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THE IMPACT OF PRIVATE HEALTHCARE ON GDP GROWTH IN THE BALTIC COUNTRIES DURING THE COVID-19 PANDEMIC

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I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
have been properly referenced and the same paper
has not been previously presented for grading.

The document length is 8328 words from the introduction to the end of the conclusion.

Nikita Tselpanov 09.05.2024

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ABSTRACT

The COVID-19 pandemic has had a significant impact on the global economy. To combat its consequences, the government had to invest in the health sector to vaccinate, test and cure people, and thereby overcome the decline of the economy. However, not only the government could combat the pandemic. Private healthcare sector is one of the few that could benefit from the pandemic and thereby reduce the decline in GDP growth. The thesis uses data from Orbis and OECD datasets for the Baltic countries adopting pooled OLS methodology for years 2019-2022. Results show that the private healthcare sector was indeed able to benefit from the pandemic by increasing its income. At the same time, however, the growth in the profit of private healthcare companies in the Baltic countries negatively impacted GDP growth, which means that private healthcare companies were able to benefit from the pandemic and at the same time failed to help the economies of the Baltic countries overcome the economic crisis caused by the COVID-19 pandemic.

Keywords: COVID-19, GDP growth, private healthcare, Baltic countries

INTRODUCTION

The COVID-19 pandemic has had a major impact on the economic and social situation of countries around the world. In a short period of around two years, the pandemic greatly affected the Gross Domestic Product (GDP) of countries. (König & Winkler, 2021; Yilmazkuday, 2019) Such crisis has been studied from various economic angles, including the link between the health sector and GDP growth during the pandemic. The healthcare sector has played a key role in overcoming the pandemic crisis by treating and vaccinating people and developing a vaccine. Therefore, private healthcare economic sector is one of the only ones that could benefit from the pandemic. Since the demand for services and goods of this sector has increased greatly and thereby could offset the deterioration in the performance of other economic sectors, the demand for which, on the contrary fell. For example, the tourism sector has suffered the most during the COVID-19 pandemic. (Xiang *et al*., 2021).

Naturally, during the pandemic, the government had a strong influence on the healthcare sector, which financed the healthcare sector. (Kondilis & Benos, 2023) However, research shows that in during the COVID-19 pandemic, spendings on healthcare did not have a significant impact on sustainable economic growth. Under more stable circumstances such as the period before the pandemic, investments in healthcare have driven economic growth while during the COVID-19 pandemic the overwhelming costs of healthcare had a negative impact on economic stability. (Vysochyna *et al*., 2023) On the other hand, the question of how the private healthcare sector influenced the economic growth during the pandemic remains open, as well as what factors influence this. Especially, in the Baltic countries where the pandemic situation was different from other European countries. Operating budgets in these countries were lower than in other European countries and Estonia, Latvia and Lithuania had to introduce restrictions earlier to fight the COVID-19 pandemic. (Webb *et al*., 2022)

The purpose of this thesis is to find out whether and to what extent the private healthcare sector influenced GDP growth in the Baltic countries during the COVID-19 pandemic so that the

government has a better understanding of the financing of the private healthcare sector during pandemics.

To achieve the purpose of the thesis, the following research questions have been set:
1. How has the COVID-19 pandemic affected private healthcare in the Baltic countries?
2. Did and what impact did private healthcare companies have on GDP growth?
3. What determines the impact of the private healthcare sector on GDP growth?
4. What factors, other than the financial performance of private healthcare companies, influenced GDP growth in the Baltic countries during the COVID-19 pandemic?

In this thesis, a Pooled OLS (Ordinary least squares) model is adopted, in which the financial indicators of private medical companies are taken as the main independent variable, and GDP growth will be taken as the dependent variable.

This study uses panel data collected from three Baltic countries, Estonia, Latvia and Lithuania between 2019 and 2022 collected from Orbis and Organization for Economic-Cooperation and Development (OECD) datasets. Financial indicators are collected from 303 private companies in the Baltic countries, during the COVID-19 pandemic. Profit margin and number of employees, as well as changes in these indicators, are used as financial indicators in the work. In addition to financial indicators, this thesis uses the percentage of health sector funding, education level, testing, vaccination and mortality rate of COVID-19 and the percentage of voluntary private health insurance use.

The thesis is divided into two chapters. The first chapter provides a review of the previous literature, healthcare sector and GDP in the Baltic countries during COVID-19 pandemic. In the second chapter, the empirical analysis is carried out and its process is described. Results are discussed and based on those, conclusions are provided.

1. LITERATURE OVERVIEW

The purpose of this chapter is to describe the nature of COVID-19 in the Baltic countries, to provide a summary of the early literature, and to present the results of empirical studies on similar topics. The content of the chapter gives the reader an idea of the economic problem under consideration.

1.1. Understanding COVID-19 in the Baltic countries

The first confirmed case of COVID-19 in the Baltic countries was in Estonia on March 1, 2020 and within a month, infected people appeared in Latvia, and then in Lithuania. (Worldometers, 2024) The Baltic countries responded drastically to the first wave of the pandemic in a similar way. Latvia, Lithuania and Estonia introduced restrictive measures to combat COVID-19 even before 30 cases of infection were confirmed in each country (Webb *et al*., 2022). The first wave of the pandemic was relatively easy for these countries, with a maximum number of new infections per day of 795 in Estonia, 30 in Latvia and 50 in Lithuania. (Worldometers, 2024) Naturally, the number of confirmed cases directly depends on the number of COVID-19 tests performed. Estonia, Latvia and Lithuania had lower operating budgets than other European countries at the start of the pandemic and also experienced lack of health workforce, so it is likely that restrictions were introduced so early to compensate for smaller operating budgets and labour shortages. (Webb *et al*., 2022) However, despite the restrictions introduced, the second and third waves of the COVID-19 pandemic turned out to be more severe for the Baltic countries and had many more cases of infection and deaths.

The following figure (see Figure 1) shows how the number of new COVID-19 cases per day changed in each Baltic country from January 5, 2020 to December 31, 2023.

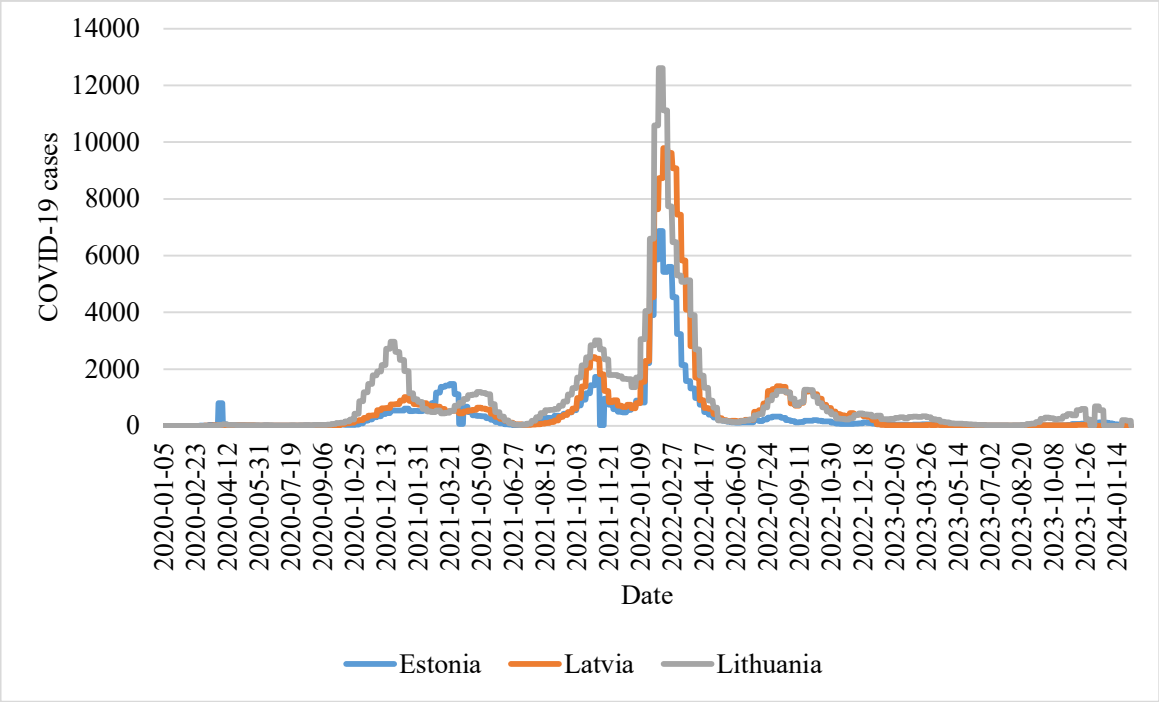

Figure 1. Daily cases of COVID-19 per day in the Baltic countries in 2020-2023
Source: Worldometers (2024)

Figure 1 clearly shows the tendency of daily new cases of COVID-19. The first wave of COVID-19 turned out to be the easiest for the Baltic countries. The hardest period was the period at the end of 2021 and beginning of 2022. During this period, the number of infections per day reached 6861 in Estonia, 9788 in Latvia and 12,614 in Lithuania. And naturally, with such numbers of infected people, the development of the healthcare sector was necessary.

