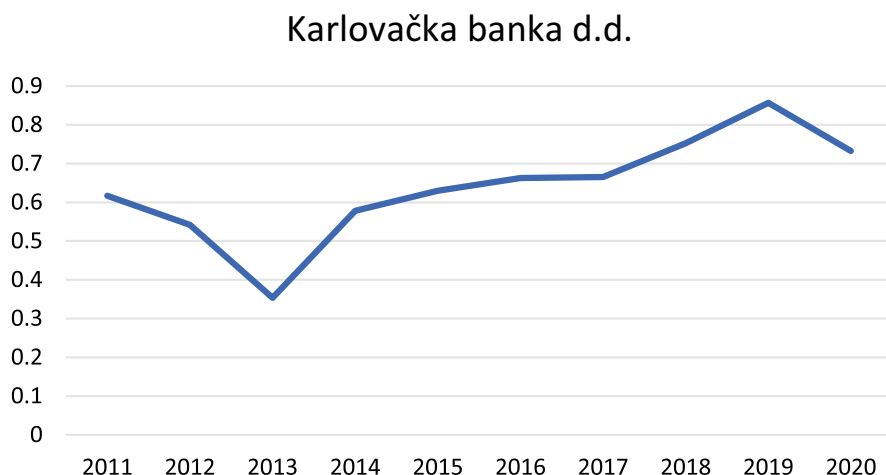


Fig. 2 The efficiency of Karlovačka Banka d.d. (2011–2020). Source: Authors' work

4.2 The Acquisition of Banco Popolare Croatia by OTP Banka Hrvatska d.d. (2014) and the Acquisition of Splitska Banka d.d. by OTP Banka Hrvatska d.d. (2017)

In December 2014, the Croatian banking sector witnessed the consolidation of Banco Popolare Croatia d.d. and OTP Banka d.d. The primary motivation behind this transaction was to expand the banks' branch network. Following the acquisition, the network of OTP branches increased from 97 to 112 (Blašković, 2014).

In December 2018, OTP Banka d.d. completed the legal process of merging with Splitska Banka d.d. This merger involved the subsidiary of the Hungarian OTP Group, OTP Banka Hrvatska, acquiring Splitska Banka from Société Générale, "which significantly strengthened OTP's position in the Croatian banking market" (Deloitte, 2018). After the acquisition, OTP rose to the third position on the market, with a market share of 11%.

The CEO of the bank, Békeffy, stated: "Through the merger, we have created a nationally strong market player, with the best characteristics of both banks and a rich product portfolio and great market development potential" (OTP Banka, 2018).

The efficiency scores from the WDEA model reveal that, in the case of OTP Banka d.d., the M&A deals had a positive impact on the efficiency and performance of the bank. Namely, the lowest efficiency result was noted in 2014 (66.2%), which is before the two analyzed M&A transactions. The highest efficiency results, on the other hand, were observed in 2019 and 2020, with an efficiency result of 100%. The average efficiency of OTP Banka d.d. for the entire analyzed period is 81.67%, which is quite higher than the Croatian average of 71.5%.

Therefore, it is safe to conclude that, in the case of OTP Banka d.d., the two M&A transactions did indeed have a very positive impact on its efficiency and

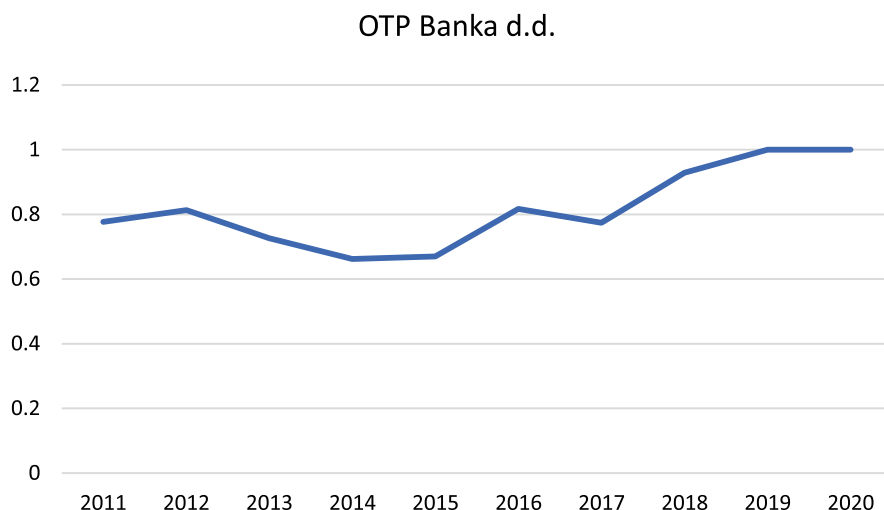


Fig. 3 The efficiency of OTP Banka d.d. (2011–2020). Source: Authors' work

performance. Moreover, the fact that OTP Banka d.d. is a large bank should also be taken into consideration, thus concluding that large banks do indeed perform more efficiently than small-sized and middle-sized banks (Fig. 3).

