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THE EFFECTS OF FINANCIAL RISK MANAGEMENT PRACTICES ON FINANCIAL PERFORMANCE OF RURAL BANKS IN GHANA: A CASE OF AKUAPEM RURAL BANK

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Abstract
The collapse and extensive financial loss in the Ghanaian banking sector have become a major concern to industry players in recent times. The primary aim of this study was to examine the effects of financial risk management practices on financial performance of banks in Ghana. Descriptive and Inferential statistics in the form multiple linear regressions is employed to analyze this relationship. It was realized that banks are exposed in a dominant order of prevalence to liquidity, market, credit, and operational risks. The study finds risk management practices to be positively related to financial performance. Endogeneity among risk variables was also established. Banks are encouraged to view and consider banking regulations, policies, procedures and guidelines from regulators as a comprehensive risk management practice instead of just seeking to meet the regulatory requirements or creating risk awareness and risk management culture among all employees of the bank. They should review their risk appetite level and try other risk mitigation strategies that aim to optimize risk-return trade-off to improve on its profitability.

Keywords
Financial Performance, Risk Management, Financial Risks, Rural Banks.

JEL classification
G21, G32, L25

1 Introduction

The banking industry in Ghana is generally lucrative and developing very fast. Looking beyond the mere surface, nonetheless, makes the story somehow different and complicated. Risks exposures in the industry are escalating treacherously and security structures are becoming more vulnerable to breaches. This calls into question the strength of the internal control structures, risk management structures as well as the sustainability of the present business model into the near future. Bessis (2002) argues that, banks are profit-making institutions who primarily act as intermediaries between borrowers and lenders drawing temporarily available resources from individuals and companies with excess funds and extending these funds to individuals and institutions who immediately need these funds for business and/or personal usage. From this angle, banks deal with funds belonging to people and other institutions and they (banks) assume several financial risks as they perform these intermediation activities.

Financial Risk Management is a serious subject matter in this modern dynamic economic setting. Basically, financial risk management deals how to identify financial risks in an institution, how to control these identified risks and with the aim of adding utmost maintainable value to all business undertakings. The Institute of Risk Management defines risk management as the process whereby institutions meticulously address the uncertainties related to their undertakings with the aim of attaining continuous benefit in every activity (CIMA, 2008).

Nielson et al. (2005), argues about the evolution of risk management in three generations with the first being specifically about risks identified within a company, while the second generation is

expanded to have third-party liability claims and the third generation further expanded to involve board and senior management in risk management communication. Thus, a few years ago, risk managers and analyst were perceived as individuals who do not have desire to inhibit the progress of institutions as they carried out their responsibilities. However, this perception is gradually changing as people and institutions begin to understand the implication of unmanaged risk. Financial Institutions are now strengthening their risk units, developing new and effective risk management frameworks, setting up new governance structures, implementing risk related policies, providing more resources to risk departments and as well assigning more responsibilities to the risk management units within their organizations.

Nonetheless, according to Fall-Guys (2010), Risk management remains in its infancy stage despite its improvement. They noted that, even though senior management recognizes the importance of risk management, it does not reflect in practice. Banking institutions assume several types of financial risk every day as they conduct their banking business with the aim of realizing returns on shareholders' investments. Even though these assumed financial risks have the potential to wipe out projected returns and even collapse of the entire institutions, they also do have significant positive influence on financial performance when properly managed.

Most banks and financial Institutions in Ghana are bleeding and struggling to maintain operations. This claim is evidenced by the numerous bankruptcies, closures and the recent revoke of licenses of several banks, savings and loan and numerous Microfinance Institutions by the central Bank (Bank of Ghana (2018, 2017, 2015), Boakye (2016)). Although statistics on failed financial institutions, especially microfinance institutions are rare to come by, it is clear, following the demise of several too-big-to-fail banks and non-bank financial institutions such as UT Bank, Capital Bank, The Beige Bank, 'DKM', 'God is Love', etc. that the entire industry is floundering, calling into question the strength of the financial risk-management and internal control practices put in place by financial institutions in Ghana.

The current situation of the banking industry in Ghana have led to several questions like; what type of risks are banks exposed to in Ghana? What risk management practices are employed by these banks? and what are the effects of risk management practices on the financial performance of these banks? Having identified this major research gap, this study seeks to firstly, identify the types of risks banks are exposed to. Secondly, identify the risk management practices employed by banks to mitigate these risks and finally examine the effects of financial risk management practices on financial performance of banks in Ghana. The rest of the paper is as follows. Section two which deals with a survey of literature theoretical and conceptual backgrounds of risk management practices and financial performance. Section three touches on the methodologies used in achieving set objectives of the study. Section four reveals the results of the study that are further discussed in section five. Finally, the study concludes in section six of this paper.

2 Theoretical Background/ Literature Review

2.1 Forms of Risks Facing Rural Banks

Risk has been an area of interest to lots of firms especially in the financial sector since the 1960's and till date still play a major role in determining the Financial Performance of firms as revealed by many studies. During which the two types of banks, commercial banks and investment banks focused on deposits, and loans and securities respectively in the United States of America but most banks in Europe were into both commercial and investment banking (Malz, 2011). More focus was drawn toward Risk management in the 1990 but became a major discipline in 2007 during the financial market crises. Risk is understood from different perspective in the financial industry leading to mixed definitions. According to Roth and Schmit (1990), "risk-management is the achievement of diverse actions framed to lessen the adverse-effect of uncertainty with regards to probable losses. The Institute of Risk Management (2002) also defines risk management as "the process whereby

organizations systematically address the risks attaching to their activities with the goal of achieving sustained benefit within each activity and across the portfolio of all activities". Ray & Ayam (2015) empirically identifies credit risk, liquidity risk, operational risk, and legal /regulatory risk as the major forms of risk faced by rural and community banks in Ghana. They find the level of risk management practices in rural as ineffective and weak.

Studies on financial risk management practices is mostly concentrated on credit risk. This is because Credit risk is considered as the oldest risk among all the financial risks and it still has serious adverse impacts on performance of banks. For instance, it has actually brought about the collapse of many big banks and companies including the two famous German banks known as Schmidt Bank and Delbruck and co because they failed to manage their credit risk (Karaviti, 2019). Thus, credit risk poses greater financial loss to financial firms that can lead to bankruptcy.

Liquidity risk cannot be neglected as a bank's failure to obtain the needed funds at the reasonable time period can put the institution at serious risk, as vividly displayed by the recent demise of some financial institutions in Ghana. For this reason, the Basel Committee on Banking Supervision lately extended its guidelines on sound practices to liquidity risk management (Lopez, 2003). According to Goodhart (2008), the term liquidity is to some extent ambiguous because of many features and definitions and hence to use it requires further clarity productively and purposely in its definitions. According to Cornett and Saunders (2008), liquidity risk in banking can be defined as the sudden rise in cash withdrawals by bank's depositors that may lead the bank to liquidate its assets in the shortest time. Nikolaou (2009) posits that, liquidity in the financial industry can be classified as central bank liquidity, market liquidity and funding liquidity.

Market risk is generally caused by changes in prices of financial instruments in the market. It is usually associated with the economic environment in which all institutions in the industry operate. This includes changes in interest rates, exchange rates, equity price risk and commodity prices. Market risk can be put into the following sub-categories; interest rate risk, equity price risk, exchange rate risk, commodity price risk (Spacey, 2015).

Operational risk generally emanates from operational failures and procedures in a business. It covers the entire scope of the transaction cycle from dealing to custody. Operational risk basically arises from system deficiencies, authorizations of transactions, delegation of powers within the company and work and document flows. Thus, the main causes of operational risks include failure to comply with laid-down operational as well as failed technical systems (Gambrah and Adjimah, 2011). The key elements of operational risks can therefore be summarized as internal processes, people (workers), systems (including IT), external events and legal risks.

The effects of these types of risks on the performance of financial institutions are mostly negative. For instance, Gadzo et al. (2019) finds credit and operational risks to negatively influence the financial performance of 24 universal banks in Ghana using PLS-SEM. This calls for studies into risk management practices and their effects on firm performance. Alshatti (2015), measures the effects of credit risk management practices on the financial performance of Jordanian banks using credit risk indicators and finds significant effect. Wani and Dar (2015), also identifies management risk, solvency risk, liquidity risk, volume of capital and size of company as eminent indicators of financial performance of insurance firms in India.

Akomeah and Agumeh (2020) argues that, there a significant relationship between credit risk management (Non-Performing Loans, Capital Adequacy Ratio and Bank Size) and the profitability of the 7 selected banks in Ghana over a ten-year period (2007-2016). However, they suggest more risk management variables be considered in future research to substantiate their findings. Adedapo and Ashogbon (2014), finds non-performing loans, liquidity, operating cost, and capital adequacy risk management practices to account significantly for the variation in the financial performance of Nigerian Deposit Money Banks. Others like Apanga, et al. (2016) posit that, even though the credit risk management practices of banks in Ghana are sound, board of directors of these banks have not played a good role in defining the acceptable types of loans and maximum maturities.

Current research trends reveal a relationship between risk management practices and financial performance, even for non-financial institutions (Gatsi, et al., 2013, Muriithi, et al. (2016), Kassi, et al. (2019)). Ofosu-hene and Amoh (2016) finds a positive relationship between risk management and bank performance when Return-on-Equity is used as a proxy for measuring performance using secondary data from banks listed on the Ghana Stock Exchange (GSE) between the periods of 2007 and 2014. However, other researchers like (Kinyua, et al. (2015); Wadesango, et al. (2016)) argues otherwise that, there is no correlation between risk management and financial performance. Critical analysis of literature reveals that, a number of studies have been conducted on risk management practices over the world; however, most of these studies were either conducted in developed countries or focused on one particular type of financial risk such as credit risk management, liquidity risk management, or operational risk management. However, few studies have been done on the complete financial risk management in Ghana. The study will be one of the first to consider more variables of risk management practice on financial performance.

2.2 Financial Performance

Financial performance is about the measuring of the efficiency of the policy and operations of the bank in in monetary terms. Financial performance indicates the generally financial strength of a firm over a period. It makes it possible to compare different companies of belonging to the same industry at the same time (Wanjohi, et al., 2017). Suka (2010) described financial performance as the general measure of how well an institution can generate revenues using its capital and other available resources. Suka viewed financial performance as a subjective measure of how an entity effectively and efficiently utilizes its assets to generate revenue. However, measuring financial performance in recent times may differ with respect to the various risks facing the financial industry. Eastburn and Sharland (2017) makes this argument by defining financial performance as "*a direct measure of management's past risk decision capabilities*". In this study, financial performance (dependent variable) is measured by Profitability, Liquidity and Solvency.

Profitability of organisations is best measured using profitability ratios as they illustrate how well a firm utilizes its assets and other resources to generate profit to maximise shareholders value. According to Dar and Dar (2017), profitability makes it possible to measure the degree to which the bank creates profit from the factors of production such as labor management and capital. Some suitable ratios generally used to measure profitability are return on assets (ROA), return on equity (ROE), operating profit margin and return on investment (ROI). Return of assets (ROA) is used to assess the relationship between profited and assets over a period. It is mathematically expressed as the ratio of net income to total assets. Return on equity is used to assess the relationship between profit and shareholders' equity. Sekirin (2019) noted that from the investor's point of view; return on equity is seen as a profitability ratio but not from the farm's viewpoint. Mathematically, return on equity is expressed as the ratio of net income to average stockholders' equity. Olalekan, et al. (2018) posits that, a favourably high return on equity ratio is mostly cited as a reason to purchase a firms' stock or shares. Return on Investment ratio basically measures the relationship between return earned on investment and the cost of the investment. Return on investment (ROI) is mathematically expressed as the ratio of interest on investment to cost of investment.

Availability of cash to cater for present and near future financial obligations is very essential for the sustainability of every business entity, most importantly, banking institutions. Banking institutions need continuous flow of cash to be able to meet financial obligations as well as meet future investment needs. This ability of an institution to make cash available or to convert assets into cash without incurring any unacceptable cost, in order to meet its financial obligations without obstructing normal business operations is known as liquidity (Saleem and Rehman, 2011). Liquidity is generally measured using liquidity ratios which examine the relationship between assets and liabilities or using liquidity gap analysis.

This is vital measure of financial performance. Solvency measures the value of debt capital and other expenses obligations used by the bank with respect to shareholders equity. Solvency shows an institution current and long-term financial health and stability. Solvency ratios give the indication as to whether the bank has the ability to pay all its liabilities when total assets are liquidated as well as the ability of the firm to remain in normal business following a financial adversity (Zorn, et al., 2018). Common ratios used to measure solvency of a firm include the ratio loans to asses, expressed as total loans portfolio/ total bank deposits, equity to asset ratio, debt to asset ratio, debt to equity ratio, capital adequacy ratio and interest coverage ratio.

2.3 Risk Management Practices Adopted by Banks

Financial risk management is about putting in place measures to get a better grip on the opportunities, understanding the sources and potential causes of failure and how to manage them with the aim of minimizing or at least mitigating the adverse effects when risk do occur. According to Rejda (2003), financial institutions particularly banks need to employ several techniques in managing financial risks. Adopting a particular risk mitigation strategy however involves weighing the potential expected benefits or return when objectives are met against the costs, effort, or disadvantages of implementation (National Bank of Ethiopia, 2010). The basic risk mitigation strategies commonly used to control or treat significant risk in order to eliminate or minimize the adverse effects on the bank include risk avoidance, risk transfer, risk sharing, risk retention, risk diversification and hedging (University of the Sunshine Coast, 2018).

Internal controls play a major role in the management of financial risks of every banking sector all over the world. Specifically, internal control system aims to support management in its tasks to ensure that there is; appropriate governance processes, improved efficiency and effectiveness of the operations, minimum risk of asset losses, reliable financial information, compliance to laws, regulations and contracts, improved information security, prevention of misconduct and that ethical issues are well managed. Coleman (2011) is of the view that the underlying foundations for thinking about, discussing, and measuring risk can and should be consistent throughout the all the different departments and units in all level of the bank.

Governments continue to pursue policies that provide appropriate measures to minimize financial system instability and deal with emerging risks using regulatory mechanisms. Act 930 of the Bank and Specialized Deposit-Taking Institutions Act 2016 is currently the main decree governing the banking industry in Ghana. The Act 930 gives Bank of Ghana the power to formulate corporate directives and rules for banks and as well punish banks for non-compliance of these rules. Banks are also compelled to make sure certain key departments such as risk department, compliance and internal audit are in place and filled by qualified people (Tawiah, 2019). Compliance to the Basel Accord by banks is also a form of risk management practices for such banks. Currently, there are three Basel Accords, which include Basel I, Basel II and Basel III. In terms of risk management, Basel III Accord focused on how to manage market risk, credit risk, operational risk as well as liquidity risk in bank (Bank for International Settlements, 2011).

Liquidity gap or mismatch analysis is a tool generally employed to measure the sensitivity of an exposure, asset or portfolio to market rate or price changes by considering the mismatch between assets and liabilities. Gap analysis is traditionally undertaken by bank and other financial institutions to manage balance of assets to liabilities. When there is a mismatch between assets and liabilities or cash inflows and cash outflows, there is exposure and an opportunity for loss (Makesh and Megha, 2009). Financial Risk Management Practices (Independent Variable) in this study are represented by risk mitigation strategies, adequate internal control systems, risk management environment, banking regulation, policies and guidelines, and liquidity gap analysis.

2.4 Research Questions and Hypothesis

After careful analysis of literature, the study asks the following questions that have not been adequately been answered by past studies.

i. What types of financial risks are banks in Ghana exposed to?
ii. What types of financial risk management practices are put in place to control and manage these risks?
iii. What are the effects of financial risk management practices on financial performance of banks in Ghana?

With these questions, we then sought to identify the different types of financial risks banks are exposed to and the forms of financial risk management practices that are adopted by these banks to mitigate the risks they face.

We further hypothesize below with regards to the effects of the adopted risk management practices on the financial performance of banks.

H_1: Adoption of risk management practices positively affects financial performance of banks

2.5 Theoretical Review

A theory is a contemplative and rational type of abstract or generalizing thinking, or the results of such thinking. It is a coherent group of tested general propositions, commonly regarded as correct, that can be used as principles of explanation and prediction for a class of phenomena (Kombo and Tromp, 2009). According to Trochim (2006), a theoretical framework guides research, determining what variables to measure, and what statistical relationships to look for in the context of the problems under study. On this note, the study anchors its variables on two famous theories namely, financial distress theory and shiftability theory. According to Baldwin and Scott (1983) if a business entity deteriorates to a level where it cannot settle its financial obligation, then the entity is said to have entered the state of financial distress. Whitaker (1999) is of the view that entry level of financial distress is the first year in which cash flows are less than current maturities of long-term debt. Wruck (1990) pointed out that business entities enter financial distress because of economic distress, deteriorations in their financial performance and poor management especially on poor risks management. Boritz (1991) describes a process of a financial distress that originates with an incubation period characterized by a set of poor economic conditions and poor management which commits costly errors.

The shiftability theory of liquidity was originally formulated by "Harold G, Molton in 1915". This theory states that, banking institutions can successfully protect themselves against enormous deposit withdrawals by holding credit instruments for which there exist ready secondary markets as a form of liquidity reserve. It was founded on the premises that banks can maintain adequate liquidity when they hold liquid assets that can easily be shifted or sold to other lenders or investors for readily available cash. Ngwu (2006) was of the view that such assets can be shifted to the Central Bank for cash without any significant loss in value when the need arises rather than relying on maturities to solve liquidity challenges.

The theory recognizes shiftability of a bank's assets as a basis for ensuring continuous liquidity and argues that holding highly marketable securities by a bank is an excellent source of liquidity and a good liquidity risk management strategy. Dodds (1982) pointed out that, liquidity management theory comprises of activities that can lead to obtain funds from depositors and other creditors and as well determine the appropriate funding mix for the bank. He noted that the liquidity theory has critically been reviewed by a number of researchers, and the general agreement is that during the period of distress, a bank may find it difficult to obtain the desired liquidity because of loss of confidence in the market, particularly in the bank in questioned. However, according Muriithi (2016), the liabilities of a healthy bank or company should rather constitute an important source of liquidity for the business. The liquidity shiftability theory provides for explicit understanding of how the

liquidity risk affects financial performance using liquidity coverage and net stable funding ratios as stated by the Basel III framework.

2.6 Conceptual Framework

Considering the literature review above, the following conceptual framework as shown in the Figure 1 was developed for the study.

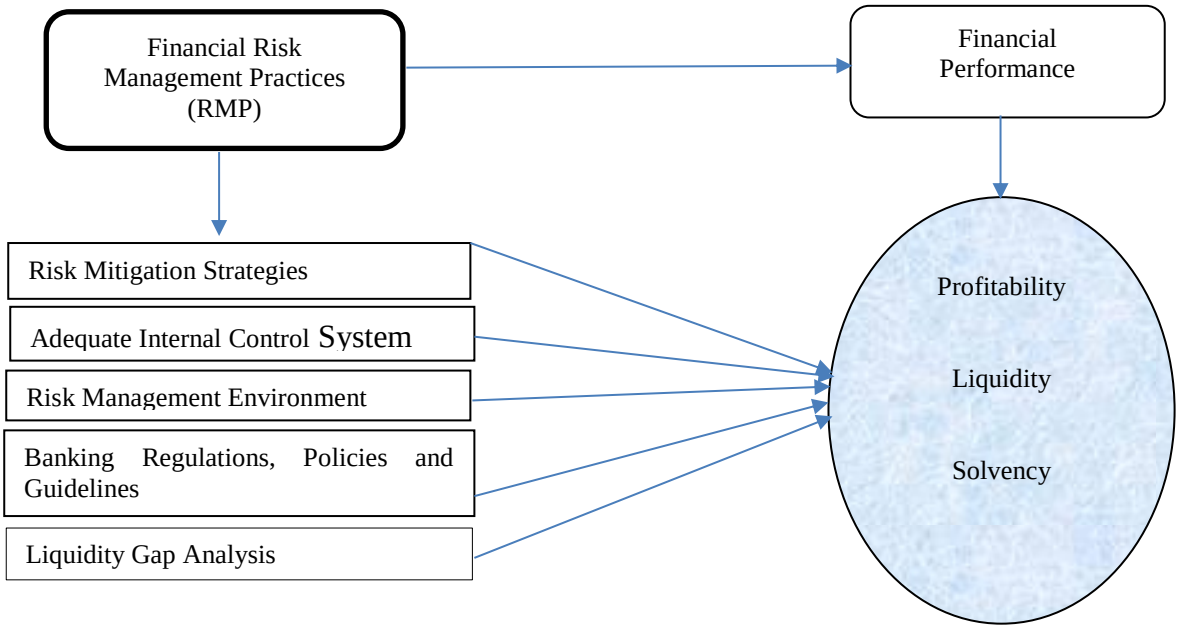

Fig. 1. Conceptual Framework (Source: Bagh, et al., 2017)

3 Methodology

3.1 Data Collection

This study adopted the descriptive case study approach of research as it allows the researcher to define the prevailing association by using observation and interpretation methods. It provides the researcher with the appropriate methodology to illustrate characteristics of the variables under study. Again, the study opted for case study research designs because of its numerous advantages such as its flexibility, making it applicable to answer different forms of research questions and in diverse research settings, and makes the research accessible to wider readership than some other designs (Eisenhardt and Graebner, 2007). Akuapem Rural Bank Ltd was selected as the study area due to proximity and convenience for data collection.

Data from the Human Resource department of shows a staff size of one hundred and twenty-nine (129) which comprises of one hundred and seventeen (117) permanent staffs and twelve (12) contract staffs. Primary data was collected from employees and management of Akuapem Rural Bank Ltd, through the use of questionnaires and interviews whilst secondary data was gathered through books, journals, reports, banking policy documents, banks' financial statements and other related published materials. For effective analysis, questionnaires were made up of open questions and closed questions.

Interview was used to seek further clarifications on some of the responses offered by respondents and on certain items found in the bank's policy document relating to risk management. The study employed the simple random as well as quota, purposive and convenience sampling techniques sampling techniques in gathering primary data from study area. According to Lewis, Saunders, and Thornhill (2009), except quota sampling method, the issue of sampling size is ambiguous when using all non-probability sampling techniques; there are no rules, unlike probability sampling.

The study uses a sample size of 70 (59.8%) out of the total permanent workforce of one hundred and seventeen (117) at the study area with the aim to get respondents from management and staffs whose normal daily activities are related to credit, banking operations, customer service, finance, treasury management, and most importantly risk management.

3.2 Methods of Analysis

The raw data gathered through research questionnaires was first presented, edited, and then coded for the purposes of data analysis. This was done to ensure quality, completeness, and accuracy in data processing. Coding of the data was done with the help of Microsoft excel and Statistical Program for Social Sciences (SPSS). It was then summarized and presented using descriptive statistics in the form of frequency distribution tables and models for easy interpretation.

Descriptive analysis was used in answering research questions 1 and 2 while inferential statistics in the form multiple linear regressions was used to analysis research question 3. The study employed the use of multiple linear regressions to determine the relationships between financial risk management practices adopted by the bank and financial performance of the bank. The model can mathematically be expressed as follows:

Where,

$$F\ PERF = \beta 0 + \beta\ 1X1 + \beta\ 2X2 + \beta\ 3\ X3 + \beta\ 4X4 + \beta\ 5\ X5 + \varepsilon t \ldots\ldots (1)$$

Financial-Performance (dependent variable) is measured by Profitability, Liquidity and Solvency and is represented by F_PERF. X1, X2, X3, X4 and X5 are the independent variables representing Risk Mitigation Strategies, Adequate Internal Control Systems, Risk Management Environment, Banking Regulations, Policies and Guidelines and Liquidity Gap Analysis financial risk management practices, respectively. Also, β0 is the constant of regression while β1, β 2, β 3, β 4, and β 5are coefficients independent regression variables, X1, X2, X3, X4 and X5 and finally εt being the error term of the regression.