The following figure (see Figure 2) shows the change in total amount of COVID-19 tests performed in each Baltic country from January 2020 to July, 2022.

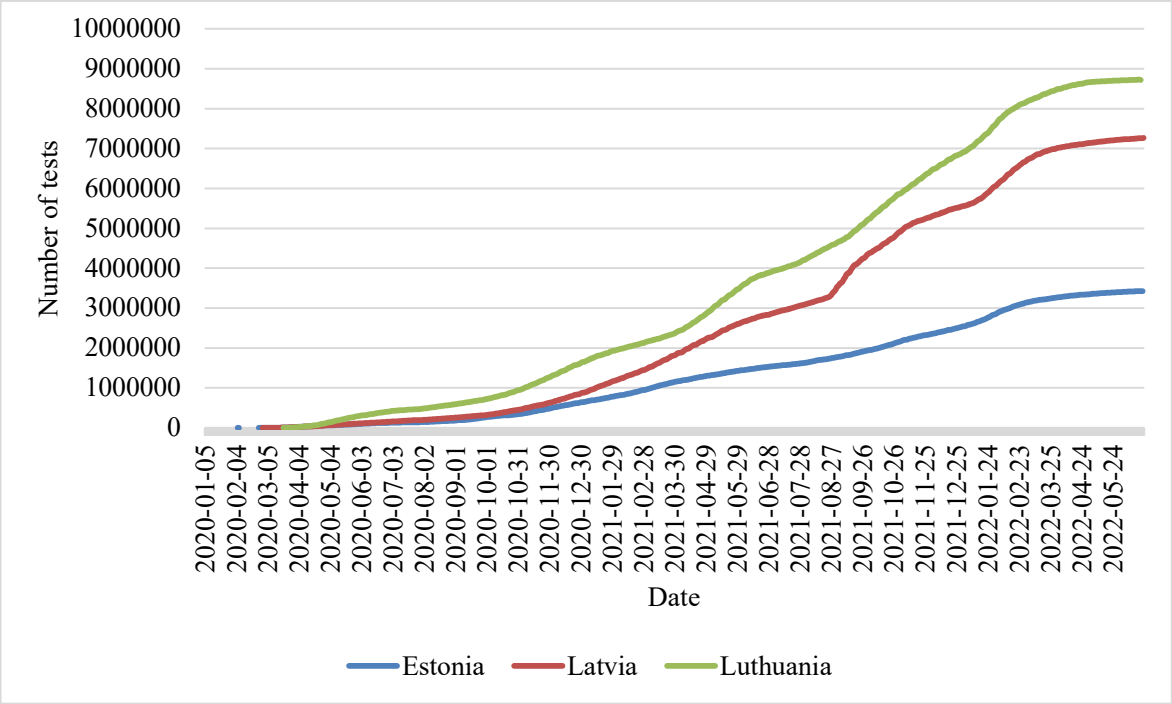

Figure 2. Total COVID-19 tests in the Baltic countries in 2020-2022
Source: Worldometers (2024)

The total number of COVID-19 tests performed in Baltic increased throughout the entire period. The first tests were performed in February 2020 in Estonia and by the end of the period shown in Figure 2, three and a half million tests were done in Estonia, more than seven million in Latvia and more than eight and a half million tests in Lithuania. The difference in tests performed may be due to differences in the populations of the countries. Lithuania has the largest population and Estonia the smallest among the Baltic countries and the number of tests performed is distributed accordingly.

The following figure (see Figure 3) shows the change in total amount of vaccinations performed against COVID-19 in each Baltic country from January 2020 to July, 2022.

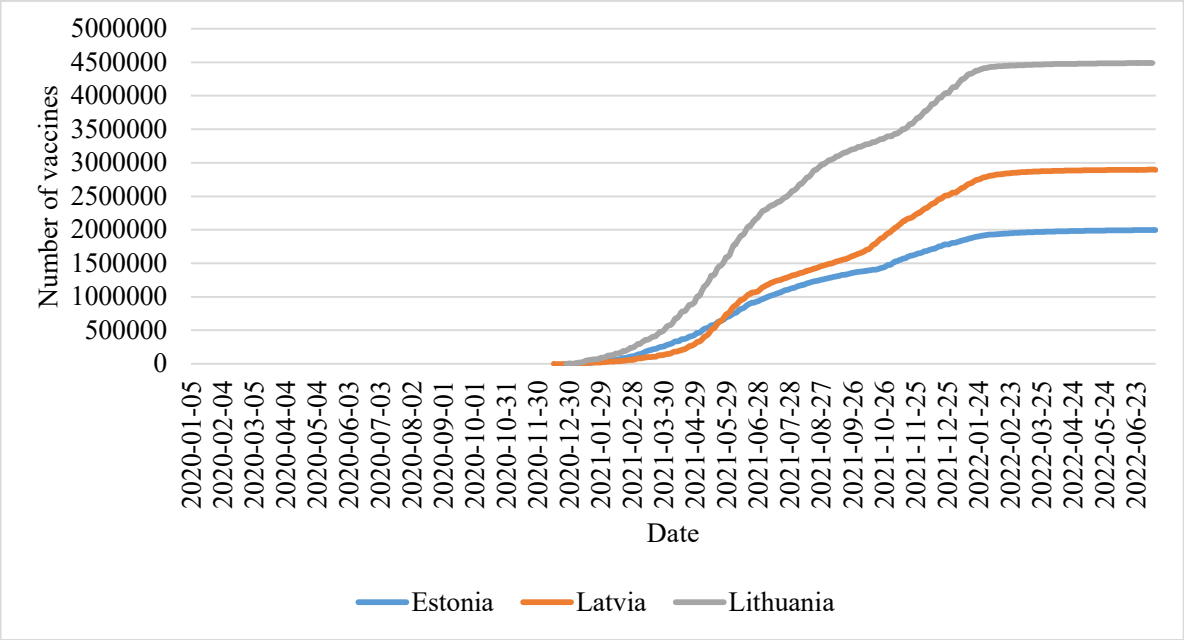

Figure 3. Total amount of COVID-19 vaccinations performed in the Baltic countries in 2020-2022
Source: Worldometers (2024)

The total number of COVID-19 vaccinations performed in Baltic also increased throughout the entire period. The first COVID-19 vaccine was in Latvia in December, 2020. By the middle of 2022, the number of vaccines administered in Estonia reached almost two million, in Latvia more than three and a half million and in Lithuania almost four and a half million. It should be taken into account that the number of vaccines given does not show the total number of vaccinated people, since some vaccines required more than one vaccination, and in addition to that some people were revaccinated. The difference in the number of vaccinations may be also due to differences in the population of the Baltic countries. As well as the number of tests performed, the number of vaccines is distributed in the Baltic countries by population, most in Lithuania and least in Estonia.

One of the main indicators of healthcare development during a pandemic is the number of vaccinated people and the number of tests performed. Figures 2 and 3 show that in the Baltic countries the growth trend in vaccination and COVID-19 testing was approximately the same in the countries, taking into account the population. What illustrates the development of the healthcare sector and the growth in funding for this sector. The speed of vaccination depends on the political system of the country and in authoritarian countries the pace of vaccination is lower.

