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End of capitalism: Debt and trust economy

Bachelor's thesis

Author: Kristián Buryš

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Supervisor: Petr Polák, Ph.D.

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain any other academic title.

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Prague, May 3, 2023

Kristián Buryš

Abstract

This paper examines the relationship between debt and trust in the financial system and their potential impact on the capitalist system using a panel dataset of 400 Czech firms from 2018 to 2021. Specifically, the relationship between inflation, capital structure, firm age, and the debt-to-equity (D/E) ratio of firms in different sectors and size categories was investigated. To this end, we employed a fixed effect regression on each sector and size category in our data. Capital structure was found to have a positive relationship with D/E ratio in certain firm sizes and sectors and older firms were found to have lower D/E ratios than younger firms in some cases. Additionally, we used the logistic regression model to investigate the relationship between the occurrence of economic crises and three predictor variables, including the debt-to-GDP ratio, interest rate, and GDP. Our results from the logit model suggested that an increase in the Debt-to-GDP ratio and Interest Rates may increase the risk of an economic crisis or recession.

JEL Classification	B21, C33, D25, E44, E51, G01, G21, G32, P1
Keywords	debt-to-equity ratio, capital structure, debt financing, Czech firms, capitalism
Title	End of capitalism: Debt and trust economy

Abstrakt

Tento článek zkoumá vztah mezi dluhem a důvěrou v finančním systému a jejich potenciální vliv na kapitalistický systém pomocí panelového datasetu 400 českých firem v období 2018 až 2021. Konkrétně jsme zkoumali vztah mezi inflací, strukturou kapitálu, věkem firmy a poměrem dluhu k vlastnímu kapitálu (D/E poměr) firem v různých odvětvích a velikostních kategoriích. K tomuto účelu jsme použili regresi s fixními efekty pro každé odvětví a velikostní kategorii v našem datasetu. Bylo zjištěno, že kapitálová struktura má pozitivní vztah k D/E poměru v určitých velikostech a odvětvích firem a starší firmy mají v některých případech nižší D/E poměr než mladší firmy. Dále jsme použili logistický regresní model ke zjištění vztahu mezi výskytem hospodářských krizí a třemi prediktivními proměnnými, včetně poměru dluhu k HDP, úrokové sazby a HDP. Naše výsledky z logit modelu naznačily, že zvýšení poměru dluhu k HDP a úrokové sazby může zvýšit riziko hospodářské krize nebo recese.

Klasifikace JEL	B21, C33, D25, E44, E51, G01, G21, G32, P1
Klíčová slova	poměr dluhu k vlastnímu kapitálu, struktura kapitálu, financování dluhu, České firmy, kapitalismus
Název práce	Konec kapitalismu: Dluh a důvěra v ekonomice

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Acronyms

D/E ratio Debt-to-equity ratio

CFO Chief Financial Officer

FE Fixed effects

RE Random effects

OLS Ordinary least squares

Logit Logistic regression model

GAM Generalized additive model

ADF Augmented Dickey-Fuller test

GDP Gross Domestic Product

COVID-19 Coronavirus Disease 2019

BPLM Breusch-Pagan Lagrange multiplier

KPSS Kwiatkowski-Phillips-Schmidt-Shin

ADF Augmented Dickey-Fuller

Bachelor's Thesis Proposal

Author	Kristián Buryš
Supervisor	Petr Polák, Ph.D.
Proposed topic	End of capitalism: Debt and trust economy

Research question and motivation My main research question is how the financing of Czech firms shifted towards debt policy in past years and how the companies were affected by this change.

Many economists say that we live in capitalism. What does that mean and is it true nowadays? In capitalism, capital should be the key building Block in the economy, but when we look around, companies emerge differently. There are big companies that have never created a profit and they still operate. What is the key ingredient today is debt. The thesis will explore such a hypothesis and will use available data to evaluate it empirically. Borrowing money seems like a necessity in our modern world. Governments, people, and firms all lend and borrow money from each other. Understanding the debt balance of Czech firms is important not only for those who are looking into how to start a successful business in the Czech Republic but may also be critical during times when a large portion of the firms will face serious financial problems. One of these problems may be the aftermath of the Covid-19 pandemic, which was the inspiration for this thesis. Theoretical explorations about the debt and capital ratio started around 70 years ago. While the previous literature about this topic, Strýčková, L. (2019), continued in the survey tradition of this topic, I will not use a survey. I will theoretically describe the topic and later move toward practical analysis. The analysis will contain a series of descriptive statistical methods focused on the variables that change in time. This type of analysis will build on previous studies about Czech companies and their debt policies.