4 Results

We begin by the demographics of respondents as follows. Table 4 shows that, out a total of seventy (70) staff sampled at the study, 67.1% were men and 32.9% were female. It is observed that, 60% of total respondents belonged to the 30-39 age-bracket followed by 22.9% in the 20-29 age-bracket. These were followed by the age brackets 40 – 49 years and 50 – 59 years representing 11.4% and 5.7% of total responses received, respectively. Deductions indicate that, the study area has a high level of education as all respondents were found to have a minimum level of tertiary education where 61.4% had Bachelors' Degree or its equivalence. This is followed by 24.3% who had a Diploma/HND while 14.3% were postgraduate/masters' degree as their highest level of education. Majority of respondents (44.3%) had 5-9 years banking experience but 30% has less than 5 years banking experience. Again, 15.7% have been in banking for the past 10 – 14 years. The rest are 5.7%, 2.9% and 1.4% for respondents who have been in the banking profession for 15 – 19 years, 25 – 30 years and 20 – 24 years, respectively. In an attempt to assess the level to which working activities of respondents expose the bank to financial risks, 37.1% indicated that they belong to the microfinance department, 31% belong to the operations department and 11.4% said they belong to the credit department of the bank. Details of the responses received are shown in the appendix of this paper.

Banks can only develop and put in place effectives measures to manage financial risk when they are aware of the types of financial risk they are most likely exposed to. To achieve this outcome, a Likert scale of 1-5, where 1= Strongly agree, 2= agree, 3= Not sure, 4= Disagree and 5 =Strongly disagree is used. Lower scale (less than 3.00) is an indication that respondents agreed with the statements and higher scale (Greater than 3) gives the indication that respondents were not in

agreement with the statements. This attempt in answering question revealed that, liquidity risks, market risks, credit risks and operational risks had means of 2.94, 2.86, 2.80 and 2.31, respectively.

In answering the second question of what types of risk management practices banks adopted the study presents the following results. Lower mean indicates that respondents agreed with the statements and vice versa. As indicated in the Table 13 in appendix, compliance to banking regulations, policies and Guidelines was found to be the most important risk management practice with majority of the respondents representing 87.1% and mean of 2.0286. The second major risk management practice identified 52.9% of the respondents agreeing to "creating of conducive risk management environment with mean of 2.4714. About 41.4% of the total responses sided with the use of adequate internal control systems with mean of 2.6857. Another group (18.6%) revealed that the bank uses liquidity gap analysis as a major risk management practice with a mean of 2.8857. A minority of the respondents representing 7.1% agree to the statements related with risk mitigation with the highest overall mean of 3.1571.

To measure the effects of financial risk management practices on financial performance a multiple regression analysis was employed. An R-square of 0.436 was obtained after a regression model as indicated in Table 1 and model significance was established with F calculated is 9.912 and F critical from F distribution table shows that F (5%, 5, 64) is 2.36 in Table 2.

Table 1. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.661[a]	.436	.392	3.55181

a. Predictors: (Constant), Liquidity Gap Analysis, Risk Mitigation Strategies , Adequate Internal Controls Systems , Banking Regulations, Policies and Guidelines , Risk Management Environment

Source: authors (2019).

Table 2. ANOVA [b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	625.187	5	125.037	9.912	.000 [a]
	Residual	807.384	64	12.615		
	Total	1432.571	69			

Source: authors (2019).

Table 3. Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	17.115	3.771		4.538	.000
	Risk Mitigation Strategies	-.046	.129	-.034	-.354	.725
	Adequate Internal Controls Systems	.129	.120	.105	1.074	.287
	Risk Management Environment	.003	.186	.003	.018	.986
	Banking Regulations, Policies and Guidelines	.504	.106	.608	4.739	.000
	Liquidity Gap Analysis	.038	.173	.025	.217	.829

Source: authors (2019).

Considering the coefficients in Table 3, the regression equation can be obtained as

$$F\_PERF = 17.115 - 0.046X_1 + 0.129X_2 + 0.003X_3 + 0.504X_4 + 0.038X_5 \quad \ldots \quad (2)$$

5 Discussion

In an attempt to examine the effects of financial risk management practices on financial performance of banks in Ghana, the study discovered the main forms of financial risk banks in Ghana are confronted with, identified the risk management practices adopted by banks in Ghana and also analysed the relationship between the adopted financial risk management practices and financial performance at the study area. The study area is dominated by youthful population, with good level of education and considerably good level of working experience. Banks were exposed to four main forms of financial risk. Operational risk was found to be the most dominant financial risk followed by credit risk, market risk and the least being liquidity risk. Endogeneity of independent variables was ascertained.

Majority of respondents were of the view that, banks are exposed to, business destruction and system failures. Others also claimed, majority of the bank's income goes into operational expenses. These respondents indicated that some loan customers fail to meet repayment obligations due to deterioration in business and/or financial conditions, some also willingly refuse or fail to honour repayment obligations resulting in default of loans/advances, some credit staffs lack the required skills to properly appraised and process credit applications, leading to adverse selection of loan applications. Others revealed that, sudden economic changes, environmental changes, and even natural disasters also exposes the bank to a lot of credit risk. Table 10 below shows details of the responses received.

The study found that banks followed compliant regulations, policies and procedures to the latter knowing the benefits they stand to gain and that enables them to manage its liquidity risk, its credit

risk and its operational issues unconsciously. Respondents acknowledged the presence of system to educate and train all employees of risk related issues in the bank. It was identified that banks had a solid internal audit department coupled with an effective compliance department which together ensures that the banking operations are carried out in the predetermined manner and have enabled the bank to reduce operational errors, data capturing errors, employee misconduct, etc. to very minimal level. This is consistent with Muhunyo and Jagongo (2018) who noted that internal controls build firms' confidence and their ability to perform specific tasks, prevents errors and losses as well as ensure compliance with relevant laws and regulations.

The study revealed that, through liquidity gap analysis, the bank has been able to manage its liquidity risk effectively and has always met liability obligations without much difficulty. Risk mitigation practice was highly disagreed upon by respondents. This could be attributed to the fact that the bank is a risk-averse bank with very low risk appetite. Responses received indicate that, the main risk mitigation strategy adopted by the bank is risk avoidance. Also, the bank adopted risk reduction, risk transfer, risk sharing and then risk retention risk mitigation strategy. It was discovered that, through insurance, the bank can transfer and share most of its risks related to credit and advances, investments, and other operations.

R square in the table 1 indicates that, 43.6% variations in financial performance can be accounted for by changes in the five financial risk management practices adopted by the bank at 95% confidence interval. Thus, other factors which are beyond the scope this study accounts for the changes in remaining 56.4% of the financial performance. There exists a strong positive relationship between financial performance and financial risk management practices adopted by the bank with R of 0.661 and the regression model is reliable for prediction. The regression model above indicates that, holding all the risk management practices constant, the financial performance of the bank would be at the level 17.115. A unit improvement in risk mitigation strategies, risk management environment, compliance of banking regulation, policies and guidelines and liquidity gap analysis adopted by the bank, holding other risk management practices constant at a time, would lead to an increase in financial performance by a factor of 0.129, 0.003, 0.504, and 0.038 respectively. Again, it was also realized that all the risk management practices adopted by the bank are positively related to financial performance of the bank except risk mitigation practices which has an inverse relationship with financial performance.

Avoiding risks or eliminating them usually leads to abandoning certain projects and/or transactions associated with high risk, hence losing the corresponding high returns. Transferring risk to third parties comes with transferring part if not all, of the reward associated with the project/transaction to that third party. Both scenarios could lead to decrease in financial performance as explained by the variable risk mitigation in the model above. This finding confirms the statement by Asl, et al. (2008) that, the profitability in banking to some extent is dependent on the ability of the bank to assume and manage financial risks.

6 Conclusion

The following conclusions were made in line with-the key finding above. The study concludes that banks in Ghana are generally confronted with to four major forms of financial risk (operational risk, credit risk, market risk and liquidity risk) which are interrelated with operational risk being dominant followed by credit risk, market risk and liquidity risk. These different types of financial risk were found to have direct or indirect impacts on liquidity of the bank. Risk management practices adopted by banks such as Adequate Internal Control Systems, Risk Management Environment, Banking Regulation, Policies, Procedures and guidelines and Liquidity Gap Analysis are positively related to financial performance of the bank except risk mitigation strategies which is negatively related to financial performance of the bank. This can be attributed to the fact that most of the risk mitigation strategies adopted by the study area were aimed at avoiding all forms of financial risks or eliminating all forms of financial risks or minimizing all forms of financial risks to the lowest minimum rather

than minimizing the adverse effect of financial risks and ultimately optimizing risk-return trade-off in the bank.

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Appendix

Table 4.1: Sex/Gender of Respondents

		Table 4.	Percent	Valid Percent	Cumulative Percent
Valid	Female	23	32.9	32.9	32.9
	Male	47	67.1	67.1	100.0
	Total	70	100.0	100.0	

Source: authors (2019).

T able 4.2: Age Brackets of Res-pondents

		Table 5.	Per cent	Valid-Per cent	Cumulative Per-cent
Va-lid	20-30 years	16	22.9	22.9	22.9
	30-39 years	42	60.0	60.0	82.9
	40-49 years	8	11.4	11.4	94.3
	50-59 years	4	5.7	5.7	100.0
	To tal	7 0	1 0 0.0	1 0 0.0	

Source: authors (2019).

Table 6. Level of Education

		Freq uency	Per cent	Va lid Per cent	Cumulative Per cent
Val id	HND/Diploma	17	24.3	24.3	24.3
	First Degree	43	61.4	61.4	85.7
	Masters' Degree	10	14.3	14.3	100.0
	To tal	70	1 0 0.0	100.0	

Source: authors (2019).

Table 7. Yea rs of Ser vice in Banking

		Fre quency	Per cent	Val id Per cent	Cumulative Percent
Valid	Less-than-5-years	21	30.0	30.0	30.0
	5 – 9 years	31	44.3	44.3	74.3
	10 – 14 years	11	15.7	15.7	90.0
	15 – 19 years	4	5.7	5.7	95.7
	20 – 24 years	1	1.4	1.4	97.1
	25 – 30 years	2	2.9	2.9	100.0
	To tal	**7 0**	**1 0 0.0**	**1 0 0.0**	

Source: authors (2019).

Table 8. Department of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Credit department	8	11.4	11.4	11.4
	Operations department	22	31.4	31.4	42.9
	Customer service department	6	8.6	8.6	51.4
	Microfinance department	26	37.1	37.1	88.6
	Finance department	3	4.3	4.3	92.9
	Management unit	2	2.9	2.9	95.7
	Others	3	4.3	4.3	100.0
	Total	70	100.0	100.0	

Source: authors (2019).

Table 9. Types of Financial Risks

Descriptive Statistics

Types of Financial Risk	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Credit Risk	70	2.00	4.00	196.00	2.8000	.67244
Operational Risk	70	1.00	3.00	162.00	2.3143	.57843
Market Risk	70	1.00	5.00	200.00	2.8571	.59675
Liquidity Risk	70	1.00	4.00	206.00	2.9429	.50750
Valid N (listwise)	70					

Source: authors (2019).

Table 10. Operational Risk
Descriptive Statistics

Statements	N	Mean	Std. Deviation
The bank is exposed to business destruction and system failures as a result of hardware and software failures, telecommunication problems, and power outages.	70	1.7286	.63523
Very high proportion of the bank's income goes into operational expenses	70	1.7857	.77820
The bank is exposed to external fraud and damage from computer hacking	70	1.8000	.69366
The bank is exposed to data entry errors, collateral mismanagement, incomplete legal documentation, unapproved access given to client accounts sometimes do occur in my bank	70	1.8857	.77165
The bank is exposed to internal fraud, such as intentional misreporting of positions, employee theft and insider trading	70	2.0714	.83962
The bank is exposed to inadequate or failed internal process, money laundering and fiduciary breaches	70	2.6857	1.24578
Valid N (listwise)	70		

Source: authors (2019).

Table 11. Credit Risk
Descriptive Statistics

Statements	N	Mean	Std. Deviation
Some loan customers sometimes willingly refuse to pay or meet loan obligations	70	1.8000	.75373
Credit customers sometimes experience deterioration in financial condition	70	1.9143	.77540
Adverse selection of loan applications has led to high losses in my bank	70	2.3429	1.06166
The bank is sometimes exposed to poor loan portfolio quality	70	2.4714	1.15120
High interest rate makes it difficult for customers to meet loan obligations	70	2.5000	1.36997
Credit staff lack required skills	70	2.5000	1.03209
The bank has a high non-performing loan ratio	70	3.4429	.91105
Valid N (listwise)	70		

Source: authors (2019).

Table 12. Market Risk

Descriptive Statistics

Statements	N	Mean	Std. Deviation
Changes in the market environment can compel the bank to adjust its prices and interest rates on products and services	70	1.8143	.64365
Changes in interest rates affect the value of bank's assets and liabilities	70	1.9286	.72874
The bank is exposed to loses due to adverse movement in financial market rates (interest rate and exchange rate)	70	2.0429	.69022
Launching of new product or service can lead to losses due to market uncertainty in terms of response to the product or service	70	2.8143	1.06720
The bank is exposed to foreign exchange risk as a result of fluctuations in values and prices of foreign currency	70	3.3143	1.08405
Valid N (listwise)	70		

Source: authors (2019).

Table 13. Risk Management Practices
Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Banking Regulations, Policies and Guidelines	70	1.00	5.00	142.00	2.0286	.85077
Risk Management Environment	70	1.00	4.00	173.00	2.4714	.60724
Adequate Internal Control Systems	70	2.00	4.00	188.00	2.6857	.64926
Liquidity Gap Analysis	70	2.00	4.00	202.00	2.8857	.49761
Risk Mitigation Strategies	70	2.00	4.00	221.00	3.1571	.52848
Valid N (listwise)	70					

Source: authors (2019).

REINVESTMENT AS A TOOL FOR INNOVATION DEVELOPMENT

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Abstract
The main goal of the paper is to find out in which areas of the enterprise innovations are implemented and to what extent they are supported in the form of reinvestments. Today's times are characterized by openness in the field of business and therefore it is necessary for the company to be very competitive. This status of the company is also related to the fact if the company invests in innovations and also that it invests its profit back into the company. The paper is therefore focused on finding out what percentage of reinvestments is invested in pure and combined innovations in companies, where the condition is that the sum of pure and combined innovations is 100%. Managers of individual companies answered questions in a questionnaire survey focused on reinvestment and innovation. Data collection was performed in 288 companies and is supported by the project Social Enterprise Sharing Best Practice as a tool in Youth Work. At the conclusion of the paper, the possibilities of further research in this area will be pointed out.

Keywords
Innovations, Reinvestment, Managers, Enterprises, Entrepreneurship, Czech Republic.

JEL classification
L26, O39, M19, M21

1 Introduction

The topic of reinvestment and drawing on resources is current, even in the current situation. Respectively, it is more current than ever, because it is now necessary to draw resources (whether internal or external) in order for the company to get at least in the same condition as it was before the crisis. The paper examines the sources from which companies draw funds and where the sources go to the company, even in the field of innovation.

Expanding, maintaining and otherwise taking care of the company is a very important business decision. This decision is influenced by life experiences and other psychological processes, McCarthy, A. M., Schoorman, F. D. and Cooper, A. C. wrote about this in 1993. Reinvestment is easy tool for company growth. Today, companies are pushed to makes new and better services and products. (Vandermerwe, S. and Rada, J., 1988). Because competitors are ready to come and catch our customers and don´t let go them. It is used for these and company grow and transformation very important and companies' can´t stop it. For it is possible to use innovations, which one's competition don´t have. One way to make financial for it is, that companies use own money, especially in this uncertain time. Reinvestments are money one generated company and only the entrepreneur know which way is the best for improve their goods and services (Steiner, G. A., 1967). Reinvestment is that financial activities which make company like profit from previous investment activities (Pokorná, P., Šebestová, J. and Čemerková, Š., 2019). So, for successful reinvestment process is necessary to be prosperous business. It means that the entrepreneur had to have previous investment to make new and new profit, that profit can entrepreneur use to use it the business again and again, too make reinvestment process. It is illustrated below.

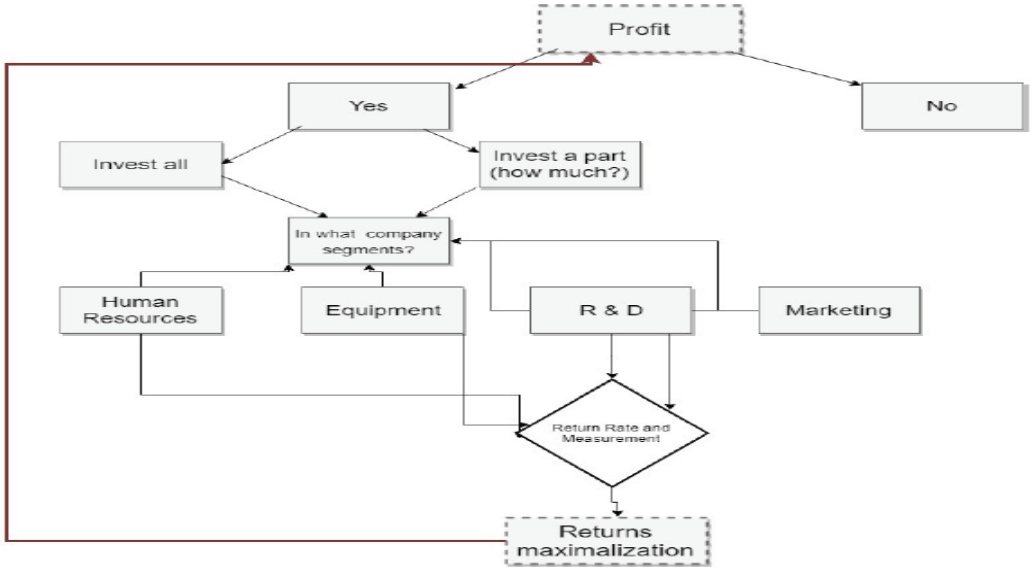

Fig. 1. Decision tree (Source: Pokorná and Šebestová, 2019)

The reinvestment is possible to divide into four segments, as you can see in the figure number X, of course all business don´t have all segments but in generally we (they) can choose, which one they have and prefer. Innovation is important part of this growing process a company. Choosing more segments is common, because reinvestment segments are connected and make the successful business.

Meanwhile each segment is very important, for example: none of compenies can´t be exist without employees. Investments in human capital have the common property of investments with the prospect of benefits to the individual and society distributed over the remaining lifetime of company (Glewwe, 2002; Huffman, 2019). Equipment is in nowadays very important and still changing part of business. Trend of this time is industry in which one is more and more technologies and using "clouds" technologies, called Industry 4.0 mentioned by many authors (Hedvičíková and Král, 2019; Agostini, L. and Nosella, A., 2019). Some companies are built on the R&D, so they are focused on this and they need invest a lot of money to this segment (Meng, Y et. al., 2020). Marketing is now very important and Direction, S. (2019) wrote that now it is very important life part of companies and author see that investment to marketing should be considered an investment rather than expenditure.

1.1 Literature review

An innovation is very often associated with the activities of companies, especially in industry. Companies invest their resources to innovation for achieve competitiveness and market success. (Saunila, 2019). These companies are therefore characterized by a so-called innovation capability, which can be described as the potential to create new knowledge or products. (Zheng, Liu, and George, 2010). The innovative capability can also be explained as a certain transformation of the mentioned knowledge and products into new systems that serve the company for future success. (Lawson and Samson, 2001). Thanks to this fact, it can also be concluded that the innovation capability is very important, especially for small and medium-sized enterprises, which need to compete with large companies. (Saunila, 2019).

Innovation capability is a little-studied concept in small and medium-sized enterprises. Despite the fact that some studies show differences between the innovative capability of small and medium-sized enterprises and large enterprises. (Forsman, 2011; Saunila and Ukko, 2014). There are also studies showing a positive relationship between company performance and innovative capability, even for small and medium-sized enterprises. (e.g., O'Cass and Sok, 2014; Zhang and Hartley, 2018).

In order to identify any activity in the field of innovative capability, innovation needs to be scaled in some way. Innovations according to the type of focus are commonly used. These include, for example, product, business, service, social, responsible or technological innovation. (Edwards-Schachter, 2018). According to Wigboldus et al. (2016) scaling is a certain effort that leads to defining results. In this meaning, scaling is associated with a positive change, and becomes to be an indicator for research and development evaluators. Scaling is also suitable for meeting the goals of sustainable development. (Wigboldus et al., 2016). Scaling is therefore a suitable tool for measuring various indicators in a company.

In this paper, innovations are scaling due to the focus of research on pure and combined innovations. These categories of innovation were originally created for social enterprises, but they can also be used in ordinary enterprises. There are six types of innovations divided into two basic categories. The first category is pure innovation, which includes employee, product and enterprise innovations. The second category is combined innovations, which include employee and product-oriented, employee and enterprise-oriented and product and enterprise-oriented innovations. (Krejčí, 2018).

Innovation is an important source of companies supporting their development. (Ni, Zhao and Chu, 2020). Some studies have already examined the reasons underpinning investment decisions. (Mantovani, 2006; Lambertini and Orsini, 2015). Some authors suggest that supply chain contracts, learning or market competition, for example, can play an important role in investing in innovation. (Li and Ni, 2016; Lambertini, 2018).

However, research on the relationship between reinvestment and innovation is essentially non-exist. It may also be a confusion of terminology which prevents the finding of appropriate studies in support of the goal of this paper. Reinvestments themselves are very little solved problem. Therefore, this article focuses on the initial identification of a possible gap in the relationship between reinvestment and innovation. The main goal is to find out in which areas of the enterprise innovations are supported in the form of reinvestments. This goal is supported by several hypotheses.

The first hypothesis is: If enterprise innovations are financially supported by business owners, then they are supported through profits already made from previous business activities.

The second hypothesis is: If employee innovations are financially supported by business owners, then they are supported through profits already made from previous business activities.

The third hypothesis is: If a reinvestment invested in a certain area of the company, then it is invested in an innovation focused on the same area.

The paper is structured as follows Shenton (2004).

2 Methodology and data collection

The primary data used in this paper were obtained from a questionnaire survey. This study serves to first look at the relationship between reinvestment and innovation in the company. The researched innovations are based on the study by Krejčí and Šebestová (2018), where they are specifically defined. The study describes one's own division of innovations into pure and combined, one's own view of innovations and various innovation activities in business.

The procedure of the pilot study was based on sending prepared questionnaires to the managers of selected companies. Companies were randomly selected from the Merk database. Companies had to have a minimum turnover of CZK 1 for the last three years. This fact was an assurance that it was an active company. The companies were selected from all over the Czech Republic. A total of 288 correctly completed questionnaires were returned for evaluation.

All information obtained in the questionnaire survey was recoded for the use of the SPSS program, which evaluated some data. Basic information about managers was recoded as follows:

- Education was divided into four forms of education in the questionnaire. These were elementary education, vocational education, high (secondary) school and university. Elementary education has been assigned a number 1, vocational education has been

assigned a number 2, high (secondary) school has been assigned a number 3 and university has been assigned a number 4.