4.3 The Acquisition of Jadranska Banka d.d. by Hrvatska Poštanska Banka d.d. (2018)

The acquisition transaction occurred in July 2018, and on April 1, 2019, Hrvatska Poštanska Banka and Jadranska Banka d.d. started operating as one entity. The merger was expected to yield positive outcomes, such as enhanced market efficiency, cost savings, and an increase in the number of clients and distribution channels. Moreover, HPB planned to open one of its largest regional centers in Šibenik to manage operations in Šibenik-Knin County and continue strengthening its position in the Dalmatia region (HPB, 2018).

The findings from the window DEA method indicate that these expected results were achieved, with the bank reaching its full potential and noting an efficiency score of 1 (100%) in 2019. This has been the single relative efficient year from the observed period. However, the efficiency score dropped to 93.75% in 2020, most likely due to the impact of the COVID-19 crisis (which needs to be investigated in detail in further work). The average efficiency score for the period 2011–2020 was 70.31%.

Therefore, it can be concluded that the acquisition of Jadranska Banka d.d. had a positive impact on the large Hrvatska Poštanska Banka d.d.'s efficiency (Fig. 4).

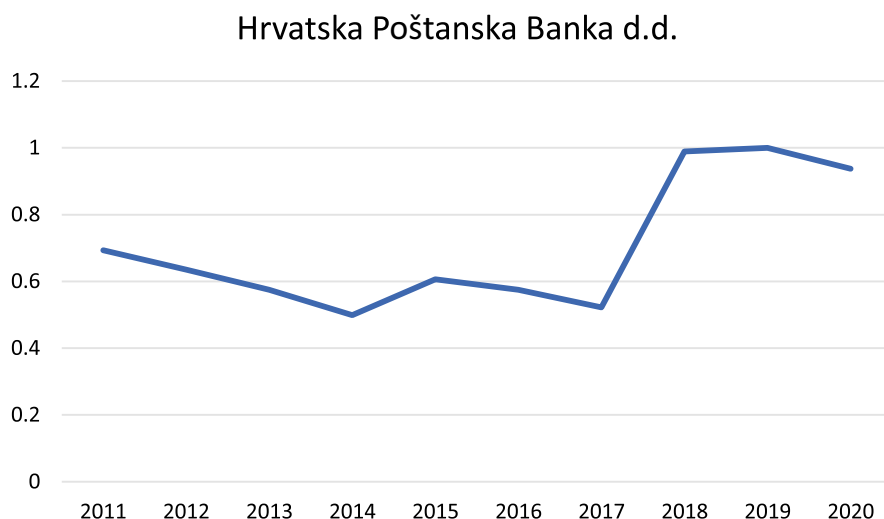


Fig. 4 The efficiency of Hrvatska Poštanska Banka d.d. (2011–2020). Source: Authors' work

The Croatian banking market is expected to concentrate even more over the following years. Namely, the small-sized Croatia bank d.d. is expected to be acquired soon, according to statements made by the manager of the Croatian Deposit Insurance Agency (Seebiz, 2021). Moreover, in 2022, as a result of the global geopolitical circumstances, there was another M&A transaction (i.e., takeover) of the Russian-owned Sberbank d.d. by Hrvatska Poštanska Banka d.d. in March 2022, renaming the bank as Nova Hrvatska Banka d.d.

5 Discussion and Conclusion

Banks are major players in the global financial system and are crucial for the economic development of countries with both developing or underdeveloped financial systems (Fotova Čiković & Cvetkoska, 2017). Banks facilitate the flow of credit and are the main channel for savings and deposits. They also facilitate capital formation and contribute to economic growth. Nevertheless, the stability of the banking system is the main factor that enables banks to perform to their full potential (Omankhanlen, 2012; Palalić et al., 2022). However, existing literature shows that banks need to improve their profitability, the efficiency of their operations, and their market power. One way to improve stability in the banking industry is for banks to engage in mergers and acquisitions. Existing literature has supported the argument that “the consolidation of the banking sector contributes to a better quality of bank services, lower cost of capital, higher profitability and higher efficiency of the whole banking industry” (Fotova Čiković & Fotov, 2015).

