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Natasha Trajkova Najdovska

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LABOR PRODUCTIVITY*
Rasim Yilmaz

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SOFTWARE COMPANIES*
Zeljko Stojanov

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CONTENTS

EDITORIAL	7
Aneta Risteska Jankuloska.....	
ANALYSIS OF DETERMINANTS OF CORPORATE CASH HOLDING OF LISTED MANUFACTURING COMPANIES ON THE MACEDONIAN STOCK EXCHANGE	9
Aleksandar Naumoski, Simona Ruseva.....	
OPERATING COSTS OF TRADE IN SERBIA	26
Radojko Lukic.....	
EMPIRICAL APPROACH TO GROWTH ANALYSIS – PECULARITIES FOR MODELING STRATEGY IN THE CASES OF BIG EXOGENIOUS SHOCKS	44
Natasha Trajkova Najdovska.....	
THE RELATIONSHIP BETWEEN EXPENDITURE AND LABOR PRODUCTIVITY	65
Rasim Yilmaz.....	
SOFTWARE MAINTENANCE MANAGEMENT IN MICRO SOFTWARE COMPANIES	75
Zelko Stojanov.....	
FINANCING SUSTAINBLE GROWTH	93
Gligor Bishev	

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EDITORIAL

Aneta Risteska Jankuloska

Today, the world is still faces with huge challenges as a direct consequence of the COVID pandemics and the global economic crisis imposed by war operations and political crises in many countries throughout the world. Such an unstable and unpredictable situation paves the way to enormous risks of energy and food deficit, and higher inflation rates as a result of the severe disruptions in both global and regional supply chains. The actual economic, environmental, sociological, and health-related circumstances are putting substantial pressure on governments, organizations, and enterprises throughout the world to respond quickly. To meet the immense problems they face, countries, communities, businesses, ecosystems, and even individuals must rethink their roles and responsibilities, and rebuild their competitiveness. The aim of the journal is to provide opportunities for researchers to present their findings in the areas of business and economics, and other fields of research and to assist in creation of adequate policies and approaches for treatment of actual economic and business problems. Hence, we encourage experienced scholars, business practitioners as well as young researchers to submit their original work on various problems in the areas of business and economics. In this number of Southeast European Review of Business and Economics (SERBE) are presented three papers from the authors of the Universities in our country and abroad and three selected papers from the XII International Conference “Economy, Business & Society in Digitalized Environment (EBSiDE 2022)” held at the Faculty of Economics - Prilep.

ANALYSIS OF DETERMINANTS OF CORPORATE CASH HOLDING OF LISTED MANUFACTURING COMPANIES ON THE MACEDONIAN STOCK EXCHANGE

Aleksandar Naumoski¹, Simona Ruseva²

Abstract

In this study, we identify the determinants of cash holding in Macedonian manufacturing companies. The analysis was conducted using accounting data from publicly available financial statements of the sample of Macedonian industrial companies for the 2005 to 2019 period. The research was conducted through the prism of the postulates of the three main theories in corporate finance, i.e., the trade-off theory, pecking order theory, and the free cash flow theory. To that end, we applied a panel regression analysis, while from the obtained results we assess which theoretical model best explains the cash management in Macedonian companies. We found that the cash to total assets ratio averaged 3.1%. The cash holding decreases with the decrease of the net working capital, financial leverage, cash flow variability, and cash conversion cycle. Cash holding increases with the increase of the company size, cash flow, debt maturity, and capital investments. We concluded that most of the results are in line with the pecking order theory, which indicates that Macedonian companies do not have predefined cash balances, and the cash holdings are a buffer between retained earnings and investments. The level of cash holding is not planned and is not optimized, but is determined during the work processes and depends on other business decisions.

Keywords: cash holding, trade-off theory, pecking order theory, free cash flow theory, North Macedonia

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1. Introduction

Effective and efficient management of the company's liquidity includes the management of cash, which is necessary for the normal execution of the company's business operations. The amount of cash is not a static parameter in different companies, nor the same company at different times. The financial statements of the companies offer a picture of the size and dynamics of the cash holding. Of course, it is indisputable that cash holding or lack of cash, causes costs of various kinds. On the one hand, the excess cash causes an opportunity cost, i.e., unrealized returns that companies could achieve if they invested them in other assets. On the other hand, the lack of cash leads to liquidity problems, inability to pay liabilities on time, loss of trust with suppliers, penalties, costs for providing cash, etc. Many analysts over time have tried to find the answer to the question of why and what is the optimal amount of a firm's cash holding. Their explanations are related to the identified motives for cash holdings, such as transaction motive, precautionary motive, speculative motive, agency motive, and tax motive. The motives for holding cash are elaborated through the three main theories in corporate finance: trade-off theory, pecking order theory, and the free cash flow theory. According to trade-off theory, companies optimize cash, which is the amount of cash that equates to the marginal benefits and costs of cash holding. In contrast, the pecking order theory is based on the postulate that there is a hierarchy in corporate financing. Namely, companies should strive to be financed primarily from their internal sources of retained earnings, and if they are not sufficient, they should access external sources of financing, primarily debt issuance, and in the last instance a new issue of shares. Based on that, there are no optimal cash balances, but the size of the cash holding is a result of the financial and investment policies of the companies. Free cash flow theory is based on the impact of agency problems, conflicts of interest between the company's stakeholders, primarily managers as shareholders' agents and shareholders as principals, on business decisions. According to this theory, managers do not aspire to optimize cash, according to costs and benefits of cash holding, but hold cash at a level that will serve to satisfy their interests, which is sometimes opposite or to the detriment of the interests of shareholders. Based on these three theoretical assumptions, several determinants of cash holding have been identified.

The purpose of this research is to identify the determinants of corporate cash holding according to theoretical models. We used the numerous scientific researches on this topic as a basis especially those that have the greatest impact, such as the researches of Opler et al. (1999), Ozkan and Ozkan (2004), Ferreira and Vilela (2004), Bates et al. (2009). The research was conducted on a selected sample of Macedonian industrial

companies listed on the Macedonian Stock Exchange, for which we took their accounting data from their audited financial statements for the period 2005 to 2019. We employed a panel regression model where the dependent variable is cash ratio and the exogenous independent and control variables are consistent with the transaction motive and the precautionary motive of the cash holding: net working capital, leverage, firm size, cash flow, cash flow variability, and cash conversion cycle.

The main goal of this paper is the identification of the influence of determinants on the cash holdings by Macedonian companies. The analysis was conducted on the representative sample consisting of ten Macedonian industrial companies in the time period from 2005-2019. To conduct the analysis, we used the publicly available financial reports published on the Macedonian Stock Exchange. The focus will be on the elaboration of the basic theoretical models for the motives for holding cash balances by companies, i.e. the trade-off theory, pecking order theory, and the free cash flow theory. We applied a panel regression analysis to find the causalities and explanation of how the obtained results correspond with the cash holding theories. The main question we would like to get an answer to is whether companies have pre-defined cash balances, which is the basic postulate of the trade-off theory, or cash balances are not planned but are defined during work processes and depend on other business decisions. This paper will make a great contribution to the disclosure of the cash management practices and policies of Macedonian companies. The greatest contribution will be in determining the causal determinants of cash holding as implications for improving managers' cash management practices.

2. Determinants of cash holding

In this section, we elaborate on the determinants that influence the company's cash holding decisions. Inspired by previous studies conducted on this issue, we focused on those having the greatest impact and considered the most relevant. Subsequently, we will explain each of them one by one as well as each positive or negative impact on cash.

The size of the company. Trade-off theory assumes that larger companies are stable, highly profitable, having a high degree of diversification of business activities. Analogously, they have a constant cash flow, and thus a minimal likelihood of financial distress. These features represent the basis for companies to save less cash. Thus, there is a negative relationship between cash holding and company size. In their studies, Miller and Orr (1966), and later Bigelli and Sanches - Vidal (2012) point out that larger

companies enjoy the benefits of economies of scale in their operations, which in turn allows these companies to access faster and cheaper external sources of funding. It should be noted here that borrowing costs are inversely proportional to the size of borrowing, and these costs are significantly higher for smaller companies (Kim et al., 2011). According to Al-Najjar and Belghitar (2011), the higher diversification of larger companies compared to smaller ones makes larger companies less susceptible to financial distress, which can even lead to the bankruptcy of the company. Given the fact that borrowing transaction costs are lower for larger companies, company size and cash are expected to be inversely related. Previous research conducted on this topic by Opler et al. (1999), Ferreira and Vilela (2004), Drobetz and Gruninger (2007), Chen (2008), Al-Najjar and Belghitar (2011) and Bigelli and Sanches-Vidal (2012), indicates a negative relationship between company size and corporate cash holdings. Pecking order theory implies a positive relationship between the size of the company and the corporate cash holdings, because the size of the company is considered a kind of accelerating force towards the business success of the company. Ferreira and Vilela (2004) point out that large companies, after the completion of their investment projects, achieve greater financial success and, as a result, have even higher cash holdings. Free cash flow theory also assumes a positive relationship. Large companies have many dispersed shareholders, which then allows managers to exercise greater autonomy over investment decisions, so they keep larger cash balances. Opler et al. (1999) suggests that company size can be a barrier to takeover. Namely, the larger the targeted company, the more cash the buyer should have. A large company can take advantage of this, which finally indicates that large companies should have excess cash.

Liquid assets substitutes. If the company has a shortage of cash, it can sell other assets it owns or access the financial markets. Other working capital items, primarily cash equivalents, are considered cash substitutes. Liquid assets substitutes are all those non-cash items that can be converted into cash quickly and with little or no transaction costs (Al-Najjar & Belghitar, 2011). At the same time, as Ozkan and Ozkan (2004) point out, liquid assets can be converted into cash much cheaper than other assets, thus avoiding expensive financing in capital markets. According to this, per the trade-off theory, companies that have more liquid assets have fewer cash reserves. This view is supported by several researchers including (Bates et al., 2009; Gill & Shah, 2012; Bigelli & Sanchez-Vidal, 2012; Uyar & Kuzey, 2014).

Leverage. According to trade-off theory, companies having high leverage face significantly higher risks of financial distress and potential bankruptcy, precisely because of the pressures of such debts on financial management. Al-Najjar and Belghitar (2011) and Kim et al. (2011), state that highly indebted companies, driven by prudent motives, hold large amounts of

cash to avoid possible bankruptcy. In contrast, D'Mello et al. (2008) predicted that companies, with a high ability to secure additional borrowing, would keep smaller cash balances. Thus, the trade-off theory is unconvincing about the relationship between cash and leverage. According to pecking-order theory, the level of debt increases when the investments exceed the retained earnings of the company, and consequently the cash decreases (Ferreira & Vilela, 2004). This indicates a negative relation between cash and leverage. Additionally, several studies confirm that high levered companies have lower cash holdings (Opler et al., 1999; Ferreira & Vilela, 2004; Ozkan & Ozkan, 2004; Al-Najjar & Belghitar, 2011). Although some researchers like Drobetz and Gruninger (2007) and Guney et al. (2003) found a nonlinear relationship between leverage and cash holding, the latest studies on this topic find that highly indebted companies tend to hold less cash (Al-Najjar & Belghitar, 2011; Subramaniam et al., 2011; Uyar & Kuzey, 2014; Wasiuzzamam, 2014).

Cash flow. Cash flow is a source of liquidity for companies. According to trade-off theory, there is a negative relationship between cash flow and cash holding. By this, Kim et al. (1998), Subramaniam et al. (2011), Islam (2012), and Nyborg and Wang (2014) confirm a negative relationship, as operating cash flow reduces the need to hold large cash balances. Conversely, the pecking order theory points to a positive relationship between cash flow and cash holdings, supported by the fact that companies that generate large cash flows are likely to retain some of the cash they will use to finance new investments and eventually use it in a situation of financial difficulties. According to this theory, previous research conducted by Opler et al. (1999), Ozkan and Ozkan (2004), Drobetz and Gruninger (2007), García Teruel et al. (2009), Duchin (2010), Ogundipe et al. (2012), Mugumisi and Mawanza (2014), Maheshwari and Rao (2017), Chauhan et al. (2018) demonstrates a positive relationship between cash flow and cash holding.

Cash flow volatility. Companies that have high cash flow volatility face liquidity constraints, which in turn leads to a lack of cash, forcing companies to give up some profitable investment projects (Ozkan & Ozkan, 2004). For this reason, companies having high volatility of their cash flows are expected to keep larger cash balances, which would eliminate liquidity constraints and related costs. Thus, according to Trade-off theory, there is a positive relationship between the volatility of cash flows and the cash balances held by companies. Empirical research conducted by Guney et al. (2003), Al-Najjar and Belghitar (2011) and Bigelli and Sanchez-Vidal (2012) confirms this positive relationship.

Cash conversion cycle. The cash conversion cycle is a metric that shows the length of time from the moment of outflow of cash for the purchase of raw materials that are included in the production process until the collection, i.e., cash inflows from finished products and services sold. Namely, the cash cycle shows the time in which cash is included in the company in various forms of assets before being returned in cash. Drobetz and Gruninger (2007) in their research found that the shorter cash conversion cycle ensures better alignment of cash inflows and outflows, thus reducing the need to hold cash. Hence, according to trade-off theory, a positive relationship is expected between the conversion cycle and the cash balances. At the same time, the research of Deloof (2001) emphasizes the existence of a negative relationship between the cash conversion cycle and the cash holding, because the longer cash conversion cycle leads to a larger amount of receivables and inventories that are significantly more liquid than other assets, while the long cash conversion cycle also leads to a smaller volume of liabilities to be paid in a shorter period. Hence, the longer conversion cycle is a kind of additional source of company liquidity. John (1993), Kim et al. (1998), and Wang et al. (2014), also support this claim.

Debt maturity. Ferreira and Vilela (2004) found that debt maturity affects cash holdings. The use of short-term debt involves the renewal and negotiation of credit terms regularly. As a result, companies may face refinancing risks if they fail to meet these criteria, which can lead to disruption of financial stability. The risk of not being able to refinance is the risk that the company will not be able to borrow additional funds to repay its existing debt. This situation causes financial difficulties, because the company does not have the financial sources to cover the outstanding liabilities and repay the debts to the creditors. Thus, the company must approach alternative sources of cash, i.e., sell some significant assets at a lower price to repay its debt. Harford et al. (2008) found that high cash balances could help avoid selling the company's key assets, thus preventing inefficient disposal. Thus, if the other variables are under control, Ferreira and Vilela (2004) consider that there is a negative relationship between debt maturity and cashholdings. On the other hand, the research of Barclay and Smith (1995) shows that the companies with the highest credit rating easily provide short-term financing. If we consider the fact that the companies with the highest credit rating have easier access to the capital markets, then they are expected to have less cash, which causes a positive relation of the debt maturity with the cash holdings.

Capital investments. Trade-off theory suggests that capital investments reflect the financial strength of the company (Bates et al., 2009). Hence, companies with the high capital investment will face high transaction costs in the capital markets to provide the necessary funds. Riddick and Whited

(2009) argue that to avoid these high transaction costs, companies maintain higher cash balances. Kim et al. (2011) points out that capital expenditures lead to investments in new assets that later can be used as collateral, which strengthens the lending capacity of companies. Consequently, companies that have easier access to lending will keep smaller cash balances, establishing a positive relationship between cash and capital expenditures. Pecking order theory assumes that cash balances depend on capital investment (Dittmar et al., 2003). Based on this, any increase in capital expenditures reduces cash balances, resulting in a negative relationship between cash holdings and capital investments (Dittmar et al., 2003; Bates et al., 2009). However, empirical research on the relationship between cash holdings and capital investment has so far been unconvincing. Namely, Chen (2008) indicates that companies with high capital expenditures tend to keep lower cash balances, while Opler et al. (1999) in his research presents diametrically opposite evidence.

Table 1. Expected impact of the determinants on the cash holding according to the theories

Variable	Trade-off theory	Pecking order theory	Free cash flow theory
Company size	Negative	Positive	Positive
Liquid assets substitutes	Negative		
Leverage	Positive and negative	Negative	Negative
Cash flow	Negative	Negative	
Cash flow volatility	Positive		
Cash conversion cycle	Positive and negative		
Debt maturity	Negative	Positive	
Capital Investments	Positive	Negative	

Source: Authors' own calculations

3. Data and measurements

To examine the impact of the above determinants on the cash holding of Macedonian companies, we used the accounting data from the financial statements that are available on the Macedonian Stock Exchange. We analyzed a balanced sample of data from 10 industrial companies in the 2005-2019 period.

The dependent variable in our research is the cash to assets ratio, which we calculated as the ratio between the sum of cash and short-term investments divided by total assets. We define cash as bank cash and cash on hand plus liquid short-term financial instruments that are considered cash equivalents.

Measurement of exogenous variables.

- **Net working capital.** This ratio is calculated as follows: total current assets minus cash and cash equivalents divided by total assets;
- **Leverage.** This ratio is calculated as follows: total debt (short-term and long-term) is divided by total assets;
- **The size of the company.** We calculate it as a natural logarithm of the total assets;
- **Cash flow.** This ratio is calculated when pre-tax profit plus depreciation is divided by total assets such as Ozkan and Ozkan (2004);
- **Cash flow volatility.** We measure it by the standard deviation of the company's cash flows divided by total assets;
- **Cash conversion cycle.** We calculated as the sum account receivables collection period plus inventories period minus account payables payment period;
- **Debt maturity.** According to Ferreira and Vilela (2004), the maturity of the debt is calculated when the difference between the total debt and the debt due for payment within one year is divided by the total debt;
- **Capital expenditures.** This ratio is calculated when capital expenditures are divided by total assets.

4. Empirical results

The results of the descriptive statistics showed that the cash in the total assets of the companies that were the subject of this research in the 2005-2019 period averaged 3.1%. Macedonian companies in the analyzed period have lower cash to assets ratio compared to companies from other countries.

Thus, this ratio for companies in the UK is 9.9% (Ozkan and Ozkan, 2004), in EU countries it is 14.8% (Ferreira & Vilela, 2004) while for US companies it is 7.2%. (Bates et al., 2009). The maximum relative share of cash in the total assets in our analyzed sample reaches 48.7%, and the minimum is 0%.