Methodology I will use the Magnusweb site, which is a web software compiling data about Czech firms. I will use statistical and econometric methods to analyse the data, which will be used to assess differences between the variables in time.

Contribution This thesis aims to provide a new perspective on the debt financing practices of firms in the Czech market, leveraging the existing data. Currently, the existing literature on this issue in the Czech Republic is scarce, making this study a significant contribution. By analyzing the changes in the financing choices of firms, this study can provide insights into the stability of the market and the degree to which it is dependent on an optimistic economic outlook.

Outline

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Chapter 1

Introduction

Corporate debt has been a staple in financing business activities and promoting growth and profitability. However, the optimal level of debt remains a debated topic among economists. Excessive debt can lead to financial instability and economic crises.

Debt and trust are essential factors in the capitalist system, enabling businesses to grow and individuals to invest in their future. However, accumulating debt has raised concerns about the stability and sustainability of the system, with the erosion of trust in financial institutions.

As more experts question the integrity of capitalism, we analyzed the debt-to-equity ratio's relationship with inflation, capital structure, and firm age among Czech firms from 2018 to 2021. Our focus is on specific firm size categories and sectors in the Czech Republic. We aim to explore the sustainability of capitalism and its potential for future economic paradigms.

Through our exploration of the D/E ratio, we aim to provide insights into the impact of debt on corporate behavior and the economy. Our ultimate goal is to contribute to the ongoing discourse on the optimal level of corporate debt and its implications for the capitalist system.

The thesis is structured as follows. The second section expands on existing relevant literature, mainly on debt and trust economy. The third section covers the theoretical framework of the thesis, including the research objectives and hypothesis, as well as the key theoretical concepts for the analysis. The fourth section describes the data used and gives more context to our analysis. The fifth section presents the specifications and limitations of the models we use and panel data tests. The sixth section focuses on the presentation, interpretation, and discussion of our results. The final section concludes.

Chapter 2

Literature review

In this chapter, we review the papers related to the topic of this thesis. Firstly, we will discuss the structural challenges to contemporary capitalism and related papers. Secondly, we will cover the existing literature on debt financing. Thirdly, we will go through relevant papers on capital structure and factors that influence the debt-to-equity ratio. Lastly, we will clarify the importance of the proposed topic and how it contributes to the existing research.

2.1 Structural Challenges to Contemporary Capitalism

As concerns about the accumulation of debt, declining trust in institutions, and widening income inequality continue to grow, the notion of a crisis in capitalism has become increasingly prevalent. Some experts argue that these issues are indicative of broader structural challenges within capitalist societies, threatening the stability and sustainability of the current economic system.

Streeck (2014) explores the idea that contemporary capitalism may be facing a fundamental crisis, reaching a point of institutional exhaustion, where it is no longer capable of adapting to changing economic and social conditions. The paper highlights structural challenges, including economic stagnation, political gridlock, and ecological decay, which threaten the continued existence of capitalism.

The paper by Chowdhury & Żuk (2018) examines the recurring crises affecting capitalism since the 1970s, leading to a chaotic and unpredictable global economic system. The authors argue that high levels of debt and declining trust have created a volatile and unsustainable environment. They suggest a need

for a new approach to economic governance prioritizing stability, sustainability, and equity, through a social, democratic model of capitalism.

Plys (2014) examines the connection between financialization and the economic crisis in the United States. According to the paper, financialization significantly contributed to the present capitalist crisis and caused a number of structural changes in the US economy. The author concludes that the US's current economic structure cannot be sustained and needs to be significantly changed in order to solve concerns of inequality and instability and avert further crises.

2.2 Debt financing

Debt financing is a crucial aspect of any company's capital structure. It involves borrowing funds from external sources to support vital operations or investments. Companies can borrow using bank loans, bonds, or commercial paper. These debt financing choices each have specific characteristics such as interest rates, repayment plans, and collateral requirements. The financial stability and risk profile of a company is significantly influenced by these factors. Therefore, it's crucial to fully understand the benefits and drawbacks of each option. Long-term success depends on making smart borrowing decisions and managing debt well. Firms can make sensible decisions by being aware of aspects like market conditions and tax implications.