With the application of the leading nonparametric DEA approach (window technique), this paper is an effort to assess the impact of M&A transactions on bank efficiency, as well as their overall impact on the Croatian banking industry. Moreover, the main objective of this research is to empirically assess the impact of M&A transactions on banks' efficiencies in Croatia and that large banks exhibit better efficiency than small-sized banks. In that sense, the consolidation of the whole banking sector in Croatia could potentially bring many benefits to the whole banking sector, as well as to each bank involved in the M&A process. The observed sample included 20 Croatian commercial banks from the period from 2011 to 2020. The output-oriented BCC window DEA model consists of two input variables (the interest and the noninterest expenses) and two output variables (the interest and the noninterest revenue).

In the first stage of the study, the obtained results present the total average efficiency (by windows and by term-years) for each of the observed Croatian banks. These findings reveal that the most efficient Croatian banks in the period 2011–2020 belong to the group of large banks, namely, Erste & Steirnerische Bank d.d. (0.9324 by windows and 0.8851 by years), Privredna Banka Zagreb d.d. (0.9505 by windows and 0.9623 by years), and Zagrebačka Banka d.d. (0.9550 by windows and 0.8930 by years). On the other hand, the least efficient banks are two small-sized commercial banks, Croatia banka d.d. (0.5609 by windows and 0.5168 by years) and J&T Banka d.d. (0.4875 by windows and 0.5227 by years), while Addiko Bank d.d. had an efficiency score of 0.5507 by windows and 0.5848 by years. Moreover, the obtained results show that the average relative efficiency of the Croatian banking sector for the entire observed period (2011–2020) is 71.5%. The average efficiency was highest in the first observed year, 2011, with a result of 80.82%, after which it experienced a decrease until 2017 (65.90%). The efficiency results for 2018 and 2019 improved to 73.37% and 77.77%, respectively, but decreased dramatically in 2020 to 68.36%. This notable decline could be attributed to the COVID-19 pandemic's impact on banks' efficiency, an issue requiring further investigation in future works. Moreover, the obtained DEA results prove that larger banks experience higher efficiency than small-sized banks. Furthermore, the M&A activities in the Croatian banking sector have indeed contributed to increasing the efficiency of both merged banks and the banking sector in general, as shown in previous relevant research by Al-Sharkas et al. (2008) and Ikpefan (2012).

The second stage of the study contains a case study approach to investigate whether the analyzed M&A transactions had a positive efficiency impact on banks. This approach provides a more detailed analysis offers new insights. Namely, in all of the four analyzed case studies of M&A in the Croatian banking sector, the banks experienced efficiency gains and improved relative performance after the M&A transaction. Interestingly, the findings from the current study differ from those of a previous study conducted by Fotova Čiković et al. (2022a) regarding the Macedonian banking market, where consistent and clear conclusions could not be drawn.

The improvement of banking efficiency after M&A is a rather complex phenomenon and is influenced by many different contextual variables. Even though there are authors that found that M&A processes in banking indeed improve banks' efficiencies, there are studies that showed otherwise. For instance, Halkos and Tzeremes (2013) found that the majority of the 45 possible bank M&As in Greece between 2007 and 2011 "did not generate short-run operating efficiency gains," particularly during the Greek fiscal crisis. Tiwari (2014) further emphasized the importance of synergy-driven consolidation in the banking sector, which can potentially lead to a quantum jump in performance and efficiency. These findings suggest that while M&A can lead to short-term efficiency gains, its sustainability and long-term impact depend on various factors, including the economic conditions at the time and the strategic approach to the M&A process.

This study is, however, not without limitations. Firstly, it utilizes the window DEA (WDEA) methodology, which measures performance and efficiency in a relative rather than objective manner. Additionally, the window DEA technique has been criticized because "the first and the last year in the analysis are not tested as frequently as the other analysed years" (Cooper et al., 2007). However, it should be taken into consideration that the DEA window analysis was meant "to diminish the effect of an inadequate number of DMUs in the dataset while measuring the efficiency" and to "enable researchers to overcome the weak discrimination power of the DEA because of the small sample size" (Shamohammadi et al., 2022). Moreover, the issue of the used methodology to address such an important issue of the impact on efficiency and performance of banking should be tackled using different methodologies, which authors plan to conduct in future work. Secondly, this study does not consider newer M&A transactions in the Croatian banking market since they occurred after 2020 (i.e., in 2022). It is important for future research to include these transactions for a more comprehensive analysis. Thirdly, this study covers only one national economy, i.e., the Croatian economy and banking market. Conducting a cross-country empirical study would provide broader insights. Furthermore, this paper does not consider or address the cost of equity used for funding takeovers, such as in the case of the takeover of Societe Generale Splitska Banka d.d. The authors plan to explore this issue in future work. Finally, the biggest limitation of this study, as well as previous studies of Le (2017) and Fotova Čiković et al. (2022a), is the exclusive focus on the impact of M&A on bank efficiency without considering other important perspectives, market conditions or circumstances that influence the efficiency, performance, and sustainability of merged banks. The results obtained from the window DEA analysis provide new insights and valuable feedback for many bank stakeholders, especially bank management, potential investors, and regulatory and government bodies. Nevertheless, this study should be regarded as a stepping stone for future work and a reference for other scholars since it covers a longer period (2011–2020) and revolves around the impact of M&A on banks, thus being the first empirical study on this subject in Croatia and Southeastern Europe.