Net working capital is 2.5% of the total assets. This ratio is also lower compared to developed countries where, for example, for companies in the US, is 17.6% (Bates et al., 2009), for companies in the UK is 4.8% (Ozkan&Ozkan, 2004), while in the countries of the EU is 3.5% (Ferreira & Vilela, 2004). The maximum share of the net working capital reaches up to 52.5%, and the minimum to -84.7%.

Macedonian companies in the analyzed period have a total indebtedness rate of 29.2%. This rate indicates that Macedonian companies have a high degree of indebtedness compared to companies from other countries. For example, in the United Kingdom, the corporate debt ratio is 16.2%. The maximum indebtedness rate of Macedonian companies reaches 80.4%, and the minimum is 0%.

The average cash conversion cycle for the analyzed companies is 277 days, with a maximum number of days of 3598 and a minimum of -59 days. Precisely, the average account receivables conversion period is 101 days, the inventory conversion period is 315 days, and the account payables payment period is 138 days.

Table 2. Descriptive statistics

	Cash to assets ratio	Net working capital	Leverage	Company size	Cash flow	Cash flow volatility	Cash conversion cycle	Debt maturity	Capital expenditures
Average	0.0305	0.0252	0.2922	21.02	0.0367	1.2760	277.5	0.4161	0.0426
Median	0.0167	0.0706	0.2883	21.29	0.0465	0.0391	161.8	0.3983	0.0269
Maximum	0.4876	0.5259	0.8040	23.33	0.6080	23.539	3598.3	1.0000	0.3190
Minimum	0.0000	-0.8479	0.0000	17.00	-0.9708	0.0049	-59.3	0.0000	0.0000
Standard deviation	0.0541	0.2546	0.1844	1.410	0.1867	4.5636	415.4	0.3103	0.0492
Observations	150	150	150	150	150	150	150	150	150

Source: Authors' own calculations

Table 3. Correlation matrix

	Cash to assets ratio	Net working capital	Leverage	Company size	Cash flow	Cash flow volatility	Cash conversion cycle	Debt maturity	Capital expenditures
Cash to assets ratio	1								
Net working capital	0.2003	1							
Leverage	-0.304	-0.6343	1						
Company size	0.0732	-0.1235	-0.0794	1					
Cash flow	0.3773	0.5064	-0.3644	-0.0471	1				
Cash flow volatility	-0.0375	0.2809	-0.0797	-0.7039	0.1184	1			
Cash conversion cycle	-0.0449	0.3679	-0.1759	-0.0299	-0.0906	0.1101	1		
Debt maturity	0.1973	0.3145	-0.1119	-0.1000	-0.0141	0.1996	0.1089	1	
Capital expenditures	0.1365	0.0942	-0.0551	0.0559	0.2696	0.0680	-0.2441	0.2114	1

Source: Authors' own calculations

The next step in our research is to conduct a panel regression analysis. The dependent variable is the cash ratio, and independent variables are net working capital, leverage, company size, net cash flow, cash flow volatility, cash conversion cycle, debt maturity, and capital expenditures.

We implemented Fixed effect model and Random effect model. To determine which model we should accept as the most relevant, we conducted the Hausman Test. The hypotheses of the Hausman test are:

- Hypothesis H₀: Random effect model is the most appropriate
- Hypothesis H₁: Fixed effect model is the most appropriate

The results obtained by conducting this test indicate that we should accept Hypothesis 1, i.e., that the Fixed Effect Model is the most appropriate. The results of this model are shown in Table 4.

Table 4. Results from the regression analysis

Variable	Coefficient	Standard error
Intercept	-0.4264**	0.2392
Net Working Capital	-0.0426*	0.0266
Leverage	-0.0415	0.0300
Company size	0.0223**	0.0111
Cash Flow	0.0884***	0.0286
Cash Flow volatility	-0.0047**	0.0024
Cash Conversion Cycle	-0.0000242*	0.00000928
Debt Maturity	0.0167	0.0132
Capital Investments	0.0763	0.0711
R^2	0.6744	
Adjusted R^2	0.6325	
F -statistic	16.085	
$Prob(F$ -statistic)	0.0000	

Source: Authors' own calculations

Note: ***statistically significant variables at 1%, **statistically significant variables at 5%, *statistically significant variables at 10%

According to the model estimation, statistically significant variables are the net working capital, company size, cash flow, cash flow volatility, and cash conversion cycle. The other variables are not statistically significant.

The obtained results indicate that any increase in net working capital by one percentage point will cause a decrease in the share of cash in total assets by 4.2 p.p., any increase in the size of the company (i.e., any increase in total assets of the company) for one percentage point will cause an increase in the share of cash in total assets by 2.2 p.p., any increase in cash flows by one percentage point will cause an increase in the share of cash in total assets by 8.8 p.p., while increase of the cash conversion cycle by one day will cause a decrease in the share of cash in total assets by 0.0000242%.

Net working capital is a measure of the company's liquidity, a measure of operational efficiency, and an indicator of the short-term financial health of the company. The results of our analysis indicate a negative relationship between cash and net working capital, which is in line with the Trade-off theory.

The results obtained by conducting the analysis indicate that there is a negative relationship between cash holdings and leverage, and this is consistent with the predictions made by pecking order theory and free cash flow theory. Pecking order theory elaborates on this negative correlation with the view that as soon as all possibilities for securing cash from own sources are exhausted in a situation when the company's investments exceed the retained earnings, the company must approach alternative sources of cash from other external sources, i.e., increase the debt. Free cash flow theory suggests that companies with high debt ratios keep lower cash balances to protect themselves from a sort of powerful managerial discretion. Trade-off theory explains that the costs of providing liquidity increase with the increase of borrowing, which would mean a decrease in cash because of the increased percentage share of debt in the overall capital structure.

We found a positive relationship between cash holding and company size. Such results are in line with pecking order theory which predicts that large companies seek to implement larger projects, which result in increased company performance and subsequently contribute to achieving even larger cash balances. Free cash flow theory joins this view for a positive relationship between cash and company size, and explains that large companies often have dispersed shareholders, giving managers greater discretion over financial and investment decisions in the company, which in turn contributes to higher cash balances. We cannot prove this theory in this research, because we do not have data to measure the dispersion of shareholders, as well as the discretionary power of managers.

Our results indicate a positive relationship between the cash holdings and the cash flow of the company. They are in line with the pecking order theory which explains the positive relationship by the fact that companies that have high cash flows and do not face restrictive investment policies, will use the cash for new investments or use it in a situation of financial distress.

We found a negative correlation between cash and cash flow volatility. They do not correspond to the Trade-off theory which points to a positive correlation. Namely, the companies that have riskier cash flows keep larger cash balances. However, our study as well as the studies of Opler et al. (1999), which use a fixed-effects model, detected a negative correlation.

Trade-off theory claims that there is both a positive and a negative relationship between cash and the conversion cycle. Our results indicate a negative relationship. According to Deloof (2001), John (1993), Kim (1998) and Wanget al. (2014), the negative relationship of cash with the cash conversion cycle is a consequence of the fact that the longer period of cash conversion contributes to an increased number of receivables and stocks that are significantly more liquid compared to other types of assets, and at the

same time contributes to a smaller volume of liabilities, which must be paid in a short period.

Our results point to a positive relationship between cash holdings and debt maturity and are consistent with the pecking order theory. We can explain such claims with real examples that indicate that banks are more inclined to approve loans to companies with higher credit ratings than to companies with high credit risks. Thus, companies that have achieved positive financial results will need less borrowing and less debt, and companies with low credit risk will have better access to borrowing and lower cash balances because they will be driven by a precautionary motive, which would contribute to a positive relation between debt maturity and cash.

The results of the analysis indicate a positive relationship between cash and capital investment. This outcome is consistent with the trade-off theory. Although this result is a bit more difficult to explain, it would suggest that companies that have their own funds tend to increase their investments by tending to rely on their own sources instead of borrowing funds.

Most of the obtained results are by the pecking order theory, which indicates that Macedonian companies do not have pre-defined optimal cash balances, but cash is used as a buffer between retained earnings and investments. The coefficient of determination determines that the internal factors explain the size of the cash owned by the company with 67%, and the unexplained part is due to other factors that are not part of our analysis. This size of the determinant coefficient is considered a high degree with high explanatory power

5. Conclusion

In this paper, we investigated the determinants of corporate cash holdings on a selected sample of Macedonian industrial companies listed on the Macedonian Stock Exchange using their accounting data for the 2005-2019 period. The average share of cash in the total assets of the companies subject to this research is 3.1% and is significantly lower compared to developed countries with developed capital markets, such as the United Kingdom with 9.9%, the EU with 14%, and the United States with 7.2%. The maximum share of cash in the total assets reaches 48.7%.

According to the obtained results, the cash to assets ratio decreases with the increase of net working capital, leverage, cash flow variability, and conversion cycle, while it rises with the increase of the company size, cash flow, debt maturity, and capital investments.

The negative relationship between cash with net working capital and the conversion cycle is consistent with the Trade-off theory. Meanwhile, the negative relationship of cash with leverage is consistent with the pecking order theory. Our research has also shown a negative relation between cash and cash flow volatility which is not in line with Trade-off theory, yet our results correspond to research conducted by (Opler et al., 1999) and (Ferreira & Vilela, 2004), when using the fixed effects model. A positive relation between cash and company size, cash flow and debt maturity, is consistent with pecking order theory, while a positive correlation between cash and capital investment is consistent with trade-off theory. Most of the obtained results correspond, i.e., are in line with the pecking order theory, which on the other hand indicates that Macedonian companies do not have a predefined optimal cash balance, but cash is used as a buffer between retained earnings and investments.

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OPERATING COSTS OF TRADE IN SERBIA

Lukic Radojko¹

Abstract

In order to achieve the target profit, it is necessary to manage costs and sales revenues as efficiently as possible. With this in mind, this paper focuses on the specifics of operating cost management in trade with special reference to Serbia. Among other things, the analysis of the efficiency of operating cost management in Serbian trade is based on the Super Radial DEA model. Consequently, according to Super Radial CCR-I and Super Radial CCR-O, efficient management of trade operating costs in Serbia was only in 2014, and inefficient in other years. According to Super Radial BCC-I, efficient management of trade operating costs in Serbia was in 2013, 2014 and 2020, and inefficient in other years. According to Super Radial BCC-O, efficient management of trade operating costs in Serbia was efficient in 2013, 2014 and 2015, and inefficient in other years. In order to improve the efficiency of operational cost management, as well as the overall business, in Serbian trade it is necessary, by applying modern concepts of cost management (for example, costing by activities) and new business models. organic products, etc.), more efficiently manage input elements (real growth rate of gross domestic product, number of employees, assets, capital, employees' salaries, purchase value of sold goods and operating costs), as well as output (sales, margin and net profit) .

Key words: efficiency, costs, profit, Serbian trade, determinants

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1. Introduction

It is specific, due to the very nature of business, the size and structure of trade costs in relation to production (Berman, 2018; Levy, 2019; Lukić, 2011, 2020; Lovreta, 2021; van der Laken, 2021; Lukic, 2021; Lukic and Kozarevic, 2021; Lukic and Hadrovic Zekic, 2022a,b). The structure of total operating costs of trade consists of: costs of sold products (purchase value of sold goods) and operating costs (operating costs). In the structure of operating costs of trade, the share of employee costs (personnel costs) is significant, despite the increasing digitalization of the entire business (Riegger, 2021). This is quite understandable given the fact that trade belongs to the tertiary (service) activity whose general characteristic is a high share of "living labor" in the overall business (Pandey, 2021). The costs of goods sold, due to their nature, are covered from the proceeds from the sale of goods. In contrast, operating costs are, by their nature, covered by gross margin. The gross margin should be such that it can cover all operating costs, to make some profit for the needs of growth and development of trade and to keep consumers satisfied with its size (Lukić, 2011, 2020). Operating costs in trade are covered from the gross margin. The gross margin should be such that it can cover all operating costs and achieve the target profit for the needs of growth and development of trade. It is also acceptable for consumers, who are in the focus of trade business. Knowing the size and structure of trade costs is a prerequisite for achieving (more efficient management, in addition to sales revenue) target profit. Given the importance of literature, the literature is very rich in analysis of the size and structure of trade costs (Berenguer - Contrí, 2009; Edvardsson, 2021; Hamermesh, 2021; Krisnadewi, 2020; Malenkov, 2021; Sokolov Mladenović, 2019; Berman, 2018 ; Levy, 2019 ; Lukić, 2011, 2020; Lovreta 2021; Horobet, 2021; Gustafsson, 2021, Lukic, 2022a-g). The existing relevant literature in this paper serves as a theoretical-methodological and empirical basis for a complex comparative empirical analysis of total operating costs (costs of goods sold and operating costs) of trade between the European Union and Serbia (Horobet, 2021). It is very challenging to study the cost efficiency, ie the overall efficiency of all companies, which means trade, based on DEA (Data Envelopment Analysis) models, as well as the method of multi-criteria decision making (Ersoy, 2017). The literature devoted to the development of the DEA model is very rich (Andersen, 1993; Banker, 1984; Chen, 2021, Chang, 2020; Guo, 2020; Lee, 2011; Lin, 2020; Pendharkar, 2021; Tone, 2002; Dobrovich, 2021; Podinovski , 2021; Rostamzadeh, 2021). Also, an increasing number of papers are dedicated to the specifics of the analysis of the efficiency of commercial enterprises based on the DEA model (Ko, 2017;

Baviera-Puig, 2020; Fenyves, 2020; Shuangyan, 2018; Pachar, 2021). In the relevant literature in Serbia, special attention has recently been paid to the application of the DEA model in the evaluation of the efficiency of trade companies in Serbia (Lukic, 2019, 2020). In this paper, the existing literature on DEA models serves as a theoretical-methodological and empirical basis for evaluating the cost-effectiveness (i.e. as a whole) of trade in Serbia using, in addition to ratio analysis and statistical analysis, Super-Radial DEA models. Starting from the above, the subject of research in this paper is a dynamic analysis of cost efficiency (i.e. as a whole) of trade in Serbia based on the Super-Radial DEA model. The goal and purpose of that is to point out when trade in Serbia was cost-effective (that is, as a whole) and when it is not in the function of improving in the future by taking appropriate measures. The research hypothesis in this paper is based on the fact that costs, in addition to sales revenue, are among the most important factors in the efficiency of all companies, which means trade. Therefore, it is necessary to permanently control them and take appropriate measures in the function of their "optimization". Ratio analysis, statistical analysis, DEA analysis and methods of multi-criteria decision-making have a significant role in that, in the methodological sense of the word. In this paper, the emphasis is on the application of the Super Radial DEA model in the function of "optimization" of total operating costs (costs of goods sold and operating costs) of trade in Serbia and thus the realization of the target profit. The research of the treated problem in this paper is based on the empirical data collected from the Business Registers Agency of the Republic of Serbia, which are "produced" in accordance with relevant international standards, so that there are no restrictions in terms of international comparability. Eurostat data are also used to some extent.

3. DEA Super-Radial model

The research of the efficiency of trade companies in Serbia in this paper is based on the application of the Super Radial DEA model. Given this, we will briefly point out its methodological characteristics. Suppose we have n DMUs $\{DMU_j (j = 1, 2, \dots, n)\}$. Each consumes a set of m inputs, x_{ij} ($i = 1, 2, \dots, m$), in producing a set of outputs, Y_{rj} ($r = 1, \dots, s$). Based on VRS (variable return to scale) model (Banker et al., 1984), the input-oriented VRS super-efficient model for measuring efficiency can be expressed as:

$$\begin{aligned}
& \min \quad \theta \\
& s. t \quad \sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{ik}, \quad i = 1, \dots, m \\
& \quad j \neq k \\
& \quad \sum_{j=1}^n \lambda_j y_{rj} \geq y_{rk}, \quad r = 1, \dots, s \quad (1) \\
& \quad j \neq k \\
& \quad \sum_{j=1}^n \lambda_j = 1 \\
& \quad j \neq k \\
& \quad \lambda \geq 0, \quad j \neq k
\end{aligned}$$

4. Size and structure of total operating costs of trade in Serbia

It is very important to know the size and structure of operating costs of trade in the function of their optimization. Starting from that, this paper empirically investigates the factors of the size and structure of the total operating costs of trade in Serbia. Total operating costs include: costs of goods sold (purchase value of goods sold - costs of goods sold) and operating costs (operating costs). Table 1 show the dynamics of the size and structure of total operating costs of trade in Serbia for the period 2016-2020.

Table 1: Dynamics of the size and structure of total operating costs of trade in Serbia

	Share of purchase value of sold goods in sales, (%)	Margin share in sales, (%)	Share of operating expenses in sales, (%)	Share of net profit in sales, (%)
2016	86.07	13.93	10.43	3.50
2017	85.27	14.73	10.86	3.87
2018	85.34	14.66	11.04	3.62
2019	85.09	14.91	11.04	3.86
2020	84.21	15.79	11.12	4.67
Statistics				
Mean	85.1960	14.8040	10.8980	3.9040
Median	85.2700	14.7300	11.0400	3.8600
Std. Deviation	.66587	.66587	.27842	.45654
min	84.21	13.93	10.43	3.50
max	86.07	15.79	11.12	4.67

Note: Author's calculation. Statistics were calculated using SPSS software/Source: Agency for Business Registers of the Republic of Serbia

In Serbian trade, the average is: share of purchase value of sold goods in sales 85.2700%, share of sales margin 14.7300%, share of operating costs in sales 11.0400% and share of net profit in sales 3.8600%. In 2020, compared to 2019, partly due to the Covid-19 coronavirus pandemic, the share of the purchase value of sold goods decreased and the margin, operating costs and net profit in the sale of trade in Serbia increased. Due to the different intensity of the influence of individual factors, the size of the operating costs of trade certainly differs from country to country. In itself, for the sake of illustration, this is indicated by the presented average personal costs of trade of selective countries of the European Union and Serbia for 2019 (Table 2).

Table 2: Average personal costs of trade of selective countries of the European Union and Serbia, 2019

	Average staff costs (staff costs per employee - in thousands of EURO)
Germany	34.0
France	45.7
Croatia	14.1
Italy	34.9
Slovenia	25.2
Northern Macedonia	5.5
Serbia	8.7
Bosnia and Herzegovina	7.4

Source: Eurostat

The average personal costs in Serbian trade are therefore lower compared to Germany, France and Italy (leading countries in the European Union). They are also lower than in Croatia and Slovenia (countries in the region, members of the European Union). The reason for that is lower labor productivity in Serbian trade compared to these countries. In Serbia's trade, however, due to higher labor productivity, the average salary of employees is higher than in northern Macedonia and Bosnia and Herzegovina. The structure of operating costs in trade is determined by external and internal factors, as well as its very nature of business. Table 3 shows the structure of total operating costs of trade in Serbia for the period 2016-2020.