In addition, the speed of vaccination depends on the level of education and the strength of the economy and on the region; in Europe and Asia the initial pace of vaccination was on average higher. (Ngo *et al*., 2022) In total, countries that managed COVID-19 pandemic control (including testing and vaccination) better also experienced higher GDP growth (Cartaxo *et al*., 2022).

1.2. Economies of the Baltic countries during the COVID-19 pandemic

Many studies have been done on the impact of the COVID-19 pandemic on the GDP growth of countries. Research shows that mortality has little impact on a country's GDP growth, while the severity of government restrictions has had a strong negative impact, especially in countries with emerging and developing economies. International trade and globalization also had an impact on the spread of the economic consequences of the pandemic. (Gagnon *et al*., 2023) At the same time, other studies show that the relationship between GDP and deaths from COVID-19 may be considered as a reverse U-curve pattern. That is, in the early stages of economic development, the mortality rate from COVID-19 will increase as economic activity increases. After all, mortality rates decline at higher levels of economic development, which is associated with increased opportunities to invest in disease control. In turn, mortality is affected by wealth distribution, income inequality represented by Gini index and urbanization. (Law *et al*., 2022)

The impact on trade, however, was not uniform. Ferrari *et al*. (2022), in their work, draw attention to the fact that trade varied depending on the region and the product. For example, trade with the Asian region quickly recovered, while trade with America took longer. In addition, COVID-19 pandemic had only a partial impact on trade in luxury goods and food products, while on the other hand, trade in other more long-lasting goods such as cars was hit the hardest. (Ferrari *et al*., 2022) The impact of COVID-19 on businesses depends on whether the firm trades on domestic market or sells goods for export. Export-oriented firms suffered more. (Waldkirch, 2021) In addition, the pandemic led to the closure of many industries and an increase in unemployment, which also negatively affected GDP growth. (Jena *et al*., 2021)

The pandemic also had an impact on the economy and at the enterprise level. The level of business confidence during COVID-19 was influenced by the response and capacity of both the public and private healthcare sectors. (Gopalakrishnan *et al*., 2023) The impact of COVID-19 on companies' return on assets (ROA) varies from country to country. In general, where financial systems are

more developed and institutions are stronger in terms of accountability, government effectiveness, regulatory quality, businesses have fared better during the pandemic. That is, businesses in countries with stronger financial systems and better governance have suffered less damage during the pandemic. (Hu & Zhang, 2021) The government needed support to combat the pandemic, and to some extent, the private healthcare sector could provide it to the state. Thus, public-private relations were formed in some countries to combat the COVID-19 pandemic. That is, the public health sector and the private health sector worked together to test, vaccinate and treat people. (Park & Chung, 2021)

The pandemic had a negative impact on the countries of the European Union, but how vulnerable the countries of the European Union were varied greatly from country to country. The southern countries were most vulnerable due to the strong emphasis of the economy on tourism, and the Baltic countries are also considered vulnerable countries. On the other hand, Germany and the Scandinavian countries were the least vulnerable to the pandemic. (Brzyska & Szamrej-Baran, 2022)

The following figure (see Figure 4) shows the quarterly change in GDP growth in the Baltic countries from the last quarter of year 2019 to the second quarter of 2023.

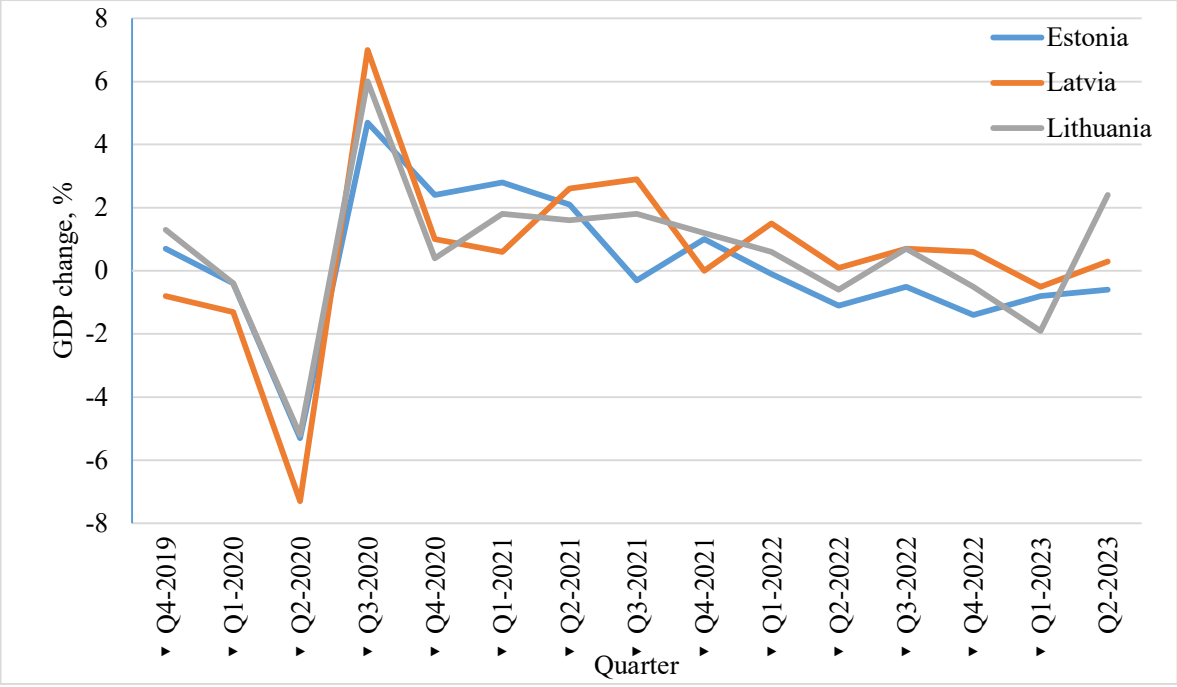

Figure 4. Quarterly change in GDP growth in the Baltic countries in 2019-2023

Source: OECD (2024a)

Figure 4 shows that the largest drop in GDP in the Baltic countries was during the first wave of the COVID-19 pandemic in the first and the second quarters of the year 2020. Although Figure 1 shows that the number of people infected by COVID-19 during the first wave was relatively small, such a strong negative change in GDP is most likely due to the quickly imposed restrictions and the unwillingness of the health sector to treat, test and vaccinate people. Also, a strong slowdown in GDP growth rates can be observed in the third and fourth quarters of 2021. During this period, Estonia's GDP decreased on a smaller scale than during the first wave, and the GDP of Latvia and Lithuania continued to grow, albeit at a slower pace. This suggests that by the second wave of the pandemic, countries were more adapted to fighting the pandemic, the number of tests performed increased, and a vaccine against COVID-19 appeared. In Figure 1, shows the number of infected per day of the third wave of COVID-19 that, during the first quarter had the most infected per day in each of the Baltic countries. Also, Figure 4 shows that only in Latvia there was a relatively strong drop in GDP growth, the growth rate was equal to 0, and in other countries the growth was positive. However, during this period, changes in GDP growth may be associated with other factors. On February 24, 2022, Russian aggression began in Ukraine, which started a crisis that also affected the GDP growth of European countries (Liadze *et al*., 2022).