References

- Al-Delaimi, K. S. K., & Al-Ani, A. H. B. (2006). Using data envelopment analysis to measure cost efficiency with an application on Islamic banks. *Scientific Journal of Administrative Development*, 4, 134–156.
- Aljadani, A., & Toumi, H. (2019). Causal effect of mergers and acquisitions on EU bank productivity. *Journal of Economic Structures*, 8(44), 1–22.
- Al-Sharkas, A. A., Kabir, H. M., & Shari, L. (2008). The impact of mergers and acquisitions on the efficiency of the U.S. banking industry, further evidence (2007-03). *Journal of Business Finance & Accounting*, 35(1-2), 50–70.
- Altunbas, Y., Evans, L., & Molyneux, P. (2001). Bank ownership and efficiency. *Journal of Money, Credit and Banking*, 33(4), 926–954. <https://doi.org/10.2307/2673929>
- Andries, M. A., Cazan, S., & Sprincean, N. (2021). Determinants of Bank M&As in Central and Eastern Europe. *Journal of Risk and Financial Management*, 14(621), 1–21.
- Avkiran, N. K. (2006). Developing foreign bank efficiency models for DEA grounded in finance theory. *Socio-Economic Planning Sciences*, 40(4), 275–296.
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models of estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078–1092.
- Blaškovčić, A. (2014). *Poslovni dnevnik 2014. Banco Popolare Croatia became part of OTP, full integration by the end of the year*. Poslovni HR. Available at: <https://www.poslovni.hr/kompanije/banco-popolare-croatia-postala-dio-otp-a-puna-integracija-do-kraja-godine-284872>
- Boda, M., & Piklova, Z. (2018). The production or intermediation approach?: It matters. In *Contemporary trends and challenges in finance: Proceedings from the 3rd Wroclaw international conference in finance* (pp. 111–120). Springer International Publishing.
- Buch, C. M., & DeLong, G. L. (2004). Cross-border bank mergers: What lures the rare animal? *Journal of Banking and Finance*, 28(9), 2077–2102.
- Caiazza, S., & Pozzolo, A. F. (2014). Do domestic and cross-border M&As differ? Cross-country evidence from the banking sector. *Applied Financial Economics*, 24(14), 967–981.
- Charnes, A., Cooper, W., & Rhodes, E. (1978). Measuring the efficiency of decision-making units. *European Journal of Operational Research*, 2(1978), 429–444.
- Charnes, A., Clark, C. T., Cooper, W. W., & Golany, B. (1984). A developmental study of data envelopment analysis in measuring the efficiency of maintenance units in the U.S. Air Forces. *Annals of Operations Research*, 2(1), 95–112.
- Cooper, W. W., Seiford, L. M., & Tone, K. (2007). *Introduction to data envelopment analysis and its uses: With DEA-solver software and references*. Springer Science 1 Business Media.
- Croatian National Bank (2021). Financial stability report 22, Available online: <https://www.hnb.hr/documents/20182/3899508/h-fs-22.pdf/76d8bf81-191c-c0af-d642-ee31f937d4fc>
- Cvetkoska, V., & Barišić, P. 2017. The efficiency of the tourism industry in the Balkans. In Proc. of the Faculty of Economics in East Sarajevo, 14, pp. 31–41. <https://doi.org/10.7251/ZREFIS1714031C>.
- Cvetkoska, V., & Fotova Čiković, K. (2020). Assessing the relative efficiency of commercial banks in the Republic of North Macedonia: DEA window analysis. *Croatian Operational Research Review*, 11(2), 217–227.
- Cvetkoska, V., Fotova Čiković, K., & Tasheva, M. (2021). Efficiency of commercial banking in developing countries. *Mathematics*, 9(14), 1597.
- Davidović, M., Uzelac, O., & Zelenović, V. (2019). Efficiency dynamics of the Croatian banking industry: DEA investigation. *Economic Research-Ekonomska Istraživanja*, 32, 33–49.
- Delalic, A., Curkovic, M., & Antic, J. (2018). The Croatian banking system total assets concentration dynamics: Performing a variety of inequality measures. *Croatian Review of Economics, Business and Social Statistics*, 4(1), 14–26.
- Deloitte 2018. CEE banking M&A dynamics remain stable. Multiple factors to further boost consolidation. Deloitte website. Available at: <https://www2.deloitte.com/bg/en/pages/finance/articles/cee-banking-study-2018.html>