Table 3: Structure of total operating costs of Serbian trade

	Share of material costs in total operating costs, (%)	Share of fuel and energy costs in total operating expenses, (%)	Share of salary costs, salary compensation and other personal expenses in total operating expenses, (%)	Share of depreciation costs in total operating expenses, (%)	Share of other operating expenses in total operating expenses, (%)	Share of purchase value of sold goods in total operating expenses, (%)
2016	3.36	1.19	5.62	1.09	7.95	80.78
2017	2.94	1.11	5.83	0.80	8.47	80.86
2018	2.82	1.14	6.15	1.16	7.90	80.82
2019	2.91	1.12	6.25	1.30	8.32	80.09
2020	2.77	0.97	6.83	1.38	7.66	80.38
Statistics						
Mean	2.9600	1.1060	6.1360	1.1460	8.0600	80.5860
Median	2.9100	1.1200	6.1500	1.1600	7.9500	80.7800
Std. Deviation	.23377	.08204	.46226	.22445	.32917	.33761
Minimum	2.77	.97	5.62	.80	7.66	80.09
Maximum	3.36	1.19	6.83	1.38	8.47	80.86

Note: Author's calculations. Statistics were calculated using SPSS software/Source: Agency for Business Registers of the Republic of Serbia

In the structure of total operating costs (operating expenses) in trade, the share of the purchase value of sold goods (costs of sold goods) is significant, i.e. in operating costs (operating costs) of employee costs.

5. Empirical analysis of the efficiency of managing the total operating costs of trade in Serbia

This paper focuses on the empirical analysis of the efficiency of managing total operating costs in Serbian trade. Table 4 shows the initial data for the analysis of the factors of efficiency in the management of total operating costs in Serbian trade for the period 2013 - 2020.

Table 4: Initial data for the analysis of the efficiency of managing the total operating costs of trade in Serbia

	(I) Gross domestic product growth rate	(I) Number of employees	(I) Assets	(I) Capital	(I) Earnings of employees	(I) Acquired value of sold goods	(I) Operating costs	(O) Sales	(O) Margin *	(O) Net profit
2013	2.9	193210	2160474	746992	151978	2300147	501641	2891518	591371	89730
2014	-1.6	191621	2157564	761305	154833	2244057	263590	2594602	350545	86955
2015	1.8	159621	2197931	805009	164718	2358585	278149	2731999	373414	95265
2016	3.3	206092	2324843	859749	180367	2590399	314014	3009651	419252	105238
2017	2.1	208020	2375290	920992	194924	2705077	344589	3172393	467316	122727
2018	4.5	219373	2524897	1007972	218410	2868190	371088	3361094	492904	121816
2019	4.3	222049	2682931	1073056	238022	3070400	398520	3608329	537929	139409
2020	-0.9	227618	2837599	1183026	262322	3085928	407567	3664505	578577	171010

*Note: Data are expressed in millions of dinars. Number of employees in the whole number. I - input. O - output. * Author's calculation / Source: Agency for Business Registers of the Republic of Serbia*

Table 5: Data input / output statistics

Statistics on Input / Output Data										
	Real GDP growth rate	Number of employees	Assets	Capital	Earnings of employees	Purchased value of sold goods	Operating costs	Sale	Margin	Net profit
Max	4.5	227618	2837599	1183026	262322	3085928	501641	3664505	591371	171010
Min	-1.6	159621	2157564	746992	151978	2244057	263590	2594602	350545	86955
Average	2.05	203450.5	2407691	919762.6	195696.8	2652848	359894.8	3129261	476413.5	116518.8
SD	2.104757	20546.25	237146.5	146764	37951.78	314842.6	72696.39	368460.5	84787	26764
Correlation										
	Real GDP growth rate	Number of employees	Assets	Capital	Earnings of employees	Purchased value of sold goods	Operating costs	Sale	Margin	Net profit
Real GDP growth rate	1	0.169164	0.072201	0.068648	0.085865	0.260293	0.333327	0.28502	0.27206	-0.04351
Number of employees	0.169164	1	0.813046	0.793347	0.802141	0.83245	0.429165	0.851814	0.610579	0.768584
Assets	0.072201	0.813046	1	0.995054	0.996885	0.972694	0.31126	0.963452	0.574954	0.975981
Capital	0.068648	0.793347	0.995054	1	0.999428	0.974704	0.261788	0.955615	0.533432	0.978815
Earnings of employees	0.085865	0.802141	0.996885	0.999428	1	0.978918	0.274161	0.961404	0.542939	0.975328
Purchased value of sold goods	0.260293	0.83245	0.972694	0.974704	0.978918	1	0.298626	0.981406	0.551581	0.936255
Operating costs	0.333327	0.429165	0.31126	0.261788	0.274161	0.298626	1	0.474639	0.953751	0.305235
Sale	0.28502	0.851814	0.963452	0.955615	0.961404	0.981406	0.474639	1	0.701427	0.932872
Margin	0.27206	0.610579	0.574954	0.533432	0.542939	0.551581	0.953751	0.701427	1	0.57737
Net profit	-0.04351	0.768584	0.975981	0.978815	0.975328	0.936255	0.305235	0.932872	0.57737	1

Note: Author's calculation using DEA-Solver software

In Serbian trade, there is therefore a strong correlation between operating costs (operating costs) and margins. This is quite understandable because the operating costs in trade are covered from the margin, and the rest represents the realized profit for the needs of growth and development of trade.

6. Determinants of operating costs of trade in Serbia

The size and structure of operating costs in trade are influenced by numerous macro and micro factors (Berman, 2018; Levy, 2018; Lukić, 2020; Lovreta, 2021). Suppose that the operating costs of trade in Serbia are a function of the number of employees, assets (as an expression of the size of the company), sales, margins and net profit. Accordingly, Table 6 shows the empirical results obtained using linear regression analysis.

Table 6: Regression analysis of factors of operating costs of trade in Serbia

Coefficients ^a								
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Zero order	Partial	Part
(Constant)	-7,098	5,320		-1.334	.314			
Number of employees	-.021	.016	-.006	-1.285	.328	.429	-.672	-.003
Assets	.005	.005	.018	1.009	.419	.312	.581	.002
Sale	.001	.003	.005	.350	.760	.475	.240	.001
Margin	.998	.003	1.165	287,714	.000	.954	1,000	.684
Net profit	-1.033	.031	-.383	-33.248	.001	.304	-.999	-.079
R 1,000 ^a ; R Square 1,000; Adjusted R Square 1,000; F Change 35388,902; Sig. F Change .000; Durbin-Watson 2,661								
a. Dependent Variable: Operating costs								

Note: Author's calculations using SPSS software

The empirical results obtained by applying linear regression analysis show a significant impact of margin and net profit on the size of operating costs of trade in Serbia. There is a strong correlation between them at the level of statistical significance. Such a result is quite logical, considering that the margin serves to cover operating costs and the realization of a certain profit for the needs of growth and development of trade. An important factor in the size of operating costs in Serbian trade is certainly the digitalization of the entire business, which is at an increasing level (Gustafsson, 2021).

7. Super Radial DEA analysis of the efficiency of managing the total operating costs and performance of trade in Serbia

We will analyze the efficiency of managing total operating costs and performance in Serbian trade using the Super Radial DEA model of input and output orientation with constant and variable yield. Input elements are: the rate of real growth of gross domestic product, number of employees, assets, capital, salaries of employees, cost of goods sold and operating costs. Output elements are: sales, margin and net profit. Table 7 shows the obtained empirical results of a comparative analysis of the efficiency of managing total operating costs and trade performance in Serbia based on the Super

Radial DEA model of input and output orientation with constant and variable yield.

Table 7: Efficiency of operating costs and trade operations in Serbia (Super-CCR-I and Super-CCR-O)

		DEA-Solver LV (V7) / Super-Radial (Super-CCR-I) Returns to Scale = Constant (0 = <Sum of Lambda <Infinity)		DEA-Solver LV (V7) / Super-Radial (Super-CCR-O) Returns to Scale = Constant (0 = <Sum of Lambda <Infinity)		DEA-Solver LV (V7) / Super-Radial (Super-BCC-I) Returns to Scale = Variable (Sum of Lambda = 1)		DEA-Solver LV (V7) / Super-Radial (Super-BCC-O) Returns to Scale = Variable (Sum of Lambda = 1)	
No	DMU	Score	Rank	Score	Rank	Score	Rank	Score	Rank
1	2013	1.623058	1	1.623058	1	1	5	1	5
2	2014	1	7	1	7	1	5	1	5
3	2015	1.082075	3	1.082075	3	1.223064	1	1	5
4	2016	1.01956	6	1.01956	6	1.020704	4	1.019704	4
5	2017	1.03133	4	1.03133	4	1.03282	3	1.056163	2
6	2018	0.996668	8	0.996668	8	0.996868	8	0.996837	8
7	2019	1.02944	5	1.02944	5	1.072279	2	1.038841	3
8	2020	1.545116	2	1.545116	2	1	5	1.824638	1
		No. of efficient DMUs = 1		No. of efficient DMUs = 1	1	No. of efficient DMUs = 3		No. of efficient DMUs = 3	
		No. of inefficient DMUs = 7		No. of inefficient DMUs = 7	7	No. of inefficient DMUs = 5		No. of inefficient DMUs = 5	

Note: Author's calculation using DEA-Solver software

According to Super Radial CCR-I and Super Radial CCR-O, efficient management of total operating costs and trade performance in Serbia was only in 2014, and inefficient in other years. According to Super Radial BCC-I, efficient management of total operating costs and trade performance in Serbia was in 2013, 2014 and 2020, and inefficient in other years. According to Super Radial BCC-O, efficient management of total operating costs and trade performance in Serbia was efficient in 2013, 2014 and 2015, and inefficient in other years. In order to improve the efficiency of operational cost management in Serbian trade, it is necessary, by applying modern concepts of cost and business management, to manage input elements as efficiently as possible (real growth rate of gross domestic product, number of employees, assets, capital, employees' salaries). costs) as well as output (sales, margin and net profit). The digitalization of the entire business certainly plays an important role in this (Gustafsson, 2021).

Table 8 illustrates the projection of input / output data. It indicates the deviation of the achieved from the planned values and what measures should be taken in the function of achieving the target values. Thus, for example, in 2020, the realized operating costs are higher than projected by 31.57%. This means, in other words, in order to improve cost efficiency and overall performance of trade in Serbia, it is necessary to manage operational costs as efficiently as possible (improvement of human resource management, application of new cost management concepts - for example costing by activities, and application of modern information and communication technology - for example radio frequency identification).

Table 8: Input / output data projection (Super Radial BCC-O)

Model Name = DEA-Solver LV (V7) / Super-Radial (Super-BCC-O) Returns to Scale = Variable (Sum of Lambda = 1)									
	No.	1	2	3	4	5	6	7	8
	DMU	2013	2014	2015	2016	2017	2018	2019	2020
	Score	1	1	1	1,019704	1,056163	0,996837	1,038841	1,824638
(I) Real growth rate of gross domestic product	Projection	2,897622	-1,6	1,799812	0,690624	1,109062	2,693697	2,221362	-0,9
	Change (%)	-0.08%	0.00%	-0.01%	-79.07%	-47.19%	-40.14%	-48.34%	0.00%
(I) Number of employees	Projection	193207,2	191621	159621	201736,8	180780,4	214680,8	222049	194723,5
	Change (%)	0.00%	0.00%	0.00%	-2.11%	-13.09%	-2.14%	0.00%	-14.45%
(I) Assets	Projection	2160451	2157564	2197907	2291833	2375290	2524897	2644015	2198755
	Change (%)	0.00%	0.00%	0.00%	-1.42%	0.00%	0.00%	-1.45%	-22.51%
(I) Capital	Projection	746992	761305	804998,8	859749	907624	996993,6	1073056	791516,1
	Change (%)	0.00%	0.00%	0.00%	0.00%	-1.45%	-1.09%	0.00%	-33.09%
(I) Earnings of employees	Projection	151978	154833	164715,9	179549,8	191351,1	215979,6	234709,1	162417,8
	Change (%)	0.00%	0.00%	0.00%	-0.45%	-1.83%	-1.11%	-1.39%	-38.08%
(I) Acquired value of sold goods	Projection	2300095	2244057	2358556	2528462	2559282	2868190	2942309	2331277
	Change (%)	0.00%	0.00%	0.00%	-2.39%	-5.39%	0.00%	-4.17%	-24.45%
(I) Operating costs	Projection	501511,7	263590	278145,5	314014	328212,5	371088	389843	278914,1
	Change (%)	-0.03%	0.00%	0.00%	0.00%	-4.75%	0.00%	-2.18%	-31.57%
(O) Sales	Projection	2891978	2594602	2731999	2951495	3003696	3371760	3473416	2703914
	Change (%)	0.02%	0.00%	0.00%	-1.93%	-5.32%	0.32%	-3.74%	-26.21%
(O) Margin	Projection	591371	350545	373414	423033,7	444413,3	503570,1	531107,3	372636,8
	Change (%)	0.00%	0.00%	0.00%	0.90%	-4.90%	2.16%	-1.27%	-35.59%
(O) Net profit	Projection	89747,62	86955	95265	109019,7	116200,8	132482,1	141264,3	93722,68
	Change (%)	0.02%	0.00%	0.00%	3.59%	-5.32%	8.76%	1.33%	-45.19%

Note: Author's calculations using DEA-Solver software

Table 9 shows the Slack analysis. It indicates what measures should be taken in the function of converting inefficient DMUs into efficient units. Thus, for example, in 2020, in order to achieve unit cost efficiency and business efficiency as a whole, it was necessary to reduce inputs (except the rate of real growth of gross domestic product) and increase outputs by appropriate values (except net profit). For the sake of illustration, it was necessary to reduce employment by 32894.49 workers.

Table 9: Slack

Model Name = DEA-Solver LV (V7) / Super-Radial (Super-BCC-O) Returns to Scale = Variable (Sum of Lambda = 1)												
No.	DMU	Score	Excess Gross domestic product growth rate	Excess Number of employees	Excess Assets	Excess Capital	Excess Earnings of employees	Excess Purchased value of sold goods	Excess Operating costs	Shortage Sale	Shortage Margin	Shortage Net profit
			S- (1)	S- (2)	S- (3)	S- (4)	S- (5)	S- (6)	S- (7)	S + (1)	S + (2)	S + (3)
1	2013	1	2.38E-03	2.761395	23.12346	0	0	52.27471	129.2546	459.5864	0	17.62242
2	2014	1	0	0	0	0	0	0	0	0	0	0
3	2015	1	1.88E-04	0	23.99288	10.23011	2.140259	29.29869	3.507716	0	0	0
4	2016	1.019704	2.609376	4355.223	33010.3	0	817.1867	61937.49	0	0	11882.95	5815.222
5	2017	1.056163	0.990938	27239.58	0	13368	3572.928	145794.6	16376.5	0	1947.59	0
6	2018	0.996837	1.806303	4692.159	0	10978.43	2430.424	0	0	0	9101.908	10279.52
7	2019	1.038841	2.078638	0	38916.02	0	3312.899	128090.8	8677.007	0	13291.03	7067.697
8	2020	1.824638	0	32894.49	638843.6	391509.9	99904.22	754651	128652.9	695568	55545.5	0

Note: Author's calculations using DEA-Solver software

Conclusion

The empirical results obtained by applying linear regression analysis show a significant impact of margin and net profit on the size of operating costs of trade in Serbia. There is a strong correlation between them at the level of statistical significance. Such a result is quite logical, considering that the margin serves to cover operating costs and the realization of a certain profit for the needs of growth and development of trade. According to the Super Radial CCR-I and Super Radial CCR-O models, efficient management of trade operating costs in Serbia was only in 2014, and inefficient in other years. According to the Super Radial BCC-I model, efficient management of trade operating costs in Serbia was in 2013, 2014 and 2020, and inefficient in other years. According to Super Radial BCC-O model, efficient management of trade operating costs in Serbia was efficient in 2013, 2014 and 2015, and inefficient in other years. In order to improve the efficiency of operational cost management in Serbian trade, it is necessary, by applying modern concepts of cost and business management, to manage input elements as efficiently as possible (real growth rate of gross domestic product, number of employees, assets, capital, employees' salaries). costs) as well as output (sales, margin and net profit). The digitalization of the entire business also plays an important role in that.

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EMPIRICAL APPROACH TO GROWTH ANALYSIS – PECULARITIES FOR MODELING STRATEGY IN THE CASES OF BIG EXOGENIOUS SHOCKS

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Abstract

Empirical investigation on growth, especially in the course of big exogenous shocks is still relatively ambiguous. While models of developed economies describe the growth process as a smooth movement along the balanced growth path, this pattern is altered in the cases of big exogenous shocks that hit economies. The later accumulation of evidence, including the big shocks due to pandemic and Russia - Ukraine war led to more realistic specifications of growth models as well, putting the emphasize on the impact of shocks on growth processes. Hence, the main objective of this paper is to provide a review of the papers that investigate empirically growth and its main determinants, with the accent on analysis of the impact of shocks on growth patterns. A distinction is made between studies that investigate developed economies and those that concentrate on developing or transition economies. The former ones usually apply the modelling strategy based on the neoclassical linear framework and, their review offers valuable insight and overview of the variables mostly used in growth studies. On the other side, the studies concerning developing or transition countries are rather focused on finding new ways of empirically modelling growth in specific conditions of shocks. Although still the majority of the analyses are based on the linearity assumption, in this review we shall treat only the ones that introduce non-linearity in the growth studies, assessing the ways they address the non-linearity observed in the data generating processes. Finally, the proposed strategy for modelling big shocks in the growth pattern is

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adjusted growth accounting formula with Markov Switching Vector Autoregressive modelling. The modest number of variables is due to the intention of the empirical exercise to put a focus on the shifts in growth rather than on the detailed determinants behind the shifts. Additionally, it should be emphasized that the informative purpose of this empirical model is limited by the lack of data for other possible variables and by the modelling procedure.