1.3. Healthcare sector in the Baltic countries

Xiang *et al*. (2021) in their study show that the healthcare sector is a sector that has been greatly affected by the pandemic. Medical staff lacked PPE (personal protective equipment), beds and other equipment needed. However, this study takes into account both the private and public health sectors. (Xiang *et al*., 2021) On the other side Kondilis & Benos (2023) examine in their paper the impact of the COVID-19 pandemic on the private healthcare sector in Greece. The study showed that in private hospitals, despite benefits from the state, the number of beds increased slightly, by only a couple of percent. At the same time, private healthcare companies in Greece were able to maintain their profits in 2020 despite the decline of the country's economy. Also in 2021, private healthcare companies increased their revenue by 18.7%, which is more than two times the economic growth in Greece. Using this study, it can be stated that private healthcare companies in Greece were "Profiting without Socially Contributing" during the COVID-19 pandemic. (Kondilis & Benos, 2023) This paper shows that the private healthcare sector, unlike other sectors, was able to benefit from the pandemic, but the question of whether the growth in profits in healthcare

companies could influence the overall trend in GDP growth remains open. The impact of healthcare sector financing on GDP growth is mixed. Before the pandemic, growth in healthcare spending, whether from public or private sources, positively influenced sustainable economic growth. However, during the pandemic, when healthcare sector played a key role, healthcare expenditures did not notably impact sustainable economic growth. This suggests that in more stable periods, healthcare spending can influence economic growth, while the excessive costs associated with healthcare during the COVID-19 crisis have negative impact on economic stability. (Vysochyna *et al*., 2023)

While the study, based on data from Greece, shows that private healthcare companies were able to benefit during the pandemic, other studies show that COVID-19 has actually led to a market failure in global private healthcare sector. As the demand for beds peaked to fight acute COVID-19 cases, private healthcare providers encountered financial crises due to lockdowns and government regulations. Consequently, the private healthcare sector responded with hospital closures, staff layoffs, treatment refusals, and even attempts to profit through patient fraud, what prevented companies from treating people. On the other hand, this affect in higher extend only countries with low- and middle-income, countries with higher income level were affected less. (Williams, 2020) Therefore, whether private healthcare companies have actually benefited from the COVID-19 pandemic remains in question. In addition to the controversial impact of COVID-19 on the private health sector, research shows that private health spending, depending on countries' income level, urbanization, demography and political system, may significantly increases the prevalence and mortality rate of COVID-19 in different countries. Which calls into question the ability of private healthcare systems to cope infectious diseases, including COVID-19. (Assa & Calderon, 2020)

The health care system in Estonia is financed by a social tax paid on workers' wages, and all insured persons have access to health care. Healthcare services are provided primarily by private providers. In Estonia, the provision of health care services is almost completely decentralized. Medical services can be provided by persons and institutions acting as legal entities under private law: companies, foundations or individual entrepreneurs. Healthcare is financed primarily from the state budget as part of the health insurance budget. By 2023, Estonia spent 6.9% percent of GDP on the healthcare sector. (*Tervisekassa*, 2024; OECD Health at a Glance, 2023a; State of Health in the EU, 2021a)

In Latvia, the National Health Service (NHS) offers universal coverage through tax-funded healthcare services. The majority of service providers contracted with the NHS are private companies. Latvia spent 8.8% of GDP in 2021. (OECD Health at a Glance, 2023b; State of Health in the EU, 2021b)

Similar to Latvia and Estonia Lithuania's healthcare system is financed by contributions to a social health insurance program administered by the National Health Insurance Fund (NHIF). Funding is provided through contributions to the wage fund of the working population and the state budget to cover the non-working population and ensure universal coverage. The Ministry also (co)owns some healthcare providers, including all tertiary hospitals. The role of the private sector in hospital care is very limited. For 2023, Lithuania spent 7.5% of GDP. (OECD Health at a Glance, 2023c; State of Health in the EU, 2023c)

In general, the health care systems in the three Baltic countries are similar. Each country has a private healthcare sector, but in Lithuania it plays a smaller role than in Latvia and Estonia. Countries spend different percentages of GDP on health, but all three countries spend less than the average (9.2% of GDP) for OECD countries. (OECD Health at a Glance, 2023d)

In Estonia one of the biggest healthcare service providers are (Top Hospitals and health care companies in Estonia, 2024a):

- Confido, which was founded in 2013 and offers more than 4000 different medical services - both paid services and within the framework of the *Tervisekassa* (Estonian Health Insurance Fund) agreement; (Confido, 2024)
- Qvalitas (now Meliva), whic is one of the largest private medical centers in Estonia operating since 1996; (Meliva, 2024)
- Heba, a new clinic founded in 2019. (Heba, 2024)

For Latvia biggest healthcare service providers are (Top Hospitals and health care companies in Latvia, 2024b):

- AB City, which is the parent company of two joint stock companies. The group includes suppliers of medical services, retail and wholesale trade in pharmaceutical products, production, laboratory research services in the Baltic region with a total annual turnover of more than 500 million euros; (AB City, 2024)

- DoctoWell, which is a leading Latvian provider of IT solutions in the field of telemedicine and healthcare; (DoctoWell, 2024)
- *AS Veselības centru apvienība* (VCA), which is one of the largest private medical institutions in Latvia. It offers medical services in Riga and the largest cities in the regions. (VCA, 2024)

And for Lithuania these are (Top Hospitals and health care companies in Lithuania, 2024c):

- Addere Care which is a nursing and supportive care hospital; (Addere Care, 2024)
- *Altamedica klinika*, which is a medical centre providing primary health care services. The company began operations in 2001 and now has 12 clinics; (Altamedica, 2024)
- *Baltijos-Amerikos Klinika* which was founded in 1993 and is the first and one of the leading private clinics in Lithuania. (BAK, 2024)

1.4. Literature overview summary

A review of the literature on the topics related to this work showed that little research has been conducted on this topic, especially in the Baltic countries: Estonia, Latvia and Lithuania. Empirical research has shown how much the COVID-19 pandemic has impacted the global economy, and that private healthcare enterprises may have had an impact in the fight against the pandemic and could therefore influence the change in GDP growth in some countries. However, what impact did CODIV-19 have on private healthcare companies in the Baltic countries and how did these companies affect GDP growth is questionable. Some studies show that there has been a failure in the global private healthcare market and the healthcare sector has been affected strongly negatively by the pandemic (Williams, 2020; Xiang *et al*., 2021). Another study on a similar topic found that private healthcare companies were still able to benefit from the COVID-19 pandemic and increase their profitability even during the economic downturn, including through government incentives, and despite these incentives had little impact on economy and the fight against the COVID-19 pandemic. (Kondilis & Benos, 2023). The literature also shows that the relationship between GDP and other variables turned out to be ambiguous. For example, financing of the health sector did not affect GDP growth during the pandemic (Vysochyna *et al*., 2023). Also, COVID-19 mortality rate has a U-curve pattern connection with GDP (Law *et al*., 2022). In addition, the selection of variables used in the model is based on the literature review and is described in Chapter 2.

2. EMPIRICAL ANALYSES

This chapter provides an overview of the data used for analysis, explains which research method is used. Research question set out it the introduction are answered in this chapter.

2.1. Data and methods

The research is conducted on panel data, and the selection consists of data from three countries - Estonia, Lithuania and Latvia. The author use data from 2019 to 2022 from Orbis and OECD data sets. This time period was chosen because it was during the period that the COVID-19 pandemic occurred.

In this thesis, the author examines the relationship between the financial performance of private companies of the healthcare sector and GDP growth in the Baltic countries, as well as other factors during the COVID-19 pandemic. For the model, eight variables are selected, which are presented in Table 1.

Table 1. Variables used

Variable	Description	Units	Source
HealthFin	The annual percentage of GDP that the government spends on the health sector.	%	OECD
Educ	Annual percentage of people aged 25 to 64 with tertiary education.	%	OECD
Test	Annual number of COVID-19 tests performed per thousand people	Number of COVID-19 tests per thousand	Worldometers
Vacc	Annual number of COVID-19 vaccines	Number of COVID-19 vaccines per hundred	Worldometers

	made per hundred people		
Mort	Number of fatal COVID-19 cases per million people	Number of total COVID-19 fatal cases per million	Worldometers
Private	Private health expenditure as share of current health spending	% of voluntary spending on private health insurance out of current health care spending	OECD
GDPgr	Annual GDP growth change	% change compared to the previous period	OECD
Marg	Annual profit margin of private healthcare companies	%	Orbis
Empl	Annual of number of employees in private healthcare companies	Number of employers	Orbis
Marg_ch	Annual change of profit margin of private healthcare companies	% change compared to the previous period	Orbis
Empl_ch	Annual change of number of employers of private healthcare companies	% change compared to the previous period	Orbis

Source: OECD (2024b), Worldometers (2024), Orbis (2024a)

The level of funding for the healthcare sector is directly related to the fight against COVID-19, and part of the funding can also go to private healthcare companies, as for example in Greece, benefits were provided to private healthcare companies. (Kondilis & Benos, 2023) Ngo *et al*. (2022) in their article, note that overcoming the pandemic also depends on the level of education. In addition, GDP growth may be influenced by the level of COVID-19 testing and vaccination (Cartaxo *et al*., 2022) and also COVID-19 mortality rate may have impact on the economy of countries (Law *et al*., 2022). The level of private use is directly related to the structure of the health sector in countries, that is, the role of private and public health enterprises (FOCUS ON Private health..., 2022).