- The business experience was also divided into four categories. It was a business experience of 1 to 3 years, 4 to 10 years, 11 to 20 years and 20 and more years. The first category has been assigned a number 1, the second category has been assigned a number 2, the third category has been assigned a number 3 and the fourth category has been assigned a number 4.
- Age was divided into five categories. These were the categories 18 to 25 years, 26 to 40 years, 41 to 55 years, 56 to 65 years and 65 and more years. The first category has been assigned a number 1, the second category has been assigned a number 2, the third category has been assigned a number 3, the fourth category has been assigned a number 4 and the fifth category has been assigned a number 5.
- The last information about managers was their gender, which was divided into male and female. Male were assigned number 1 and female were assigned number 2.

The basic indicators include the number of employees in the company, education, business experience, age and gender of the manager. Additional information is the time spent on completing the questionnaire. In the questionnaire survey participated small, medium and large companies. As the largest company was a company with a total of 92,000 employees and the smallest company was a company without employees. The education indicator pointed the variability of all categories. So there are managers with elementary education and also university education. On average, most managers have vocational education and high (secondary) education. The business experience of managers also ranges in all categories, as well as age and gender. On average, there are most managers with experience from 4 to 10 years. The average age is between 41 and 55 years. To inform the reader, the longest time to complete the questionnaire was 120 minutes and the shortest 10 minutes. On average, each manager used 40 minutes and 54 seconds to complete the questionnaire.

The actual ratios of the individual categories in the area of indicators of gender, age, education and business experience are shown in Table 1.

Table 1. Descriptive statistics

Gender	
Female	31.60%
Male	68.40%
Age	
18 to 25 years	2.40%
26 to 40 years	28.80%
41 to 55 years	53.50%
56 to 65 years	12.50%
65+	2.80%
Education	
Elementary	0.30%
Vocational School	18.80%
High (secondary) School	44.10%
University	36.80%
Business experience	
1 to 3 years	6.60%
4 to 10 years	24.30%
11 to 20 years	26.00%
20+	43.10%

Source: own research

Table 1 above shows the percentages of all the categories mentioned above. It is clear here that there are more male than female in the gender field. Over 50 percent of managers were between the ages of 41 and 55. Most managers had high (secondary) education and university education, and approximately 43 percent of managers had more than 20 years of business experience.

2.1 Relationship between reinvestment in the company, pure and combined innovations in enterprise

Creating innovation can be affected by various factors. These may include, for example, business experience, education (Krejčí, 2020), innovation capability or the ability to scale innovations, as already mentioned in the introduction to the paper. The possibility of investing in innovation can be a great motivator, but there can certainly be other variables. Here, reinvestment in the company was selected as a dependent variable. The Cramer V coefficient at α = 0.05 was used for statistical evaluation of nominal variables. Table 2 shows the results of the individual relationships between the variables.

Table 2. Determinant of innovation by reinvestment in the company

Variables	Determinants	
	Reinvestment in the company	sig.
Pure innovations		
Enterprise innovations	0.152	0.119
Combined innovations		
Product and enterprise-oriented innovations	0.118	0.606
Employee and enterprise innovations	0.131	0.391
Role of entrepreneur		
Business experience	0.118	0.577
Innovative proactivity as a whole	0.159	0.13

Source: own research, Cramer V coef. Used, sig. α = 0.05, * mean sig. at α = 0.1

In this case, all relationships are statistically non significant on α = 0.05. According to the results, it can be said that there is no relationship between any variables. Direct reinvestment in the company, therefore, is not related to reinvestment in both pure and combined innovations. It should be noted that there is no relationship in the field of business experience or the innovative proactivity as whole of the manager.

2.2 Relationship between reinvestment in the employees, pure and combined innovations in employees

According to the research results, there is a clear link between reinvestment in employees and employee-oriented innovations. According to the results of the methods used, there is the maximum connection between two investigated quantities. This is assumption that these (this type of) innovations also have a financial origin in the profit from already successful business activities in which the entrepreneur has already invested. The entrepreneur team increases the competitiveness and value of the entire company. However, whenever we use this thought process to reinvest in product and business-oriented innovations, no connection has been found there. If we have to pay for reinvestment in employment in order to find in research the link with certain combined innovations, namely employee and business innovation, taken as a whole, these segments follow each other and are an integral part.

Table 3. Determinant of innovation by reinvestment in employees

Variables	Determinants	
	Reinvestment in employees	sig.
Pure innovations		
Employee oriented innovations	0.248	0.000*
Combined innovations		
Employee and product-oriented innovations	0.146	0.171
Employee and enterprise innovations	0.177	0.013*
Role of entrepreneur		
Business experience	0.156	0.112
Innovative proactivity as a whole	0.145	0.231

Source: own research, Cramer V coef. Used, sig. α = 0.05, * mean sig. at α = 0.1

There was no link between reinvestment in employees and business experience. No connection was identified between reinvestments in employees and the overall innovation activity that entrepreneurs already had. The link between reinvestment in the company's equipment and business experience and those carrying out innovation activities has not been proven. It is therefore clear that the length of experience does not affect the decision-making process in the field of reinvestment in selected segments. Thanks to the values above, we know that almost half of the respondents (43.1%) have been in business for a long time, specifically more than 20 years. Nevertheless, entrepreneurs combined this experience with reinvestment and innovation activities as much as possible.

2.3 Limitation of study

There are several limits of this paper, and therefore also research whose output is this paper, which means that we do not want to reduce the final value of the paper, but it is necessary to mention them. The questionnaire survey from which this research was taken was not primarily intended for this scientific work, but the data are from the primary source and therefore are not distorted or missing in any way. The paper wanted to point out possible relationships between reinvestment and selected innovations in separate parts of the questionnaire survey. So, they wanted to find out if there was a connection that even entrepreneurs did not have to realize and could do so subconsciously. In the questionnaire survey, managers assessed only the amount of reinvestment they make in a certain area. They did not directly assess in which areas the reinvestment is going (for example: to buy a machine or to create innovations). In these circumstances, it cannot be determined that the reinvestments were directed at specific innovations. Another limit of this paper is also the size of the examined sample. The sample examined was the size of 288 business entities involved in the research. This sample is not among the largest within the total number of business entities in the territory of the studied state (Czech Republic). It is therefore debatable whether this sample has sufficient informative value. Limitation of this paper is also the process of deciding on innovations and reinvestments. There is a different approach to investing in innovation in small and medium-sized enterprises and large enterprises, which was also not taken into account here. This is already discussed in the introduction. There is also a lack of literature in the field of literature on innovation into specific business areas, including in the field of reinvestment. It is also possible that investment and reinvestment terminology may be confused in the search for appropriate research studies. This causes problems when searching for research studies.

3 Findings

The findings resulting from the research are presented in Table 2 and Table 3. The tables answer to the hypotheses designated in subchapter 1.1.

Table 2 therefore gives us the answer to the first hypothesis, which is: „If enterprise innovations are financially supported by business owners, then they are supported through profits already made from previous business activities." As the link between reinvestment in the company and innovations aimed at the company cannot be proved here, it cannot be argued that enterprise innovations would be financially supported by the owners of the company through the already generated profit from previous business activities. The first hypothesis was rejected.

Table 3 gives us the answer to the second hypothesis, which is: „ If employee innovations are financially supported by business owners, then they are supported through profits already made from previous business activities." Since, here the connection between reinvestment in the company, pure innovation in employees and combined innovation in employees and enterprise can be proved; *the second hypothesis is confirmed.* In view of the results shown in Tables 2 and 3, it is possible to answer the third hypothesis, which is: „ If a reinvestment invested in a certain area of the company, then it is invested in an innovation focused on the same area." Table 3 confirms the relationship between reinvestment and innovation to the same area and *the third hypothesis is also confirmed.*

4 Discussion

This paper is focus to assess the possible gap and to evaluate the possible relationships between the variables. The paper answered three hypotheses. The first hypothesis could be confirmed from this research. If the hypothesis were to be elaborated into partial parts, it would be possible to examine it better and interesting information would certainly be found in a deeper survey. The research confirmed the second hypothesis aimed at relationship between reinvestment in employee and employee innovation. If some limits of research were eliminated, the research would be more accurate, for example. The thirt hypothesis was confirmed, especially in the area of employees, where agreement was found empirically, but there is a need to take into account the limits of research. The research has shown that reinvestments focused on the company's employees and employee-oriented innovations are to a certain extent interconnected.

But there is a combination of sources of finance from these financial sources, i.e. reinvestment. The relationship between internal and external funding can be a source of inspiration for further, deeper research. In this respect, it is possible to extend the past potential research to the differences in the size of the company, as already described in the introduction, so large companies have a different approach to innovation, both in terms of their financial coverage and the volume and directions of innovation. The relationship between reinvestment in the company and corporate innovation has not been investigated, so the question arises in which other areas that are thematically identical (such as employee reinvestment and employee-oriented innovation) we would find or not find a relationship and connection with the internal source of funding. Firms may have different approaches to sources of finance to different segments of the firm, for some they may prefer internal sources (reinvestment) and for some external ones. This can affect the cost of funding, the profitability of innovation, the gender of the entrepreneur, the age of the entrepreneur, whether the entrepreneur grew up in a family business and was close to this from a young age or something that has been described, these incentives would certainly be worth further research.

However, the limitations that are extensive here also need to be considered. It should be noted that the change of the questionnaire survey could significantly affect these relationships. For future research, it would therefore be appropriate to focus on the correct composition of the questions in the questionnaire survey. Reinvestment questions should specifically identify the areas in which reinvestment has been directed. These areas would include innovation. It is also possible to think about the method of data collection in the form of an interview with managers. This would reduce the

possibility of incorrect answers from managers. Future research should also be accompanied by a thorough literature search. This search should be used to find scientific studies that consider reinvestment as an investment. So find out if there really is a terminology problem in this area.

5 Conclusion

A thorough search of scientific studies can serve to identify the differences between investing in innovation and reinvesting in innovation. These two areas can be very interesting from the point of view of research questions. For example, *"Is there a difference between a return on investment in area of investment in innovation and a reinvestment in innovation?"* Future research could show whether and under what circumstances investing or reinvesting in innovation is more advantageous. There is no need to focus only on innovation in this area. As companies invest and reinvest in various areas, research can be directed to them as well. Future research can bring a lot of interesting information not only for the scientific field, but also for managers.

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SUPPLY CHAIN EXCLUSIVITY IN OMNICHANNEL RETAIL

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Abstract
Growing the technology alongside the advancement of customer needs leads the companies to serve omnichannel retail and service where the customers have the right to choose among the different channels to gain knowledge and fulfill their needs. From the service point of view, omnichannel retail needs fundamental development in various business elements. Among these elements, the supply chain process has to adapt more rigorously. A well-established supply chain for omnichannel retail has to be cost-effective and responsive to customer needs. This research tried to investigate implementing omnichannel SCM strategies on supermarket chain expenses and customer experience.

Keywords
Omnichannel, Supply chain management, Supermarket chain, Multichannel retail.

JEL classification
M15, L15, L11, O32, L81

1 Introduction

Customer access to new markets and numerous suppliers can potentially proceed the purchasing in different channels (Marchet et al., 2018). Customers could gain information from one channel and purchase another (Cai and Lo, 2020). Alternatively, buy the product online, pick it from a physical shop, or conclude his shopping in a modern locker. From the marketing perspective, a new channel has been added to the business to penetrate new markets or develop in the current market (Seock and Norton, 2007). In the traditional described atmosphere, each channel worked independently and tried to acquire as much market share as possible. Each channel was responsible for its benefit or loss and worked as a potential rival for the other channels. In this model, providing a new channel could empower the companies in a new market or new target in the current market. In contrast, the omnichannel business offers a seamless experience for customers and makes a synergized cooperation in different channels.
Table 1 indicates the traits of omnichannel retail.

Table 1. Multichannel vs Omnichannel

	Multichannel	Omnichannel
Definition	*"A siloed approach that operates channels as independent entities." (Shen et al. 2018)*	*A unified approach that manages channels as intermingled touch points to allow consumers to have a seamless experience within an ecosystem.(Shen et al. 2018)*
Channel characteristics	Separated channels work in competition with each others.	A seamless customer experience which uses different touchpoints as a unified and integrated channel
Channel scope	Physical Store, Online website, and mobile apps.	All customer touchpoints, which used in multichannel plus Social media any other possibility.
Channel integration	The customer does switching between channels.	All channels are switchable seamlessly.

Channel management	Optimizing the usage of each channel	Optimizing the holistic channels
Data	Data are secret, and the level of share of knowledge is Zero	All data are accessible for all the channels.
Channel Goals	Sales and experience per channel.	All touchpoints and channels cooperate in providing a holistic customer experience
Customer	"*Perceived interaction with the channel. No possibility of triggering interaction. Use a channel in parallel* "(Shen et al., 2018)	The interaction of the customer is with the brand, not only with a channel
Retailers	There no possible integration and Comprehensive control	Integrated and simultaneous control in all the channels.
Salespeople	Are not in the same manner.	A different argument, according to the customer needs in each channel.

Source: Shen et al.

As it is understandable, from the comparison in table 1. The central concept of Omnichannel retails trying to make a comprehensives solution that can improve the different channels synergies to make a unique customer experience based on Brand (Payne et al., 2017). while the concept of omnichannel has been addressed in many marketing scientific works, few pieces of research highlighted the Supply chain management(SCM) (Saghiri et al., 2018). SCM, as Keystone of omnichannel retail, could be the most attractive area for the developed technology such as the internet of things to ensure the business systems is doing their work seamlessly (Piotrowicz and Cuthbertson, 2014).

Implementing Omnichannel Retail could benefit the organization from the advantages of free information flow or a Comprehensive financial system (Hansen and Sia, 2015). Overlooking these benefits, business owners have to consider the cost and performance of their omnichannel Business elements. The omnichannel-related activities have to be cost-effective and responsive (Shen et al., 2018). Cost-effectiveness is related to all effort a company does to reduce operation costs, especially in the last mile delivery (Christopher and Gattorna, 2005). Responsiveness in business means the shortest time to market, but omnichannel means the average lead time to fulfill the customer needs (Adivar et al., 2019). Like other businesses, Supermarket retail started to provide omnichannel service recently (Fransoo et al., 2019). particularly in response to Covid crises. They have armed themselves with new channels and tried to act as an omnichannel business to overcome these difficulties. While other businesses developed their omnichannel concept to improve their customer experience, supermarkets have to play in the omnichannel market, relying more on their performance. Little profit margin in the commodity products price beside perishable goods logistic requirements, force them to act agile and productive.

On the other hand, the number of customers in supermarket chains is much more than other businesses, and these businesses have to satisfy the need of different customer groups. Considering these two main attributes of supermarket retail, while most business units are infecting with implementing omnichannel business. We tried to analyze how Supply chain Elements are cost-effective and responsive in the supermarket omnichannel retail. In this paper, We assess each Element from two points of view. The first group of analyses is related to the financial consequences of implementing omnichannel strategies. The second group of analyses investigates Responsiveness from the customer's point by developing an omnichannel supermarket chain.

2 Omnichannel Supply Chain

Different SCM Strategies has been used in companies to supply a demand. Similarly, four different strategic areas in omnichannel retail mentioned in the literature. They are Delivery service, Distribution setting, Fulfillment strategy and Returns management (Marchet et al., 2018). The first area is the Delivery service-related strategies. More than the physical selling points in omnichannel retail, business owners have to provide numerous product delivery points. The first group is home delivery (HD). This group of activities can be divided into two different actions; the first can happened when the receiver is attended in the destination. Second is the time that the final consumer is not attended. The other modes are click and collect, in the same way, according to the method customer selects to collect the goods could this mode can divide into three stages. In-store C&C means the customer collect the product from the store. Attached C&C, which concludes by driving to a center of collecting. And Solitary C&C is about using shared our private lockers .all these delivery modes could affect the company's logistic radically (Hansen and Sia, 2015).

Relating to the product type, the velocity of delivery could be different in some unique products such as warm meat, and fresh fruit velocity has to be done in the fastest. A time slot can be select by the customer or offered by the business owner, and it is different according to the company offers. Price slot is not a common feature in omnichannel, but companies may offer this in gamification and other offers (Marchet et al., 2018).

The distribution setting strategy combines Logistic variables picking locations in the delivery and transport service area. Picking service could be managed by one of the following ways; an independent warehouse, a typical warehouse by the specific gate for an online shop. In/store warehouse, the currently available products in the physical shop are used to feed the distribution process.

strategic area	logistics variable	options			
Delivery service	Delivery mode	Attended HD	Unattended HD	In-store C&C	Solitary C&C
	Velocity	Same day	Next day	Two or more days	
	Time slot	Specific	Undefined		
	Slot price differentiation	Yes	No		
Distribution setting	Picking location	Central warehouse	Separate fulfilment centre	In-store	
	Delivery area	Local	Regional	National	International
	Transport service	Milk run	LTL - express courier	LTL - courier	FTL + local distribution
Fulfillment strategy	Automation	Manual	Semi-automated	Fully automated	
	Integration	Separated	Integrated	Capacity-optimised and integrated	
Returns management	Returns mode	No returns	CEP returns	In-store returns	

Fig. 1. Omnichannel logistic area (Source: Marchet et al.)

According to the supported service area, a business can fulfill locally, regionally, national or international. Transport service can be milk run means the transport means round in a root and share the products, Less than Truck Load (LTL) small packages distributed by courier, express courier, LTL courier means using the local courier to deliver the products with other suppliers. Besides, Full Truck Load (FTL) like the milk run by a domestic courier.

Fulfillment strategy can be vast range from manual to fully automated order. Resources allocating such as Human capital is another issue in omnichannel. Either human capital can manage all channels or separated workers are responsible for new channels. Return good management strategies is another critical Logistic Strategic area of the supply chain in omnichannel retail. In some countries, regulation enforces service providers to accept returned goods with no question (Morten Jarblk Pedersen, 2015). there are three strategies in this area no return, Express and Parcel Delivery (CEP), which use the same courier that handles the delivery and only in-store return.

In our work, we will analyze the framework presented by (Marchet et al., 2018) in the field of omnichannel supermarkets. They mentioned that their framework is a sale-based. We tried to find out the most influential variables from their model from two different points of view. First financial consecuences of implementing omnichannel strategies in the supermarket stores. Besides that, we will analyze the level of Responsiveness for customer needs in the same area. The research questions we want to answer in this research are :

RQI. Is implementing omnichannel strategies improve the cost-effectiveness in omnichannel retail?
RQII. Is implementing omnichannel strategies improve Responsiveness in omnichannel retail?

3 Method

We have target one supermarket chain in Iran. This supermarket established new omnichannel strategies recently after two years of selling products in the independent online and offline channel. They decided to merge these two channels and add other channels to their business to overcome the radical demand growth in the year 2020 related to the corona pandemic. As mentioned in the previous parts, Delivery service, Distribution setting, Fulfilment strategy is the omnichannel supply chain's strategic area. We have considered these elements as the independent variable and tried to understand these variables' effects on the different hypotheses. The cost-effectiveness and Responsiveness of the systems are based on the cost-effective part; we assumed four different hypotheses divided into separate items.

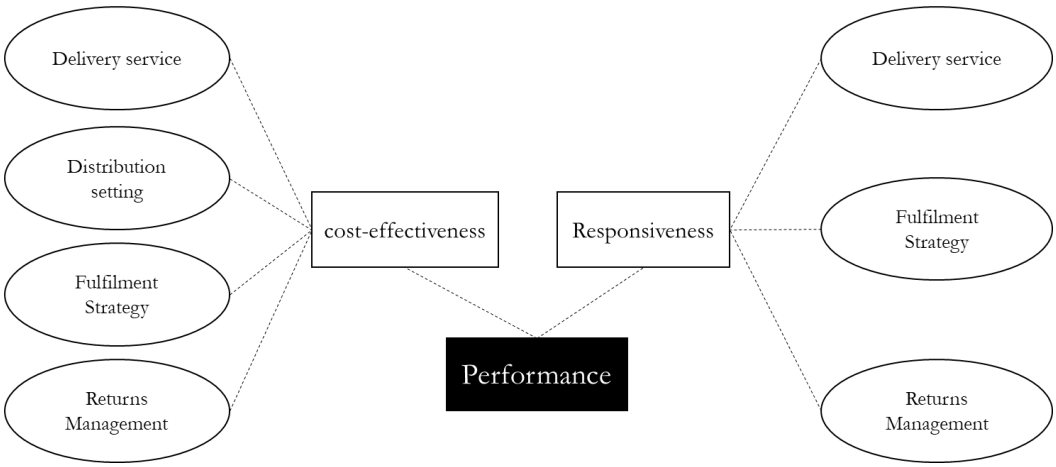

Fig. 2. Conceptual model of the research (Source:own)

H1: Implementing Omnichannel Delivery service strategies improved the cost-effectiveness
H2: Implementing Omnichannel Distribution setting improved the cost-effectiveness
H3: Implementing Omnichannel Fulfilment strategy improved the cost-effectiveness
H4: Implementing Omnichannel Return management improved the cost-effectiveness

The second group of variables has been clustered in three hypotheses to analyze the relationship between implementing the omnichannel strategies and Responsiveness from the point of view of the customer

H6: Implementing Omnichannel Distribution setting improved the Responsiveness

H7: Implementing Omnichannel Fulfilment strategy improved the Responsiveness
H8: Implementing Omnichannel Return management improved the Responsiveness
The conceptual model of our research has been illustrated in **Fig. 2**. The final result of cost-effectiveness and Responsiveness is the performance, which is not in our research scope. And has not been mentioned in other work.

To analyze the first group of hypotheses related to cost-effectiveness. Because of the complexity of the subject, We used Convenience Sampling. We could find two experts that are familiar with the concept of omnichannel and supermarkets. The first expert was a financial advisor with a strategic management background and worked as a retail consultant for the last ten years. The second expert was the head of the finance department in the mentioned supermarket chain. We ran an open interview with Both of them and arranged their minds to understand better our concern and then asked them to give us a number between one to nine to improve the effect s of omnichannel strategies in cost-effectiveness. One means the effect was not appropriate, and the cost was more than their gain. And nine means earning was by far more in implementing such strategies. The results have been shown in **Table 2**.

Table 2. First group hypotheses Analysis

Hypotheses	A1	A2	Average Result
H1: Implementing Omnichannel Delivery service strategies improved the cost-effectiveness	1	3	2
H2: Implementing Omnichannel Distribution setting improved the cost-effectiveness	3	3	3
H3: Implementing Omnichannel Fulfilment strategy improved the cost-effectiveness	5	5	5
H4: Implementing Omnichannel Return management improved the cost-effectiveness	7	9	8

Source: own.

Using the saw method (Zanakis et al., 1998) to combine the result which is shown in **Table 2** we find out the first two hypotheses related to cost-effectiveness of omnichannel retail are rejected and deliver service and distribution strategies related to omnichannel businesses are not cost-effective and add more expenses on the burden of organization. Fulfillment strategies are not improving and do not worsen the cost-effectiveness. But for the return management, both of the questioned experts believed that omnichannel strategies could positively affect cost-effectiveness. Many of the follow-ups could be done on online channels rather than in-store activities.

Fore The second group of variables, we have run a questionnaire in a Telegram questionnaire bot where the omnichannel system's real user stands. We received 35 answers to the questionnaire. We asked about the customer experience before and after the supermarket strategies changes to determine if there was a significant difference before and after implementing omnichannel strategies. After gathering the data, we ran F test analysis; the results are illustrated in **Table *3***. Where we find that the first and third hypothesis has been accepted. But the answers did not prove the second hypothesis. According to delivery, the questioner analysis shows that customer experience has been improved, and they are more satisfied with new strategies. At the same time, they claim that they are more convenient with new strategies related to return goods. But according to the fulfillment they could recognize the significant difference.