Key words: economic growth, shocks, modelling strategy, transition countries

1. Introduction

In general, growth theory does not offer a clear-cut path towards empirical investigation on growth, especially in the course of big exogenous shocks. Temple (1999) noticed that the empirical work on growth has often been controversial due to the widespread feeling that growth theory and econometrics are best kept apart. In fact, the lack of an apparent theoretical background has led empirical economists to follow theory loosely and simply "try" various variables as potentially important determinants of growth (Sala-i-Martin, 1997, Fischer and Gelb, 1991, Temple 1999). In consequence, the number of growth regression has grown far faster than the economies they analyse (Hendry and Krolzig, 2004). Many of these novel and informal models were initially described as mongrel or ad hoc regressions. Yet, they have gradually become the principal mode of analysing growth in general (Fischer, 1993).

The main goal of this paper is to provide a review of the papers that investigate empirically growth and its main determinants, with the accent on analysis of the impact of shocks on growth patterns. A distinction is made between studies that investigate developed economies and those that concentrate on developing and transition economies. The reason for this is that they are different with respect to the modelling approach, yet share the same neoclassical origins in terms of selection of the variables. The former ones usually apply the modelling strategy based on the neoclassical linear framework and, their review offers valuable insight and overview of the variables mostly used in growth studies. On the other side, the studies concerning developing countries are rather focused on finding new ways of empirically modelling growth in specific conditions of shocks. Although still the majority of the analyses are based on the linearity assumption, in this review we shall treat only the ones that introduce non-linearity in the growth

studies, assessing the ways they address the non-linearity observed in the data generating processes.

The aspiration to address the above questions shaped this paper. Hence, it is organized as follows. Second section gives the main theoretical background, followed by the review of papers that apply this approach in this research. Section 3 is setting out the main characteristics of the models in the case of transition or developing countries, followed by the discussion of the problem of endogeneity in growth regressions. Section 5 presents the adjusted growth accounting formula with MSVAR that could be applied for capturing big shocks. The last section concludes.

2. Theoretical background on modelling growth and its determinants through modified growth accounting framework

The augmented-Solow model is the starting point in the review of the empirical findings on growth. Mankiw et al. (1992) examined whether the original Solow growth model can explain the international variations in the standard of living. The first tested model regressed the real GDP per worker for each year on two main variables: n - average rate of growth of the working-age population between 15 and 64 years and s - the average share of real investment (including government investment) in real GDP. The data used in the study are from the Real National Accounts constructed by Robert Summers and Alan Heston from 1988.

Using the model, the data on three samples of countries (98, 75 and 22 OECD countries) and OLS techniques they found that the model correctly predicts the direction of the effects of the different factors, such as saving (s) and population growth (n), but it overstates their magnitudes. The saving variable actually is the fraction of income invested in physical capital, which indirectly in the equation measures the share of change of capital. The value of α implied by the coefficients should equal capital's share in income, which according to Mankiw et al. (1992) is roughly 1/3. However, the estimates without human capital imply a much higher value (0.59) with a standard error of 0.02.

Because the estimates implied a high capital share, Mankiw et al. (1992) augmented the Solow model by including accumulation of *human capital* as an explanatory variable in their cross-country regressions. The improved model regresses $\ln(\text{GDP per worker})$ on $\ln(\text{capital per worker})$ and $\ln(\text{human capital per worker})$, while the estimate for capital per worker is the investment rate in physical capital over 1960-1985 and the estimate for human capital is the investment rate in human capital over 1960-85

measured as a percentage of secondary-school students in the working-age population.

Inclusion of human capital altered the empirical modelling, but also the theoretical modelling of economic growth. At the theoretical level, the inclusion of human capital altered the notion of diminishing returns to reproduceable capital, which became constant returns to broad capital (Lucas, 1988). However, Mankiw et al. (1992) preserved the notion of diminishing returns to all capital in their modelling, assuming that $\alpha + \beta < 1$. In this case, the economy will converge to its steady state as explained in Solow. After imputing the human capital variable and regressing, Mankiw et al. (1992) found out that the human capital accumulation measure enters significantly in all three samples. In addition, their augmented model explains 80 per cent of the cross-country variation in income per capita from three variables: population growth; and investment rates in physical and human capital. The high R^2 is the basis of Mankiw's (1995) conclusion that: "Put simply, most international differences in living standards can be explained by differences in accumulation of both human and physical capital" (p. 295). The corollary of their finding is that differences in technical efficiency, which on the other hand depend on resource endowments, climate, education, institutions and so on, and differ across countries, can have a relatively small role (less than 20 per cent) to play in explaining cross-country income variations.

Subsequently, Klenow and Rodriguez-Clare (1997) have drawn attention to the relatively exaggerated estimation of human capital in the Mankiw et al. model arguing that an important issue is how exactly human capital is measured in the models as sometimes human capital estimates can absorb part of the TFP specific for the countries. Klenow and Rodriguez-Clare (1997) offer more exact measures of human capital for 98 countries, by updating Mankiw et al.'s data and adding data on primary and tertiary schooling in the model, as well as taking into account worker experience and the quality of education. Additionally, they offer extensive explanation and estimation of experience and quality of education for the countries in their analysis. The main finding is not surprising; namely, that richer countries have older workforces and higher quality of education which, combined with the physical capital, results in higher growth rates. In addition, they argue that the Mankiw et al. (1992) estimates of human capital effects do not capture only private gains but also the social gains of schooling that are always larger than the private benefit, consequently amplifying the role of human capital in the regressions. Correcting for this and using the same estimates for physical capital, they find that total factor productivity differences account for half or more of level differences in 1985 GDP per

worker levels. In addition, when testing the growth rates (instead of levels) for the four Asian tigers (Hong Kong; Singapore; South Korea and Taiwan from the study of Young, 1995) they find that roughly 90% of country differences in Y/L growth are attributable to differences in A growth. Combining these growth results with their findings on levels, they call for returning productivity differences to the centre of theorizing about international differences in output per worker.

Although with various findings with respect to the size of the contribution of human capital to growth, growth empirics in general did emphasize the importance of the exact measure of human capital that enters the growth regression. This seems especially important for the case of developed economies where human capital plays a significant role in growth through the engagement in research and development.

Bassanini and Scarpetta (2001) also have tested the augmented Solow model in the case of 21 OECD countries over a period 1971-1998. They started with a simple specification of the growth equation and then analysed extended models. Their initial specification is consistent with the neoclassical growth model including the convergence factor and the basic determinants such as accumulation of physical capital and population growth, similar to the one used in our model. The first extension involves human capital and further considers R&D, and a set of policy and institutional factors potentially affecting economic efficiency. Considering pooled cross-country time series (i denotes countries and t time) they have written the model in general form:

$$\begin{aligned} \Delta \ln y_{i,t} = & a_{0,i} - \phi_i \ln y_{i,t-1} + a_{1,i} \ln sk_{i,t} + a_{2,i} \ln h_{i,t} - a_{3,i} n_{i,t} + \sum_{l=4}^m a_{l,i} \ln V_{i,t}^l + a_{m+1,i} t + b_{1,i} \Delta \ln sk_{i,t} \\ & + b_{2,i} \Delta \ln h_{i,t} - b_{3,i} \Delta n_{i,t} + \sum_{l=4}^m b_{l,i} \Delta \ln V_{i,t}^l + \varepsilon_{i,t} \end{aligned}$$

Equation 1

where y is GDP per capita, sk is the propensity to accumulate physical capital, h is human capital, n is population growth, the V^l is the vector of variables affecting economic efficiency, t is a time trend, the b - regressors capture short-term dynamics and ε is the usual error term.

As the equation suggest, the most interesting novel aspect in this study is the differentiation between the long-run and the short-run dynamics in the model by including first differences of the steady-state determinants as short-run regressors in the estimated equations (Bassanini and Scarpetta, 2001). Under the assumption of long-run slope homogeneity, they use the pooled mean group estimator that allows intercepts, the convergence parameter (ϕ), short-run coefficients and error variances to differ freely across countries, but imposes homogeneity on long-run coefficients. The homogeneity of the

long-run coefficients actually implies that the countries will approach the same steady state growth rate in the long run, which is due to similarity of the countries in terms of common technologies and intensive intra-trade and FDI and also due to the constancy of the coefficients across time.

Nonetheless, the introduction of the short-run dynamic and the allowance for it to differ across countries clearly implies that even in the case of developed and very similar countries the movement towards the steady state is not always smooth and linear; and neither is it equal for all the countries at a certain point of time.

3. Empirical studies of growth in the case of big shocks

Since growth processes in developing and transition countries may be very different to those countries near the technological frontiers, one should often be careful about extrapolating findings from the developing countries to the more developed and vice versa (Temple, 1999). As shown in the previous section, while explaining growth differences among developed countries most studies use balanced growth models, which means that several aggregate "great ratios" evolve smoothly over time, following the transitional path given in the neoclassical model. However, Pritchett (1997) notices that the history of many developing and transition countries has been marked by alternating booms and growth collapses that are rarely studied in the growth studies of transition. Instead, most empirical studies of transition still employ balanced growth models, following the example of growth studies of developed countries, generally disregarding the dramatic shifts of growth experienced by developing and transition countries, or alternatively only including them as variables in the otherwise linear system (Jones and Olken, 2005). In many cases, although the output fluctuations can be easily perceived by looking at the time series behaviour of growth rates within countries, mainly in recent times, several influential authors as Pritchett (2000), Easterly et al. (1993, 2000) and Easterly (2009c) stressed the serious shortcoming of the standard empirical approach to growth. They claimed that a general framework is needed for thinking about macroeconomic discontinuities – one that encompasses differences among countries.

Jones and Olken (2005) explored a less common approach to growth that emphasizes actually the variation of the growth experience *within* countries. They examined more deeply the changes that occur when growth starts and stops in one country. Claiming that the transition between different growth regimes is highly important for better understanding of growth in all countries (except for richest ones), firstly, they identify structural breaks in

the growth series for individual countries using the methodology of Bai and Perron (2003) and data from the Penn World Tables (Heston et al. 2012). Then, they use the accounting exercise to analyse whether observable factors, such as the accumulation of physical capital, human capital, or changes in factor intensity, can account for significant parts of the structural change, or whether TFP, the unobserved residual, is left to explain the growth breaks. The growth rate in the physical capital stock per-capita is defined as

$$g_k = \frac{I}{K} - \delta - n$$

Equation 2

where I is gross investment, and n , the population growth rate and the depreciation rate, δ , is assumed to be 7%; while for measuring the human capital they start with taking the standard assumption of Mincerian returns to schooling which implies a 10% return in wages to an additional year of schooling, hence if s is years of schooling the growth rate of human capital can be calculated as:

$$g_h = 0.1 \frac{ds}{dt}$$

Equation 3

The analysis suggests that changes in the rate of factor accumulation explain relatively little of the growth reversals, especially for accelerations. Instead, the growth reversals are largely due to shifts in the growth rate of productivity. They find very similar results by using independent data on electricity consumption to infer total capital utilization rather than relying on investment data from the national accounts. The electricity data only confirms the previous findings, suggesting an efficiency story.

Young (1995, 2000) has emphasized another problem related to the growth analysis in the developing countries and that is the problem of misstating the data in the national statistics in the socialist country of China. He analysed the economic performance of the Republic of China using the statistics given by the national statistical office of China but making systematic adjustments using their own data. By simple descriptive but rather profound analysis on each data sets on labour market movements, he showed that the growth rates during the reform period in China 1978-98 are close to ones previously experienced by other rapidly growing economies. Namely, he claimed that the key force explaining the extraordinary improvements in per capita living standards in China is the labour deepening (the rise in participation rates, transfer of labour out of agriculture, and improvements in educational attainment) and *not* capital deepening. After taking into account

these labour changes, he found that labour and total factor productivity growth in the non-agricultural economy are found to be 2.6 and 1.4 per cent per year, respectively; a respectable performance, but by no means extraordinary.

4. Growth regression exercises in developing and transition countries

In the case of developing and transition countries, growth empirics are even more ambiguous owing to the complexity of economic growth, the short span of data and the absence of coherent theory that explains and encompasses all processes. However, even in the limited cases that empirically analyse big shocks, the analysis is mainly based on the balanced linear growth model which, in turn, as mentioned before, disregards the huge changes experienced in the course of shocks (De Melo et al, 1996 and 2001; Fidrmuc, 2003; Havrylyshyn and Rooden, 2000; Fischer and Sahay, 2000).

In general, alongside with the short length of data necessary for growth analysis, the main problem is that growth literature, which makes heavy use of balanced growth models, generally disregards the dramatic changes experienced by all developing and transition economies, whether these are described as structural changes, factors' reallocations, institutional changes and so on (Kongsamut et al. 2001). In fact in empirical work, these changes are included as a separate variables in the growth regression models, but still within the linear framework, not allowing for their more substantial impact in the estimation procedure.

In general, the main model, which is used in studies, has the following linear equation form:

$$y = \alpha + \beta Z + \chi X + u$$

Equation 4

where y is the GDP per capita growth rate, Z is a vector of core variables that usually appear in growth regressions such as initial level of GDP per capita, the investment rate, the secondary school enrolment rate and the rate of population growth, X is a vector of variables of interest and u is the error term. The choice of the included variables is based on past empirical studies and economic theory, while usually panel modelling is used in order to overcome the problem of lack of data and to obtain results, which will be relevant for the whole or separate groups of the world (Hamma et al., 2012).

5. Endogeneity in the regression analysis of growth

One important problem already recognized in the growth empirical literature is the potential endogeneity of the variables used in the growth regressions stemming from the interrelation of the determinants within the growth system (Pritchett, 2000).

Broadly, endogeneity is a situation when one or more independent variable(s) is correlated with the error term in the regression model, which gives rise to biased regression coefficients² (Wooldridge, 2002). In brief, there are several reasons for endogeneity, such as omitted variables, measurement problem and simultaneity, which may be particularly pronounced in dynamic systems.

- In the omitted variables case, there is a variable (or more than one variable) that needs to be included in the analysis based on the theoretical and empirical grounds and is correlated with the included variables, but still, it is not represented in the empirical model due to lack of data or insufficient knowledge.
- In the measurement error case, the estimation of the effect of certain explanatory variables on y is ambiguous if one or more variables are mismeasured.
- In the case of simultaneity, one or more of the explanatory variables and the dependent variable mutually determine one another (Wooldridge, 2000).

In the former two cases, the problems can be solved if better data are collected, while the latter case requires specific modelling approaches that will enable estimating unbiased regression coefficients (Wooldridge, 2002).

However, the last important source of endogeneity relevant for the dynamic systems econometric modelling, in particular, is simultaneity. Simultaneity arises when one or more of the explanatory variables and the dependent variable mutually determine one another (Wooldridge, 2000). In fact, simultaneity is the situation when the one-way causal relationship between the independent and dependent variable is accompanied by a backward causal relationship i.e. the dependent variable affects the independent variable, creating a two-way causal connection(s) among the dependent and independent variable(s) in the model. This situation is particularly relevant in the context of time series analysis of causal processes. Simultaneity occurs in dynamic models and systems where the variables, dependant and independent, are interconnected.

² More on the explanation and sources of endogeneity see Wooldridge, 2002.

The possibility of mutual causation between determinants of growth and the growth of GDP has been already recognized in the growth literature (Mirestean and Tsangarides, 2009, Durlauf et al., 2008). Many authors have stressed that alongside the main relation – from the growth determinants - physical and human capital- to GDP growth, there is also a backward relation; that is:

- GDP growth is a determinant of the flow of investments and hence the physical capital flow (Jorgenson, 1963, Lucas and Prescott, 1971, Hall and Jorgenson, 1971, De Long and Summers, 1991); and,
- GDP growth is a determinant of employment and human capital development (Lucas, 1988, Barro and Lee, 2000).

Conventional economic thought has already established the relation between the growth of the economy and the *physical capital changes* in the concept of the accelerator effect. According to this conception, businesses will be encouraged to make new investments increasing the physical capital stock, determined by - among other factors - the expected profit rate; which in turn depends on the growth of the economy (Jorgenson, 1963). Broadly, rising GDP (in an economic boom or prosperity) implies that businesses expect increasing sales, cash flow, more efficient use of the capacity and rising profits, which would encourage further investment in physical capital such as equipment and improved technology (Hall and Jorgenson, 1967). The opposite happens in the case of falling GDP when businesses are reluctant to invest as they expect falling sales and a worsened economic environment. As business confidence falls, the discouraged businesses may lead to negative growth of the economy through the further decrease of consumer incomes and purchases resulting in negative multiplier effects (Lucas and Prescott, 1971). Although mainly related to business cycle movements and the business cycle concept, the feedback relationship between GDP growth and physical capital growth has general economic relevance, because it is part of the reasons behind deeper recessions and growth failure (Hall, 1993, Kornai, 1994). Namely, Hall (1993) found that the falling investment played a part in deepening recession. Explaining the vicious circle that developed in the course of the recession in United States in 1990-91, Hall (1993, p.5) concluded:

Firms cut all forms of investment; again, as they would if there had been some permanent adverse shock. As usual in a recession, firms cut production by more than their sales fell, making up the difference from inventories.

The economic literature also documents the two-way relationship between GDP growth and changes in the labour market (employment growth

and human capital development). Namely, economic growth is not only determined by the labour and human capital among other factors, as discussed by the endogenous growth theories (Lucas, 1988, Barro and Lee, 2000); but also economic growth causes changes in the employment and human capital in an economy (Hull, 2009, Satchi and Temple, 2006). Although it is not always clear how economic growth translates into labour market outcomes, in general, the literature suggests that positive economic growth exerts two main effects on labour markets: firstly, it stimulates job creation or employment increase (changes in the quantity of labour); and, moreover, it stimulates human capital development (changes in the quality of labour)³. The first effect is usually measured by the employment intensity of economic growth that is the growth in employment resulting from the growth in output (Hull, 2009). High employment intensity indicates that growth in output leads to considerable job creation, while low estimates of employment intensity suggest little correlation between economic growth and employment. The latter case is usually referred to as a “jobless recovery”, which can happen due to a variety of situations (Glosser and Golden, 2005). Namely, in some cases, economic growth favours increase in labour utilization rather than increase the number of jobs. This is especially emphasized in the eve of recessions, when companies are more reluctant to hire new workers until they are convinced about the sustainability of a new economic recovery (Glosser and Golden, 2005). Finally, another possibility is that companies employ new technologies and high-skilled labour resulting in increased productivity instead of mass job creation. In the latter case, the effects are related to improving the labour quality that is human capital development instead of increase in employment (Hull, 2009). In the opposite case of negative economic growth, the relation between the economic decline and labour market outcomes is again confirmed; with prompt or lagged conversion of economic downturn into increase in unemployment and negative impact on human development (Maddison, 1987).