- Floros, C., Zopounidis, C., Tan, Y., Lemonakis, C., Garefalakis, A., & Tabouratzi, E. (2020). Efficiency in banking: Does the choice of inputs and outputs matter? *International Journal of Computational Economics and Econometrics*, 10(2), 129–148.
- Focarelli, D. and Pozzolo, A. F. 2001. The patterns of cross-border bank mergers and shareholders in OECD countries. SSRN. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=301643
- Fotova Čiković, K., & Cvetkoska, V. (2017). Efficiency of the Macedonian banking sector: A non-parametric approach. *CEA Journal of Economics*, 12(2), 17–26.
- Fotova Čiković, K., & Fotov, R. (2015). Consolidation of the banking sector in Macedonia: Effects and benefits. In V. Filipovski (Ed.), *Economic recovery in the post-crisis period. Proceedings from International Conference* (pp. 262–277). Cyril and Methodius University in Skopje Faculty of Economics—Skopje.
- Fotova Čiković, K., Lozić, J., & Guzovski, M. (2022a). Do mergers and acquisitions improve bank efficiency? Evidence from North Macedonia. *Journal of International Studies*, 15(2), 77–93.
- Fotova Čiković, K., Lozić, J. and Kecek, D. 2022b. The impact of mergers and acquisitions (M&A) on bank efficiency in Europe: A prisma compliant systematic review of DEA applications. Interdisciplinary Management Research XVIII, Faculty of Economics in Osijek-Postgraduate study Management, Josip Juraj Strossmayer University of Osijek.
- Godswill, O. O., Ochei, A. I., Olawale, Y. O., & Abimbola, A. J. (2021). A systematic literature review on mergers and acquisitions: A bibliometric analysis approach international. *Journal of Financial Research*, 12(4), 125–134.
- Hahn, F. R. (2007). Domestic mergers in the Austrian banking sector: A performance analysis. *Applied Financial Economics*, 17(3), 185–196.
- Halkos, G. E., & Tzeremes, N. G. (2013). Estimating the degree of operating efficiency gains from a potential bank merger and acquisition: A DEA bootstrapped approach. *Journal of Banking & Finance*, 37(5), 1658–1668.
- Hang, H. T. T., Vy, P. D., & Bandaralage, J. (2016). Mergers, acquisitions and market concentration in the banking sector: The case of Vietnam. *Asian Journal of Economics and Empirical Research*, 3(1), 49–58.
- Holod, D., & Lewis, H. F. (2011). Resolving the deposit dilemma: A new DEA bank efficiency model. *Journal of Banking & Finance*, 35(11), 2801–2810.
- HPB (2018). HNB odobrio pripajanje Jadranske banke HPB-u. Available at: <https://www.hpb.hr/hr/hnb-odobrio-pripajanje-jadranske-banke-hpb-u/3901>
- Huljak, I. (2014). Net effect of bank market power in Central and Eastern Europe, PhD dissertation, Economics Faculty, Split.
- Ikpefan, O. A. (2012). Post-consolidation effect of mergers and acquisitions on Nigerian deposit money banks. *European Journal of Business and Management*, 4(16), 151–162.
- Jayadev, M., & Sensarma, R. (2007). Mergers in Indian banking: an analysis. *South Asian Journal of Management*, 14(4), 20–49.
- Jemrić, I., & Vujčić, B. (2002). Efficiency of banks in Croatia: A DEA approach. *Comparative Economic Studies*, 44(2-3), 169–193. <https://doi.org/10.1057/ces.2002.13>
- Kaštelan Mrak, M. and Dimitrić, M. (2004). M&As in banking sector of Croatia. In: 20th EGOS Symposium: The organization as a set of dynamic relationships at Ljubljana University in Ljubljana. 1–24.
- Klopp, G. (1985). *The analysis of the efficiency of production system with multiple inputs and outputs*, Ph.D. Thesis. University of Illinois at Chicago, Industrial and Systems Engineering College.
- Kozak, S., & Wierzbowska, A. (2021). Banking market concentration and bank efficiency. Evidence from Southern, Eastern and Central Europe. *South East European Journal of Economics and Business*, 16(1), 38–52. <https://doi.org/10.2478/jeb-2021-0004>
- Kraft, E. and Huljak, I. 2018. How competitive is Croatia's Banking system? A Tale of two credit booms and two crises. Working Papers W-54, Croatian National Bank.