As financial indicators of private companies, the author uses profit margin, which is a measure of profitability, expressed as the percentage of revenue that companies keep as profit (Investopedia, 2024). The author uses this indicator because in the chapter with the literature review it was

mentioned that chat companies have increased their income and the profit margin shows an increase in profit. Also, the number of employees is used as a financial indicator in the work.

Based on the literature overview, the model could have used other indicators such as the number of people working in health care, but due to the lack of data for 2022, for example in OECD database, these indicators are not used in the model.

The main variables for the model used in this work are changes in GDP growth and financial performance of private healthcare enterprises. The additional variables are the percentage of GDP that the government spends on the health sector, percentage of people aged 25 to 64 with tertiary education, number of COVID-19 tests performed, number of COVID-19 vaccines made, number of people employed in healthcare, number of fatal COVID-19 cases and private health expenditure as share of current health spending. All quantitative variables are adjusted due to population differences that is shown per thousand or per hundred, thousand or million people.

The study uses pooled OLS in the Gretl program. First, a simpler model is created that examines the relationship between changes in GDP growth and the financial performance of private healthcare enterprises, then an additional extended model is created with more variables presented in Table 1. For this, the change in GDP growth in the Baltic countries is taken as a dependent variable, and other characteristics are taken into account as independent variables. In order to choose which model to use for the study, Test for differing group intercepts, Breusch-Pagan test and Hausman test will be carried out. The resulting model tests whether the model and features are statistically significant at the 5% and 1% levels, as well as heteroskedasticity, whether the residuals are normally distributed, autocorrelation and Ramsey RESET test for the shape of the model.

2.2. Data description

Data are collected for three countries: Estonia, Latvia and Lithuania from 2019 to 2022. Financial indicators which are profit margin and number of employers and the change of these variables of private healthcare companies collected from 303 enterprises in selected countries in the period from 2019 to 2022 are also included. The selection of enterprises is based on the main activity of enterprise in Orbis database. In this thesis, for data used from Orbis database activity code 86

(human health activities) is used, excluding 8623 - Dental practice activities, since this type most likely had the least to do with the fight against the COVID-19 pandemic.

Table 2 provides general statistics for the sample. Study of the data shows that the average percentage of GDP that is transferred to the health sector is 7.64%, the minimal percentage is 6.61% in Latvia in year 2019 and the maximum percentage is 9.04% also in Latvia in year 2021. Standard deviation is 0.86901 and coefficient of variation is 0.1. The average percentage of people with tertiary education among people of age 25-64 in Baltic countries during the selected time period is 40.035%. The minimal percentage is 35.71% in year 2019 in Latvia and the maximum percentage is in Lithuania in year 2022 and the percentage is 46.53%. Standard deviation of the average percentage of people with tertiary education among people of age 25-64 is 2.7358 and the variation coefficient is 0.0748.

Table 2. Descriptive Statistics: full sample

Variable	Arithmetic average	Minimum	Maximum	Standard deviation	Coefficient of variation
HealthFin, %	7.64	6.61	9.04	0.87	0.11
Educ, %	40.04	35.71	46.53	2.74	0.07
Test	1606.50	3.07	3873.00	1453.39	0.90
Vacc	73.65	0.13	163.23	73.88	1.00
Mortality	1378.70	0.00	3504.71	1334.80	0.97
Private, %	2.12	0.20	3.40	1.47	0.69
GDPgr, %	2.87	-3.50	8.00	3.11	1.08
Marg, %	10.44	-72.82	86.50	13.67	1.31
Employees	30.67	0.00	906.00	69.64	2.27
Marg_ch	3.33	-178.73	1932.00	60.24	18.06
Empl_ch,	0.09	-0.76	9.00	0.42	4.36

Source: OECD (2024c), Worldometers (2024), Orbis (2024b); author's calculations

The average number of COVID-19 tests performed per thousand people in Baltic counties in period of 2019-2022 is 1606.5. The minimum number of COVID-19 tests per thousand people (not taking into account year 2019, since the COVID-19 pandemic began in 2020) is in the first quarter of 2020 in Lithuania and the number is 3.071 tests per thousand people. The maximum number of the same variable is 3873 tests per thousand people in the second quarter of 2022 in Latvia, standard deviation is 1453.3 and coefficient of variation is 0.90467. The average number of vaccines per hundred people in the Baltics in 2019-2022 is 73.654, the minimal number of 0.13 vaccines per hundred people (also not taking into account year 2019, since the COVID-19 pandemic began in 2020) is in Latvia in the first quarter of 2020 year and the maximum number

is 163.23 in year 2022 in Lithuania. The standard deviation of number of vaccines per hundred people is 73.879 and coefficient of variation is 1.003. The average number of fatal COVID-19 cases per million people in selected countries and time period is 1378.7, the minimal and the maximum number (not taking into account 2019, since the COVID-19 pandemic began in 2020) are respectively 0 in Latvia in the first quarter of year 2020 and 3504.707 in the second quarter of 2022 also in Latvia. Standard deviation of COVID-19 mortality rate is 1334.8 and coefficient of variation is 0.968 in Latvia, Lithuania and Estonia in time period of 2019-2022. The average percentage of spendings on private health insurance is 2.1228% which means that in selected period small amount people in the Baltics used voluntary private health insurance. The minimal percentage 0.2% is in Estonia and the maximum is 3.4% in Latvia. Standard deviation of percentage of spendings on private health insurance on selected period in Baltic countries is 1.4724 and coefficient of variation of 0.693. The average change in GDP in years 2019-2022 in Baltic countries is 2.8705% which means that during the pandemic, the economy of the Baltic countries was still growing. The minimum percentage is -3.50% in year 2020 year in Latvia and the maximum percentage is 8% in year 2021 in Estonia. Standard deviation is 3.109 and coefficient of variation is 1.083. The average profit margin of private healthcare companies is 10.439%, which means that on average private healthcare companies have been profitable during the pandemic.

The minimum profit margin value was -72.821% in the Latvian company *CILVĒKS* in 2020. The maximum value was for the Estonian company *KSA MEDICA* in 2020 and the profit margin was 86.5%. The standard deviation of profit margin of private healthcare companies during pandemic is 13.670 and the coefficient of variation is 1.3095. The average number of employees in the selected countries and period is 30.667. The minimum number of employees is 0, which may mean that the company appeared during a pandemic and the maximum number is 906 employees, this value was in the Lithuanian company *AFFIDEA LIETUVA*. The standard deviation is equal to 69.639 and the coefficient of variation is equal to 2.2708. The average change in marginal profit is 3.3352, which means that private healthcare companies were able to benefit from the COVID-19 pandemic in the Baltic countries and increased their income. The minimum value is -178.73, when in the Latvian company *ER KLINIKA* the profit margin fell from -0.147% in 2019 to -26.42% in 2020. The maximum value is 1932.0, when the Latvian company *ALUKSNES SLIMNICA* profit margin increased from 0.003% in 2020 to 5.799% in 2021. Standard deviation of profit margin change is equal to 60.241 and coefficient of variation is 18.062. The average change in the number of employees is 0.096, which means that during the pandemic, the number of employees in private

healthcare companies increased. The minimum value is -0.755, when the number of employees in the Estonian company *TARTU KESKLINNA PEREARSTIKESKUS* fell from 49 in 2021 to 12 in 2022. The maximum value is 9, when the number of employees in the Latvian company *AZARYAN MEDICAL CLINIC* increased from 1 in 2019 to 10 in 2020. Standard deviation of the change of number of employees is 0.421 and coefficient of variation is 4.356.