Although brief, the above discussions suggest that economic growth measured by the GDP growth affects the two main determinants of growth, thereby implying the problem of endogeneity in the empirical model. This is an important empirical problem that results in biased regression coefficients; hence, the results of the single equation regime switching regressions undertaken in the course of this research are not reported. Instead, in order to address the possible mutual determination of the dependent and independent

³Indeed, the impact and the effects of the interrelations depend on many factors studied in the literature, such as: the level of development of the country, the type of growth, the level of urbanization of the country, the labour market characteristics such as its sectorial structure, the share of informal sector, labour income and so on (Satchi and Temple, 2006).

variables, the Markov Switching Vector Autoregressive (MSVAR) model can be applied in modelling of GDP growth dynamics in the course of big shocks. The MSVAR system addresses the problem of endogeneity as it allows modelling a system whereby each potentially endogenous variable is regressed on lags of all other potentially endogenous variables subject to the switch. In addition, this methodology has several other advantages: it not only allows for the inclusion of variables that are endogenous in a statistical sense, but it also encompasses the dynamic relationships among the variables and, also, the dynamic evolution of the growth process we are interested in. All of these - modelling the dynamics of growth as switching regimes and incorporating endogeneity - are issues of particular relevance to growth analyses that have been rarely considered jointly and, to our knowledge, have never been considered jointly in studies of growth in the course of big shocks. Hence, the following analysis attempts to fill this gap in the growth literature.

6. Adjusted growth accounting formula with MSVAR

The theoretical departures explained above, accompanied by the problems of: lack of data, suspected nonlinear nature of the growth and the inability to conduct a growth accounting exercise for developing or transition countries in the traditional fashion, urged the need for alternative ways to conduct regression analysis that would eventually yield better and feasible empirical presentation of the big structural changes in the course of economic growth.

Hence, the regression approach analogous to “growth accounting” is proposed in order to enable estimation of the contribution of the various factors to growth as identified by the Solow model, by relating growth in GDP to growth in fixed physical capital and to growth in employment. The estimable regression equation is as follows:

$$\left(\frac{\Delta Y}{Y}\right)_t = \alpha_0 + \beta_1 \left(\frac{\Delta K}{K}\right)_t + \beta_2 \left(\frac{\Delta L}{L}\right)_t + u_t, \quad u_t \sim N(0, \sigma^2)$$

Equation 5

Whereby $\frac{\Delta Y}{Y}$ is the GDP growth rate, $\frac{\Delta K}{K}$ is fixed physical capital growth rate, $\frac{\Delta L}{L}$ is the growth in employment, t – is time subscript, β_1 and β_2 are the coefficients on the variables, u_t is the error term which has a

statistical role to capture the errors not captured by the variables in the model. The constant term α_0 will play the role of the technology term in the growth accounting framework - $\frac{\Delta A}{A}$, i.e. capturing all the systematic effects

that are not included in the other two variables. In fact, the constant term will act as a “Solow residual”, capturing all the systematic changes not included in the model variables. This is a very important feature enabled by use of the Markov Switching framework into the growth regression.

Conceptually, this is the regression version of the growth accounting formula. This regression relates the economic growth over the period of observation to the basic measures of physical and labour growth and to the unobserved technical change. As given in the Equation 5, the model includes two factors: labour (L) and physical capital (K). The measure of the human capital is not included simply because of the difficulties to estimate it in the developing or transition countries context. However, we believe that the changes and possible obsolescence of human capital will be captured in the intercept term in the model. The modest number of variables is due to the intention of the empirical exercise to put a focus on the shifts in growth rather than on the detailed determinants behind the shifts. Additionally, it should be emphasized that the informative purpose of this empirical model is limited by the lack of data for other possible variables and by the modelling procedure. Namely, the MSVAR modelling procedure becomes truly data consuming, especially when the switching regimes are introduced, which exponentially increases the number of the parameters to be estimated. In summary, the empirical investigation of growth and especially of growth switches is highly restricted when the range of potential factors and changes is large relative to the number of observations.

The Markov Switching models are presented in a more technical manner in three steps, starting with the explanation of the time series y_t in the first step. Then, the second step offers a closer look into the switching property, which incorporates the characteristics of the switching hidden variable or process s_t . Lastly, the third step gives the description of the dependency between the switching hidden variable s_t and the time series y_t . The following explanation follows closely those of Hamilton (1994), Krolzig (2000) and Frühwirth-Schnatter (2006).

Step One. The properties of the time series y_t , or named as Y_t conditions.

To begin with, time series data usually reflects the dynamic consequences of events over time (Hamilton, 1994). In some cases, the events might be influenced by the events in the past. In the simplest manner, in mean adjusted form, the standard model to capture the corresponding

autocorrelation is the AR(p) model relating the value of the variable y at date t to the value that y took in the previous periods $t-1, \dots, t-p$:

$$y_t - \mu = \alpha_1(y_{t-1} - \mu) + \dots + \alpha_p(y_{t-p} - \mu) + u_t, \quad u_t \sim N(0, \sigma^2)$$

Equation 6

where y_t is the variable of interest, μ is the mean of the series, t indexes time (periods), p the number of lags and u_t is the usual error term. For the standard AR model, the Equation 6 is completely equivalent to the model given in the following familiar Equation 7,

$$y_t = \alpha_0 + \alpha_1(y_{t-1}) + \dots + \alpha_p(y_{t-p}) + u_t, \quad u_t \sim N(0, \sigma^2)$$

Equation 7

with the constant term $\alpha_0 = \mu(1 - \alpha_1 - \dots - \alpha_p)$. Since the mean is the same for the whole series in the standard AR model, the constant is capturing the effects of the autoregressive parameters multiplied by the mean.

Now, Markov Switching Models (MS) start with the assumption that y_t switches regimes according to the unobserved variable s_t . The s_t variable can be considered as a hidden stochastic process that determines the distribution of another observable stochastic process y_t . As is common in time series analysis, the y_t variable can be considered as the realization of a stochastic process. The s_t variable also. Hence, the modelling is based on a doubly stochastic time series model and the dependence between the two series.

Step Two. The properties of the hidden process s_t , or named as S_t conditions.

The variable s_t is a latent random process that can be observable only indirectly through the impact it has on the observable stochastic process y_t (Frühwirth-Schnatter, 2006). Additionally, it is assumed that the unobserved variable's movements (s_t) between regimes are governed by an irreducible, aperiodic, ergodic Markov Chain, defined by transition probabilities between N states or regimes (Krolzig, 2000).

If all the regimes have a positive unconditional probability, the process is called irreducible (Krolzig, 1998). Irreducible means that the system can equally move from any state to any state or it can remain in the same state. Aperiodicity means that the system can return to any state at irregular times. A finite Markov Chain is ergodic if exactly one of the eigenvalues of the transition matrix is unity and all other eigenvalues are inside the unit circle (Krolzig, 1998). Under this condition there exists stationarity or an unconditional probability distribution of the regimes; i.e. transition probabilities cannot be trended.

In simple words, based on the observable data y_t , the MS estimator determines: the number of regimes; their timing; and the probability of each

possible transition of the system from one regime to another. For example, the transition from regime i to regime j when the number of states is two ($N=2$) is given by the equation:

$$p_{ij} = pr(s_t = j | s_{t-1} = i), \forall i, j \in \{1, \dots, N\}$$

Equation 8

which means the probability of currently being in state j ($s_t = j$) conditional on having been in state i in the previous period ($s_{t-1} = i$). Hence, as can be seen from the equation, the probability distribution of the state at any time t depends only on the state at the time $t-1$ and not on the previous states, such as $t-2$, $t-3$...etc.⁴ That is, the basic Markov process is not “path dependent” (Brooks, 2002).⁵

Because the system has to be in one of the N states at a certain time t , it will follow:

$$\sum_{j=0}^N p_{j|i} = 1$$

Equation 9

The sum of the probabilities of being in state j , conditional on being in previous regime i equals 1. For example, since the state variable is unobservable, it is necessary to form probabilistic inferences of its value, governed by a Markov chain. If two states are assumed $s=1$, $s=2$, i.e. $N=2$ regimes, then there are four probabilistic inferences: a) the system to be in regime one and to remain in the same regime $p^{(11)} = p(s_t = 1 | s_{t-1} = 1)$ where $p^{(11)}$ is the probability that the system will remain in the same regime; b) the system to move from regime 1 to regime 2, i.e. $p^{(12)} = p(s_t = 2 | s_{t-1} = 1)$ where $p^{(12)}$ is the probability that the system will move from state 1 to state 2; c) the system to move from regime 2 to regime 1, i.e. $p^{(21)} = p(s_t = 1 | s_{t-1} = 2)$ where $p^{(21)}$ is the probability that the system will move from state 2 to state 1; d) the system to be in regime 2 and to remain in the same regime, i.e. $p^{(22)} = p(s_t = 2 | s_{t-1} = 2)$ where $p^{(22)}$ is the

⁴In order for the hidden process to be fully specified, the initial distribution of the s_t variable should be specified. As mentioned, the Basic Markov Switching Model starts with the ergodic transition matrix. However, this assumption can also be relaxed by allowing the initial distribution to be arbitrary – uniform or unknown (estimated), needed to be estimated from the data. In Ox Metrics, these options are available.

⁵However, it should be noted that the Basic Markov Switching model has been extended with the aim of formulating even more flexible models for a wide range of time series data. These models do allow for containing the history property of the regimes condensed in the “memory” of the state variable (Mizrach and Watkins, 1999; Frühwirth – Schnatter, 2006).

probability that the system will remain in state 2. These transition probabilities are restricted so that $p^{(11)} + p^{(12)} = p^{(21)} + p^{(22)} = 1$.

Step Three. Finally, the last step establishes the dependence of the distribution of y_t on s_t . In each moment in time, the distribution of y_t depends on the state s_t , but this dependency can vary, based on the various assumptions that are fulfilled in different models.

7. Conclusion

In summary, while most of the growth models of developed countries describe the growth process as a smooth movement along the balanced growth path, this impression changes for the cases of developing and transition countries as we argued in this paper. The later accumulation of evidence about growth in countries led to more realistic specifications of growth models. However, to make the best use of the existing empirical material, we believe that it is necessary to reshape and extend earlier models so as to make them more relevant to the processes of growth in the case of big shocks.

In addition, the small and simple empirical models of growth based on the basic growth accounting equation deduced from the standard production function, comprising labour and physical capital variable and technical progress, captured by the intercept, which is considered as exogenous, can be the most appropriate solution in the case of capturing big shocks. Indeed, it is a relatively modest model that attempts to acquire information on the dynamics of growth switches rather than understanding of the myriad of potential growth determinants. Hence, we consider that the omitted variables issue is not a primary concern in the research of growth in transition or developing countries.

Finally, when the big shocks cause shifts in growth patterns, creating growth regimes the use of Markov Switching framework is proposed as it has propensity to capture the nonlinear data generating process for analysing the impact of big shocks on economic growth.

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THE RELATIONSHIP BETWEEN EXPENDITURE AND LABOR PRODUCTIVITY

Rasim Yilmaz¹

Abstract

Theoretically, the relationship between health expenditures and labour productivity is ambiguous. On the one hand, health expenditures can enhance labour productivity by improving health of workers. Poor health impairs both the working hours and productivities of workers. When workers are healthy, they become physically and mentally more energetic and they have higher incentive to develop new skills and knowledge. On the other hand, increase in health expenditures may deteriorates labour productivity by crowding out physical capital investment. Causality between health expenditures and labour productivity is also ambiguous. This paper investigates the long-run relationship between health expenditures and labor productivity by utilizing a panel data covering the period between 2000 and 2015 and 35 OECD countries. Results of the study displays that there is a positive and statistically significant long-run association between health expenditures and labor productivity. Findings indicate that an increase in per capita health expenditure leads to a rise in labor productivity in terms of GDP per person employed. Results of the study also suggest that there is a mutual (bi-directional) causality relationship between health expenditures and labor productivity indicators.

Keywords: Health Expenditures, Labour Productivity, Panel Study, OECD Countries.

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1. Introduction

Theoretically, the relationship between health expenditures and labour productivity is ambiguous. On the one hand, health expenditures can enhance labour productivity by improving health of workers. Poor health impairs both the working hours and productivities of workers. When workers are healthy, they become physically and mentally more energetic and they have higher incentive to develop new skills and knowledge (Piabuo and Tieguhong, 2017). On the other hand, increase in health expenditures may deteriorates labour productivity by crowding out physical capital investment (Wei, Xia, & Kong, 2018).

Causality between health expenditures and labour productivity is also ambiguous. On the one hand, causality can run from health expenditure to labour productivity whereby increase in health expenditures can improve or deteriorate labour productivity by enhancing health of workers or crowding out physical capital investment as being set above. On the other hand, causality can also run from labour productivity to health expenditure. Increase in productivity may increase the economic performance which may lead to raise in health expenditures. Similarly, decline in labour productivity may reduce economic performance, causing countries to reduce their spending including health expenditures (Wang, 2015).

2. Literature review

Although empirical literature largely focuses on the impact of health expenditures on economic growth as well as the impact of health status on economic growth and labour productivity, there are few country-level empirical studies focusing on the effect of health expenditures on labour productivity.

Eneji, Juliana, & Onabe (2013) analysed the association between health expenditure and labour productivity proxied by output per employed person for the period between 1999 and 2012 in Nigeria. They found that health expenditure explains about 53 percent changes in labour productivity in Nigeria.

Wei, Xia, & Kong (2018) investigated the association between public health expenditure and labour productivity in China's prefecture-level cities between 2007 and 2013. Their results display that public health expenditure play a significant role in improving labour productivity through enhancing cognitive abilities of people. However, their results indicate that public expenditures in the eastern region is negatively correlated with agricultural

labour productivity. They ascribe this result to the fact that excessive health investment in rural areas in the eastern region squeezes out physical capital investment.

Mohammadzadeh, Moradi, & Khezrian (2019) examined the relationship between health expenditures and labour productivity for the period of 1972-2015 in Iran. The results of the study indicate that per capita expenditure has a positive and significant relationship with labour productivity in the long-term with a coefficient of 0.36.

Raghupathi and Raghupathi (2020) explored the relationship between public health expenditure and economic performance across the United States for the years 2003–2014. Their results suggest that healthcare expenditure is positively associated with the indicators of labor productivity in the USA.

Literature review reveals that empirical studies on the relationship between health expenditures and labour productivity are country-level studies, none of them include causality analysis, and there is no panel study on the subject. This study analyses not only the long run relationship between health expenditures on labour productivity but also causality between these two variables in a panel data context by utilizing three different labour productivity indicators.

The remaining part of the study proceeds as follows: next part explains research hypothesis, data, and methodology of the study; section three reports and discusses estimation results; and the last part concludes.

3. Research hypotheses, data and methodology

3.1 Research hypotheses and data

Based on the theoretical foundations outlined in the introduction and previous empirical studies on the subject, the following hypothesis is constructed and empirically tested:

Hypothesis: Health expenditure enhances labour productivity.

A balanced annual data spanning the period 2000 to 2015 across 35 OECD countries are used to conduct empirical analysis. The coverage of sample period and number of countries used in the analysis is determined by the availability of balanced data on health expenditure.

HEALTHEXPPC is current health expenditure per capita, PPP (current international \$). LABPROD is GDP per person employed (constant 2011 PPP \$). The data on HEALTHEXPPC and LABPROD are gathered from the World Development Indicators (WDI) of the World Bank.

The natural logarithmic transformation of each variable is in order to normalize the variables so that each variable is expressed in a uniform unit. Another advantage of this transformation is that the coefficient of each variable now displays the elasticity of the relevant variable.

3.2 Estimation methodology

Proper panel test and estimation approaches are employed to reveal the long-run association between health expenditure and labour productivity. Firstly, cross-sectional dependence test is performed to find out which panel unit root test (i.e., first generation or second-generation panel unit root test) will be preferred. Secondly, given the cross-sectional dependency identified, a panel unit root test accounting for cross-sectional dependency is applied to each variable. Having each variable integrated order one, we thirdly conduct panel cointegration test explicitly counting in cross-sectional dependency in order to reveal the long-run equilibrium relationship between health expenditure and labour productivity. Besides the panel cointegration test, the test of parameter constancy is performed to see if we have heterogeneous parameters across panels. Once a panel cointegration relation and heterogeneous parameters are detected, then long-run elasticities are obtained by using a convenient panel estimation approach taking both cross-sectional dependency and heterogeneous parameters into account. Lastly, heterogeneous panel causality test is implemented to find out the direction of causality.

In accordance with the objective of the study, the following equations is constructed as the benchmark model:

$$\text{LABPROD}_{it} = f(\text{HEALTHEXP}_{it}, v_i) \quad (1)$$

where v_i , ψ_i and π_i stands for country specific fixed effects and it subscript represents i-th country's observation at time t.

3.3 Estimation results

The existence of cross-sectional dependence in series makes the conventional unit root tests inconvenient since the conventional unit root tests assume cross-sectional independence. Therefore, rather than conventional unit root tests, it will be better to conduct second-generation unit root test, which explicitly accounts for cross-sectional dependence. Thus, we started our empirical analysis by implementing various cross-sectional dependence tests. Table 1 displays cross-sectional dependence test results for four distinct tests, namely Breusch-Pagan (1980) LM test, Pesaran (2004) scaled LM test, Baltagi, Feng, & Kao (2012) Bias-corrected Scaled

LM test, Pesaran (2004) CD test. The all test results shown in Table 1 strongly rejects the null hypothesis of "No cross-section dependence" at the 1% significance level in the data.