Table 3. Responsiveness analysis

Field	Variable 1	Variable 2	F	F Critical one-tail	Null hypothesis	Result
Delivery service	4.714286	5.942857	0.137946	1.772066	accepted	There is no significant difference between traditional physical retail and omnichannel retail in the field of delivery
Fulfillment	4.085714	6.428571	0.744828	0.564313	rejected	They're different in the field of fulfillment between traditional retail and omnichannel
Returns Management	4.428571	3.628571	1.377246	1.772066	accepted	There is no significant difference between traditional physical retail and omnichannel retail in the field of Return.

Source: own.

4 Result and conclusion

The development of technologies and the advancement of customer needs force companies to implement new strategies such as ommnichannel retail. Utilizing this model of business could affect expenses and customer experiences. This research tried to analyze these effects from the customer perspective and the financial department viewpoint in an Iranian supermarket chain that recently utilized omnichannel strategies. The final analysis shows that while implementing the omnichannel strategies could improve the customer experiences in delivery and return good. These activities could increase the costs and reduce the cost-effectiveness in the whole business. We can summarize that while implementing omnichannel SCM strategies could improve customer experience, and the companies attended in supermarket retail have to implement them cautiously to avoid unpredicted costs.

5 Acknowledgement

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FINANCIAL LITERACY AMONG ADULTS IN THE CZECH REPUBLIC

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Abstract
Financial education is becoming a more important part of science when talking about finance and economics. According to some studies financially literate person is supposed to be a basic condition for a successful economy. (OECD, 2015) With the increasing importance of this phenomenon, it is also crucial to run various studies dedicated to measuring of financial literacy level, determination advantages and disadvantages of various educational programs (devoted to the financial education) and most importantly search for possible improvements of the lower level of financial literacy among the population. The goal of this study is to provide results concerning a study in progress; run in the Czech Republic. In this particular research, the main target audience is young Czech adults. The data shows that among young citizens of the Czech Republic, gender plays an important role when it comes to the financial literacy level in favour of males (who reached higher level of the literacy). Consequently, level of education was also a valid indicator of the financial literacy level. Last but not least, whether a respondent is working or/and studying is also an important factor of the financial literacy level. On average, working students have reached higher level of the financial literacy comparing to non-working students and working people (who are not students at the same time). On the other hand, among Czech adults is not a significant difference between people from villages and small cities and people from bigger cities, where citizens usually get easier access to formal and informal education. Concerning the used methodology, this study is based on descriptive statistics as a basic tool for comparison and initial insight into the data file, further on t-tests allowing parametric comparisons of various data groups and the method analysis of variance (ANOVA).

Keywords
Financial literacy, Czech Republic, Financial education, t-test, ANOVA.

JEL classification
I22, I31

1 Introduction and Literature Review

In the first chapter of this paper (Introduction and Literature Review), there will be a short introduction of the basic knowledge related to the investigated topic and a brief summary of literature review. Consequently, the second chapter explains how the research was done, which methodology was applied and what assumptions of the methods are. The results and the way the results were obtained are presented in the chapter no. 3, where the results are also discussed and polemicized. In the last chapter (chapter no. 4), main results are summarized and the paper is concluded.

The definition of what financial literacy means might differ, depending on the particular book or internet source we read. From the point of the author of this article, the most relevant definition seems to be "set of knowledge which is necessary to have to make proper decisions related to personal financial administration, financial investment and personal budget.." (Ministry of Finance ČR, 2010). Financial literacy might not be taken as a separate area of skills, yet it is more a complex science that should be elaborated from the very young age throughout the whole life. This forces to use to investigate the financial literacy level across the whole population and according to various criteria. (Nesleha, Janosova, 2019).

Financial literacy is a skill or group of skills that a person gains from a very young age and this learning process never stops. There are some parts of our lives when these skills are deepened more, while in other life phases less. As a consequence of this "lifelong process", financial literacy level cannot be measured only on primary schools, secondary schools and universities, however, also among adults, especially young adults. (Lusardi et al., 2010)

Financial literacy is a spread term consisting of several parts. In the Czech Republic, Ministry of Finance divides financial literacy into:

- Money literacy
- Price literacy
- Budget literacy (Ministry of Finance ČR, 2010)

Previously, in some studies, we took into consideration only particular parts of the financial literacy (when it comes to the spread of testing) or subjective assessment of respondents' financial literacy level. (Nesleha, 2017). However, this study aims at an objective evaluation of financial literacy level with a focus on all of its parts (money, prices and budget financial literacy).

The goal of this study is to provide results concerning an ongoing study in the Czech Republic. The main target of the study is to find out what crucial predictors of financial literacy among Czech citizens are. Such conclusions and findings are intended to be used for further investigation and mainly suggestions for possible improvement of financial literacy in the Czech Republic.

In total, four research questions have been formulated in this study:

- Research question no. 1: Does the gender of respondents have an impact on the financial literacy level?
- Research question no. 2: How significant is the influence of the respondent's education on the financial literacy level?
- Research question no. 3: Is there a difference between students and working people when it comes to the financial literacy level?
- Research question no. 4: How significant is the influence of the respondent's location (villages and small cities and big cities) on the financial literacy level?

2 Data and Methodology

The data for this research has been collected via an electronic questionnaire, which has been chosen particularly with regard to the set target audience - young citizens of the Czech Republic aged between 18 and 30 years. The questionnaire consists of two parts. In the first part, respondents have been asked a few questions providing us with demographic data about the respondents. The second part has been designed as a test of financial literacy with a focus on all the three parts of financial literacy (money, price and budget literacy). For this study, only a few demographic indicators have been used. The level of the respondents' financial literacy level has been measured by the number of points from the test part. The test contains 30 questions and the scale ranks between 0 and 30 points, depending on the number of correct answers.

The study is based on quantitative research, particularly on statistical methods. As in the case of all of the research questions, respondents are divided into two groups, parametric t-test of independent samples is preferred when measuring the difference. The assumptions of this test are:

- Normality of the sample (the dataset has to be derived from the normal statistical distribution)
- Homoscedasticity (variances of the groups/datasets are homogenous)
- Independence of both the samples (Corder, Foreman, 2014)

However, if one or more of the assumptions fail (particularly normality and/or homoscedasticity), a non-parametric test is processed to measure the difference between the groups. In such case, with focus on the investigated questions, Mann-Whitney Test is applied. For all the tests, the 5% significance level has been set.

For the third research question, the analysis of variance (ANOVA) is employed as we measure the average values of three groups (K) at the same time. In such case, t-test or an equivalent of such test would not provide a comparison of all the groups at the same time.

3 Results and Discussion

The first part of this chapter is devoted to results and answers to the formulated research questions. Consequently, computed results are discussed and suggestions for further research are stated.

Research question no. 1: Does the gender of respondents have an impact on the financial literacy level?

The first insight into the data shows that there might be a difference between the average values for females and males. These descriptive statistics are shown in table no. 1. According to the table, it is visible that there is a difference between males and females. Males reached around 23.25 points on average (on the scale between 0 and 30 points), while females reached approximately 20 points on average.

Table 1. Descriptive statistics

Group	Males	Females
Average	23.258	20.013
Standard deviation	3.421	5.547
Number of observations	**132**	**156**

Source: Own processing in software STATISTICA.

The original intention (how to address this research question) was to run the parametric t-test. However, two important assumptions of the test fail; normality has been rejected as well as the homoscedasticity. This means that any parametric test should not be applied. (Budikova, Kralova, Maros, 2010)

As parametric tests should not be employed, a non-parametric test has been utilized to investigate the difference between males and females when it comes to the financial literacy level. Particularly, Mann-Whitney U Test has been used. Results of the test are summarized in table no. 2.

Table 2. Results of Mann-Whitney U Test

Variables	Valid N	U	Z	p-value
Males	132	15908.00	5.177	0.0000
Females	156			

Source: Own computation processed in software STATISTICA.

Results of the test show that the null hypothesis has been rejected. It can be interpreted that there is a difference between males and females when it comes to the average value from the financial literacy test. Looking back at table 1, it is visible that the financial literacy of males is higher than the financial literacy of females. The difference of approximately 3 points has been rendered as a statistically significant difference (by the non-parametric test).

Research question no. 2: How significant is the influence of the respondent's education on the financial literacy level?

Level of education is always supposed to have a positive impact on skills, knowledge and experience. This means that the main point, in this case, is not just to verify if the data shows this relationship, but it is rather about measuring how big the difference is. For this research question, respondents have been divided into two groups. The first group consists of people with finished primary schools or school-leaving exam. In other words, all the respondents without whichever university degree. The other group consists of respondents with one or more university degrees. Basic descriptive statistics are shown in table no. 3.

Table 3. Descriptive statistics

Group	Non-university education	University education
Average	20.402	22.149
Standard deviation	5.067	4.789
Number of observations	**107**	**181**

Source: Own processing in software STATISTICA.

The data shows that there is a difference amounting to approximately 2 points (out of 30 points). As the difference does not seem to be significant, the non-parametric test (Mann-Whitney U Test) has been processed. As well as in the previous case – research question no. 1 – the normality fails, which means that the parametric test cannot be employed.

Table 4. Results of Mann-Whitney U Test

Variables	Valid N	U	Z	p-value
Males	107	7345.00	-3.423	0.0006
Females	181			

Source: Own computation processed in software STATISTICA.

The computed p-value is lower than the set significance level (0.05), meaning that the null hypothesis has been rejected. Despite the fact that the measured difference (of 2 points) does not seem to be extremely significant, the test has been confirmed that it is statistically significant, confirming that the level of education has an impact on financial literacy level among young citizens of the Czech Republic.

Research question no. 3: Is there a difference between students and working people when it comes to the financial literacy level?

Taking into account the collected dataset and with regard to the set research question, the following three groups of respondents have been created.

- Group 1: respondents who define themselves as non-working students
- Group 2: respondents who define themselves as working people (but not students at the same time)
- Group 3: respondents who study and work at the same time (working students)

As we work with three independent groups and as the datasets comply with approximate normal statistical distribution, the analysis of variance (ANOVA) has been run to address the set research question. Before doing so, the following table summarizes basic statistics, giving us an initial insight into the data characteristics.

Table 5. Descriptive statistics

Group	Non-working students	Working people	Working students
Average	21.273	20.775	24.16
Standard deviation	4.715	5.218	3.851
Number of observations	**128**	**102**	**50**

Source: Own processing in software STATISTICA.

There is a visible gap between the second group (working people who do not study) and the third group (working students). The difference amounts to approximately 3 points on 30point scale. The table 6 then provides results concerning the analysis of variance. Extremely low p-value (reaching almost zero) rejects t
he null hypothesis and accepts the alternative hypothesis, stating the at least one of the groups has different average value.

Table 6. Results of ANOVA

Variable	K – number of groups	F	p-value
Realization	3	9.03	0.000159

Source: Own processing in STATISTICA.

To investigate which group or groups cause this discrepancy, the following table has been created. It contains results post-hoc test called Scheffe Test. This provides us with particular p-value of all

combinations of the investigated groups. The previously mentioned visible difference between the second and the third groups has been confirmed as statistically significant, but also the difference between the first group (non-working students) and the third group (working students) has been rendered as statistically significant difference. With regard to the descriptive statistics stated in table 5, this means that the test implies that working students tend to have higher level of financial literacy over non-working students and also over working people who do not study at the same time.

Table 7. Results of post-hoc test, Scheffe Test

Group	1	2	3
1	**--**	0.7332	**0.0016**
2	0.7332	**--**	**0.0002**
3	**0.0016**	**0.0002**	**--**

Source: Own processing in software STATISTICA.

Research question no. 4: How significant is the influence of the respondent's location (villages and small cities and big cities) on the financial literacy level?

When it comes to the fourth and the last research question, respondents have been divided into two groups – respondents living in villages and small cities with up to 2,000 citizens and respondents living in bigger cities with 2,000 citizens and more. Table no. 8 summarizes basic descriptive statistics of both of the data samples (citizens living in smaller cities and villages and citizens living in bigger cities with at least 2,000 citizens).

It might be surprising that the average value is higher in case of people from smaller cities and villages. This value has reached on average 22.17 points, while in bigger cities the measured average value has been approximately 21.4 points out of 30.

Table 8. Descriptive statistics

Group	Citizens from smaller cities	Citizens from bigger cities
Average	22.17	21.369
Standard deviation	4.045	5.115
Number of observations	**47**	**241**

Source: Own processing in software STATISTICA.

Unlike the previous data files, in this case the normality of the datasets does not fail. This allows us to use the parametric t-test. The results of the test (shown in table no. 9) does not reject the null hypothesis. Such a conclusion means that there has not been a statistically significant difference between the first and the second group. This might be cause by the fact that the average value for the first and the second group is slightly different and at the same time the number of observations in the first group is extremely low. The table is completed by results of homoscedasticity test, which confirms that the homoscedasticity has not been rejected, taking into account the chosen significance level of 5%.

Table 9. Results of T-test (Grouping: population)

Valid N	t-value	p-value	F-ratio (variances)	p-value
288	-1.013	0.312	1.599	0.058

Source: Own computation, processed in STATISTICA.

The study has developed on initial investigation among Czech citizens when it comes to the level of financial education. It has answered four research questions, which might help us to target the future investigation more properly and more specifically. No matter how useful these statistics are, it needs to be take into account that results of this study suffer from various simplifications and that the data collection and research itself is accompanied by several limits or restrictions.

The first limitation is the number of observation, which in this study does not exceed 300. Getting data from young population is easier than from older generation, yet taking into account the length of the questionnaire, the process of the data collection becomes more difficult. On average, there has been one respondent (who was willing to fill in the questionnaire) out of five respondents who were approached.

At the same time, for further research it is important to make more specific target audiences to reveal if some relationships and tendencies are not valid only for a particular location of respondents. For instance, this could be eliminated by a creation of various datasets, depending on the particular region which every respondent belongs to.

Last but not least, the results so far only state if there is a difference and in favour of which group the difference exists. However, in further research it needs to be investigate what the predictors or indicators of such inequalities are. For instance, according to the results we know that the education has a positive impact on the financial literacy level of respondents. Still, it would be more specific to investigate this phenomenon more deeply and to find out which areas of study are linked with higher or lower level of financial education.

4 Conclusion

The goal of this article has been to provide results concerning an ongoing study related to the level of financial literacy among young citizens in the Czech Republic. The study has been based on a data sample collected electronically and that consists of approximately 300 observations (depending on the particular test made). It has been proven that gender is a statistically significant predictor of financial literacy level among Czech adults aged between 18 and 30 years. The results are in favor of males who gained on average 3.2 points more than females with scale between 0 and 30 points. As expected, university education has been already confirmed as a statistically significant indicator, however, the difference between respondents with a university degree is less than 2 points (out of 30) on average.

When it comes to the segmentation of non-working students, working students and working people without being a student at the same time, the best results have been measured in case of working students, reaching 24.2 points out of 30 on average, while working people (who do not study at the same time) gained less than 20.8 points on average. Such difference has been statistically significant via ANOVA test (analysis of variance).

Although bigger cities are usually a good place to get both formal and informal education and, therefore, financial education as well, the predictor "Location" has not been confirmed as statistically significant. In other words, people from bigger cities (with at least 2,000 citizens) do not seem to have higher level of financial education comparing to those who live in villages and smaller cities. Nevertheless, we have to be aware of limited number of respondents of the first group (citizens of villages and smaller cities), which might be the reason for not rejecting the null hypothesis of the test.

At the end of this paper, it seems to be important to stress that this research has been devoted to the environment of the Czech Republic only, with on further comparison with other countries. This has been decided due to the specific rules and government policies of the Czech Republic. The international investigation would be another stage, which, however, has not been a part of this research.

5 Acknowledgement

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ARBITRAGE OPPORTUNITIES IN ENERGETICS

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Abstract
Aim of this paper is to present arbitrage opportunities within chosen European energy commodities at chosen markets, especially Czech and Slovak markets. The paper defines operation of European electricity markets and opportunities of arbitrage (time and place). Final results are compared with possible risks and profitable scenarios are further discussed.

Keywords
Electricity, Arbitrage, Commodity markets.

JEL classification
K32, O13, P18, Q47

1 Introduction

The principle of commodity exchange is simple – offering the subjects to make deals under the roof of a transparent institution. The exchange has no risks and has incomes from all participants and all deals. This offers room for prosperity and company growth, spreading to new countries and offering more commodities to cover as much of the market as possible. Currently the situation in energetics correspond with globalization trend all over world. Energy futures are sold in centralized commodity exchanges across Europe, the biggest one is EEX (European Energy Exchange) covering Austria, Belgium, Bulgaria, Czech Republic, the Netherlands, France, Great Britain, Germany, Greece, Hungary, Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Poland, Romania, Serbia, Slovakia, Slovenia, Spain and Switzerland and most recently Japan). Those products are with financial settlement only, so that the traders use them for hedging their products, avoiding risks. When the period before future date is over, financial difference is settled, but the real commodity (electricity) has to be bought on spot market (in case of Czech Republic it is traded on OTE (the Czech electricity and gas market operator) operating daily and gas market). This spot market runs as a blind auction. If the subject is unsuccessful in this auction, there is possibility (in case of electricity) to furthermore adjust volumes on intraday market (in Czech Republic it means higher spread and lower liquidity than daily market), or to be charged the missing not purchased volume with final imbalance price. This final imbalance price depends on final situation of system imbalance, whether the subject imbalance is on the same side as system imbalance, regarding this is the subject charged with imbalance price or receives the counter-imbalance price.

What this chapter means in praxis? Commodity exchange products are only tools to avoid bigger losses and make hedging, but it is not a place providing the traders opportunity to get real future deliveries. This tool is to be used only avoiding risk, that the price of current fixed contracts multiplies within the period before delivery. After purchase of this future, current price is financially cleared with the purchased price, so if the price doubles at the end, price difference between final price and purchase price is paid buyer, but they still need to buy the real delivery products at producers, or indirectly at OTE daily market. Price of next year future at the yearend has different price as price on daily market for next days, so this cover price risks, but in previous 3 years the spot price was more convenient than the future price. Also, this system and market brings opportunity for price speculations, prediction usage for time arbitrages and (but less likely) cross country arbitrages. As the price volatility increased in recent years, this is current concern of more and more people working in field of energetics.

2 Methodology

Electricity traders and customers make deals everyday solving decision, whether to buy today, or postpone it to tomorrow and wait for better price. Is it possible to predict based on today market changes tomorrow prices and thus gain price speculation profits? Is it possible to find cross country arbitrage opportunities? When is it profitable to transfer electricity across borders (location arbitrage)? To answer the first research question, econometric modelling above historical data is used, to answer the second, historical opportunities were searched.

When looking for price speculation, econometric predictions were used for determining near future based on historical time series and further assessed. If the difference of prices today and tomorrow is higher than the spread, the deal is profitable.

Table 1. Methods used in this model

Purpose	Method	Complexity criterion
Predictor engineering	PCA	Variance
Predictor preselection	Lasso	5-fold CV error
	Ridge	5-fold CV error
	RF	5-fold CV error
Lag determination	ARIMAX	AIC
Model specification	ARIMAX	AIC

Source: own data.

There were selected data time series from January 2015 to December 2019, such as electricity market prices (BL cal+1) in Germany, Poland, France, Slovakia, Czech Republic, Italy, Hungary, contracted quantities per day in Czech Republic, gas prices (NCG cal+1 and cal+2), LGO (light gas oil), oil, coal and uranium, prices of emission allowances, information about daily electricity production by source and prices on spot electricity market of that day, exchange rates of CZK/EUR and EUR/USD, weather data (temperature, sunshine and wind), day of week, stock exchange indexes (PX and DAX), stocks of ČEZ and EON (Czech and German electricity trading and distributing companies).

Several drawbacks like multicollinearity, autocorrelation, missing values, necessity to detect high number of irrelevant variables and debatable stationarity, are to be expected. Regarding satisfying stationarity assumption, one day differences was used. As notable from Table 1, Lasso and Ridge are maintaining linear structure shared with ARIMAX models. Last method - Random Forests – was chosen for endurance against different scales, multicollinearity and autocorrelation thanks to random sampling from data common to all bagging algorithms.[6] Also, as a CART based method, RF are able to deal with missing observations by surrogate splits. [2]

Multicollinearity would be expected in financial markets setting, Principal Components Analysis (PCA) was used to orthogonalize some of the predictors exhibiting high correlation as well as to engineer new predictors with potentially higher prediction power [3]. Reducing our feature space by mentioned methods, ARIMAX assess variable relevance better [4]. It is suitable for ability to take full advantage of non-trivial link between past and present values and for interpretability and transparency common to all linear models. Prediction on strictly independent test sample was developed, accurately assessing model's prediction abilities.

When searching for location arbitrage possibilities, analytical methods and comparison are used.

3 Research

3.1 Time electricity arbitrage (statistical)

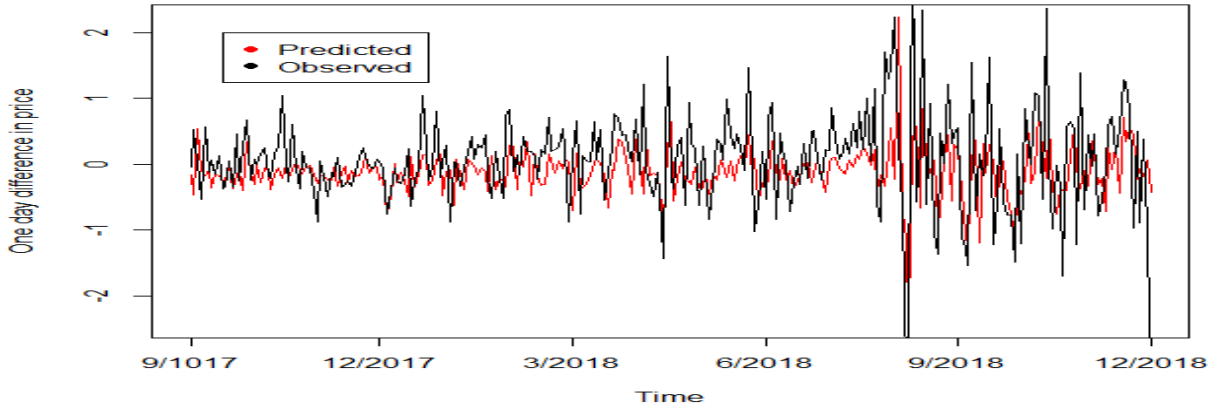
When looking for time arbitrage, time series that might affect electricity future were chosen from various fields and as well as their possible delay, so that it would be possible to predict on their behalf and thus gain profit.

Table 2. Econometric modelling output 2018

Predictor	Coefficient	P-value
AR 1	-0.471	0.003
MA 1	0.266	0.125
Gas NCG cal1	0.015	0.864
LGO	-0.006	0.017
EU emission allowance	0.570	0
Coal price index	0.110	0
Alternative power plant	0.007	0.009

Source: own data output from commodity markets' time series.

Table 3. Predicted vs. observed data



Source: own data output from commodity markets' time series.

Table 4. Output 2019

Predictor	Coefficient	P-value
Coal spot price Germany	-0.0052	0.0016
DAX index	0,0004	0.0001
NCG Germany cal+2	0.2178	0.0766
Weather – temperature	0.0148	0.0050
Coal index (NL)	0.0679	0.0144

sigma^2 estimated as 0.1672: log likelihood=-423.4

Source: own data output from commodity markets' time series.