Using the value of the coefficient of variation, it can concluded that the education variable, which shows annual percentage of people aged 25 to 64 with tertiary education varies the least, and the change in marginal profit varies the most in the Baltic countries during the COVID-19 pandemic.

2.3. Conducting the analysis and its results

First, the author tries to create the first, simple model, which will examine only the influence of financial indicators (profit margin and the number of employees and changes in these indicators) on changes in GDP growth. Since the selected data is panel data, the author creates a least square dummy variable (LSDV) model, however, test for differing group intercepts p-value is 0.999 which means that that all object-specific free members are zero and there is only one common free member in the model and should be used pooled OLS model to study this relationship. For the correctness of the division, time dummies were used, since the time period is relatively short, only four years, and the number of companies is 303. As a result, the model:

$$\boldsymbol{GDPgr} = 4.01484 - 0.00262699EMPLOYEES - 0.00723337Marg - 4.49860dt\_2 + 3.04974dt\_3 - 2.50435dt\_4 \quad (1)$$

where
GDPgr – Annual GDP growth change
EMPLOYEES – Annual of number of employees in private healthcare companies
Marg – Annual profit margin of private healthcare companies
dt_2 – time dummy. If year is 2020 then 1, else 0
dt_3 – time dummy. If year is 2021 then 1, else 0
dt_4 – time dummy. If year is 2022 then 1, else 0

Table 3. Additional data for simplified model

Variable	Coefficient	Standard error	p-value	Significance
constant	4.01484	0.07746	2.39e-152	***
Empl	0.00263	0.00067	0.00010	***
Marg	0.00723	0.00269	0.00760	***
dt_2	4.49860	0.01558	0.00000	***
dt_3	3.04974	0.09837	7.67e-096	***
dt_4	2.50435	0.13737	1.35e-50	***

Source: author's calculations

The given simplified model is statistically significant, the F-test results in a p-value of 0.00, which is less than the 0.01 level. In addition, the independent variables t-test results are also less than the 0.01 level, the p-value of the number of employees is 0.0001, marginal profit p-value is 0.00076 and time dummies two to four p-values are 0.7.67e-096 and 1.35e-050 respectively. There is heteroskedasticity, the p-value of the White test is 1.76755e-79, and because of heteroskedasticity robust standard errors are used in the model. The result of the Ramsey Reset test is the p-value of 0.01955, which is greater than the level of 0.01, and it can be assumed that the shape of the model is correct (linear). The residual terms of the model are not normally distributed, the p-value of this test is 4.53498e-88, after that the p-values of the t-test may actually differ from the ones presented in the model. The coefficient of determination (R square) of the model is 0.825003, which shows that the model has a high descriptive power. The model shows that private healthcare companies have failed to recover the decline in GDP growth in the Baltics during the COVID-19 pandemic. Both profit margin and the number of employees have a negative relationship with GDP growth, that is, when the income of private companies grew, then GDP fell, also considering time dummies, then a positive relationship between financial indicators can only be at dt_3, that is, in 2021, when GDP growth started to grow greatly. In all other selected years the relationship is also negative. It can be said that in the Baltic countries private companies are also "profiting without socially contributing", as Kondilis & Benos (2023) concluded in their work.

The model shows that if marginal profit increases by 1%, then GDP growth decreases by 0.0072%. Also, if the number of employees increases by one employee, then GDP growth falls by 0.00262699%.

In addition to this, using time dummies data, in 2020 GDP growth decreased by 4.49860%, in 2021 it increased by 3.04974% and in 202 it decreased again by 2.50435%. This result may mean that the COVID-19 pandemic had a strong negative impact on the economies of the Baltic countries only in 2020. Already in 2021, the economies of the Baltic countries began to recover from the pandemic and GDP began to grow rapidly compared to 2020. However, in 2022, the GDP of the Baltic countries began to fall again, but this crisis can already be associated with Russia's aggression in Ukraine, since this also negatively affected the GDP of European countries (Liadze *et al*., 2022).

Next, the author creates an augmented model in which it is examined what other variables may influence changes in GDP growth in the Baltic countries during the COVID-19 pandemic. For this, a correlation matrix is used. Changes in GDP growth most closely correlate with the number of COVID-19 vaccines administered. In order to determine which model to use, the author creates a model with random effect and looks at the result of Hausman test. Hausman test p-value is equal to 4.45441e-05, therefore the model with random effect cannot be used. Next, author creates a fixed effect model and P-value of the test for differing intercepts is equal to 1, so the author again uses the pooled OLS model. The number of vaccines was found to be statistically significant (p-value of t-test is 6.79e-038). Next, the author adds variables in turn from those most correlated with changes in GDP growth to those most uncorrelated. Variables correlate with changes in GDP growth in the following order: annual number of COVID-19 vaccines performed per hundred people, annual percentage of GDP that the government spends on the health sector, annual number of fatal COVID-19 cases per million people, annual number of COVID-19 tests performed per thousand people, annual percentage of people aged 25 to 64 with tertiary education, private health insurance expenditure as share of current health spending, number of employees in private healthcare enterprises, change in marginal profit, marginal profit and change in the number of employees in private healthcare enterprises. The final form of the augmented model is:

$$\boldsymbol{GDPgr} = 70.1986 - 7.53945 \times 10^{-6} Vacc^3 + 0.204521 Vacc + 0.0179184 Mortality - 0.0162016 Test - 1.58249 Educ - 2.61204 Private - 0.000220427 Marg\_ch \quad (2)$$

Where
GDPgr – Annual GDP growth change
Vacc – Annual number of COVID-19 vaccines made per hundred people
Mortality – Number of fatal COVID-19 cases per million people
Test – Annual number of COVID-19 tests performed per thousand people
Educ – Annual percentage of people aged 25 to 64 with tertiary education
Private – Private health expenditure as share of current health spending
Marg_ch – Annual change of profit margin of private healthcare companies

Table 4. Additional data for augmented model

Variable	Coefficient	Standard error	p-value	Significance
Constant	70.1986	0.58817	5.54e-256	***
Vacc	0.20452	0.00208	7.27e-231	***
Mort	0.01792	0.00018	2.92e-233	***
Test	0.01620	9.00382e-05	4.94e-309	***
Educ	1.58249	0.01334	3.56e-255	***
Private	2.61204	0.03797	1.71e-186	***
Vacc ^3	7.53945e-06	1.34668e-07	1.63e-161	***
Marg_ch	0.00022	7.83541e-05	0.00520	***

Source: author's calculations

The variables that affected GDP growth were the vaccination rate, the COVID-19 mortality rate, the COVID-19 testing rate, the level of education, the percentage of private health insurance financing and the change in margin profit. The t-test p-values of each variable are significant at the 0.01 level. The P-value of the F-test is zero, which means the model is statistically significant. Ramsey Reset p-value is 0.0177263, which, when using a level of 0.01, means that the model type is selected correctly. The model has heteroskedasticity and autocorrelation, in addition, the residuals are not subject to a normal distribution, therefore the author uses Robust standard errors.

The model shows that initially, an increase in vaccination has a positive effect on GDP growth, but when the number of vaccinations is already high, then with a further increase, vaccination can negatively affect GDP growth. This can be explained by the fact that during the pandemic, the vaccine contributed to GDP growth, as it could reduce the number of infected people, but at the end of the pandemic, when the number of vaccines was already high, further, the same active vaccination was less effective and could require more resources. Also, GDP growth has a positive relationship with the number of fatal COVID-19 cases per million people. This connection suggests that Baltic countries generally coped with the pandemic, and when deaths from COVID-

19 increased in countries, GDP growth was still positive. On the other hand, the positive relationship between COVID-19 fatal cases and GDP growth can by the fact that these two indicators have not linear relationship, but an inverted U-curve pattern, as described in their work by Law *et al*. (2022) Testing in the Baltic countries during the pandemic was negatively associated with GDP growth, meaning that unlike vaccination, which reduces number of COVID-19 cases, testing that detects the presence of the disease has not helped the Baltic countries recover from the COVID-19 pandemic crisis. Education level also had a negative impact on GDP growth, showing that countries with more people with tertiary education fared worse during the pandemic. In addition, the percentage of private health insurance uptake is also negatively associated with GDP growth, meaning that countries with higher rates of private health insurance have fared worse during the COVID-19 pandemic.