Table 1. Cross-Section dependence test (H_0 : No cross-section dependence (correlation))

LABPROD	Test-statistic	P-Value
Breusch-Pagan (1980) LM	6096.520	0.000
Pesaran (2004) scaled LM	159.4811	0.000
Baltagi, Feng, & Kao (2012) Bias-corrected Scaled LM	158.3144	0.000
Pesaran (2004) CD	68.96151	0.000
HEALTHEXPPC	Test-stat.	P-Value
Breusch-Pagan (1980) LM	8526.302	0.000
Pesaran (2004) scaled LM	229.9170	0.000
Baltagi, Feng, & Kao (2012) Bias-corrected Scaled LM	228.7503	0.000
Pesaran (2004) CD	91.85382	0.000

Residual cross-section independence test for the error terms of the model is also conducted. As can be seen from the results in Table 2, null hypothesis of cross-section independence is rejected.

Table 2. Residual cross-section independence test (H_0 : Cross-section independence)

LABPROD3- HEALTHEXPPC	Test-stat.	P-Value
Breusch and Pagan (1980) LM test	2258	0.000
Pesaran, Ullah, & Yamagata (2008) bias-adjusted LM test	97.45	0.000
Pesaran (2004) CD test	26.84	0.000

Given the detection of cross-sectional dependence in the data suggested by the test results in Table 1 and 2, the CIPS test for unit roots in heterogeneous panels developed by Pesaran (2007) accounting for cross-sectional dependence is applied. The CIPS test results are displayed in Table 3 below. The test results disclose that all series are not stationary in levels but they are stationary in first differences at 1% significance level. In other

words, the CIPS unit root test findings imply that variables of LABPROD and HEALTHEXPPC are integrated of order one (i.e. I (1)).

Table 3. CIPS test (H0: homogeneous non-stationary)

	Levels	First Differences
LABPROD	-2.350	-3.571*
HEALTHEXPPC	-2.347	-3.332*

Notes: * indicates statistical significance at 1% level. Critical values at %1 level for levels and first differences are -2.85 and -2.93 respectively. The model used in CIPS unit root test contains a constant term and time trend.

After identifying that our variables are I(1), the cointegration relation among variables is checked by utilizing two different panel cointegration test paying attention to cross-sectional dependence across panels. First, Persyn and Westerlund (2008) error-correction-based panel cointegration tests with robust P-values, which is obtained through bootstrapping, is applied. The findings are reported in Table 4 and the last column shows the P-values, which are robust to cross-sectional dependence. $G\tau$ and $G\alpha$, which allow error correction terms to be heterogeneous across panels, stand for group-mean test results while $P\tau$ and $P\alpha$, which assume error correction terms to be homogeneous across panels, stand for panel test results. Besides, group-mean test looks for cointegration in some panels whereas panel test seeks for cointegration in all panels. Robust P-values in Table 4 support the existence of a cointegrating relationship between health expenditure and labour productivity.

Table 4. Persyn and Westerlund (2008) ECM panel cointegration tests (H0: No cointegration)

LABPROD3- HEALTHEXPPC	Test- stat.	Robust P-Value
$G\tau$	-1.783	0.100
$G\alpha$	-4.816	0.000
$P\tau$	-7.947	0.000
$P\alpha$	-3.716	0.050

Next, the heterogeneous ECM panel cointegration test of Gengenbach, Urbain, & Westerlund (2015) in which cross-sectional dependence is explicitly taken into consideration is carried out and the test findings are reported in Table 5. The results show that there is cointegrating relation between LABPROD and HEALTHEXPPC variables at 1% significance

level. In overall the findings of two distinct cointegration tests in Table 4 and 5 support the presence of cointegration for the model.

Table 5. Gengenbach, Urbain, & Westerlund (2015) heterogeneous ECM panel cointegration test (H0: No cointegration)

	EC-coefficient	T-bar Stat.	Significance
LABPROD-HEALTHEXPPC	-1.119	-10.020	significant at 1%

Before proceeding to estimations of long-run elasticities, Swamy test of parameter constancy is implemented to find out whether parameters across panels are heterogeneous. Reported results in Table 6 show that parameters do not remain constant across panels for all three models. Therefore, the estimation method that will be chosen to estimate long-run elasticities should allow for heterogeneous slope coefficients across panel members and also account for correlation across panel members (i.e., cross-section dependence). For that reason, it is preferred to use the Augmented Mean Group (AMG) estimator developed in Eberhardt and Teal (2010) as an alternative to the Common Correlated Effects Mean Group (CCEMG) estimator.

Table 6. Swamy parameter constancy test

	Test Stat.	P-value
LABPROD-HEALTHEXPPC	26634.76	0.000

The long-run elasticities for the model are presented in Table 7. As to the mean group estimation results, coefficient of error correction term takes the expected negative sign at 1% significance level and hence this guarantees existence of a log-run association between LABPROD and HEALTHEXPPC. The long-run coefficient of HEALTHEXPPC is positive and statistically significant at 1% significance level. This finding hint that an increase in per capita health expenditure by 1% leads to a rise in labour productivity in terms of GDP per person employed by 0.0754%. Meanwhile, according to the group specific estimation results, both coefficient of error correction term and long-run coefficient are statistically significant for just Australia, Belgium, Chile, Denmark, France, United Kingdom, Japan, Korea, Netherlands, Poland, Portugal, Slovak Republic, Sweden, and United States.

Table 7. Long-run elasticities for equation 3

Mean group estimation results		
	EC-coefficient	Long-run coefficient
	-0.6402	0.0754
	0.0000	0.0000

Table 8. Dumitrescu and Hurlin (2012) Granger non-causality test

H0: HEALTHEXPPC does not Granger-cause LABPROD.	
Z-bar tilde	P-value
4.3711	0.000
H0: LABPROD does not Granger-cause HEALTHEXPPC.	
Z-bar tilde	P-value
7.0068	0.000

Notes: Optimal number of lags is selected based on BIC criteria.

4. Conclusion

Theoretically, the relationship between health expenditures and labour productivity is ambiguous. Causality between health expenditures and labour productivity is also ambiguous. In this study, the long-run relationship between health expenditures and labour productivity and causality between these two variables were examined in a panel data context. Panel data covers 35 OECD countries and the period between 2000 and 2015.

It is found that there is a mutual (bi-directional) causality and positive relationship between health expenditures and labour productivity indicators in the long run. Our finding indicate that health expenditures are important factor for labour productivity and equally labour productivity is also important for the level of health expenditures. In this understanding, an increase in health expenditure enhances the health of the workforce which lead to higher productivity and income per head. In turn, increase in incomes induces subsequent surge in health expenditures.

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SOFTWARE MAINTENANCE MANAGEMENT IN MICRO SOFTWARE COMPANIES

Zeljko Stojanov¹

Abstract

Software maintenance is one of the main processes in software companies. It is regarded as more complex and costly compared to software development, and therefore should be carefully planned and managed. Micro software companies are companies with up to 10 employees, and they represent a significant driver of economic development in many countries around the world. However, micro companies have specific internal organizations and a business model, but also have significant constraints on human and financial resources. After outlining the basic concepts of software maintenance and the characteristics of small and micro software companies, the paper presents the author's experience in software maintenance management in a local micro software company in Serbia. Maintenance management was implemented through a project aimed at improving maintenance processes in the company. The main objective was the improvement of maintenance request processing, which resulted in the implementation of a technical solution related to the timeline of maintenance requests. Since the process improvement project fosters organizational learning and knowledge management activities, a knowledge identification and systematization project was implemented as a subproject. Presented experience gained through fieldwork in the company contributed to the overall knowledge base about software engineering practice in micro software companies, which can be beneficial to both researchers from academia and practitioners from industry.

Keywords: software maintenance, maintenance management, micro software companies, software process improvement, knowledge management

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1. Introduction

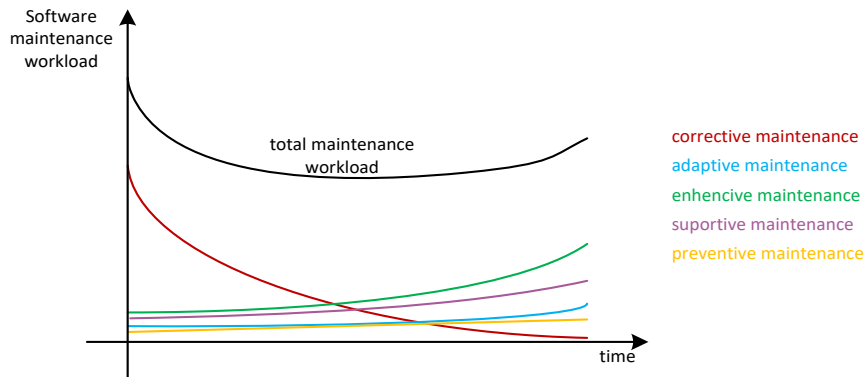
Software maintenance encompasses activities aimed at sustaining software systems operable and useful after delivery while preserving their integrity (IEEE, 2006). Maintenance of software systems should align with the overall business strategy of software organizations that produce and maintain software. This assumes planning and management of maintenance activities in the early stages of software development, and later, their adjustment to business processes in software organizations. According to *IEEE 12207-2008 International Standard for Systems and software engineering -- Software life cycle processes* (IEEE, 2008), software maintenance is one of the primary processes in the software life cycle. An organization or a person that implements maintenance activities and tasks is called a maintainer.

Software maintenance has been recognized by both practitioners from industry and by researchers from the academy as the most complex and costly phase in the software life cycle (Bourque & Fairley, 2014; Ulziit *et al.*, 2015; L'Erario *et al.*, 2020). The complexity of software maintenance activities is due to the large set of services provided to clients (Hassan & Khan, 2017). Software organizations recently recognized the importance of software maintenance to increase the positive financial effects of developed software by supporting software operation and use as long as it is possible. Software maintenance is performed to (Bourque & Fairley, 2014): correct faults, improve the design, implement enhancements, interface with other software and hardware components, adapt to different platforms, migrate legacy software, and retire software. However, software maintenance does not include major or large modifications to the architecture of software systems, but rather small modifications that enable their proper functioning (Tripathy & Naik, 2015). Various typologies of software maintenance types (activities) have been proposed, firstly stated by Swanson (1976), refined by Chapin (2000), and documented in *IEEE Std. 14764-2006 International Standard for Software Engineering - Software Life Cycle Processes - Maintenance* (2006). The most common types of software maintenance are corrective (correcting faults), adaptive (adaptation to new business and technical environment), enhanceive (adding new features), supportive (providing support and training to clients and users), and preventive (actions aimed at improving software product and preventing faults). After software delivery majority of activities relate to correcting faults, while later other types of maintenance dominate (see Fig. 1).

According to European Commission (2015), small and medium enterprises are a significant drive for the economy, fostering

competitiveness, and providing two-thirds of the jobs. Small software companies, with less than 50 employees, are essential for the growth of the economy worldwide since they comprise 85% of all software organizations (Richardson & Von Wangenheim, 2007). Micro software companies are a subset of small software companies, with less than 10 employees, while Laporte *et al.* (2008) introduced the term Very Small Enterprises (VSEs) for companies with up to 25 employees. Despite their significant part in the economy, software micro companies have several constraints regarding resources, primarily financial and human, and therefore, they have quite a specific working context deserving more research. However, research on their maintenance practice is very limited according to the literature review conducted by the author. The research made by the author of this paper on maintenance process improvement (Stojanov, 2021) and knowledge management in software maintenance practice (Stojanov, 2019) has been recently published as a result of many years of research work based on the practice in a local micro software company.

Figure 1. Software maintenance workload for typical maintenance activities



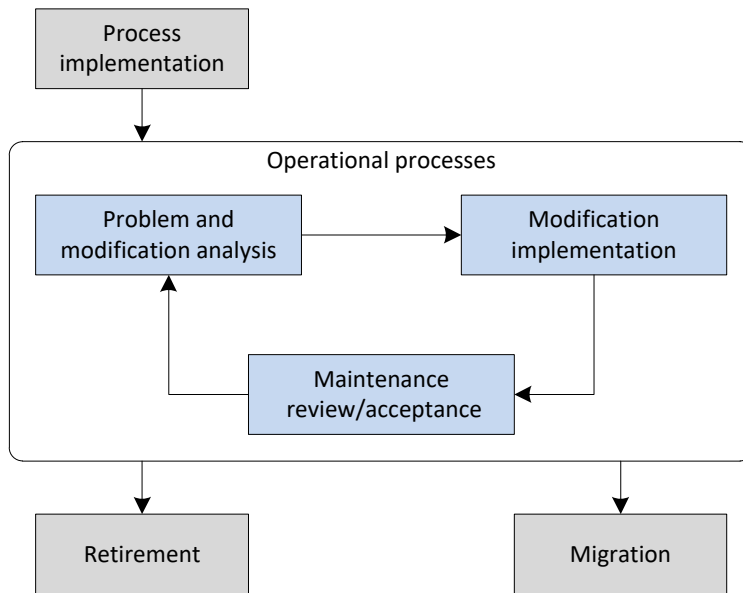
Based on the above discussion, the objective of this paper is to present the reflections on the author's experience with software maintenance management practice in a local micro software company. Section two briefly outlines issues and challenges in software maintenance management, while the third section outlines an overview of challenges faced by micro software companies. Reflections on the author's experience are presented in the fourth section. The last section presents concluding remarks and suggestions for further research.

2. Software maintenance management

Software maintenance relates to tasks performed to provide support to software users and sustain the operation of delivered software systems, requiring planning and implementation of management activities related to alignment to organization objectives and strategy, human resources, processes, organizational issues, and outsourcing (Bourque & Fairley, 2014). To optimize the costs of maintenance activities, software organizations should continuously assess and improve their maintenance processes (April & Abran, 2008). However, clients usually do not understand the real value and complexity of maintenance activities and think that software organizations provide expensive and inefficient maintenance services (April, 2010). All these suggest that software organizations should seriously plan and implement software maintenance management, which requires planning activities on the daily basis and recording all relevant data related to these activities.

The main maintenance subprocesses are (April & Abran, 2008): process implementation, problem and modification analysis, modification implementation, maintenance review/acceptance, migration, and software retirement. However, in many cases, software organizations do not have well-defined and established maintenance processes and do not follow international standards for process assessment and improvement. The key software maintenance processes according to *IEEE Std. 14764-2006 International Standard for Software Engineering - Software Life Cycle Processes – Maintenance* (IEEE, 2006) are presented in Fig. 2. Software organizations usually tailor these processes based on their needs.

Figure 2. Software maintenance processes organization



Process implementation relates to planning maintenance activities for delivered software systems. Operational processes (problem and modification analysis, modification implementation, maintenance review/acceptance) relates to usual daily activities performed to maintain software systems useful for users. Migration is a rarely used process that is used when there is a need to port a software system to a different platform, while retirement is used when there is no need for existing software.

Software maintenance management studies focus on different aspects of maintenance such as knowledge management, human factor management, process management, and improvement, prediction of costs and time, and use of approaches and tools for specific maintenance tasks (e.g. code analysis as one of the most costly and demanding tasks or change request processing), etc.

L’Erario *et al.* (2020) conducted multiple case studies with Brazilian small and medium IT companies to inquire about which strategies are the most important for software maintenance process effectiveness. The results indicate that the most important aspects of maintenance process management relate to managing users’ knowledge, managing the knowledge of maintenance teams, and managing maintenance processes.

Lenarduzzi *et al.* (2020) presented a literature review of code analysis tools used for predicting software maintenance, which is important for practitioners to select the most suitable one for the specific purpose. The tools are classified based on their support for software maintenance activities

(static or dynamic, language support, targeted use, licensing). Tian *et al.* (2021) conducted a systematic mapping study to understand the benefits, costs, and challenges of using traceability in software maintenance and evolution. The authors identified 13 approaches and 32 tools that support traceability in 11 software maintenance and evolution activities. The main challenges related to traceability are improving the quality of traceability links, and the performance of traceability approaches and tools, which is important for reducing the costs and time of maintenance activities while increasing the accuracy of performed tasks.

Hasan *et al.* (2012) conducted a qualitative case study within a small software organization aimed at identifying heuristics used for guiding and implementing maintenance processes. The authors identified three types of heuristics related to organization, individuals, and different stages of projects, which represent a framework that should be used in cases when there are no formal procedures for maintenance processes. Hassan & Khan (2017) conducted a systematic literature review to explore the state of the art of using Service Level Agreements (SLAs) in software maintenance, and by applying grounded theory they proposed a preliminary SLA management framework with the following six major phases of SLA management: Service Templates Development, SLA Negotiation, Service Deployment, Service Execution, Service Assessment, and Service Decommissioning. Balachandran (2020) discussed the need to integrate automatic knowledge management systems with modern collaboration tools to improve software maintenance. The main objective is to systematize the team knowledge, which includes troubleshooting tips, explanations of unexpected product behaviors, workarounds or fixes to common problems, and design rationale.

3. Micro software companies

Micro software companies are an important part of the software industry, providing software and services for their clients, or delivering software solutions for large companies as contractors on larger projects. Micro companies are companies with up to 10 employees (European Commission, 2015). Another classification introduces very small enterprises (VSEs) with up to 25 employees, which are recognized in the software industry as a dominant form of company (Laporte *et al.*, 2008). The main characteristic of these companies is the lack of resources, budget, and time, leading to not established processes in their practice and difficulties in implementing international standards as the best practice (Laporte *et al.*, 2016). In addition, these companies have specific business styles and internal organizations with mostly informal management processes (O'Connor &

Laporte, 2010). For these companies, *ISO/IEC 29110 Standard "Lifecycle Profiles for Very Small Entities"* has been developed, which is focused on the standardization of processes in VSEs.

Due to the recognized importance of micro companies, research studies started to address different aspects of their practice recently. L'Erario *et al.* (2020) presented a study aimed at inquiring about how small and medium-sized software organizations in Brazil perform software maintenance processes regarding user and collaborator turnovers. Based on the study conducted with 40 small and micro software companies in South-Eastern Mexico, Cima *et al.* (2018) indicated that investments in research and development and quality improvement are more important for companies' competitiveness than initiatives related to investments in marketing, human resources practices, and technological infrastructure. de Melo *et al.* (2020) conducted a field study to understand how the measurement process is implemented in seven Brazilian small and micro software companies and concluded that measurement programs are aligned with the company strategy and provide results to top management for decision-making.