- Kraft, E., & Tirtiroglu, D. (1998). Bank efficiency in Croatia: A stochastic-frontier analysis. *Journal of Comparative Economics*, 26(2), 286–300.
- Kraft, E., Payne, J., & Hofler, R. (2006). Privatization, foreign bank entry, and bank efficiency in Croatia: A Fourier-flexible stochastic frontier analysis. *Applied Economics*, 38, 2075–2088.
- Kurtishi-Kastrati, S., Ramadani, V., Dana, L. P., & Ratten, V. (2016). Do foreign direct investments accelerate economic growth? The case of the Republic of Macedonia. *International Journal of Competitiveness*, 1(1), 71–98.
- Le, T. (2017). The efficiency effects of bank mergers: An analysis of case studies in Vietnam. *Risk Governance & Control: Financial Markets & Institutions*, 7(1), 61–70.
- Li, F., Liang, L., Li, Y., & Emrouznejad, A. (2018). An alternative approach to decompose the potential gains from mergers. *Journal of the Operational Research Society*, 69(11), 1793–1802. <https://doi.org/10.1080/01605682.2017.1409867>
- Luo, Y., Bi, G., & Liang, L. (2012). Input/output indicator selection for DEA efficiency evaluation: An empirical study of Chinese commercial banks. *Expert Systems with Applications*, 39(1), 1118–1123.
- Mandac, I. and Krišto, J. (2016). Impact of deleveraging on banking profitability. Proceedings of 8th International Conference “An Enterprise Odyssey: Saving the Sinking Ship Through Human Capital”, Ekonomski fakultet Sveučilišta u Zagrebu, Zagreb, p. 604–612.
- Micajkova, V., & Poposka, K. (2013). Efficiency of macedonian banks: A DEA approach. *Research Journal of Finance and Accounting*, 2013(4), 141–149. Available online: <https://www.iiste.org/Journals/index.php/RJFA/article/view/7769/7848>
- Milenković, N., Radovanov, B., Kalaš, B., & Horvat, A. M. (2022). External two stage DEA analysis of bank efficiency in West Balkan countries. *Sustainability*, 14(2), 978.
- Miszczynska, K., & Miszczynski, P. M. (2021). Measuring the efficiency of the healthcare sector in Poland—A window-DEA evaluation. *International Journal of Productivity and Performance Management*, 71(7), 2743–2770.
- Mokhtar, H. S. A., Abdullah, N., & Alhabshi, S. M. (2008). Efficiency and competition of Islamic banking in Malaysia. *Humanomics*, 24(1), 28–48.
- Mostafa, M. M. (2011). Modeling Islamic banks’ efficiency: A nonparametric frontier approach. *International Journal of Islamic and Middle Eastern Finance and Management*, 4(1), 7–29.
- Nazim, U. and Junaidah, A. S. (2018). Merger and acquisition in banking sector: a review of the literature. Munich Personal RePEc Archive. Available at: <https://mpra.ub.uni-muenchen.de/108575/>
- Neto, P., Brandão, A. and Cerqueira, A. (2010). The macroeconomic determinants of crossborder mergers and acquisitions and Greenfield investments. GEE Papers 0017, Gabinete de Estratégia e Estudos, Ministério da Economia.
- Nnadi, M. A., & Tanna, S. (2014). Post acquisition profitability of banks: A comparison of domestic and cross border acquisitions in the European Union. *Global Business and Economics Review*, 16(3), 310–331.
- Omankhanlen, A. E. (2012). The role of banks in capital formation and economic growth: The case of Nigeria. *Economy Transdisciplinary Cognition*, 15(1), 103–111.
- Osuma, G. O., Ikpefan, O. A., Olonade, O. Y., & Joshua, A. A. (2021). A systematic literature review on mergers and acquisitions: A bibliometric analysis approach. *International Journal of Financial Research*, 12(4), 125–134.
- OTP Banka 2018. OTP Banka website. Available at: <https://www.otpbanka.hr/uspjesno-provedena-integracija-otp-i-splitske-banke>
- Özsoy, V. S., & Pehlivanli, E. A. (2022). A window DEA based efficiency evaluation of the public airports in Turkey: 2014–2019 case. *Economic Computation and Economic Cybernetics Studies and Research*, 56(2), 195–210.
- Palalić, R., Hisrić, R. D., Dana, L. P., & Ramadani, V. (2022). Sustainability of global and international business operations during the adversity and hardship. *Heritage and Sustainable Development*, 4(1), 18–26.