Taking the growth of GDP and the level of vaccination in the form of a cubic function shows that while the quality of vaccines per 100 people does not exceed approximately 171 vaccines, GDP is growing, then GDP will fall as the number of vaccines increases. The number of vaccines does not indicate the number of people vaccinated, as some vaccines require more than one vaccination. Also, the number of vaccines per 100 people of approximately 170 vaccines can be considered a very high level of vaccination for the Baltic countries, since in the selected time and period in Estonia, Latvia and Lithuania, the maximum number of vaccines per hundred people was in Lithuania in 2022 and was equal to 163.23. That is, the level of vaccination in the Baltic countries during the selected period still contributed to GDP growth in these countries. The model also shows that with each fatal case of COVID-19 per million people in Baltic countries in years 2019-2022, GDP growth increases by 0.0179184%, which means that mortality rate influence on GLD growth is positive. This can be due to the fact that the relationship of these 2 indicators is not linear, but an inverted U-curve pattern, as described in their work by Law *et al*. (2022). In addition, when the number of tests done per 1000 people increases by 1, then GDP growth decreases by 0.0162%. If educational level as percentage of people aged 25 to 64 with tertiary education., increases by 1%, then GDP growth falls by 1.58249% and if private health insurance utilization increases by 1%, then GDP growth decreases by 2.61204%. In addition, when profit margin change increases by 1, then GDP growth in Estonia, Latvia and Lithuania in years 2019-2022 decreases by 0.000220427%.

As in the simplified model, the growth of profit margin, as well as profit margin, has a negative impact on GDP growth and the mean value of profit margin growth is positive, which also confirms

the words that private healthcare companies are “Profiting without Socially Contributing” during COVID-19 pandemic, as Kondilis & Benos (2023) concluded in their work. In general, the results obtained using both models are consistent with the reviewed literature.

However, the actual influence of these variables may differ from those presented, as the model has heteroscedasticity, autocorrelation, and residuals not normally distributed.

2.4. Findings

Two models were created to study the impact of financial performance of private healthcare enterprises on GDP growth in the Baltic countries during the COVID-19 period. The first, simplified model showed that GDP growth in the Baltic countries has a negative relationship with the financial indicators (number of employees and profit margins) of enterprises in the private healthcare sector. This suggests that during the pandemic, private healthcare firms were able to increase their income and at the same time were unable to compensate for the negative impact of the COVID-19 pandemic on the economies of the Baltic countries.

The second, augmented model also shows that financial indicators (in the case of the augmented model, a change in profit margin) also negatively affects GDP growth in the Baltic countries during the COVID-19 pandemic. That is, when the revenues of private healthcare companies grew, the growth rate of GDP decreased. The augmented model also shows that the growth rate of GDP was influenced by vaccination, mortality and testing from COVID-19, in addition to the level of education and the percentage of use of private health insurance. The effects of these variables on GDP growth are described in more detail in Chapter 2.3.

Using the results of the obtained models, the thesis concludes that private healthcare companies were indeed able to benefit from the COVID-19 pandemic, having an average profit margin positive during the pandemic, however, despite this, the private sector was unable to help the economies of the Baltic countries recover from the crisis and when the pace GDP growth fell, then the income of private healthcare companies grew and vice versa. This result confirms the words of Kondilis & Benos, that private healthcare companies during the COVID-19 pandemic are “Profiting without Socially Contributing” (Kondilis & Benos, 2023).

CONCLUSION

This thesis examined the influence of private healthcare companies on GDP growth in the Baltic countries from 2019 to 2022, that is, the period during the COVID-19 pandemic, as well as the relationship between GDP growth and other indicators related to healthcare and the pandemic. The purpose of this work was to understand this connection so that the government has a better understanding of the financing of private healthcare companies during the pandemic. To achieve this goal, questions were posed that can now be answered. Literature on a similar topic does not provide a clear answer on how the COVID-19 pandemic has affected the private healthcare sector. Some studies say that the pandemic was critical for the private healthcare sector and there was a failure in the market (Williams, 2020). Other studies show that, on the contrary, private companies were able to benefit from the pandemic through benefits from the state without making an impact in the fight against the pandemic (Kondilis & Benos, 2023). The model made shows that private healthcare companies were indeed able to benefit from the COVID-19 pandemic by increasing their profit and the number of employees. At the same time, the relationship between income growth and growth in the number of employees with GDP growth is negative, which means that the growth of private health companies' profits and number of employees in the Baltic countries did not benefit the counties in the fight against the COVID-19 pandemic crisis. Also, in addition to the financial performance of private healthcare companies, GDP growth was also affected by vaccination, testing, mortality, education level and the percentage of use of private health insurance.

The relationship between GDP growth and the level of vaccination in the Baltic countries in the period 2019-2022 is such that at first the level of vaccination has a positive effect on GDP growth, but when the number of vaccines per 100 people becomes relatively high, vaccination begins to negatively affect GDP growth. The relationship between the mortality rate from COVID-19 and GDP growth is positive. The remaining variables, level of testing, level of education and private health insurance coverage, are negatively connected with GDP growth.

To identify the relationship between financial indicators, data were collected from 303 different firms in the private healthcare sector, not including private dental firms. Two models were created using the pooled OLS method. The first model is a simplified one, which shows the relationship between changes in GDP growth and the financial performance of private healthcare enterprises in the Baltic countries during the COVID-19 pandemic. The second extended model includes, in addition to the financial indicators of enterprises, also other variables related to the pandemic or the healthcare sector. The selection of variables is based on the literature reviewed in Chapter 1.

The result coincides with the literature studied and also complements the overall picture of the study of the COVID-19 pandemic, especially from private healthcare companies, however, this topic requires further research. For further research on this topic, other financial indicators can be used, such as ROA as Hu & Zhang (2021) suggested in their paper. Also, the choice of countries may be different. In addition to this, instead of annual indicators, it is possible to use quarterly data on both changes in GDP growth and financial indicators of enterprises, because the pandemic period is relatively short. For the augmented model, other indicators can be used, such as the Gini index, an indicator of income inequality. Also, instead of GDP growth, GDP per capita can be used. Furthermore, the created model contains errors of heteroscedasticity and autocorrelation, so when correcting these errors, the result may change.

KOKKUVÕTE

Käesolevas lõputöös uuriti eratervishoiuettevõtete mõju SKP kasvule Balti riikides aastatel 2019-2022 ehk COVID-19 pandeemia perioodil, samuti SKP kasvu seost teiste tervishoiu ja pandeemiaga seotud näitajatega. . Selle töö eesmärk oli mõista seda seost, et valitsus saaks paremini aru eratervishoiuettevõtete rahastamisest pandeemia ajal. Selle eesmärgi saavutamiseks esitati küsimusi, millele saab nüüd vastused leida. Sarnaseid teemasid käsitlev kirjandus ei anna selget vastust selle kohta, kuidas COVID-19 pandeemia on mõjutanud eratervishoiusektorit. Mõned uuringud ütlevad, et pandeemia oli eratervishoiusektori jaoks kriitiline ja turul esines tõrge. Teised uuringud näitavad, et vastupidi, eraettevõtted said pandeemiast kasu riigilt saadud kasu kaudu, ilma et see pandeemia vastu võitlemisel mõju oleks avaldanud. Tehtud mudel näitab, et eraettevõtted said COVID-19 pandeemiast tõepoolest kasu saada, suurendades oma sissetulekuid ja töötajate arvu. Samas on sissetulekute kasvu ja töötajate arvu kasvu seos SKP kasvuga negatiivne, mis tähendab, et Balti riikide eratervishoiuettevõtete saadud hüved ei toonud pandeemiakriisiga võitlemisel riigile kasu. Samuti mõjutasid SKP kasvu lisaks eratervishoiuettevõtete majandustulemustele ka vaktsineerimine, testimine, suremus, haridustase ja sagedase ravikindlustuse kasutamise protsent.