Through a systematic literature review to identify factors that affect the development process in small software companies in Africa, Tuape & Ayalew (2019) identified that the most important factors are organizational, governance, and business environment. Based on a survey of 385 employees from small software companies in China, Huang & Li (2021) indicated that an innovative climate has a positive impact on knowledge management and idea realization, leading to the improvement of enterprise performances. Ochoa *et al.* (2017) inquired about small companies in the Chilean software industry, and based on research results suggested that generalist software companies should move to niche software companies to increase their competitiveness and business reputation. Based on the results of an exploratory study, O'Connor & Basri (2014) suggested that knowledge management practice provides a basis for process improvement in very small companies. A study aimed at diagnosing requirements engineering practice in very small software companies in Chile (Quispe *et al.*, 2010) revealed that there is a lack of focused communication with clients, while requirements engineering practice is implemented in an ad-hoc manner, leading to imperfect requirements specifications and problems in implementing projects.

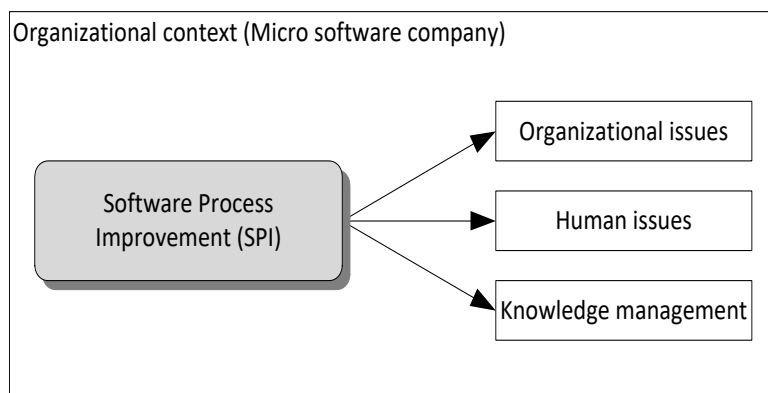
4. Reflections on the experience

The author's experience has been gained through organizing and conducting a research project within a local micro software company.

The project was jointly prepared by the author and the company manager, while in the implementation phase all company employees and other researchers with specific research skills (statistical methods, fuzzy methods) were involved. The main objective of the project was to assess and improve software maintenance processes. However, project implementation led to inquiring organizational issues, human factors, and knowledge management because they influenced processes in the company (see Fig. 3).

The company develops and maintains over 40 business software applications for over 100 clients in Serbia. The trend analysis of recorded developers' tasks points out that more than 80% of tasks relate to software maintenance (Stojanov *et al.*, 2013; Stojanov *et al.*, 2017; Stojanov & Stojanov, 2018), which indicates the importance of researching and improving software maintenance practice in the company.

Figure 3. Software Process Improvement within an organizational context



4.1 Process improvement

The primary project proposed to be implemented in the company related to Software Process Improvement (SPI), which is one of the most effective ways for improving practice in software companies. Process improvement was focused on maintenance processes in the company since they consume the largest part of programmers' daily activities. For the improvement, the basic maintenance process related to handling

Maintenance Requests (MRs) submitted by the clients was selected. All MRs were recorded in the internal software application for tracking MRs and associated tasks, which is the basis for charging software maintenance services. Work on solving MRs includes three types of work: working in the company, accessing clients' infrastructure over the Internet, and working on the client side.

Due to the very specific internal organization within the company, and the very busy working hours of programmers, it was decided for the SPI project that a *lightweight and inductive approach* that will not disturb regular working days in the company should be used. All employees were included in the SPI project, but in a way that does not seriously change their typical working days. SPI project contains the following phases (Stojanov, 2021):

- *Planning*. It includes planning all relevant aspects of a process improvement project, including objectives, involved people, indicative timelines, sources of data, and the selection of appropriate scientific methods for collecting and analyzing data. This resulted in a plan for the SPI project and a plan for process assessment.
- *Process assessment*. It includes activities aimed at collecting and analyzing data in the company to determine potential process improvements.
- *Implementation of the selected improvements*. This includes all necessary activities to implement the selected improvements at a technical and organizational level in the company.
- *Long-term monitoring of implemented improvements and maintenance practices*. This includes activities of monitoring and measuring parameters of the maintenance practice for the long term to conclude the effects of implemented improvements on the maintenance practice and overall business performance of the company.

The lightweight and inductive SPI approach assumes active observation of everyday practice in the company and active involvement of the company employees in the research process, which ensures that proposed improvements will emerge from the real need identified in the everyday practice. This required familiarization with the company organization and business process, which assumed spending several days in the company and observing "how things work".

The main phase in the SPI project was process assessment, which was implemented as a set of activities aimed at assessing the current state of the maintenance processes in the company and identifying potential improvements. For the process assessment, the *Lightweight Inductive*

Method for Process Assessment based on Frequent Feedback (LIMPAF²) was proposed (Stojanov *et al.*, 2019). Process assessment was based on frequent feedback to the company employees to ensure that all research steps were correctly implemented and that all intermediate data and proposed improvements reflect the current state of the practice and the real needs. The main characteristics of process assessment are:

- *Inductive.* All findings of the research process are grounded and generalized from the data collected in the company through fieldwork.
- *Participative.* Active participation of the company employees in all phases of the project ensures that findings will reflect their real needs.
- *Triangulation of data sources and methods.* Several sources of data (interviews, practice observations, documents, databases) and a variety of data types (numerical and raw text) required using both quantitative and qualitative methods for collecting and analyzing data, which increased the validity of the findings.
- *Frequent feedback.* Feedback was ensured through organized meetings in the company in which the current state of the research and the current findings were presented to the company manager and the relevant programmers.
- *Support for organizational learning in the company.* Systematization of data about the processes in the company fostered identification and systematization of knowledge about the maintenance practice.

For the implementation, the following improvement proposal was selected: *Optimization of maintenance requests' processing timeline with a focus on recording and triaging maintenance requests.* This included the modification of an internal software application for tracking MRs and a database for storing all relevant business data in the company. Implemented improvement is regularly used in everyday practice in the company.

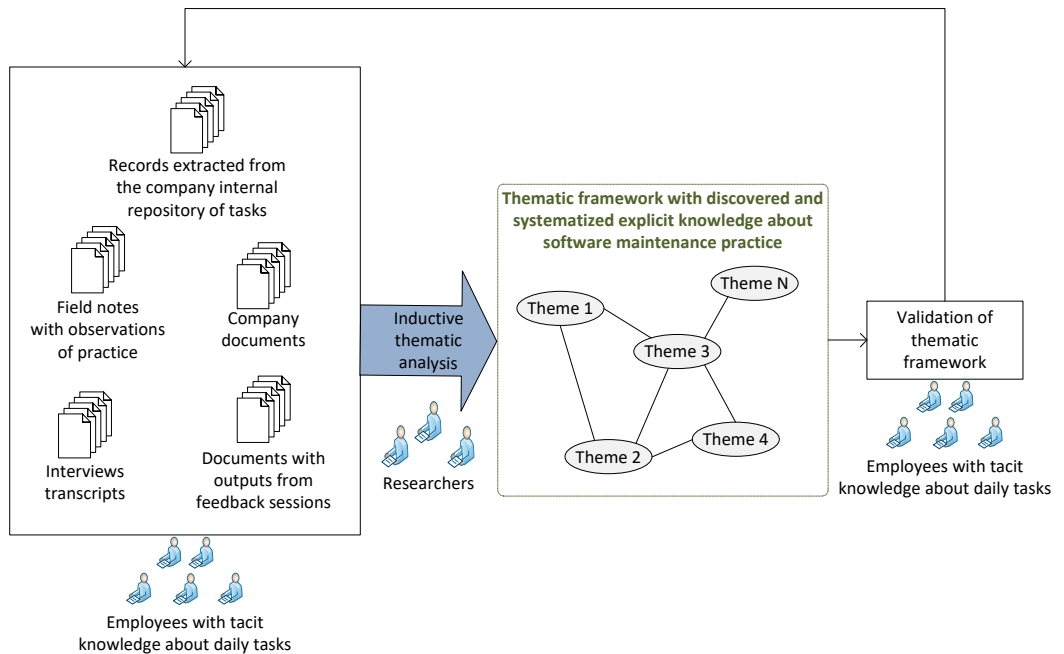
4.2 Knowledge management

As it was stated in the previous subsection related to process improvement, any SPI project provides support for organizational learning and knowledge management. The success of the SPI project is closely related to getting real data about the practice, and this data is also a valuable starting point for the identification and systematization of knowledge about the practice (Stojanov, 2019). However, the implementation of a knowledge management project should consider a variety of factors that can impact its

success and increase the usefulness of the findings (Stojanov & Dobrilovic, 2019).

The main idea in systematizing knowledge on software maintenance was the conversion of tacit knowledge residing in programmers' heads into implicit knowledge available to all employees in the company. A variety of sources were used for identifying knowledge, such as interviews with the employees, observation of everyday practice, company documents, records extracted from the internal database, and records from feedback sessions in the company (meetings organized in the company for discussing the state of the research). Knowledge identification and systematization were realized through joint analysis of collected data by the researchers and employees, whose important role was validation of created framework with systematized knowledge (Fig. 4).

Figure 4. Knowledge management subproject in the company



Systematized knowledge was developed as a thematic framework by using inductive thematic analysis (Attride-Stirling, 2001; Braun & Clarke, 2006), a qualitative research methodology that originated in social sciences.

Knowledge framework contains knowledge relevant to software maintenance practice since it emerged from data collected in the company.

Knowledge is organized into three thematic areas with themes important for maintenance practice.

The thematic areas are:

- *Processing maintenance requests.* It contains technical issues related to MRs and activities needed for processing them.
- *Human factor.* It contains issues related to humans involved in maintenance practice (programmers and clients).
- *Company business policy and organization.* It contains issues related to the internal organization of the company and some policies that govern processes and activities.

4.3 Organizational issues

Software maintenance processes are situated in the organizational context of the company which influences all activities. On the other hand, the execution of processes also impacts the internal organization of the company, its relations with clients, and its positioning in the market. Identification of organizational issues in the company was done within the SPI project, particularly through a subproject related to knowledge management practice in the company. Identification of organizational issues as a specific thematic area of the practice was done by using inductive thematic analysis.

Through inductive thematic analysis of software maintenance practice, the following themes related to organizational issues were identified:

- *Managing relationships with clients.* Clients are the main source of profit for the company and managing relationships with them is essential for the overall business performance of the company. This includes management of Service Level Agreements (SLAs) for arranging maintenance services, classification of clients to prioritize MRs, and selection of reliable users within clients' organizations that can submit valid MRs.
- *Distributing programmers' responsibilities and work.* Programmers perform maintenance tasks within the organizational context, which assumes the distribution of responsibilities and work to achieve a balanced workload and fast processing of MRs.
- *Maintaining versions of software products.* The company has over 100 clients; it tracks which version of software products are used by which clients, which is essential for sustaining and

increasing the quality of maintenance services and delivered software products.

4.4 Human factor

In the software industry, it has been widely recognized that the most important asset in software companies are people that possess skills and knowledge for performing tasks. The selected micro company has 3 senior programmers with over 15 years of experience on average and 3 junior programmers. Inquiry into human factors was performed during the knowledge management subproject within the main SPI project because it has been evident that programmers are the main source of information on how software maintenance processes were performed. Human factor issues were identified through inductive thematic analysis, in the same way as organizational issues.

Through inductive thematic analysis of software maintenance practice, the identified themes related to human factors were classified into themes related to programmers' characteristics and themes related to clients' characteristics (Stojanov, 2019). Programmers' characteristics are comprised of cognitive characteristics, organizational skills, and working experience. Clients' characteristics include domain knowledge, communication skills, and technical knowledge. All these characteristics interrelate and influence how maintenance processes are performed. For example, programmers' working experience with technical issues and a variety of activities will positively influence organizational skills related to organizing personal tasks or organizing teamwork for more complex tasks.

5. Conclusion

In this paper, the importance of software maintenance practice in micro software companies is emphasized. Since micro and small software companies comprise the majority of companies in the software industry, any empirical research related to their practice has an important contribution to the knowledge base. This knowledge base is valuable for both researchers and practitioners from the industry.

The presented experience has been gained through several years of inquiring about maintenance practice in a local micro software company, while several published papers present details of different aspects of the experience. The more comprehensive research conducted in a larger number of micro and small software companies is a further research assignment,

aimed to gain a more comprehensive insight into the state of software maintenance practice.

Acknowledgment

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FINANCING SUSTAINBLE GROWTH

Gligor Bishev¹

Abstract

North Macedonia is relying on Market Failure theory for the role of Government in the economy. The Government should take a back seat and simply create condition for private sector to invest and generate growth. Thus, public expenditures are kept at 1/3 of GDP for many years. Private sector investments in fix assets are anchored on average in last two decades at 22.4 percent of GDP. Result has been a moderate growth, that is not sufficient in foreseeable future to close the gap in living standard between the North Macedonia and EU.

Innovative ecosystem and de-risking private sector investments is perceived more adequate model for achieving smart, sustainable and green growth. Such policies must put innovation at heart of growth policies. The Government should have a mission to fund innovations, direct economy to green and smart. This will require public expenditures steadily to reach threshold of 40 percent of GDP. Higher private investments: domestic and foreign, should be attracted by de-risking private sector and by strong private public partnership. This should accelerate growth to 5 percent on long-run, make it more inclusive and secure swift living standard convergence towards EU.

Key words: growth, public expenditures, private public partnership, de-risking, mission driven state.

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1. Introduction

Great recession (2007-2009), definitely bring back the essential role of state in securing sustainable economic development. Market alone, has been perceived not sufficient to deliver inclusive growth, on long run. Covid-19 further strengthen role of modern well fare state. Without securing health care services, free for all, financial support to companies and households, defeating Covid without prolonged severe economic recession was not possible.

Modern state, definitely can not seat on back seat and simply create condition for private sector to invest and generate growth. Modern entrepreneurial state has to play many governmental roles in order to achieve sustainable, inclusive and fair development. Policymakers have a critical role to help private sector players overcome various market failures. To assist the process of discovering new and promising opportunities. To de-risk investing in such opportunities, reduce cost of investing (Miriana Mazzucato, 2012).

On other hand every country has a different set of factor endowments and “binding constraints” at any given time: policies that work well for some countries could wreck havoc on others. Countries need to upgrade their policy interventions based on the constantly evolving sources of comparative advantage (Justin Yufi Lin, 2012).

Building development institutions that are focused on ensuring implementation of policies and accountability are an integral part of modern state development policies. Policies and programs must be implemented well, not just designed. Policy makers need to continue to invest in improving institutions and their capacities to ensure that their policies and programs can have the intended impact (Daron Acemoglou, James Robinson, 2012).

Based on empirical data of outperforming countries in respect of growth, McKinsey Global Institute (September 2018), as crucial development policies is emphasizing following three blocks of measure: I) Measures directed to increase productivity: a) promoting competition and market efficiency; b) Investing in infrastructure and mechanization; c) Increasing total factor productivity by improving technology, innovation, and processes, especially direct government investment in R and D, enablers for private sector R and D, innovation clusters, incentivize “first movers”; d) Boosting scale of production and investing in talent; II) Income policy measures that translate productivity into strong and inclusive income growth through: a) Boosting household incomes and middle class formation through higher wages; b) Increasing corporate profit growth broadly distributed

among companies; and III) Demand side policies by: a) Driving higher domestic consumption and investment from income and credit growth; b) Supporting investment by mobilizing domestic savings and capital accumulation; c) Tapping into regional and global demand by enhancing global connectivity.

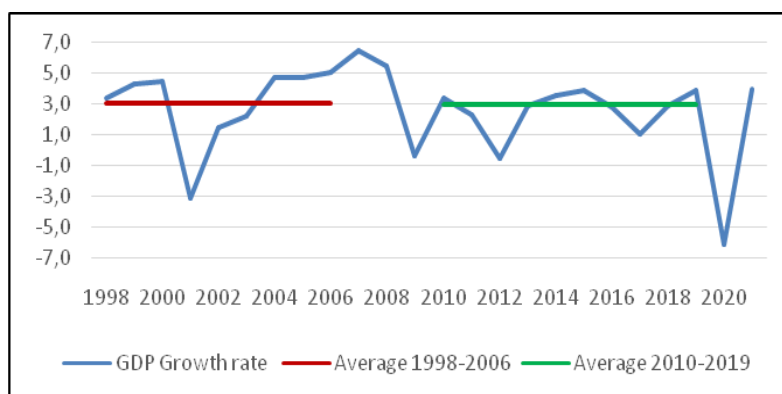
Purpose of this paper is to analyze growth model of North Macedonia from the point of view of the role of private sector and government in financing and investing in growth opportunities. In chapters that follow we investigate first, characteristics of growth – pace of growth, key drivers and distribution of growth – second chapter. In third chapter we analyze the role of state in financing growth and measures oriented to growth. Fourth chapter is devoted to role of private sector in financing growth, risk undertaking, implementing innovations, and new technologies implementation. Concluding remarks are presented in last, fifth chapter.

2. Poor growth performance

In last two decades Macedonia has not succeeded to become fast growing economy. Despite high price and financial stability an average pre-pandemic growth rate (2001-2019) was around 3.0 percent. In the period 1998 – 2006, if we exclude 2001, a year of internal conflict, average GDP growth was 3.03 percent. In the period of 2009 – 2019, if we exclude two recessionary years (2009 and 2012), average growth rate was slightly lower 2.98 percent. This was not sufficient to close the income gap between average EU country and North Macedonia. At the end of 2019, GDP per capita in North Macedonia was accounting 37.2 percent of EU average.

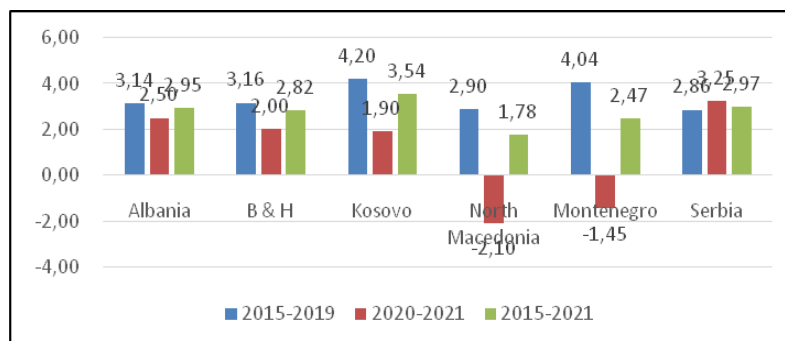
In the period 2015-2021, North Macedonia has poor performance from point of view of growth within Western Balkan countries, as well. In the period before Covid-19, North Macedonia, achieved average growth rate of 2.9 percent, sufficient for the fifth position out of six Western Balkan Countries. During Covid-19 period (2020-2021), North Macedonia was the poorest growth performer within the group of Western Balkan Countries, achieving average growth rate of -2.1%.