- Paradi, J. C., Vela, S., & Yang, Z. (2004). Assessing bank and bank branch performance. In W. W. Cooper, L. M. Seiford, & J. Zhu (Eds.), *Handbook of data envelopment analysis* (pp. 349–400). Kluwer Academic.
- Pavković, A., Cesarec, A., & Stojanović, A. (2018). Profitability and efficiency of the Croatian banking sector: Impact of bank size. *International Journal of Trade and Global Markets*, 2018(11), 243–258.
- Pazarskis, M., Giovanis, N., Chatzigeorgiou, P., & Hatzikirou, H. (2022). Does company performance really improve following mergers? A pre-post analysis of differences in Greece. *Problems and Perspectives in Management*, 20(1), 543–553.
- Peşkani, P., Saen, R. F., Esmaili, F. S. S., & Gheidar-Kheljani, J. (2021). Window data envelopment analysis approach: A review and bibliometric analysis. *Expert Systems*, 38(2721), 1–25.
- Pisarović, A., Tišma, S., Dujmović, K. A., & Škrtić, M. M. (2021). The event of Croatia's EU accession and membership from the Croatian high school students' perspective. *Journal of Risk and Financial Management*, 14(1), 1–18.
- Rebić, M., Paunović, S., & Popović, B. (2022). Measuring concentration and efficiency in Bosnia and Herzegovina banking sector using dynamic panel model. *South East European Journal of Economics and Business*, 17(1), 14–29. <https://doi.org/10.2478/jeb-2022-0002>
- Reininger, T., & Walko, Z. (2004). The Croatian banking system. *Financial Stability Report*, 9, 110–126.
- Rezitis, A. N. (2008). Efficiency and productivity effects of bank mergers: Evidence from the Greek banking industry. *Economic Modeling*, 25(2), 236–254.
- Rodrigues, A. O., Marques, C. S., & Ramadani, V. (2024). Artisan entrepreneurship: Influence and network in the development of sustainable strategies in cross-border low-density territories through a quintuple helix paradigm. *Review of International Business and Strategy*, 34(1), 1–23.
- Ružić, T. (2006). *Kontrola koncentracija u hrvatskome bankarskom sustavu*. Hrvatska Narodna Banka.
- Santiso, J. (2008). Banking on development private financial actors and donors in developing countries. Policy Brief No. 34, OECD. <https://www.oecd.org/dev/40265826.pdf>
- Seebiz (2021). Croatia banka će biti privatizirana ili pripojena HPB-u. Available at: <https://www.seebiz.eu/banke/croatia-banka-ce-biti-privatizirana-ili-pripojena-hpb-u/266208/>
- Shamohammadi, M., Park, Y., Choi, J. H., & Kwon, O. K. (2022). Exploring the performance of international airports in the pre- and post-COVID-19 era: Evidence from Incheon International Airport. *Sustainability*, 14(4222), 1–22.
- Shi, H. L. and Wang, Y. M. (2020). A Merger and Acquisitions matching method that considers irrational behaviour from a performance perspective. IEEE Access. Digital Object Identifier.
- Sindi, S. M., Noordin, B. A., Hisyam, N., & Kamarudin, F. (2017). Assessing the effect of mergers and acquisitions on banks price efficiency, evidence from banking sectors in Middle East & North Africa (MENA) region. *International Journal of Economic Research*, 14, 1–17.
- Stojanović, A., Leko, V., & Krišto, J. (2016). Profitability of traditional banking in Croatia. *The Business Review Cambridge*, 24(1), 52–59.
- Sufian, F., Muhamad, J., Bany-Arifin, A. N., Yahya, M. H., & Kamarudin, F. (2012). Assessing the effect of mergers and acquisitions on revenue efficiency: Evidence from Malaysian banking sector. *Vision*, 16(1), 1–11.
- Sugiyanto, C., & Yolanda, Z. (2020). The effect of financial deepening on economic growth, inequality, and poverty: Evidence from 73 countries. *South East European Journal of Economics and Business*, 15(2), 15–27. <https://doi.org/10.2478/jeb-2020-0012>
- Tipurić, D., Kolaković, M., & Dumičić, K. (2003). Croatian banking industry concentration changes in 1993-2002. *Proceedings of the Faculty of Economics in Zagreb*, 1(1), 1–22.
- Tiwari, B. K. (2014). Effectiveness of banks after M & A. *American Journal of Industrial and Business Management*, 4, 1–8. <https://doi.org/10.4236/ajibm.2014.41001>
- Tomičić, I., Čorić, A., & Klačmer Čalopa, M. (2012). Croatian banking sector research: Relationship between ownership structure, concentration, owners' type and bank performance. *Journal of Information and Organizational Sciences*, 36(2), 159–167.