Table 5. Confusion matrix

Obs. / Pred.	0	1
0	107	75
1	62	104

Source: own data output from commodity markets' time series.

Result of this econometric modelling is possibility to predict tomorrow price increase (based on today data) with 62 % chance, decrease with 59 %. This percentage seems a bit low, nevertheless using this strategy should be profitable in long term period. Final significant predicators for tomorrow electricity future price are today change in coal prices (reflecting that highest volume of electricity in Czech republic is produced in coal power plants, DAX (German stock index reflecting German economy), weather forecast for tomorrow (°C) and long-term gas contract price. We must consider not only the spread "gap", but also the fact, that this tool is only 10 % better then coincidence. R squared value would be around 0,1 explaining that 90 % is coincidence and we predict remaining 10 %., so therefore the model is very unstable, the key indicators and number can change within time, so they would have to be updated very often for commercial use. Even this might produce profits due to high volatility as presented below on Figure 1.

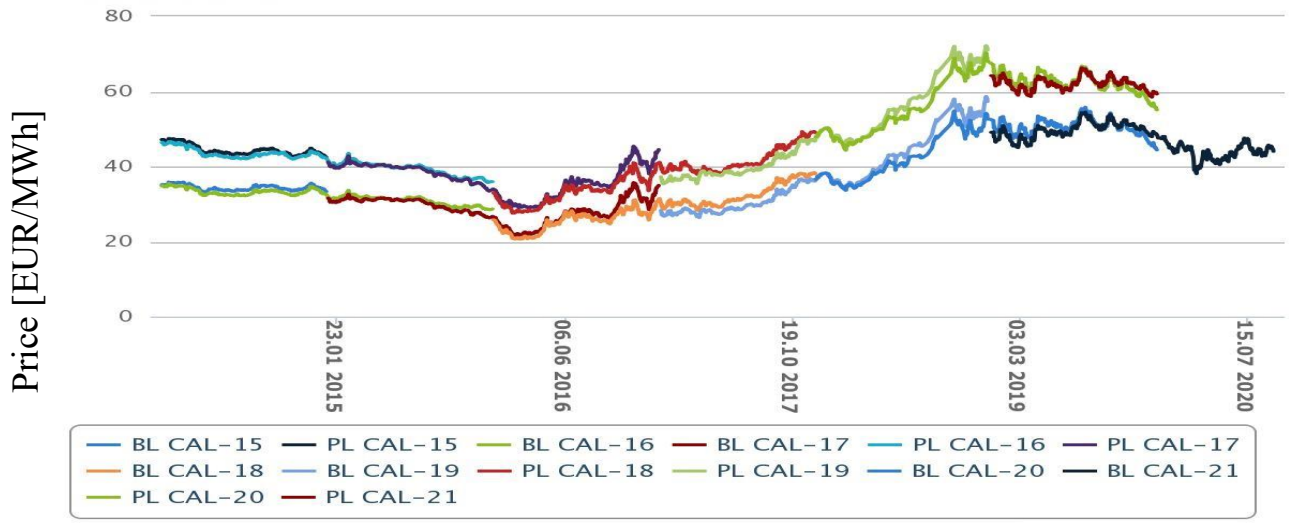


Fig. 1. Electricity price historical data (CZ cal+1) [8] (Source: www.pxe.cz)

This formula and economic modelling attitude might be applicable on any market in Europe, as the correlations are nearly 100 % (as in table 6)

Table 6. Correlation of Czech market with other European countries

	CZ
SK	0,9906
H	0,9537
RO	0,9596
PL	0,9664
SLO	0,9601
SRB	0,9666
BG	0,9252
D	0,9868
F	0,9747
I	0,9729

Source: www.eex.com, www.pxe.cz.

3.2 Location electricity arbitrage

In all countries with unmonopolized markets is the price outcome of supply and demand of the market, so every country has different electricity market price. There is possibility to buy product at different country and buy border transfer (transferring real commodity, so real delivery contract only, no financial settlement products). This service is operated by JAO company (jao.eu), running as an auction. On this auction there are used mostly daily, monthly and yearly products. If the bidder is successful (demand meets supply), there is allocated volume to be transferred. The winner does not have to use the whole volume (it is right to transfer, not obligation).

When looking on historical final data to answer, whether the transfer option is convenient and it is possible to gain better price using foreign future price and transfer option than domestic future, historical data from JAO were used. There is only one auction for yearly product for following year.

Table 7. Price comparison

CZ->SK 26.11.2019 for 2020 at 1,36 EUR/MWh, price differential of this day at EEX: 48,56 –> 44,8 = -3,76
SK->CZ 26.11.2019 for 2020 at 0,03 EUR/MWh, price differential of this day at EEX: 44,8 –> 48,56 = 3,76
DE->FR 14.12.2018 for 2019 at 6,34 EUR/MWh, price differential of this day at EEX: 50,93 –> 63,65 = 12,72
FR->DE 14.12.2019 for 2019 at 0,71 EUR/MWh, price differential of this day at EEX: 63,65 –> 50,93 = -12,72

Source: www.jao.eu.

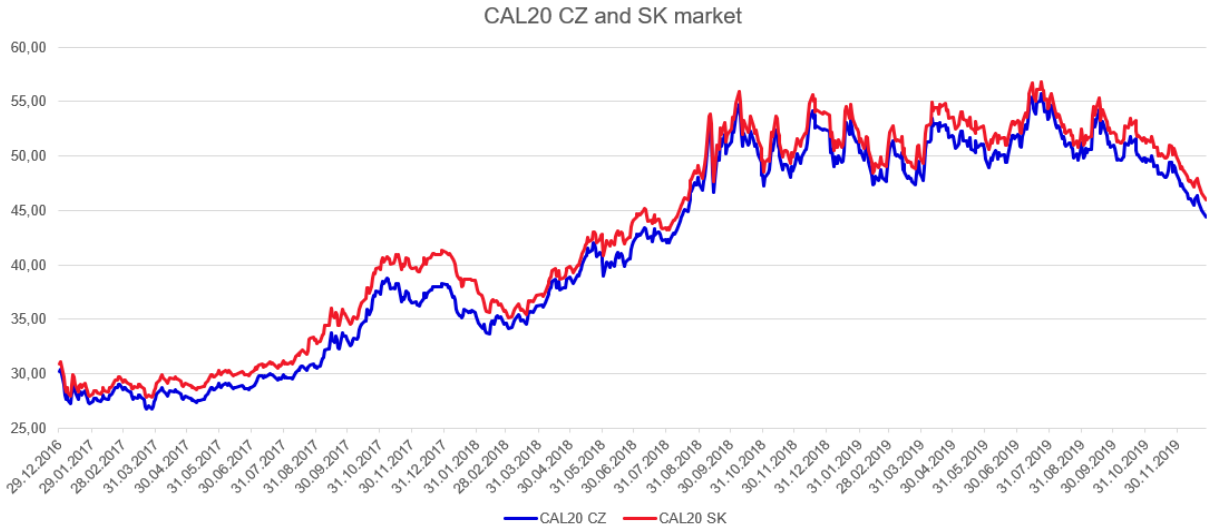


Fig. 2. CZ and SK market price historical differences for CAL20 (Source: pxe.cz)

From data mentioned above, it is obvious, that some transfers are more convenient than other, nevertheless, to make this deal and gain profit from it, there have to by some conditions fulfilled. The company must have status of electricity trader in both countries (necessary license in both countries), excessive volumes of electricity, that the company really needs to transfer and consume in different country, or to have a buyer of real commodity in this country. Only transferring to other country because of low transfer price and then selling the volumes on daily markets would be extremely risky. There is current trend, that spot prices are lower than future prices (but this can of course change).

To get real settlement future the first step would be contract with an electricity producer willing to sell, which would be further used for transfer. This real product is not hard to get, but it comes with guarantees and prepayments from the side of powerplant owner. Guarantees and prepayments are inevitable, as if the company buying the contract for next year goes into insolvency, there would be a not hedged delivery and loss would be on side of supplier (difference of settled and current price).

This means it would be more convenient if the delivery in other country is really needed in another branch of same company, then just buying the product for speculation on price difference. But even this scenario is possible – after calculating price difference in countries, nominating willingness to transfer between those countries for price lower than this difference, and if bid is successful, buying product in one country and look for buyer in another.

To sum up, As the products on EEX or PXE (Power Exchange Central Europe) are financial only, but border transfer rights are real deliveries, so it is not possible to think about buying financial product, buying border transfer (real) and sell it on another market as financial product. Nevertheless attendance of the auction is important for companies selling real product on several markets, so they can take advantage and transfer their own volumes (produced at their powerplants or bought from partner powerplants via bilateral contracts) to other countries and avoid higher price differences than transfer fee.

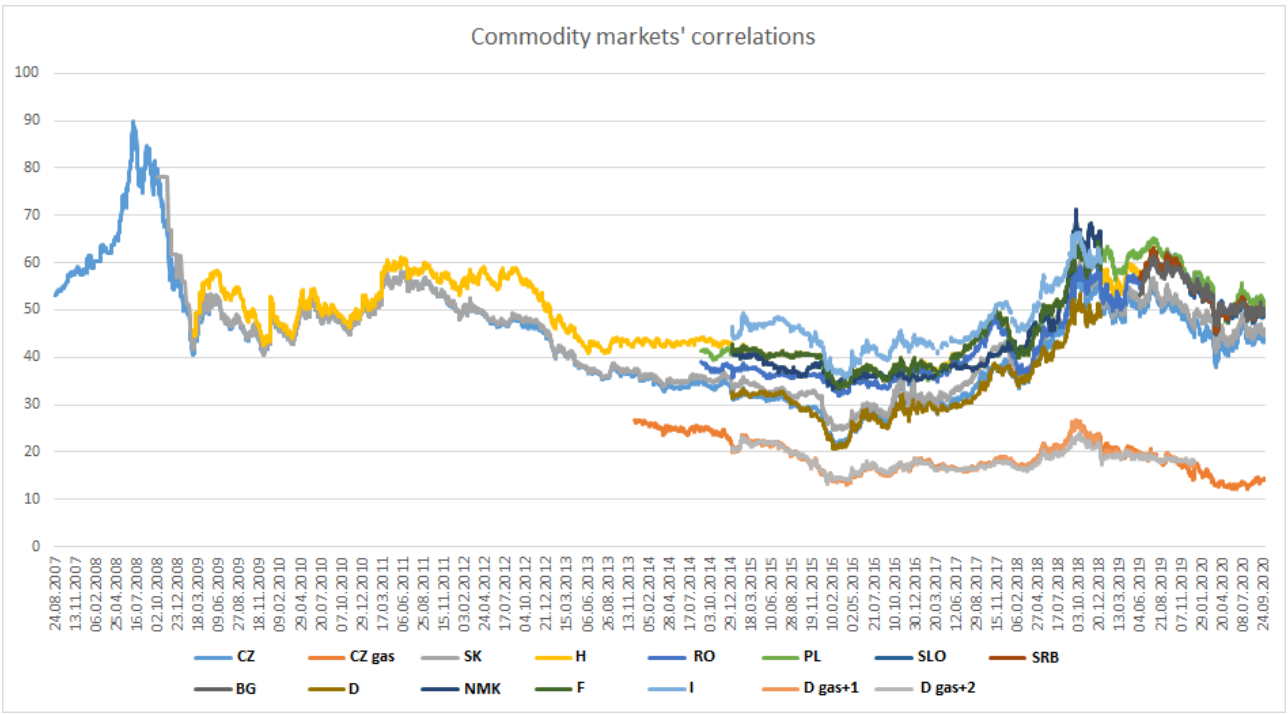


Fig. 3. Historical electricity prices (Source: own data output, www.pxe.cz; www.eex.com)

Taxes are another thing to be mentioned. As the condition is that the company must have branches and license in both countries, this trade is basically selling the volumes (revenues) at price raised by

transfer costs (costs –> revenues) from one company (from one branch) to another (costs). There is no VAT between electricity traders. This trade seems straightforward, but we can imagine situation, when in the portfolio of Czech company are several purchases with different price. Company decides to transfer part of it to branch in Slovakia, choses some exact deal that transfers (with additional costs) abroad. As the company has chosen some cheap purchase, potential profit was thus transferred from Czech Republic to Slovakia. In Czech Republic is corporate profit tax 19 %, meanwhile in Slovakia is 15 % (for smaller entities). Profit was realized in Slovakia when the electricity was sold to Slovak households and 4 % were saved on taxes.

3.3 Other arbitrage options in energetics

There is time to time another possibility of arbitrage in energy sector such as Euro-Asian LNG (liquefied natural gas) arbitrage in 2019. In this case it was convenient to transfer LNG on tankers, but this window usually closes quickly, as the market reacts on the arbitrage possibility with price reduction the or the arbitrager fills the gap. [8]

When looking for arbitrage opportunities, Balkan countries are in the field of energies said to be last haven, but also this gap is closing. [5]

Considering time arbitrage via real instrument, accumulator and pumped-storage power plants can be mentioned. The principle of consuming electricity at off-peak hours and delivering at peak hours is more and more popular, in case of accumulators, the investment return rate is getting under 10 years, resulting in future wider usage and production. [1]

4 Conclusion

It is possible to gain profits from both time and location arbitrage. The time arbitrage is possible and easiest way is purchasing futures (EEX – financial settlement) and sell it later, but the chance of success of prediction tool is 62:38, the price difference must exceed buy-sell spread, the model is very unstable and also it is connected with fees paid to the commodity exchange. If the company needs to buy some volumes anyway to final customers portfolio, they can make purchases regarding to this model prediction, if they are successful, they can sell some volumes with immediate profit, if not, they can hold this volumes as final real delivery prices (thus receive smaller profits in next year).

Location arbitrage is only reachable for product with real settlement and is convenient only if the volumes transferred via borders are consumed by the company branch or if there is a buyer willing to buy straight ahead, otherwise it would be too risky to wait on final prices on daily market. The transfers are with restricted capacities, which should be beard in mind when purchasing the remaining volumes. If successful, companies can gain here the profits from arbitrage as well as tax benefits.

Main contribution of this paper is advice for companies considering possibility to enter another market as well as all people working on research on factors having impact on electricity prices and market behavior. Main conclusion is knowledge, that we can partially predict tomorrow electricity prices, what factors have impact, that the model is keen for frequent changes and that having branches abroad can gain profits to companies trading electricity.

5 Acknowledgement

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BUSINESS MODELS OF MASSIVE OPEN ONLINE COURSES

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Abstract
The Massive Open Online Course (MOOC) educational platforms have emerged in the last ten years. Initially, they offered free online courses, and then, as the number of users increased, they tried out different business models in recent years. The purpose of our analysis is to examine which business models have been successful? We selected fifteen large MOOC providers and examined the services along which they generate revenue, and the monetization development steps they go through. The results show that MOOC providers initially offer their courses for free, allowing them to register a significant number of users. After that, one course or a group of them is offered for a fee. The largest MOOC providers, on the other hand, have begun to develop subscriber models in recent years, similar to large streaming providers. Collaborations with universities and the corporate sector play an important role in the development of business models. The results of the research may therefore be useful for both higher education institutions and large companies planning to establish a MOOC.

Keywords
MOOC, Digital platform, Business model.

JEL classification
I23, M14, O33

1 Introduction

Online platforms have begun to transform our daily lives in many areas in recent years, from shopping through banking to entertainment. Accordingly, the digital transformation of education has also begun. However, for this process to continue, online educational platforms like MOOCs need to find a business model that ensures their sustainable and profitable operations. In recent years, more than 900 higher education institutions have established MOOCs, and more and more large companies are developing on this topic. Therefore, the results of the research provide important information on what monetization steps as a provider of a MOOC lead to results and which are worth skipping.

In our research we are looking for the answer to the question what monetization tools are used by the largest MOOC providers to generate revenue. The number of students using Massive Open Online Courses exceeded 110 million in 2019, according to a survey by the Class Central education portal. In 2019, the largest MOOC portals were Coursera (45 million students), Udemy (40 million students), edX (24 million students) and Udacity (11.5 million students) (Shah, 2019). This trend continued in 2020 as a result of the COVID-19 global epidemic. For so many students, high-quality curriculum, seamless portal operation, and online customer service can only be provided at a huge cost.

It is an important challenge for MOOC providers to develop sustainable business models. In recent years, MOOC providers have tried to sell different service packages, first to individual consumers and then to corporate players. The first step of MOOCs from free courses to a profitable business model was to make a stand-alone course paid for. The fees for these courses range from a few tens of dollars to a few hundred dollars at major providers. An important moment was that after completing one such course, the participant received a certificate (Shah, 2018). The next level was the emergence of so-called "micro-credential" programs. As part of this, participants will no longer receive not only one course at a time, but a group of courses gathering specialized knowledge on a particular topic, as

well as certification that they have completed this complex program (Grau, 2018). Their fees have ranged from a few hundred dollars to nearly a thousand dollars, depending on the number of course components. As the next step in the evolutionary process the large MOOC providers started offering online degrees in partnership with universities. Obtaining these degrees already costs participants tens of thousands of dollars, but they still offer a competitive alternative to spending on degrees in the traditional higher education system. The COVID-19 global epidemic has also significantly transformed corporate training tools with the dynamic spread of the home office as a form of employment. All of this offers a huge opportunity for MOOC providers to form collaborative partnerships with the corporate sector and make their curricula available through corporate training programs.

This analysis is structured as follows: First we review the literature and definitions related to the development of business models and the MOOC movement. Then we examine the largest international MOOC providers along with the monetization steps they use. Finally, we analyse in relation to which tools we can identify common characteristics and patterns, as well as general development paths.

2 Review of literature

The term "Massive Open Online Courses" was devised by Dave Cormier in 2008 in response to the development of free, open, online courses which allow for an unlimited number of participants (Power & Coulson, 2015). Different from segmented learning objects or learning resources, MOOCs are a whole course experience with a predefined learning sequence (Phan et al., 2015). Inside this full learning sequence, learners can experience reading contents, meeting prestigious experts in the field, interactions, assessment, certification and reviewing archived courses any time after completion. Therefore building a MOOC is not just assembling a number of already existing documents and notes and quickly shooting some videos. It is much more demanding because all documents will be available worldwide and judged by numerous people (Epelboin, 2016). MOOCs are courses and not just published resources. A course differs from Open Educational Resources (OERs) in the sense that there is an underlying teaching concept in a digital environment based on a coherent topic divided into subtopics and implemented based on a pedagogical theory or an instructional design approach (Lin, 2019). If we look in detail at the dynamically growing companies in the educational technology sector, we can basically delineate two main service areas. Some of the startups were able to build a wide user base by developing platforms and frameworks that support learning, and the other half developed educational content in a popular topic (eg mathematics, English) (Bethlendi & Szőcs, 2019). The two primary, separate types of MOOCs, according to their pedagogical existence have currently been widely adopted as 'cMOOC' and 'xMOOCs' (Yousef et al., 2014). cMOOCs, in which knowledge and material from supporters are generated as they evolve during the training course, are involved in education focused on social networking (Wang et al., 2017). xMOOCs are instead official courses, which are also organised for regular academic courses, which include content-based lectures, video addresses, tests, and tasks as the main learning exercises (Janssen et al., 2016). Finally, those that consist of cMOOCs and xMOOCs characteristics are called as hybrid, or hMOOCs.

So nowadays a large part of learning happens in the virtual cloud. Social media in particular with their various functionalities of networking, sharing, blogging have a considerable impact on how learning experiences are designed (Bernhard et al., 2013). In recent years, however, the increase in the number of users and the need for continuous improvement have raised the question of how these online education platforms can be operated sustainably.

Every company uses a specific combination of assets and this utilization leads to the capabilities to build a business model that is unique to its goals. In today's fast changing environment these capabilities will make the difference between innovation leaders and the competitive advantage of business models. (Ahmad et al., 2020). Traditionally a business model can be defined as "a summation of the core business decisions and trade-offs employed by a company to earn a profit"

(Hamermesh et al., 2002). On the other hand "a business model describes the rationale of how an organization creates, delivers, and captures value" (Osterwalder & Pigneur, 2010). Kalman identified the following three components of business models: (1) Customer Value Proposition; (2) Infrastructure (both resources and processes) and (3) Financial Aspects (Kalman, 2014).

The digitalization of products and complementary services can enable or require different forms of company monetization, or even adjustments to companies' business scope if other markets or new customer segments are addressed (Hess et al., 2020). As a result of the development of the digital economy, business models have undergone dynamic development and diversification in recent years. A 'digital business model' can be defined as the underlying business logic deliberately acknowledges the characteristics of digitization and takes advantage of them; both in interaction with customers and business partners and in its internal operations (Bärenfänger & Otto, 2015). By Bock and Wiener, digital business models are described as "business models for [products and] services provided through digital platforms" (Bock & Wiener, 2017). Remane et al. point out that digital business models rely on platforms (Hanelt et al., 2017). The pursuit of a digital business model requires a robust and flexible enterprise platform, on which smart products and digital (smart) services can be readily delivered (Sia et al., 2016).

According to Class Central 's analysis, the largest MOOC providers have gone through the following evolutionary process in developing their business model. Originally, all MOOCs were offered as free courses. The big MOOC providers now have developed products and services that range in price from free (or partially free) to hundreds of thousands of dollars. Class Central has identified six different tiers that MOOC providers monetize on. To be clear not all MOOC providers monetize their courses at all six tiers (Shah, 2018)

Fig. 1. Six tiers of MOOC monetization (Shah , 2018)

3 Research methodology and examined data

To analyse the monetization tools presented above, we need to assess which of these are used by the large MOOC providers. Accordingly, we selected fifteen major international MOOC providers as part of our analysis. The first MOOCs originated in the United States, but several major international players have emerged in the last nearly ten years. In Europe, the UK and Scandinavian countries have traditionally been strong in digital education. Recently, however, MOOCs based on German, French and Spanish language courses have also been able to present a significant number of users. At the global level, MOOCs in China and India have started to grow dynamically, building on the significant number of user bases achieved domestically.

In examining the revenue potential of MOOCs, we used, on the one hand, the MOOC monetization observations of six tiers according to Shah (Shah, 2019). On the other hand, we examined what additional monetization tools have recently been introduced by the largest service providers. It is then analyzed which monetization instruments are the most typical within the study group, and what common patterns the MOOCs show in relation to the developmental phases.

3.1 Sample

The range of MOOCs included in this study was determined based on the related literature and online analyses. In 2020, the number of users of all MOOC providers is expected to increase because of the COVID-19 global epidemic, however, related analyzable data will only be available in Q4 or early 2021. This analysis examined data from the following fifteen MOOCs:

Table 1. Fifteen international MOOC providers examined in the analysis

MOOC	Headquarters Location	Number of learners[1]
Coursera	Mountain View, California, United States	45 million**
Udemy	San Francisco, California, United States	40 million**
edX	Cambridge, Massachusetts, United States	24 million**
Udacity	Mountain View, California, United States	11.5 million**
Kadenze	Valencia, California, United States	no data available
LinkedinLearning	Carpinteria, California, United States	17 million***
Skillshare	New York, New York, United States	8 million***
FutureLearn	London, England, United Kingdom	12,5 million***
Openclassrooms	Paris, Ile-de-France, France	2 million***
Coorpacademy	Lausanne, Vaud, Switzerland	0,8 million ***
iversity	Berlin, Berlin, Germany	0,75 million *
FUN-MOOC	Paris, Ile-de-France, France	no data available
Miríadax	Madrid, Spain	no data available
Swayam	Kolhapur, Maharashtra, India	10 million**
XuetangX	Beijing, Beijing, China	16 million**

Source: own editing.