Picture No. 1 Real GDP growth



Source: GDP Survey, State Statistical Office, April 2022.

Picture No. 2 Average GDP growth rates of Western Balkans Countries



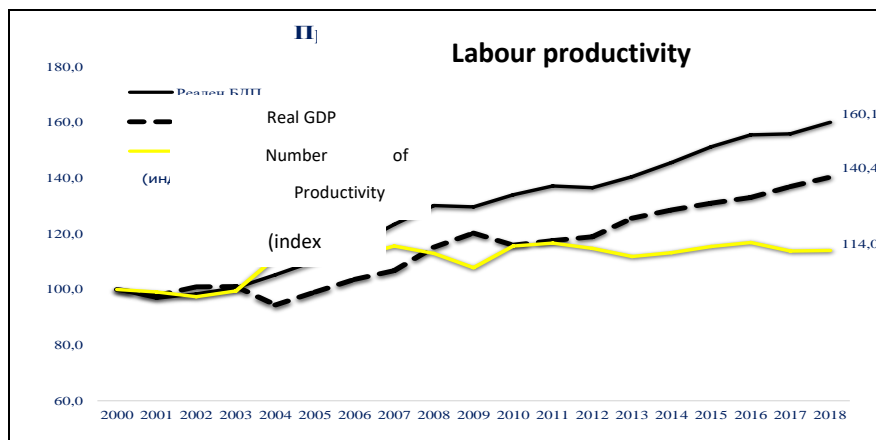
Source: World Bank, Western Balkans Regular Economic Report: Spring 2022, Steering through Crisis.

Poor economic growth is highly correlated with low productivity growth, low research and development, and low level of innovations. On other side, high uncertainty and high risks associated with private investments blocked exploiting opportunities of private sector.

Thus, in last two decades, economic development has been mainly driven by employment. Productivity on average grew by 0.2 percent. In the same period, employment increased by 40 percent. This brings us to conclusion that North Macedonia was relying on labor intensive model of economic growth. Through arbitrage of labor force price and arbitrage of tax rates, the model of growth attracted FDIs and employment in industries with

low to middle technological development, that were not generating significant added value and sustainable development. However, such model of development, based on arbitrage of labor force and arbitrage of tax rate can bring some results on short run. On long run such a model is not viable (McKinsey Global Institute, 2019).

Picture No. 3 Real GDP growth, productivity and employment



Source: WEO October, IMF Извор: WEO October, IMF, SSO N. Macedonia and calculations.

Even in such circumstances, employment level is still low. Employment at the end of 2019 (last pre-Covid year) hardly reached 47.3 percent, in comparison to 69 percent in EU (while EU target is to reach 75 percent until 2025). Thus, significant part of labor force is discouraged to seek for employment and is not active or is on temporal employment abroad or is employed in an un-informal economy.

Growth driven by employment was very successful in poverty reduction. Citizens living with 5.5 USD per day were reduced from 35 percent in 2009 to 17.9 percent in 2018. In comparison with other Western Balkan Countries, in 2018, North Macedonia was in the middle by poverty index. However, income inequality remained high. In accordance to data of Tax Revenue Office, 1 percent of citizens with highest income account for 14.4 percent of total income in the country. This is the highest rate of income concentration in Europe. Also, citizens in extreme poverty, that live with less than 2 USD per day account for 4.4 percent of total population. This is very high poverty on European level (Tevdovski, Bishev, 2020).

3. Growth model – role of state

North Macedonia has been relying on Market Failure theory for the role of Government in the economy. During good times, Government expenditures are not as “productive” as private sector investments. Thus, during good times, Government role should be as small as possible. The Government should take a back seat and simply create condition for private sector to invest and generate growth. Role of the Government should be increased during bad times, crisis, when market mechanism is not sufficient alone, to generate growth and stability.

Policymakers of North Macedonia have been proponents of such a view since establishing monetary independence in 1992. However, we may distinguish two periods: a) period of Market Failure Theory with progressive taxation on personal income with tax rates of 15; 18 and 24 percent, and b) Ultra-Orthodox Market Failure Theory with flat income tax rate of 10 percent in the period 2008 – 2022. Policymakers believe that the smaller Government income and expenditures and interference in economic development, the better condition for private sector to deliver higher economic growth.

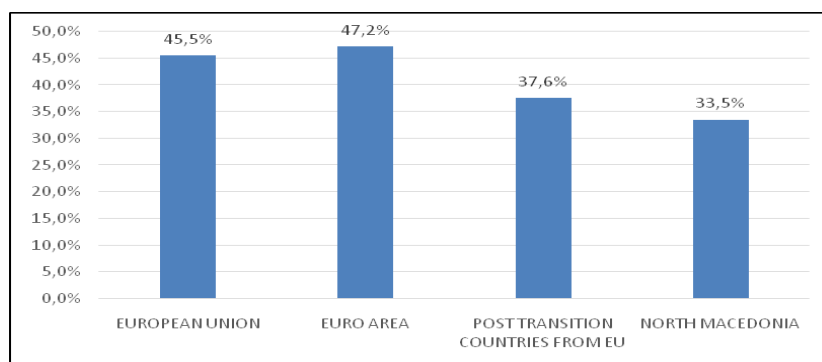
In this paper we measure role of the Government in economic development mainly by two indicators: share of public expenditures to GDP and structure of Government expenditures, especially share of expenditures for public investment, education and research and development to GDP.

Policymakers in North Macedonia systematically kept government expenditures on level of 1/3 of GDP before Covid-19 crisis. In Covid-19 years (2020-2021) public expenditures reached 38.9 percent and 37.7 percent of GDP, respectively. Allowing significant space for private sector to invest and generate growth. However, as we present in previous chapter, the growth was very poor, compared to needed to approach towards EU, as well as, in comparison to other Western Balkan Countries. Furthermore, average growth in a period of implementation of Ultra Orthodox Market failure Theory, was slightly lower, than in the previous period when progressive personal income tax rates were in place.

From six Western Balkan Countries, based on total public expenditure to GDP, three are relying on Market Failure Theory for the Government role: North Macedonia (on average 33 percent of public expenditures to GDP in pre Covid period), Albania (on average 29.5 percent before Covid period) and Kosovo (29 percent before Covid period). Other three countries: Bosnia and Hercegovina, Montenegro and Serbia, with public expenditures to GDP between 42 percent to 45 percent in pre Covid period, are proponents of important role of the Government in generating development through

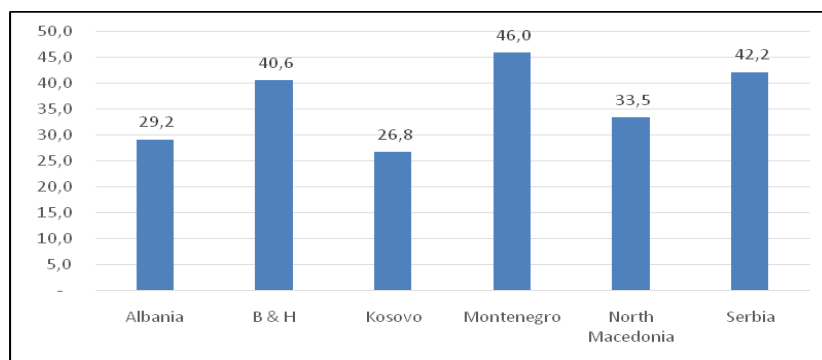
adequate infrastructure, investment in research and development, de-risking private investments, supporting innovations, green economy and digitalization.

*Picture No. 5 General government expenditures as percent to GDP:
EU, EUROZONE, NORTH MACEDONIA*



Source: IMF, World Economic Outlook, 2022.

*Picture No. 6 General government expenditures as percent to GDP:
Western Balkans Countries*



Source: IMF, World Economic Outlook, 2022.

Capacity of Government of North Macedonia, from point of view of public expenditures to GDP is far below capacity of EU governments, where share of public expenditures to GDP is between 45 to 48 percent before Covid period.

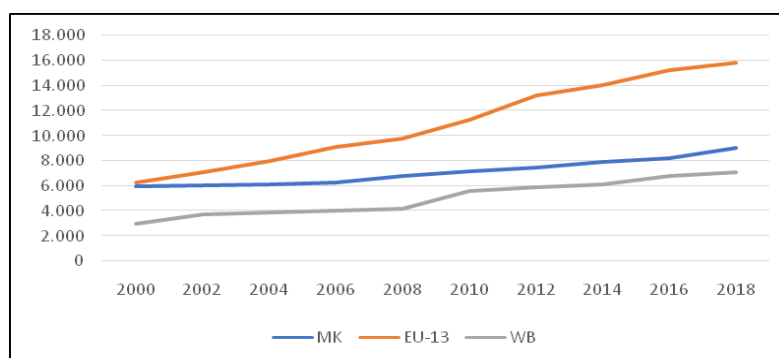
State capacity to alleviate recessions and crisis on short run is very important. "...differences in state capacity are important variable of economic development. In a big number of less developed economies,

Government revenues are small part of GDP...Societies with limited state capacity are those that invest little in public goods and does not undertake policies for income redistribution...(Acemoglu et al., 2011)”.

Limited fiscal capacity of the North Macedonia was obvious during Covid-19 recession in 2020-2021. Thus, North Macedonia at the end of 2021 did not reach pre Covid level of GDP. It was by 2.1 percent lower.

Government capital expenditures for a decade were kept around 3 percent of GDP with declining trend in last three years around 2.4 percent. This has been insufficient to improve quantity and quality of public infrastructure and support growth acceleration. North Macedonia would need at least to double public capital expenditures in order to catch up with EU countries and become fast growing economy (Fiti Taki, Antovska-Mitev Marica, Drangovska Tatjana, 2021).

Picture No. 7 Public Capital Stock (2017 PPP dollars per capita)



Source: IMF Investment and Capital Stock Dataset

North Macedonia lags EU countries in quantity and quality of capital stock. The country's per capita capital stock of public capital at the end of 2018 has nearly 50 percent gap with new EU member states, although at the beginning of 2000 gap was around 10 percent. Physical measure of infrastructure – such as kilometers of roads and railways, kilowatts of power generation capacity, and digital economy indicators reveal similar deficiencies. North Macedonia also lags EU in terms of the quality of infrastructure (IMF, Article IV Report, 2022).

Investment in education and research and development are low. Expenditures for education account for 3.7 percent of GDP and are very low in comparison with the same in EU countries (Slovenia 4.9 percent of GDP, France 5.6 percent of GDP). Quality of expenditures are also important. Public expenditures for research and development, almost do not exist. In

2018 they account 0.04 percent of GDP (Stikov, Jovanovic, Tevdovski, 2020).

Since 2017, Policymakers in North Macedonia started with swift increase of minimum wage with an aim of more equal income distribution. Cumulative increase of minimum wage in period 2017 – 2022 was 50 percent, significantly above increase of cost of living and productivity growth. This resulted in significant increase of unit labor costs, increase of domestic consumption and demand driven growth in last few years.

By undertaking measures for rapid wage increase, policymakers open a process of giving up of attracting FDIs based on arbitrage of price of labor force and income tax rate arbitrage. Policymakers shifted their focus to economic development based on higher added value and new technologies, that require skilled and well educate labor force. Such a shift requires new, different role of Government and de-coupling from Market Failure Theory.

4. Growth model – role of private sector

Labor intensive economic growth, based on low labor costs, low and flat taxes, with limited role of Government in economic development and relying on FDIs in economic zones, has not secure inclusive, sustainable economic growth. FDIs in economic zones did not bring sophisticated equipment and new technology that would boost economic growth and productivity. In North Macedonian case, FDIs were concentrated in low to middle technology level of production – spare parts assembling for auto industry, textile industry, chemical industry and metal industry. There was not significant transfer of know-how and technology. However, FDIs boosted gross export which at the end of 2019 reached 50 percent of total export.

Contribution to GDP and employment of FDIs in economic zones was not spectacular. They are contributing around 2.5 percent to GDP and 3.5 percent of total employment (Uzunov, Jovanovic, Vuckova, 2020).

Domestic private sector investments in fix assets, for two decades, on average account for 22.4 percent of GDP. Together with Government investments of 3 – 2.4 percent of GDP has been not sufficient to increase capital stock significantly, to introduce advanced technologies, innovations that would accelerate growth, reduce income inequality and significantly increase productivity, employment opportunities and living standard of citizens.

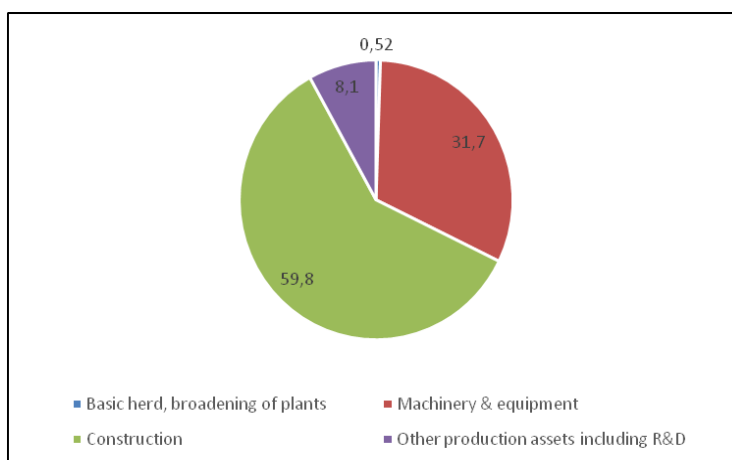
The largest part (60 percent) of private investments in fix assets were in real estate, 32 percent in equipment and machinery, and only 1.8 percent

of GDP or 8.1 percent of total investments were in other assets including research and development (3 to 5 times lower than in EU countries). Such composition of private sector investments in fix assets do not create conditions for high, sustainable and inclusive growth. Furthermore, investments of private sector were mainly oriented in traditional sectors: industry, agriculture, construction. Very little in services, green and digital economy, tourism, new design of products.

Key source for financing investments were depreciation of fix assets, retained earnings and bank loans. It appears that access to finance has been limiting factor, as well, for higher investments in fixed assets

“Over the past four decades, we have seen an explosion in availability of capital. Today, global financial assets total USD 400 trillion. This exponential growth brings with it risks and opportunities for investors and companies alike, and it needs that banks alone are no longer the gatekeepers to funding.

Picture No. 8 Structure of private sector investments in fix assets



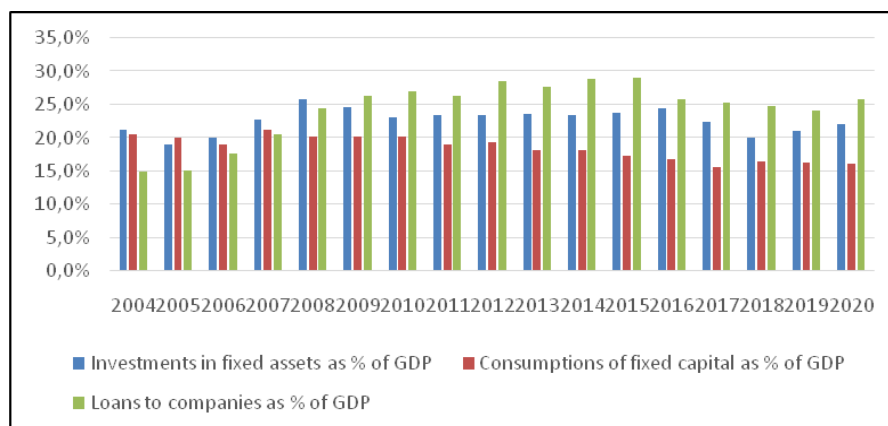
Source: Survey, State Statistical Office, May 2022.

Young, innovative companies have never had easier access to capital. Never has there been more money available for new ideas to become reality. This is fueling a dynamic landscape of innovation. It means that virtually every sector has an abundance of disruptive startups trying to topple market leaders. CEOs of established companies need to understand this changing landscape and the diversity of available capital if they want to stay competitive in the face of smaller more nimble businesses (Lary Fink, 2022)”.

From picture No. 9 we may conclude that 76 percent of private sector investments have been financed by fixed assets depreciation. 24 percent have been financed by retained earnings and bank loans.

Contrary to global trends in developed markets, banks in North Macedonia were “gatekeepers to funding”, having in mind undeveloped other capital markets, especially undeveloped market of investment funds and corporate bonds. However, even in such circumstances, bank loans to companies account for 25.2 percent of GDP, which is two to three times lower than in matured market economies and fast growing economies. Access to finance and de-risking private sector investments appears crucial factors for higher private sector engagement in economic development.

Picture No. 9 Private investment in fix assets, fix capital consumption and loans to companies



Source: Survey, State Statistical Office 2022 and NBRM Statistical Data Series, 2022.

5. Conclusion

Economic growth based on Market Failure Theory for a state role in development, in North Macedonia was very poor. Accelerating growth and boosting it to above 5 percent would require policy makers in North Macedonia to de-couple from Market Failure Theory for Government role and to accept modern, entrepreneurial state that is directing government investment through “mission oriented” not market fixing, Government institutions.

Achieving a mission of high, inclusive, sustainable economic growth that would lead to higher living standard and more equal income distribution,

requires public and private sector to work together, and North Macedonian state both willing and visionary enough to set the direction and create institutional framework. Today's societal challenges, which combine social, political, economic and technological ambitions, should guide our new "mission" which necessitate greater investment level and role of state.

This will require public expenditures steadily to reach threshold of 40 percent of GDP, and public capital expenditures to 5-6 percent of GDP. Through de-risking private investment, stimulating innovations, green and digital investments, private investments in fix assets would reach a level of 27-30 percent of GDP.

For such a new role of welfare state and its long term "mission", policy makers in North Macedonia should build a broad-based consensus in Macedonian society.

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