- Toumi, H., Fakhri, I., Bilel, A., Wassim, T., & Faouzi, H. (2016). Dynamic effects of mergers and acquisitions on the bank performance of commercial European banks. *Journal of Knowledge Economy*, 9, 1032–1048.
- Učkar, D., & Petrović, D. (2021). Efficiency of banks in Croatia. *Zbornik radova Ekonomskog fakulteta u Rijeci*, 39(2), 349–379. <https://doi.org/10.18045/zbefri.2021.2.349>
- Ullah, N. and Seman, J. A. (2018). Mergers and acquisitions in banking sector: A review of the literature. MPRA, Munich Personal RePEc Archive.
- Vankova, I., & Vrabkova, I. (2022). Productivity analysis of regional-level hospital care in The Czech Republic and Slovak Republic. *BMC Health Services Research*, 22(180), 1–14.
- Vennet, V. R. (1996). The effect of mergers and acquisitions on the efficiency and profitability of EC credit institutions. *Journal of Banking and Finance*, 20(9), 1531–1558.
- Vincova, K. (2005). Using DEA Models to measure efficiency. BIATEC 8(8). National Bank of Slovakia.
- Visković, J., Kordić, L., & Miletić, M. (2022). Banking sector race to efficiency during the COVID-19 pandemic crisis in Croatia: Does the size matter? *International Journal of Business and Economic Sciences Applied Research*, 15(2), 16–24. <https://doi.org/10.25103/ijbesar.152.02>
- Wadhwa, K., & Syamala, S. R. (2015). An empirical examination of efficiency theory of mergers in emerging market India. *Theoretical Economics Letters*, 5(6), 757–774.
- Wanke, P., Barros, C. P., Azad, M. A. K., & Constantino, D. (2016). The development of the Mozambican banking sector and strategic fit of mergers and acquisitions: A two-stage DEA approach. *African Development Review*, 28(4), 444–461.

Katerina Fotova Čiković, PhD is an Assistant Professor at University North in Croatia. She obtained her Master's degree in Monetary Economics, Banking and Finance. She received her MBA degree at the Cotrugli Business School in Zagreb and has been rewarded the Dean's award for outstanding recognition as the best student in her generation (among 60 students from 7 countries). She received her PhD from University Ss. Cyril and Methodius in Skopje, North Macedonia in 2017. Her specialisations and areas of scientific interest are finance, banking, and mathematical programming (DEA).

Mila Mitreva, Phd is a Teaching Assistant in the Finance Department at the Faculty of Economics, University Goce Delcev-Shtip, Republic of North Macedonia. She holds a Bachelor's degree in Accounting & Finance and a Master's degree in Banking & Finance from the University of Sheffield. Additionally, she earned an MBA from University Goce Delcev and a PhD from Ss. Cyril and Methodius University of Skopje. She is an assistant in a diverse range of courses, including Principles of Finance, Accounting of Financial Institutions, Public Finance, Macroeconomics and Financial Management. Her areas of scientific interest include finance, financial institutions and markets, institutional investors and business statistics. In addition to her academic responsibilities, she is an active contributor to the academic community, serving as a member of editorial board and publishing council for various journals, conferences, and events. She has authored and co-authored numerous research papers published in international journals and conference proceedings. Furthermore, she actively participates in conferences, workshops, and collaborative research projects.

Damira Keček was born in 1981 in Čakovec, Republic of Croatia. In 2007 she graduated from the Faculty of Science in Zagreb, in the Department of Mathematics, programme Financial and Business Mathematics. In 2018 she defended her doctoral dissertation at the University North within International Joint Cross-Border PhD Programme in International Economic Relations and Management, Eisenstadt, Austria. Currently she works as an assistant professor at the University North in Varaždin, Republic of Croatia. Interests: Input-output analysis; Energy economics, Operational research; Information and Communication Technology.