Constantly updated information is available on the service providers' portals about which MOOCs offer free courses or provide certification or micro-credential programs. In connection with the credits and online diplomas accepted by the universities, not only the respective MOOC providers, but also the relevant higher education institutions carry out an active communication campaign. Information related to corporate training and services is available on the MOOC websites under the "for enterprises" or "for business" menu items, typically on a separate subpage. The data for monetization tools analyzed for the fifteen MOOC providers examined are summarized in the table below:

Table 2. Monetization tools of the fifteen international MOOC providers examined

	Certification	Online degrees	Corporate trainings	Subsciption model
Coursera	1	1	1	1
Udemy	1	0	1	0
edX	1	1	1	1
Udacity	1	1	1	1
Kadenze	1	0	0	1
LinkedinLearning	1	0	1	1
Skillshare	0	0	0	1
FutureLearn	1	1	1	1
Openclassrooms	1	1	1	1
Coorpacademy	0	0	0	1
iversity	1	0	1	0
FUN-MOOC	1	0	0	0
Miríadax	1	0	1	1
Swayam	1	0	0	
XuetangX	1	0	1	0

Source: own editing

[1] MOOC providers does publicate only their last number of learners and they update it irregularly. Therefore it is not possible to collect information for a given time.
*Data of 2018, **Data of 2019, ***Data of 2020

4 Empirical results and discussion

When a MOOC platform launches and a large number of courses are not yet available, users can be collected with the promise of free service. As the number of courses grows, MOOC providers are asking for a fee for a course or group of courses or related certificates in the most popular topics. Ruth introduced in 2012 that offering courses for free and learners pay for certification, examination, and teaching assistance is a potential business model for MOOC providers (Ruth, 2012). The question here is whether these certificates will be accepted. To achieve this, MOOCs should meet the market needs by providing high-quality content as well as high-quality outcome (Lambert & Carter, 2013). And when thousands of courses are available on the portal, it is possible to introduce a subscription model on a monthly or annual basis.

For consumers to be willing to sacrifice more money for online training, MOOC providers had to also open to reputable higher education institutions. In the evolution of business models, large MOOC providers have realized that they could gain a broad consumer base if universities are willing to accept the completion of their courses in the form of credit points. Green (2013) believes that if the universities provide MOOC credits, this will be a potential route to accept these certificates in the real market (Green, 2013). Moreover, this year has given a strong boost to the corporate sector to provide employee training not only in classrooms but also online. All of this is also an important monetization opportunity for MOOC providers.

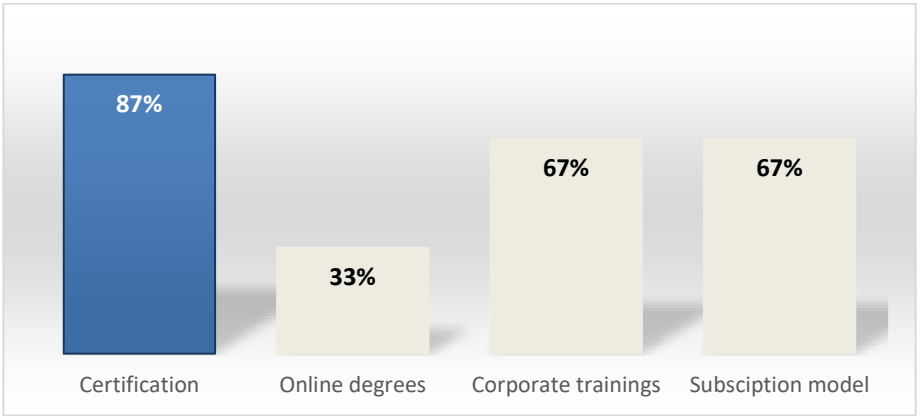
4.1 MOOC Certificates

The first step for most large MOOC providers towards a profitable business model was the fee charged for the certificates. Many courses offer a certificate but require participants to pay a fee for this. For 87% of the MOOCs analyzed, training-related certificates are an important monetization tool. In addition to individual course certificates, some providers have created their own certificate programs. These programs are something between a single course and a full degree, and they usually involve taking a sequence of courses. Examples of these would be Coursera's Specializations, edX's XSeries, or Udacity's Nanodegrees (Shah, 2018). The grouping of courses led to the next step in the development of business models for MOOCs, micro-credential programs.

MOOC providers have bundled some courses into so-called micro-credential programs, for which certificates are also important sources of revenue. The current offer of various micro-credentials lacks consistency and standardization, making it difficult to evaluate their significance and compare them, for both learners and employers (Pickard et al., 2018). The European MOOC Consortium, consisting of FutureLearn, France Université Numérique (FUN), OpenupED, Miríadax and EduOpen, announced a Common Microcredential Framework in May 2019. The framework aims at creating standardization among the micro-credential offers by Europe's leading MOOC platforms and the universities within their networks.

In the popularity of certificates LinkedIn as a professional social media platform, plays a major role. After all, today we not only take an online course, but we also post the related certificate right away, thus building our individual brand.

Table 3: Certification as a monetization tool for MOOC providers



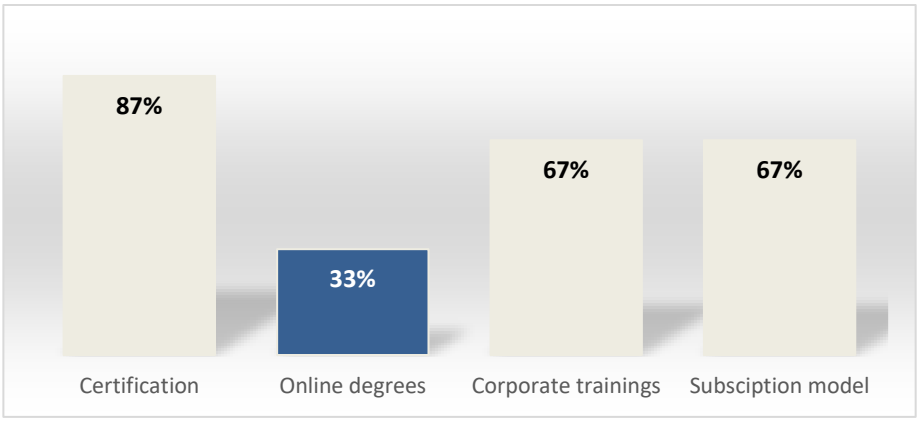
Source: own editing

4.2 Online degrees

During the development of the business model of MOOCs, the next stage of development was related to higher education institutions. The large MOOC providers started offering online degrees in partnership with universities. The Online Master of Science in Computer Science (OMSCS) from Georgia Tech via Udacity, was announced back in 2013. It took two years for the next one (the iMBA from the University of Illinois via Coursera) to be announced in 2015. By early 2017 at least nine master's degrees were available through MOOC platforms. Now, mid-2020, there are no fewer than 55 degrees that can be completed online, through a MOOC platform (Ledwon, 2020). Obtaining these degrees already costs participants tens of thousands of dollars, but they still offer a competitive alternative to spending on degrees in the traditional higher education system. This step of development is no longer easy for MOOC providers to leap forward, and reputable universities typically enter such partnerships with the largest players.

Acceptance of courses as university credits and the issuance of online diplomas are not common even among the largest providers. This is most likely since a significant regulatory environment around the world protects the accreditation processes of higher education institutions. Consistent with this, only 33% of the MOOCs surveyed can also provide online degrees and generate revenue from them.

Table 4: Online degrees as a monetization tool for MOOC providers



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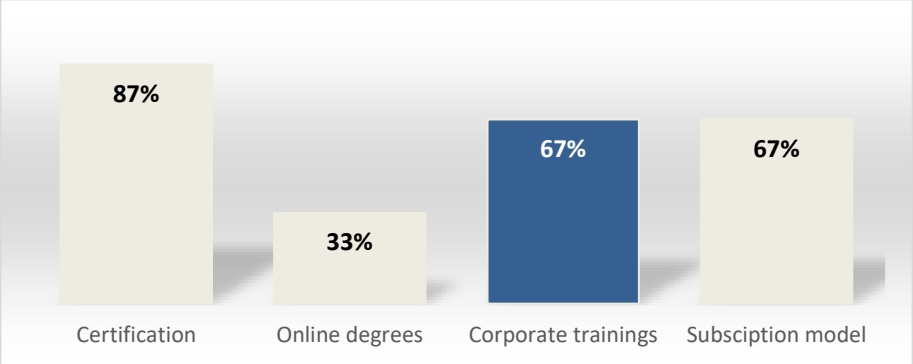
4.3 Corporate training

In spring 2020, Georgia Tech began porting their Udacity courses to Canvas, the university's learning management system. Existing courses would remain available on Udacity as MOOCs. However new courses, such as AI, Ethics, and Society or Deep Learning, would be released directly on Canvas. Georgia Tech has stopped creating Udacity accounts for new OMSCS students, ending the seven-year partnership between the university and the online course provider.

This example may caution large MOOC providers to base their business models solely on collaborations with large universities. For MOOCs, however, there is a significant market opportunity that has become even more important due to the COVID-19 global epidemic. This is the market for corporate online trainings and can be an important area of development and growth for all MOOC providers. It is consistent with that 67% of the portals surveyed are open to this service and revenue generation opportunity in recent years.

Table 5: Corporate trainings as a monetization tool for MOOC providers



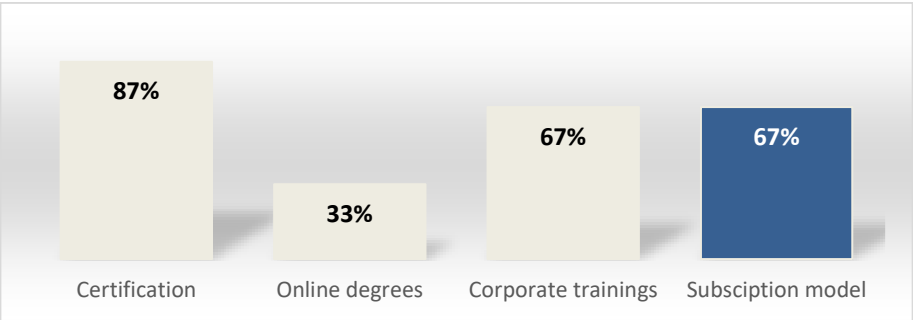
Source: own editing

4.4 Subscription model

Since the early 2000s, the digitization has led to a revival of subscription models, driven at first by purely digital goods, such as multimedia streaming services (e.g., Netflix and Spotify) (Rudolph et al., 2017). In order for MOOC providers to be able to use this monetization tool, they had to get to the point where someone could already access hundreds or even thousands of courses on the portals in exchange for a subscription fee. For the first time, MOOC providers typically offered an annual fee, but in 2020, several large portals already offered the opportunity to use their courses with a monthly subscription. This is probably because service providers can reach more students with lower monthly subscription amounts.

For two-thirds of the MOOC platforms included in the analysis, some form of subscription model has already been introduced, with either annual or monthly fee payments.

T**able 6:** Subscription model as a monetization tool for MOOC providers



Source: own editing

5 Conclusion

The barely ten-year history of online education portals provides important experience with business models for digital platforms. Like social media and streaming service portals, MOOCs first also offer free access to their digital content, reaching a broad user base. After that, several paths are open to service providers. Individual courses or groups of courses (micro-credential programs) are offered for a set amount, and the related certificates are the main value proposition. On the other hand MOOC providers started to develop partnerships with reputable higher education institutions and the corporate sector to form quasi-distribution partnerships. Moreover, when an online education platform can already offer thousands of curricula, the possibilities of different subscription models open up. Subscription models allow us to really learn at any time with the help of online video learning materials, which are available in an ever-widening range.

The most of fifteen analyzed MOOC providers have often tried these monetization tools in parallel, and the individual stages of evolutions steps cannot be delimited purely in time or in terms of their implementation. As the next step of our research, we will examine the further expansion of the range of monetization tools. The year 2020 created a difficult economic situation for many sectors, but online education portals have been given the opportunity to sell their services more widely than before. An important question will be whether MOOC providers have been able to take advantage of this historic opportunity.

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THE LINK OF PROCESS MINING TOWARDS BUSINESS PROCESS MATURITY MODELS

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Abstract
Every company nowadays encounters business processes and many of them try to implement elements of Business Process Management (BPM). The domain of BPM is more and more comprehensive as the number of tools and procedures increases. Thus, it is necessary for the companies to assess their process maturity, which if done correctly, serves as an evaluation of current state and first step towards appropriate strategy. Maturity models are broadly adopted in BPM domain, but the incorporation of process mining techniques is missing. This paper firstly addresses assumption that implementation of process mining techniques into enterprises across all maturity model stages is possible and beneficial for the company. Secondly, author present the connection between BPM maturity models and process mining techniques through a case study, based on available real life event logs.

Keywords
Business process management, Process mining, Business process maturity model, Process analysis.

JEL classification
M15, M21

1 Introduction

Business Process Management (BPM) has become a centrepiece for lot of companies and researchers over the last 15 years. It provides them with the holistic organizational management practice that aims to transform the organization into process-oriented one. From the standpoint of researchers and academics, it is interesting due to the strong foundation that derives and builds on the existing proven approaches such as Business Process Reengineering, Total Quality Management, operations management (e.g., Kanban), business process modeling and process-aware information systems (Jeston and Nelis, 2008), etc. According to Dumas (2013), BPM is a boundary-spanning field that serves as a melting pot for otherwise separate communities. These are the main arguments for raising popularity, attractiveness and relevance of BPM.

This paper addresses two prerequisite concepts, which fall below the auspices of BPM that are BPM maturity models and process mining. Process mining is a relatively new discipline and in the recent years it has been related to many BPM concepts like, e.g., BPM lifecycle, lean production, etc. However, to our knowledge, close relation between BPM maturity models and process mining is missing throughout the literature. Thus, we investigate (1) if it is possible to use process mining techniques across all maturity stages of the company, (2) possible use of process mining techniques in relation to different maturity stages of the company and (3) ways in which process mining techniques help to fulfil requirements of different maturity stages. In order to fully understand the context, theoretical anchoring within BPM and process mining is necessary. The concept of process-oriented organization is described by Willaert et al. (2007) who claims that as organizations accumulate efforts in process improvement they gain experience and develop a process-oriented view. McCormack and Johnson (2001) provide more elaborate explanation as follows: "Business Process Orientation of an organization is the level at which an organization pays attention to its relevant (core) processes (end-to-end view across the borders of departments, organizations, countries, etc.)". However, both previous definitions are abstract and hard to implement by the company without any experience with BPM or process-oriented approach. Thus, maturity models were introduced as a tool for assessing the level of process maturity of the company to make implementation of BPM ideas clearer and better graspable. The idea of maturity has been proposed for a number of management approaches as a way to evaluate "the state of being complete, perfect, or ready" or the "fullness or

perfection of growth or development". As the Iversen et al. (1999) says maturity models are used to assess as-is situations, to guide improvement initiatives, and to control progress. The Kuznets (1965) adds that it should include the characteristics of each stage and the logical relationship between them. De Bruin et al. (2005) stated three purposes of using the BPM maturity models which are descriptive, prescriptive and comparative. Descriptive purpose means only the situation where as-is assessments are applied to finding out what is the maturity level of the organization. The prescriptive purpose is the ability to outline the future potential maturity levels and provide guidance in process of implementing improvement measures. If the maturity model allows internal or external benchmarking then it fulfils the comparative purpose.

There is a high amount of BPM maturity models (Rosemann and de Bruin, 2004; de Bruin and Rosemann, 2005; Rummler and Brache, 1990; Maull et al., 2003; Fisher, 2004; McCormack et al., 2009; Hammer, 2007; Harmon, 2004; Weber et al., 2008; Lee et al., 2007) and most of them are inspired by Capability Maturity Model. It was developed for management of software development processes, but over the years, it evolved to different domains such as BPM. Röglinger et al. (2012) conducted a systematic in-depth literature review of BPM maturity models with the aim of mapping the existing BPM maturity models and analysing their applicability and usefulness. This was done by analyzing models against a framework of design principles mentioned before: (1) descriptive, (2) prescriptive and (3) comparative. For purpose of this paper, de Bruin and Rosemann (2005)'s BPM maturity model was selected as a reference maturity model. It is because of the clear descriptive purpose that is according to Röglinger (2012) review sufficiently met. Another reason is widespread of the model and number of citations of model and their extensive work on BPM maturity models. In the following section, we introduce BPM maturity models and de Bruin and Rosemann (2005)'s BPM maturity model is introduced as a theoretical basis and reference model. Third section is dedicated to introduction of process mining and its relation towards maturity stages. In the fourth section, we present results of case study based on real company's data and demonstrate the use process mining techniques in combination with comparative BPM maturity models. In the last section, we conclude and discuss our results.

2 Business Process Management Maturity Models

The BPM maturity model presented in work of Rosemann and de Bruin (2004) has a strong methodological basis, and it was validated number of times to ensure correctness and reliability. Their motivation was to overcome shortcomings of existing BPM maturity models. These shortcomings are missing rigor in the development phase, lack of empirical tests and depth in assessment levels (de Bruin and Rosemann, 2005). Despite these limitations, their proposed BPM maturity model extends and updates models and concerns about them from past such as the work from Pritchard and Armistead (1999), Maull et al. (2003) and DeToro and McCabe (1997).

Fig. 1. illustrates extended version of Rosemann, et al. (2004)'s BPM maturity model. The extended version differs in number of used factors and added dimensions of coverage and proficiency. The extended model shown in Fig. 1 is a multidimensional model that works with four different components – (1) stage, (2) factor, (3) scope and (4) coverage and proficiency. Factors were derived from existing literature and further developed and incrementally improved as the research progressed and feedback was obtained. Purpose of this dimension is to cluster individual factors that have an impact on BPM success to be able to identify strength and weaknesses. Identification of organizations' strength and weaknesses is necessary for tailoring the specific BPM strategy. Rosemann and vom Brocke (2015) call these factors six core elements of BPM. The first factor is strategic alignment (1). According to Rosemann and vom Brocke (2015) it is defined as a tight linkage of organizational priorities and enterprise processes enabling continual and effective action to improve business performance. Next is governance (2) which means accountability in terms of roles and responsibilities across the organization for different levels of BPM. Methods (3) are formulated as a set of tools and techniques that supports the processes through-out their life-cycle. Factor

information technology (4) is closely related to the factor methods. IT-based solutions are of significance for BPM initiatives, especially as they continue to manifest themselves as process-aware information systems (PAIS). Such system has an explicit understanding of the process that needs to be executed. Next important factor is people (5) which is defined as an overall capabilities of company's human capital in a process-oriented manner. These factors are forming culture (6) that creates an environment that complements the various BPM initiatives. Based on measurable aspects of culture called values, it is determined if the culture will be BPM-supportive. Generally speaking, factor dimension is considered across different BPM maturity models like, e.g., de Bruin and Rosemann, 2005; Fisher, 2004; McCormack et al., 2009; Harmon, 2004; Weber et al., 2008; Rohloff, 2009, as prior BPM maturity models were simplified and utilized only one or two dimensions.

The two scopes that are represented on the right side of the "cubic model" are the organization and time scope. The organizational scope is describing the entity or unit of analysis to which model is being applied. This enables the internal benchmarking and specific BPM strategies to be implemented in alignment with a specific business unit or subsidiary. The time scope shows the time frame in which the model has been applied. Additional two dimensions that were added to the model in the last update are coverage and proficiency. The coverage is the extent of the BPM practice extension in the organization and by proficiency is meant the quality of BPM capabilities in assessed organization.

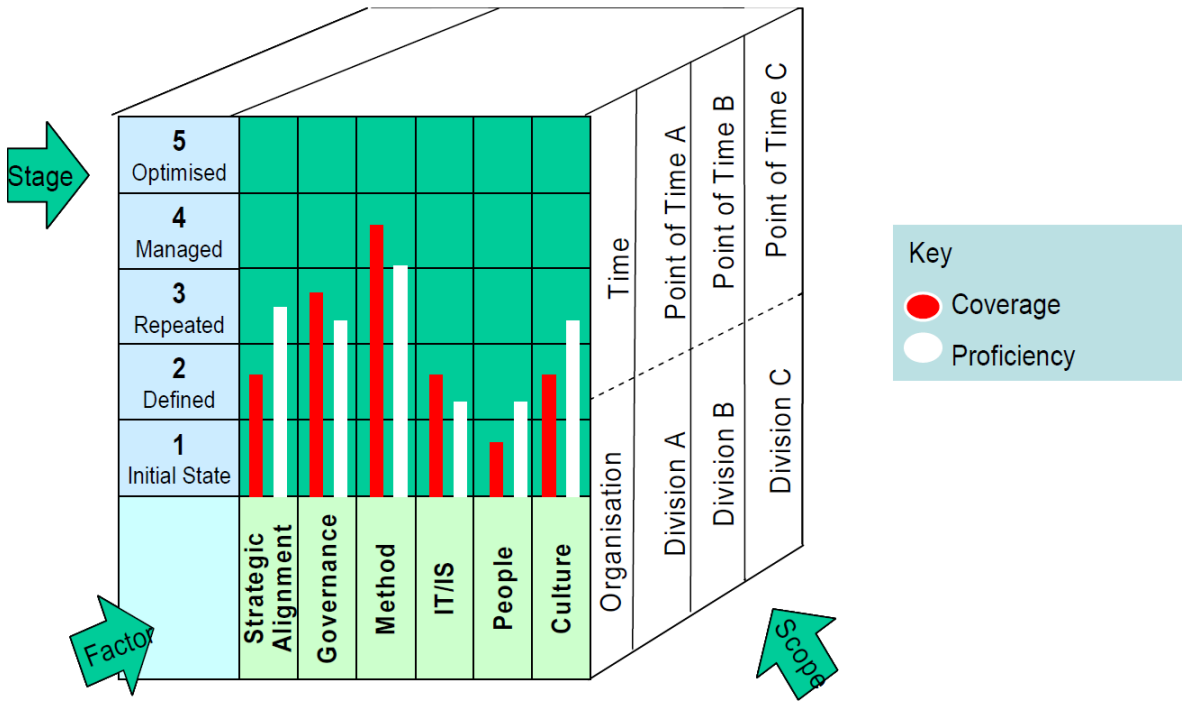

Fig. 1. BPM maturity model (Source: de Bruin and Rosemann (2005))

Next dimension is the maturity stage. It is based on the Capability Maturity Model and it forms the scale on which the quantification and summarization is done. Factor and other dimensions differ throughout different BPM maturity models. Thus, it is difficult to work with them as a whole. Maturity stages also differ based on methods of measurement, evaluation criteria, monitored aspects, etc. However, the goal of the BPM maturity models is the same that is assessment of sophistication of approach towards realization of BPM in the company. Thus, we are able to unite different BPM maturity models through the required outcomes of maturity stages. Due to the diverse nature of BPM maturity models and the fact that highest maturity stage does not have to be optimal for the company, there is not a common set of best BPM practices that is equally good for every organization. Nevertheless, based on the required outcomes of particular maturity stages, we are able to show that

process mining provides companies with a set of techniques for every maturity stage across different BPM maturity models.

3 Process mining

Process mining is relatively new discipline in BPM combining the process-centric view of BPM with a data-centric view of data science. Thus, one can define process mining as a group of techniques that focuses on extraction of information from big volumes of data produced by company's information systems. BPM and similarly process mining are raising on popularity nowadays, because the possession of information system is not a privilege of large companies anymore. Moreover, there are several other factors like, e.g., digitalization, globalization, etc.