SKP kasvu ja vaktsineerimise taseme suhe Balti riikides perioodil 2019-2022 on selline, et algul avaldab vaktsineerimise tase positiivset mõju SKP kasvule, kuid kui vaktsiinide arv 100 inimese kohta muutub suhteliselt suureks, vaktsineerimine hakkab SKP kasvu negatiivselt mõjutama. Seos COVID-19 põhjustatud suremuse ja SKP kasvu vahel on positiivne. Ülejäänud muutujad, testimise tase, haridustase ja eraravikindlustus, on SKP kasvuga negatiivselt seotud.

Finantsnäitajate vahelise seose väljaselgitamiseks koguti andmeid 303 erinevalt eratervishoiusektori ettevõttelt, välja arvatud era hambaravifirmad. Kaks mudelit loodi ühendatud OLS-meetodi abil. Esimene mudel on lihtsustatud mudel, mis näitab seost SKP kasvu muutuste ja Balti riikide eratervishoiuettevõtete finantstulemuste vahel COVID-19 pandeemia ajal. Teine laiendatud mudel sisaldab lisaks ettevõtete finantsnäitajatele ka muid pandeemia või tervishoiusektoriga seotud muutujaid. Muutujate valiku aluseks on 1. peatükis vaadatud kirjandus.

Tulemus ühtib uuritud kirjandusega ja täiendab ka COVID-19 pandeemia uurimise üldpilti, eriti eratervishoiuettevõtetelt, kuid see teema vajab täiendavat uurimist. Selle teema edasiseks uurimiseks võite kasutada muid finantsnäitajaid, näiteks ROA-d, nagu Hu & Zhang oma artiklis soovitasid. Samuti võib riikide valik olla erinev. Lisaks saab aastanäitajate asemel kasutada kvartaliandmeid nii SKP muutuste kui ka ettevõtete finantsnäitajate kohta, sest pandeemiaperiood on suhteliselt lühike. Täiustatud mudeli puhul saab kasutada muid näitajaid, näiteks Gini indeksit, mis on sissetulekute ebavõrdsuse näitaja. Samuti saab SKP kasvu asemel kasutada SKP-d elaniku kohta. Samuti sisaldab loodud mudel heteroskedastilisuse ja autokorrelatsiooni vigu, mistõttu nende vigade parandamisel võib tulemus muutuda.

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APPENDICES

Appendix 1. Correlation matrix

GDPgr	Marg_ch	Empl_ch	Healthfin	Educ	
1.0000	0.0482	0.0138	0.2659	-0.1984	GDPgr
	1.0000	-0.0070	0.0408	-0.0303	Marg_ch
		1.0000	-0.0247	0.0065	Empl_ch
			1.0000	0.0549	Healthfin
				1.0000	Educ

Test	Vacc	Mort	Private	Marg	
0.2217	0.3577	0.2463	0.1548	0.0331	GDPgr
0.0183	0.0188	0.0182	0.0366	-0.0011	Marg_ch
-0.0290	-0.0235	-0.0242	-0.0085	0.0729	Empl_ch
0.8125	0.6709	0.8171	0.3854	-0.0266	Healthfin
0.2349	0.3144	0.2497	-0.7374	0.1478	Educ
1.0000	0.9532	0.9885	0.1800	-0.0161	Test
	1.0000	0.9297	0.0062	0.0212	Vacc
		1.0000	0.2307	-0.0222	Mort
			1.0000	-0.1804	Private
				1.0000	Marg

Empl	sq_Marg_ch	sq_Empl_ch	sq_Marg	sq_Empl	
-0.0525	0.0343	-0.0177	0.0133	-0.0082	GDPgr
-0.0018	0.9587	-0.0034	-0.0205	-0.0065	Marg_ch
0.0388	-0.0070	0.8470	0.0517	0.0419	Empl_ch
-0.0575	0.0422	-0.0259	-0.0523	-0.0202	Healthfin
0.4271	-0.0176	-0.0270	0.1271	0.2590	Educ

0.0198	0.0227	-0.0333	-0.0400	0.0400	Test
0.0578	0.0212	-0.0376	-0.0054	0.0620	Vacc
0.0703	0.0224	-0.0321	-0.0466	0.0772	Mort
-0.1790	0.0291	0.0167	-0.1684	-0.0826	Private
0.0783	-0.0125	0.0643	0.7307	0.0629	Marg
1.0000	-0.0051	-0.0034	0.0307	0.8803	Empl
	1.0000	-0.0024	-0.0134	-0.0050	sq_Marg_ch
		1.0000	0.0463	-0.0037	sq_Empl_ch
			1.0000	0.0257	sq_Marg
				1.0000	sq_Empl

vacc3	
0.2691	GDPgr
0.0093	Marg_ch
-0.0231	Empl_ch
0.6410	Healthfin
0.3428	Educ
0.9614	Test
0.9857	Vacc
0.9500	Mort
0.0188	Private
0.0084	Marg
0.0869	Empl
0.0137	sq_Marg_ch
-0.0357	sq_Empl_ch
-0.0149	sq_Marg
0.0845	sq_Empl
1.0000	vacc3

Appendix 2. Simplified model

Model 8: Pooled OLS, using 1212 observations

Included 303 cross-sectional units

Time-series length = 4

Dependent variable: GDPgr

Robust (HAC) standard errors

	coefficient	std. error	t-ratio	p-value	
const	4.01484	0.0774640	51.83	2.39e-152	***
Empl	−0.00262699	0.000672859	−3.904	0.0001	***
Marg	−0.00723337	0.00269087	−2.688	0.0076	***
dt_2	−4.49860	0.0155805	−288.7	0.0000	***
dt_3	3.04974	0.0983743	31.00	7.67e-096	***
dt_4	−2.50435	0.137370	−18.23	1.35e-050	***

Mean dependent var 2.870462 S.D. dependent var 3.109247

Sum squared resid 2048.732 S.E. of regression 1.303373

R-squared 0.825003 Adjusted R-squared 0.824278

F(5, 302) 211309.3 P-value(F) 0.000000

Log-likelihood −2037.873 Akaike criterion 4087.745

Schwarz criterion 4118.345 Hannan-Quinn 4099.266

rho −0.052631 Durbin-Watson 1.302309

Test for normality of residual -

Null hypothesis: error is normally distributed

Test statistic: Chi-square(2) = 402.231

with p-value = 4.53498e-88

RESET test for specification -

Null hypothesis: specification is adequate

Test statistic: F(2, 1204) = 3.94744

with p-value = P(F(2, 1204) > 3.94744) = 0.0195543

Appendix 3. Augmented model

Model 6: Pooled OLS, using 1212 observations

Included 303 cross-sectional units

Time-series length = 4

Dependent variable: GDPgr

Robust (HAC) standard errors

	coefficient	std. error	t-ratio	p-value	
const	70.1986	0.588964	119.2	5.54e-256	***
Vacc	0.204521	0.00208848	97.93	7.27e-231	***
Mort	0.0179184	0.000179560	99.79	2.92e-233	***
Test	−0.0162016	9.01815e-05	−179.7	4.93e-309	***
Educ	−1.58249	0.0133609	−118.4	3.56e-255	***
Private	−2.61204	0.0379915	−68.75	1.71e-186	***
vacc3	−7.53945e-06	1.34668e-07	−55.99	1.63e-161	***
Marg_ch	−0.000220427	7.83541e-05	−2.813	0.0052	***

Mean dependent var 2.870462 S.D. dependent var 3.109247

Sum squared resid 587.6549 S.E. of regression 0.698631

R-squared 0.949804 Adjusted R-squared 0.949512

F(7, 302) 2.58e+08 P-value(F) 0.000000

Log-likelihood −1281.078 Akaike criterion 2578.156

Schwarz criterion 2618.956 Hannan-Quinn 2593.517

rho −0.411426 Durbin-Watson 2.063288

Test for normality of residual -

Null hypothesis: error is normally distributed

Test statistic: Chi-square(2) = 51.6985

with p-value = 5.9404e-12

RESET test for specification -

Null hypothesis: specification is adequate

Test statistic: $F(2, 1203) = 4.04625$

with p-value = $P(F(2, 1203) > 4.04625) = 0.0177263$

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