There are several main areas in process mining: process discovery, conformance checking, enhancement and operational support. Process discovery is a group of techniques which objective is to find patterns in logs and based on them to build process models (Medeiros, Aalst and Weijters, 2003). Conformance checking is used for assessment of quality and fit of process models (Aalst, 2005). Enhancement focuses on improving efficiency and effectiveness of processes and it is very dependent on previously mentioned areas. Operational support is done online and allows working with processes in the real time (Aalst et al., 2011).

BPM ideas are generally not easy to implement as was shown many times in the past. Moreover, processes should be managed continuously. Thus, during the implementation of such BPM ideas, maturity stage of the company plays significant role. Especially, if we consider that company's maturity stage is in de Bruin and Rosemann (2005)'s and other models evaluated with respect to every dimension and thus, company can find itself in different maturity stages considering different dimensions. In addition, thorough investigation is needed in order to determine company's overall maturity stage. All of this is very hard for the company to do, as it needs someone who is well acquainted with the company and someone who is expert in the field of BPM.

Generally speaking, process mining is much less demanding on expert knowledge in both areas. Firstly, process mining is data driven and one of its advantages is that one gains view of the real process based on the data describing the process. Such information acquitted through interviews and workshops from the managers might be lot of the times distorted, inaccurate and incomplete. On the other hand, we do not argue that these methods are improper or inferior, but rather alternative approaches with specific advantages and disadvantages. Secondly, due to the high amount of process mining software packages that are able to do the process mining analysis without much of a mandatory input from the user and then present gained information through the use of appropriate visualization techniques. Thus, it is easier for the company to utilize process mining techniques rather than some BPM techniques and methodologies like, e.g., six sigma, lean, lean six sigma, root cause analysis, workshops, etc. This is true especially for the companies characterized by lower levels of stage maturity. Fortunately, process mining provides solutions for every stage.

Table 1. Linkage of process mining techniques towards united outcomes of different BPM maturity models

	United outcomes of different BPM maturity models	Linkage of process mining towards BPM maturity stages
Stage 1	Reactiveness towards BPM; undefined processes and subprocesses, ad hoc interventions without formal measurements; changes implemented locally without cross-organizational communication; minimal involvement of IT department.	Defining business processes and subprocesses with use of automated process discovery (heuristic mining, fuzzy mining, alpha algorithm, inductive mining, etc.). Ad hoc interventions with use of heuristics and measurements built-in process mining tools.
Stage 2	Limited cross-functional integration and team coordination; processes driven by systems, some processes defined; changes in processes are one-time efforts; limited measurements and standards, monitoring and controlling of small parts of processes.	Further discovering and defining of processes as result of cross-functional integration. Monitoring of alignment of defined and underlying processes with use of conformance checking techniques (replay techniques, trace alignment techniques, behavioural alignment techniques, etc.).
Stage 3	Adaptiveness towards process changes within few months; established formal goals and individual process metrics; transition from functional towards process-centric approach, well defined process structures; some process resources defined.	Controlling the achievement of the set goals based on established metrics and investigation of reasons for deviations with use of variants analysis techniques (log delta analysis techniques, outlier detection techniques, clustering techniques etc.).
Stage 4	Adaptiveness towards process changes within weeks, process-centric focus; process metrics as main performance measures with focus on continuous improvement; focus on optimization of processes; initial vertical integration of processes, employment of BPM solutions/tools.	Improving adaptability of processes by addressing concept drift from different perspectives like, e.g., control-flow, data and resource perspectives, etc. Employment of commercial process mining tools like, e.g., Celonis, Minit, MyInvenio, etc.
Stage 5	Proactiveness towards BPM at highest level; support of monitoring and predictive capabilities based on well measured and managed processes, near real time adaptiveness with focus on efficiency, effectiveness and consistency of processes; total process integration across organization with possible horizontal integration.	Use of cross-organizational mining techniques to address both vertical and horizontal integration with focus on mostly on commonality and collaboration between organizations. Use of knowledge of operational support for management of processes in real time like, e.g., risk and maintenance prediction, resource allocation, enhancement of negatively deviating cases.

Source: authors' own.

In the initial state stage (relates to Stage 1 in Table 1.), companies are not process-oriented at all, they mainly focus on functional or production areas. Companies have little understanding of end-to-end processes and that is worsen by the fact that companies' departments either do not cooperate or compete among themselves. At this stage is not aware of need of management of business processes and business processes are not addressed at all or just partially. In the defined stage (relates to Stage 2 in Table 1.), company starts to combine different function areas into new dimensions of the process. Sometimes business process modelling might be involved through the IT department of the company. Processes start getting into the background of companies' culture characterized by cross-functional department cooperation. In the third stage called repeated (relates to Stage 3 in Table 1.), companies' management starts to link strategy, processes and companies' goals. Companies at this stage are working with global processes and they pursue its continuous improvement. Companies' culture pays attention to process values and employees are accustomed to cross-functional cooperation and communication. IT moves activities from people to rule-driven services. In the managed stage (relates to Stage 4 in Table 1.), process architecture involves also external actors like suppliers and customers. Strategic goals are linked to complicated process webs and are set up by process performance and changes. The cross-functional cooperation and communication becomes integral part of organizational culture. IT help to utilize BPM to automate process execution and monitoring. In the final stage called optimized (relates to Stage 5 in Table 1)., the process-centrism transfers also onto companies' partners. Companies' gain predictable capabilities and thus market advantage. They are able to deal with dynamically changing environment and respond in real-time. BPM becomes part of

companies' culture. In this paragraph, we related different process mining techniques to de Bruin and Rosemann (2005)'s maturity model. Table 1. shows the relation of different process mining techniques towards united outcomes of maturity stages of different BPM maturity models. Table 1. shows possible use of different process mining techniques in different maturity stages and simultaneously several ways in which process mining techniques help to fulfil requirements of different maturity stages. One can also see, that process mining techniques are useful tool across all maturity stages. Notice that techniques appropriate for Stage 1 are also appropriate for companies in later stages (Stage 2 through 5), in case of Stage 2 it applies for stages 3 through 5, etc.

4 Analysis of two processes and results of the analysis

In this section, we analyse the same loan process of the same financial institution, but with a different time span. Thus, we show the potential of process mining with respect to comparative BPM maturity models with use of real data sets. We show only several selected techniques and related results. However, there are other techniques from areas of alignment of business process or deviance analysis, etc. The first data set is from year 2012, which means there is data from year 2011 and partially from 2012. The second data set is from year 2017, which means there is data from year 2016 and partially 2017. Even though we analyse the same process, as we show the processes are not the same as the company clearly enhanced it. In our analysis we focus mainly on structural and performance differences. We are not always able to address specific reasons for the changes as we use publicly available data and we are not able to obtain further information from the company.

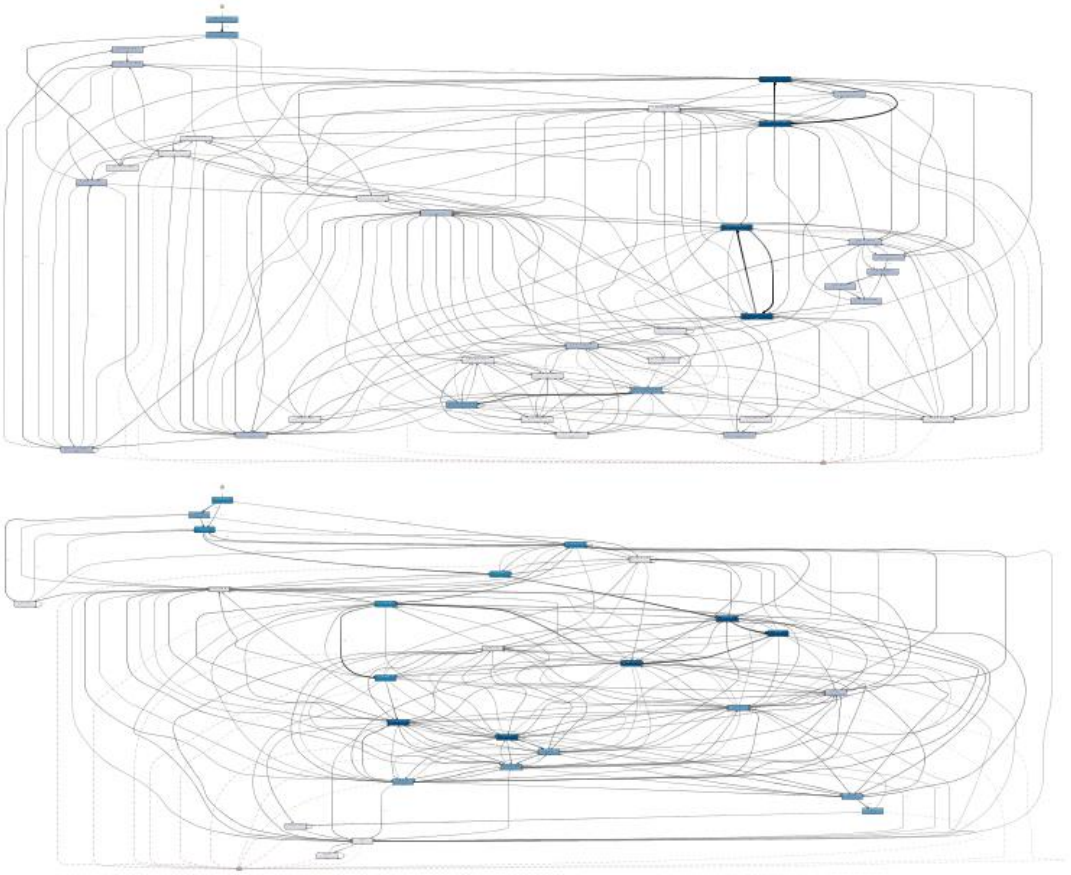

Fig. 2. Raw process model of 2012 log (top part) and raw process model of 2017 log (bottom part) (Source: authors' own)

Table 2. Fundamental characteristics of 2012 and 2017 logs

	2012	2017
Number of events	262000	561671
Number of cases	13087	31509
Number of activities	36	26
Median case duration	19,4 hours	19,1 days
Mean case duration	8,6 days	21,9 days

Source: authors'own.

Fig. 2. shows raw process models of 2012 and 2017 logs. Both logs are in form of so-called spaghetti models (Aalst, 2016). To make both models more understandable and analysable, we apply several metrics, filters and other process mining techniques. These steps help us to explore both logs and changes to the process made by the company. Table 2. presents fundamental characteristics of 2012 and 2017 logs. As one can see, characteristics "Number of events" and "Number of cases" is significantly higher in 2017 than in 2012. That is because in the 2012, data represents only a time span of 166 days, while in 2017 the time span is 398 days. The financial institution was able to reduce the number of activities forming the overall loan process by almost 30 % (27,8 %) from 36 to 26 during the years 2012 – 2017 and thus, remove 10 non-value adding activities that were decreasing the efficiency of the process.

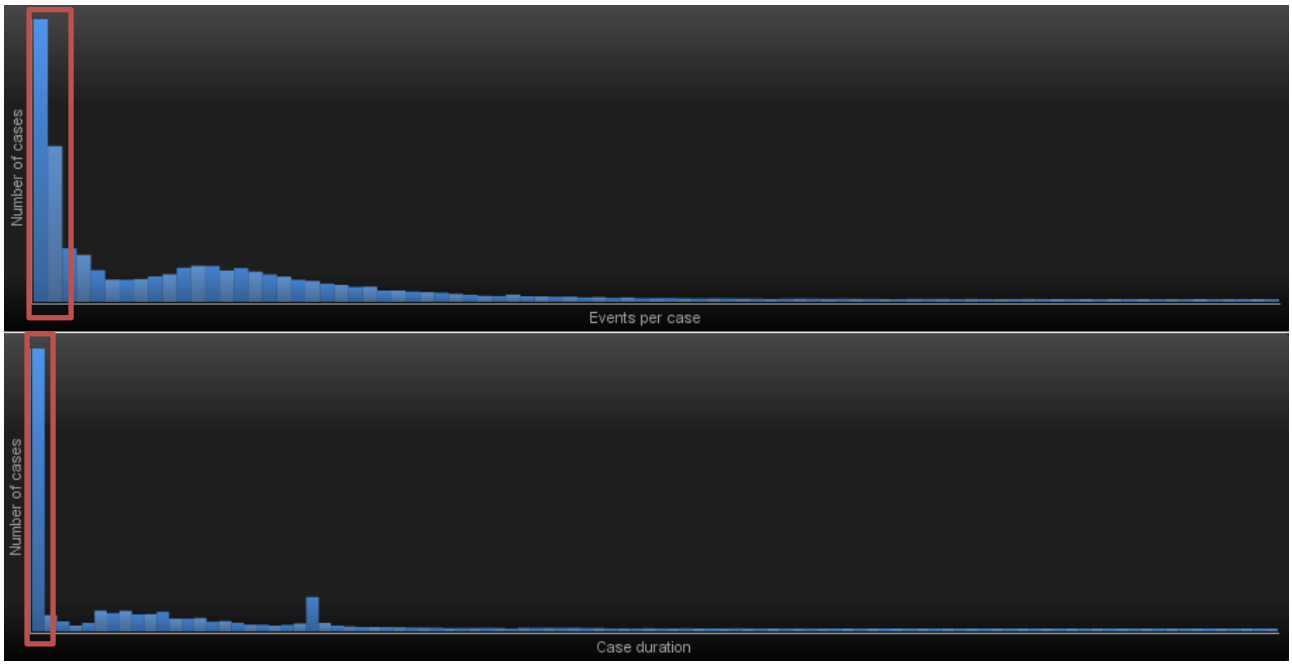

Fig. 3. Distribution of number of cases by events per case (top part) and distribution of number of cases by case duration (bottom part) for 2012 log (Source: authors' own)

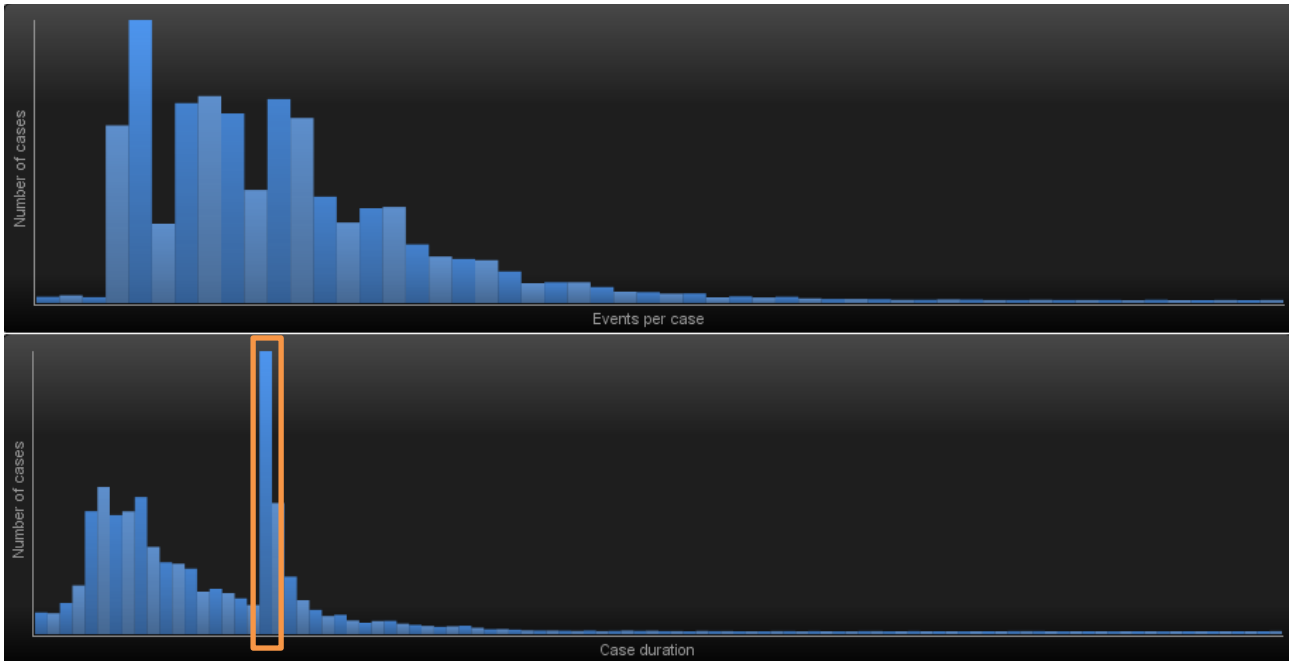

Fig. 4. Distribution of number of cases by events per case (top part) and distribution of number of cases by case duration (bottom part) for 2017 log (Source: authors' own)

What looks disturbing in Table 1. is that while "Median case duration" goes from 19,4 hours in year 2012 to 19,1 days in year 2017, but "Mean case duration" goes from 8,6 days in 2012 to 21,9 days in 2017. This means that after enhancement of the process, customer has to wait for the decision on average 2,5 times longer, which is substantial deterioration. However, if we examine this closely, we discover that in 2012 log, 26,2 % of cases consist of only 3 events and 14,3 % consists of only 5 events (Fig. 3. top diagram - red rectangle). That is 40,5 % of cases consists of 5 or less events and take up to 1 day and 8 hours to terminate (Fig. 3. bottom diagram – red rectangle). Moreover, the result of all of these cases is declination of the loan at the very beginning of the process. Firstly, it is very inefficient with respect of allocation of resources of the company. Secondly, it skews the "Mean case duration" towards lower values, and thus, "Mean case duration" is not appropriate metric based on which we can compare the efficiency of the process. In Fig. 4. orange rectangle indicates use cases running between 30,75 and 32,3 days (meaning that time required for termination of the process is between 30.75 and 32,3 days). The jump in number of cases that last between 30,75 and 32,3 days is because of the business rule stated by the financial institution. If the customer does not replay to the loan offer within 30 days, both application and offer are cancelled. From top diagrams in Fig. 3. and Fig. 4., one can see that number of cases is much more evenly distributed in 2017 log. In 2012, there was about 17,16 % of successful applications, while in 2017 the number of successful applications was 40 %. It is impossible to determine exactly to what degree is the enhancement of the process responsible for the jump in the number of successful applications. There is a lot of factors that can play the role like, e.g., marketing campaigning, state of the economy, etc. However, as we showed, company was able to significantly reduce number of unsuccessful applications just by means of improvement of monitored loan process.

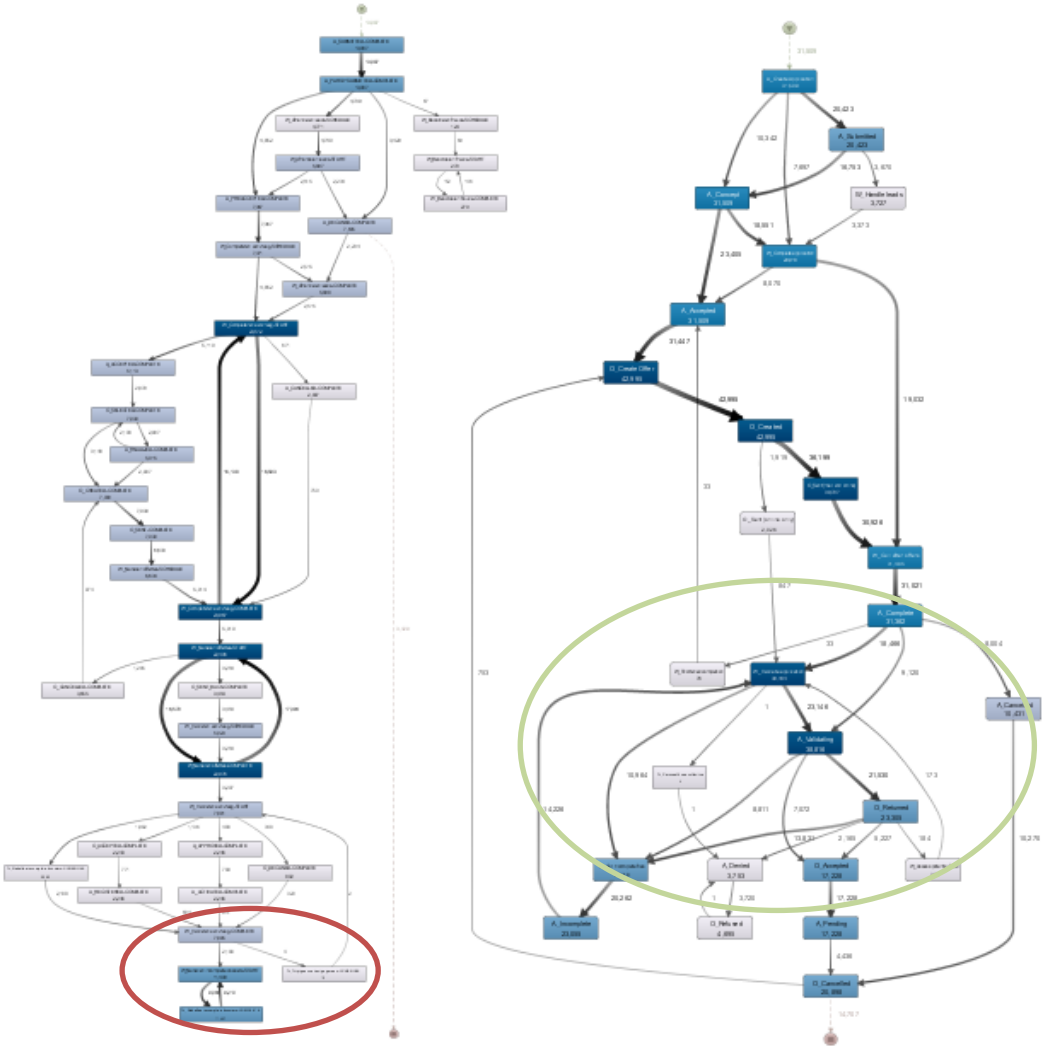

Fig. 5. Process map of the loan process in Disco - 2012 on the right, Disco, 100 % activities and 5,2 % paths - 2017 on the right, Disco, 100 % activities and 5,6 % paths (Source: authors' own)

Furthermore, Fig. 5. shows process models for both 2012 and 2017 logs. Both process models were derived from respective raw models in Fig. 2. As we stated earlier, to take full advantage of BPM, it has to be done continuously. Let us examine the potential flaws in performance of both logs.

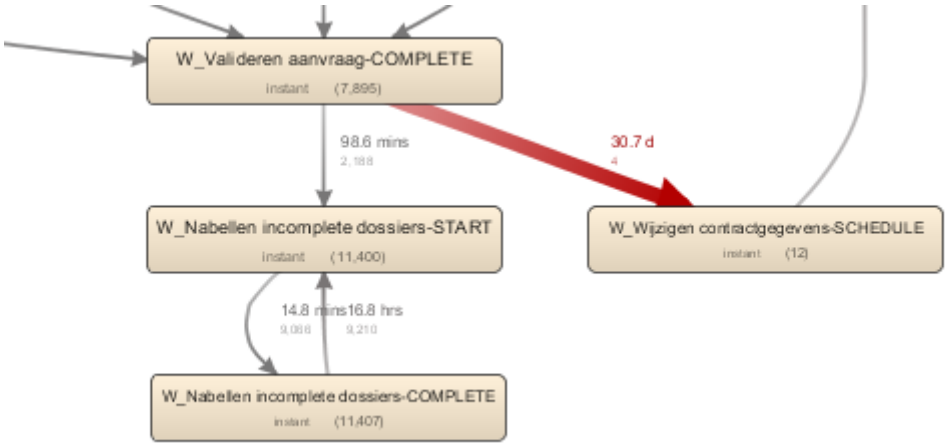

Fig. 6. Performance flaw in 2012 process model – cut-out from Fig. 5. red oval (Source: authors' own)

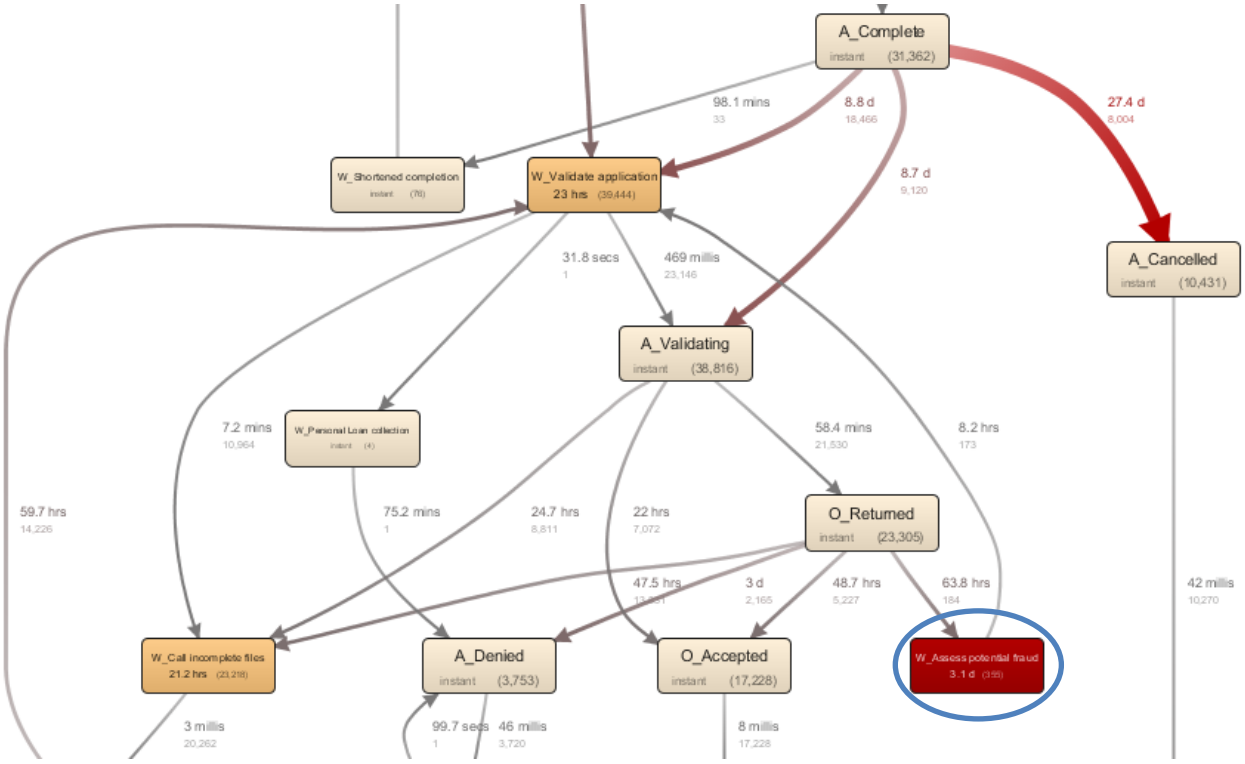

Fig. 7. Performance flaws in 2017 process model - see Fig. 5. green oval (Source: authors' own)

Fig. 6. (red arrow) shows that there is a waiting time between activities regarding assessing of application and filling the information about application. Fig. 7. shows several potential problems in process model based on 2017 log. Probably the most problematic is the validation of the application (vertices between nodes *A_Complete -> A_Validating* and *A_Complete -> W_Validate application*). Validation of application takes 8,4 days respectively 8,6 days with frequencies 5400 cases and 12360 cases respectively. Besides waiting times, there seems to also be problem in processing times of activity *W_Assess potential fraud* (blue oval Fig. 7.). To summarize, company was able to 1) reduce number of non-value adding activities, 2) reduce number of unsuccessful applications with case duration less than 5 days and 3) increase the overall contribution of successful applications more than twice.

5 Conclusion and discussion

There is established direct connection between process mining techniques and BPM lifecycle, and also between process mining techniques and many other BPM concepts. However, similar connection was not established between process mining and another important concept in BPM domain that is BPM maturity model. Thus, we focused on establishing such relation between different process mining techniques and areas and BPM maturity models. As we show in Table 1., there is relation between different process mining techniques and united outcomes of maturity stages of different BPM maturity models. Table 1. shows possible use of different process mining techniques in different maturity stages and simultaneously several ways in which process mining techniques help to fulfil requirements of different maturity stages. One can also see, that process mining techniques are useful tool across all maturity stages. Furthermore, with use of case study we show how can company address process aspects within comparative BPM maturity models. In the case study we analyse performance and structure of the same loan process based on data from years 2012 and 2017. Based on the process mining analysis from 2012, if we compare data from both years, we are able to show that the company was able to company was able to 1) reduce number of non-value adding activities,

2) reduce number of unsuccessful applications with case duration less than 5 days and 3) increase the overall contribution of successful applications more than twice.

Process mining is mainly dependent on the quality of the data produced by information systems that are more and more common even between smaller companies. Another advantage is lesser demand for expert knowledge compared to similar BPM methodologies and techniques. Among the factors of analysed BPM maturity model, process mining is mainly constrained by the factor IT/IS. This constrain is related mainly towards information system used by the company. Because process mining is mainly dependent on data, it is able to provide some ad hoc analysis like, e.g., some process statistics, process modelling, etc., even in the initial stage maturity. With raising BPM maturity, process mining is able to offer new and more complex techniques. For example, consider the highest BPM maturity stage, where the monitoring and controlling of the processes is going on proactive way and the processes are systematically used to improve and optimize processes based on real time performance data. Nowadays, many software solutions are able to monitor and process performance on weekly or daily basis or even in the real time. Thus, similarly to BPM lifecycle, process mining is very useful in every maturity stage of many BPM maturity models. Based on our findings, we would strongly recommend incorporation of process mining techniques and software tool to the companies that are considering to implement process-centric approach no matter the BPM maturity stage they find themselves in.

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EARLY FINDINGS ON THE INFLATION PERSISTENCE IN THE EURO AREA

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Abstract
Inflation is a well-known economic phenomenon reported and corrected by monetary policy, which indicates a country's inflation target. In the short term, various macroeconomic shocks, including changes in the economic activity of the economy, may cause inflation to deviate from its steady state. This is one of the profound meanings of why it is important to understand the process of inflation and the rate of convergence of inflation to a steady state. This paper examines dynamics of inflation. According to previous findings of inflation persistence well documented in the empirical literature, we employ analytic method to understand the economics of New Keynesian Phillips curve. There is used Generalized method of moments to identify New Keynesian Phillis curve in euro area countries.

Keywords
Inflation persistence, New Keynesian Phillips curve, Euro area countries.

JEL classification
E310, E520, F310

1 Introduction

With the introduction of Economic and Monetary Union, a new economy was created, with its new conditions. The conduct of monetary policy in this economy is an important and not an easy task for policy makers, as this policy must be comprehensive. While harmonized data have not been collected in this area in the past, it is important and desirable to make the right decisions for the functioning of the euro area. The recent economic crisis has caused gross domestic product to fall, unemployment to rise and inflation to rise. The ongoing period of deflationary pressures has been a response to the deteriorating effects of the economic crisis on the macroeconomic performance of euro area countries. The end of this period at the end of 2016, accompanied by rising inflation, thought that the European Central Bank's key interest rates were still close to zero, drawing economists' attention mainly to inflation, its characteristics and their ability to respond to various economic shocks. In the context of a low-inflation economy, banks responded with the aim of economic recovery and price stability by adopting several unconventional instruments. These adopted non-standard monetary policy measures have made it necessary and desirable, to change the approach to the conduct of monetary policy.

Analysing the persistence of inflation to improve inflation forecasts and respond to inflation shocks is also in the interest of central banks, as various macroeconomic shocks, including changes in economic activity or production costs, may temporarily deviate inflation from the central bank's inflation target in the short term. For this reason, an understanding of the process of inflation formation, in particular the rate of inflation, is crucial for a central bank whose policy is focused on price stability. Inflation persistence then refers to the tendency of inflation to slowly approach its long-term value in response to these shocks. Willis et al. (2003) define the degree of persistence as the rate at which inflation approaches equilibrium after a certain monetary policy shock.

Examining the dynamics of inflation will help us to better understand the inflation persistence – the rate at which inflation approaches equilibrium after a certain macroeconomic shock.

In this article, we provide an evidence of the inflation persistence. By confirming the New Keynesian Phillips curve, we will confirm the persistence of inflation in the euro area countries. So we will answer our research question: What is the dynamics of inflation in the euro area countries?

We use the method of dynamic panel data analysis. The article is divided as follows. We look at the persistence in inflation that has been researched so far. We review studies that address inflation dynamics, especially those that examine persistence in inflation through the New Keynesian Phillips curve. Subsequently, using the Generalized method of moments, we estimate the parameter of the equation of the New Keynesian Phillips curve, thus confirming the presence of persistence in inflation. We also summarize our results compared with the results of other studies. Finally, we outline another possible extension of our research.

2 Review of literature

Persistence in inflation is examined by many authors. As we indicated in the introduction, it is in the interest of central banks to examine the persistence of inflation and its examination, because it is important to know the response of inflation to various macroeconomic shocks. In the short term, various macroeconomic shocks, including changes in economic activity or production costs, may temporarily deviate inflation rates from the central bank's inflation target. Therefore, an understanding of the inflation-generating process, in particular the rate of inflation, is crucial for the central bank, especially in formulating a policy aimed at price stability. According to Willis et al. (2003), the persistence rate can be defined as the rate at which inflation approaches equilibrium after a certain monetary policy shock. Fuhrer (2010) defines two groups of persistence in inflation - reduced and structural. While the reduced form of persistence in inflation does not provide us with its sources and causes, when estimating the magnitude of the structural form of persistence, it is important and desirable to know the sources of persistence, such as various exogenous shocks. Angeloni et al. (2006) also had important research, which states that there is a so-called internal and external persistence in inflation. According to Angeloni et al. (2006), internal persistence is called the response to changes in wage and price setting, and a slow response to these changes is assumed, as wages and prices are rarely adjusted, deviations such as response to this change will gradually be included in inflation. consecutive periods. The indexation of prices and wages, which introduces a retrospective view of inflation, also contributes to the internal persistence of inflation. The response of inflation to various macroeconomic shocks is called the external inflation persistence, for example, persistent deviations of output from its potential level. Fuhrer (2005) speaks of external inflation persistence as the so-called inherited. The source of inherited inflation persistence is the output gap, for example, the difference between potential and real output. According to Fuhrer, it is the New Keynesian Phillips curve that captures and reveals that inflation must "inherit" this persistence. As the second source of inflation persistence, like Angeloni et al. (2006), the author cites the indexation of wages and prices and calls the response to these changes' external inflation persistence. Fuhrer (2005) concluded that the inflation persistence is dominated by internal persistence and inherited persistence is only a very small part of persistence.

The traditional Phillips curve suggested that there is a stable trade-off between inflation and economic activity, measured, for example, by the unemployment rate. At the same time, inflation was deemed very persistent. In the 1970s the traditional PC became to be criticised. The persistence became to be accepted feature of the inflation process. In the 1990s appeared the New Keynesian Phillips curve, which expresses the relationship between inflation and economic activity (Vašíček, 2011).

The literature on the New Keynesian Phillips Curve has increased. Understanding the nature of short-term inflation dynamics is very important for implementation of monetary policy. One matter on which uncertainty facing policymakers is particularly acute is that of the lag in effect of monetary policy at the area level. In general, the ability to quantify and, hence, model the sluggish response of inflation to changes in monetary conditions is important for monetary policymakers because it helps them understand how pre-emptive they should be in order to curb inflationary pressures at a minimum cost in terms of output gap variability. This is especially true for the recently-created European Central Bank (ECB), because it pursues the objective of price stability for the euro area as a whole,

and it is not yet clear whether the observed delay in the response of euro area aggregate inflation to monetary stimuli is a mere product of aggregation of the individual countries' price indices, rather than a structural phenomenon per se. However, the actual extent of transmission lags from policy to inflation remains unclear, since, so far, available evidence on the characteristics of aggregate euro area inflation is still rather limited (Batini, 2006).

Batini (2006) presents the evidence on lag between monetary policy actions and the response of inflation in the euro area as well as in some of its core countries (Germany, Italy and France). He examines that it takes over a year before monetary actions have their maximum effect on inflation both in the euro area and in individual countries. The basic inspiration for our article is Gali and Gertler (1999), who in their study examine inflation persistence using the New Keynesian Phillips curve and a hybrid New Keynesian Phillips curve. Results of Gali and Gertler (1999) suggest that, conditional on the path of real marginal cost, the baseline new Phillips curve with forward looking behaviour may provide a reasonably good description of inflation dynamics. Another early work by Fisher (1977), Taylor (1980) and Calvo (1983) emphasized staggered nominal wage and price setting by forward looking individuals and firms and leads to a relation that links inflation in the short run to some measure of overall real activity, in the spirit of the traditional Phillips curve. In paper of Nakahira (2015) examines inflation dynamics in Japan through estimation hybrid New Keynesian Phillips curve. Empirical study leads him to the conclusions, that the backward-looking factor has a dominant impact on inflation dynamics, the forward-looking element has an unignorable effect on the inflation process, it gives him a policy that the discussion of monetary policy should include a certain degree of emphasis on the backward-looking perspective in addition to forward-looking perspective and must examine inflation persistence, although the forward guidance policy by the central banks is a recent important topic and the degree of rationality of firm-level inflation expectations is not sufficient.

Rudd and Whelan (2005) in their study show that the new-Keynesian pricing model cannot explain inflation regressions and they find that forward-looking terms play a very limited role in explaining inflation dynamics. They use an alternative approach in order to explain the role played by lagged inflation in reduced form regressions. Cogley and Sbordone (2008) hypothesize in their study that inflation persistence results mainly from variation in the long-run trend component of inflation, which they attribute to shifts in monetary policy. Nason and Smith (2008) employed analytic methods to understand the economics of the New Keynesian Phillips curve identification problem in the canonical three-equation, new Keynesian model. They studied identification of the NKPC under Generalized Method of Moments for USA, the UK and Canada. They identified problems in the hybrid new Keynesian Phillips curve and found that the hybrid NKPC cannot be identified by GMM even when shocks are persistent.

In its basic form, the NKPC stipulates that inflation at time *t* is a function of expected future inflation and the current output gap. With its clearly elucidated theoretical foundations, the NKPC possesses a straightforward structural interpretation and therefore presents, in principle, a strong theoretical advantage over traditional reduced-form Phillips curve. When confronted with data, the curve has since evolved into its more empirically hybrid form. For example, in study of Fuhrer and Moore (1995) and Fuhrer (1997) adding lagged inflation to the model correct the signs of estimated coefficients. In Gali and Gertler (1999) using a measure of real marginal cost derived from a given production function instead of the output gap yields a better statistical fit according to GMM-based estimates and tests.

With the popularity of using New Keynesian Phillips curve, the criticism has been raised with respect to the empirical identifiability. Authors, who presented weaknesses of GMM are for example, Dufour (1997), Stock et al. (2002) and Khalaf and Kichian (2005). According to identified difficulties, several authors have led to re-examinations of NKPC models. Dufour et al. (2006) produced more reliable inference based in identification-robust tests and confidence sets. Their

applications study U.S. and Canadian data using hybrid NKPC of Gali and Gertler and a modification to the latter which consists in using survey-based measures of expected inflation.

3 Research methodology

3.1 Derived New Keynesian Phillips Curve

The New Keynesian Phillips curve has become an important part of monetary policy models. It describes the relationship between inflation and real marginal cost with focusing on the forward-looking and the backward-looking behaviour of subject on the market. In our paper we estimate this curve for euro area countries using Generalized Method of Moments (GMM). Estimation of New Keynesian Phillips curve determines the importance of real marginal cost, forward-looking and backward-looking behaviour in inflation dynamics and degree of price stickiness. For our research is important to look on behaviour in inflation dynamics in euro countries and find out if there is inflation persistence.

The New Keynesian Phillips curve is one of the key New Keynesian models. It is derived from Calvo sticky-pricing model (Calvo, 1983). We estimate coefficient from equation New Keynesian Phillips curve following Gali and Gertler (1999) and Gali et al. (2005), where inflation dynamics is defined:

$$\pi_t = \beta\, E_t\{\pi_{t+1}\} + \lambda\, \widehat{mc}_t \tag{1}$$

where π_t is inflation rate in a year t, $E_t\{\pi_{t+1}\}$ is expectation inflation rate and $\widehat{mc}_t$ are marginal costs.

In equation (1) we assume staggered price following Calvo (1983), optimal price setting by monopolistically competitive firms and constant frictionless markup μ.

Marginal cost and the output gap are defined by following equation:

$$\widehat{mc}_t = (\sigma + \varphi)\widehat{y}_t \tag{2}$$

where

$$\widehat{y}_t \equiv y_t - \overline{y}_t \tag{3}$$

is the output gap. In equation (2) we assume that all output is consumed, possible generalization: $y_t = c_t + g$, for exogenous g_t and perfect competition in labor markets.

Following equation (1) and (2) we can define the New Keynesian Phillips curve:

$$\pi_t = \beta\, E_t\{\pi_{t+1}\} + \kappa\, \widehat{y}_t \tag{4}$$

where

$$\kappa \equiv \lambda(\sigma + \varphi) \tag{5}$$

3.2 Estimating the New Keynesian Phillips Curve using Generalized Method of Moments

We estimate the New Keynesian Phillips Curve using Generalized Method of Moments. Reduced form for formal empirical estimates expresses the equation (4).

For estimating parameters of NKPC equation we use program EViews. For our research Generalized Method of Moments has follow setting. We insert data set as quarterly dated panel. Dependent variable is inflation rate. Transformation set presents orthogonal deviations and as setting we also use white period instrument weighting matrix.

4 Data

Our data set consist of quarterly time series from 1996Q1 to 2020Q2 for nineteen euro area countries, namely Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovenia, Slovakia and Finland. Some of the variables do not exist for the whole period, and similarly some countries variables are not available.

Data used in this paper is retrieved from the Eurostat database. Data set contains 1862 observations.

In our research we use following parameters: inflation rate, gross domestic product. Inflation rate is measured by Harmonised index of consumer prices (HICP). Most of authors used as dependent variable inflation rate measured by GDP deflator, but for our time period there are no available data of GDP deflator in euro area countries. Independent variables are lagged HICP and log detrended GDP, which presents marginal cost in NKPC equation. We use Hodrick-Prescott filter to detrend GDP data with setting lambda 1600 for quarterly data.

The Harmonised Index of Consumer Prices (HICP) gives comparable measures of inflation for the countries and country groups for which it is produced. It is an economic indicator that measures the change over time of the prices of consumer goods and services acquired by households. In other words, it is a set of consumer price indices (CPIs) calculated according to a harmonised approach and a set of definitions as laid down in Regulations and Recommendations. In addition, the HICP provides the official measure of consumer price inflation in the euro area for the purposes of monetary policy and the assessment of inflation convergence as required under the Maastricht criteria for accession to the euro.

In the picture below can be seem development of HICP in euro area countries.

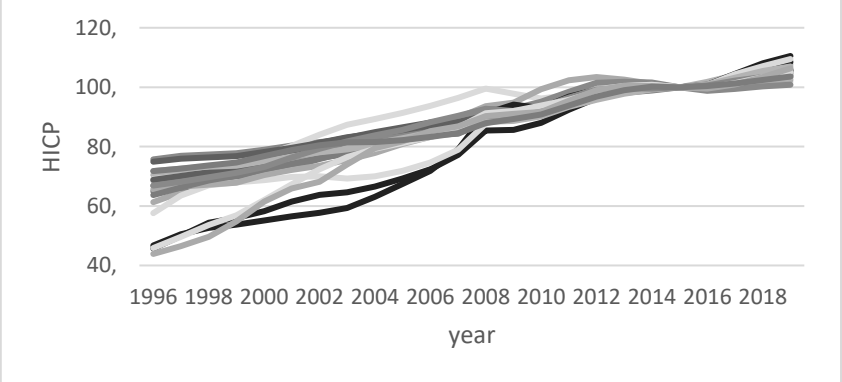

Fig. 1. Development of HICP in euro area countries (Source: Eurostat)

Gross domestic product (GDP) is the most frequently used measure for the overall size of an economy. Gross domestic product (GDP) and its components - value added by economic activity, expenditure, and income statistics - are part of the ESA 2010 annual and quarterly national accounts produced by the European Commission (Eurostat) and national statistical authorities. Euro area results are estimated using information for the individual countries. GDP is the value of an economy's total output of goods and services less intermediate consumption, plus net taxes on products and imports. GDP can be also broken down by expenditure or income components. The main expenditure aggregates that make up GDP are household final consumption, government final consumption, gross fixed capital formation, changes in inventories, and imports and exports of goods and services (including intra-euro area trade) while the income components include gross operating surplus and mixed income, compensation of employees, taxes on production and imports, and subsidies. For estimating parameters in our study, we use GDP data at market prices.

5 Empirical results

Our empirical results are corresponding with previous research. According to following results we can confirm New Keynesian Phillips curve in euro area countries, and we can see that there is inflation persistence. Figure one in the previous section already indicates that there is inflation persistence in the euro area countries.

In the table below we can see estimated parameters of New Keynesian Phillips curve. There are variables HICP and GDP, which were estimated by our model using Generalized Method of Moments. Positive coefficients of HICP and GDP assume relationship between inflation and expected inflation and between inflation and marginal costs. To sum up, positive coefficients indicate existence of New Keynesian Phillips curve.

Table 1. Estimated parameters using Generalized Method of Moments

Variable	coefficient
HICP	0.983388
GDP	0.276006

Source: Own calculations in the program EViews.

Using Generalized Method of Moments, we confirm reduced form of equation New Keynesian Phillips curve. According to Gali and Gertler (1999) our estimated parameters of equation have positive values, as it was in the case of USA, in their research.

These empirical results formed the basis for our further examination and estimates of inflation persistence in a large sample of countries under heterogeneous economic and monetary conditions.

Our results, which confirmed the existence of persistence in inflation, suggest that inflation dynamics has a major impact on price stability and macroeconomic performance in euro area countries.

6 Conclusion

In our paper we try to confirm existence of New Keynesian Phillips curve in the nineteen euro area countries with quarterly data set from 1996Q1 to 2020Q2 from the Eurostat database.

According to the previous studies, for example, Gali and Gertler (1999), Calvo (1983) and others we derived New Keynesian Phillips curve equation which confirmation presents inflation persistence in euro area countries. Our research aimed to confirm the existence of persistence in inflation in euro area countries over a longer period, including data from this year in the analysis. As the contributions dealing with the persistence in inflation and its confirmation are older data, we perceive the use of newer data as an added value of this article. At the same time, we would like to point out that research focused on persistence in inflation is conducted on the U.S.A. and U.K. data.

Using Generalized Method of Moments is one of the ways how to confirm New Keynesian Phillips curve existence. The New Keynesian Phillips curve expresses the relationship between inflation and economic activity.

The conclusion of this article is the recognition that in the euro area countries there is the existence of inflation persistence. This knowledge is important for our further research.

Our further research will focus on a closer understanding of the structural features of inflation persistence, the length of the inflation response to policy makers' decisions, and the identification of macroeconomic shocks. Quantifying the impact of structural shocks on inflation and persistence in it will allow us to clarify fundamental differences in the characteristics and nature of the initial inflation response as well as the subsequent process convergence, including its speed, to a long-term trajectory at different stages of the economic cycle.

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