Campello (2006) studies the positive impact of debt financing on business performance in product markets. The paper shows, that the more productive and profitable businesses are those with higher levels of debt. Furthermore, in highly competitive markets, the positive impact of debt financing is easier to see. Based on the author's results, debt financing can definitely improve company performance, but there are many other factors involved that have to be taken into account.

Yazdanfar & Öhman (2015) conducted a study on the relationship between debt financing and firm performance in Swedish firms. The study aimed to determine the influence of different types of debt financing on firm performance. The author's evidence suggests that long-term debt is beneficial for firms as it promotes financial stability and enables investments into long-term projects. However, short-term debt has a negative impact on firms by increasing financial constraints, leading to reduced performance. These findings highlight

the importance of careful consideration when choosing between long-term and short-term debt financing for firms looking to optimize their performance.

Ghosh & Moon (2010) wrote a paper that examines the impact of corporate debt financing on earnings quality. The study provides empirical evidence that debt financing has a negative impact on earnings quality. The authors find that firms with high levels of debt financing have lower earnings quality than firms with low levels of debt financing. The study also shows that the negative impact of debt financing on earnings quality is stronger for firms with weaker corporate governance and monitoring mechanisms. The authors suggest that the negative impact of debt financing on earnings quality can lead to potential problems for investors, creditors, and other stakeholders.

Ghosh & Moon (2010) investigates the effect of corporate debt financing on earnings quality. The study reveals that firms with higher debt financing have lower earnings quality, indicating its negative impact. Furthermore, the study suggests that this negative impact is stronger in firms with weaker corporate governance and monitoring mechanism. Therefore, the problems resulting from this effect can be problematic for investors, creditors, and other stakeholders.

Reinhart & Rogoff (2011) examined the connection between high levels of public debt and social and political unrest in their research. The results of the paper show a strong correlation between high public debt levels and social discontent, as well as an increase in economic inequality. The paper suggests that public debt could threaten the capitalist system's stability.

The paper by Strýčková (2019) studies the relationship between changes in financing strategies and the financial performance of Czech companies. The results show, that the move toward debt financing has had a substantial impact on the financial performance of Czech enterprises.

2.3 Capital structure

The paper by Graham & Harvey (2001) is considered to be one of the most influential publications on capital structure. It covers a wide range of topics in corporate finance, including debt and equity financing, investment decision-making, and risk management. The authors offer valuable insights into the challenges faced by firms and how market conditions and company performance factor into corporate finance practices.

Graham & Harvey (2001) surveyed 392 CFOs about capital structure, the cost of capital, and capital budgeting. Many authors used their survey in essentially the same form in the following years.

The paper by Bancel & Mittoo (2004) focuses on the determinants of capital structure choice among European firms. The authors used the survey by Graham & Harvey (2001) mentioned above to investigate the factors that influence the choice of capital structure. The results of the paper show that firm-specific characteristics, such as firm size, profitability, and growth opportunities, as well as country-specific factors, such as tax laws and the level of financial development, play a significant role in the capital structure of European firms.

Brounen *et al.* (2006) examined the practice of capital structure and compared it to the results obtained by Graham & Harvey (2001) and Bancel & Mittoo (2004). According to their conclusion, the static trade-off theory faced moderate confirmation. The authors further suggest that financial flexibility is the most significant factor. However, it was not driven by the pecking-order theory.

Balbinotti *et al.* (2007) documented several contrasts in financial policies between countries in developed and emerging markets by comparing 160 respondent Brazilian firms with the sample gathered by Graham & Harvey (2001). They explain the contrasts through differences in the economic environment, such as the role of the legal, institutional, and macroeconomic frameworks.

The paper by Archbold & Lazaridis (2010) summarises the results of a survey on corporate capital structure conducted between 2007 and 2008 in the UK and Greece. The authors found out that both the trade-off model and the pecking-order hypothesis are used by firms to guide their decisions over capital structure issues.

Shah & Khan (2007) use panel data from Pakistani firms to analyze the determinants of capital structure. They find that variables such as inflation and profitability have a significant impact on capital structure, while variables such as firm age and sector have a less pronounced effect. This paper provides evidence important to our analysis since it supports the idea that certain variables may have a more significant impact on capital structure than others.

2.3.1 Influencing factors

The debt-to-equity ratio of a company's capital structure model is influenced by various factors, including growth, company size, age of the firm, tangibility

of assets, and liquidity.

According to Higgins (1977), Norton (1991), Heshmati (2001), Huang & Song (2006), and many others, high-growth companies may require more financing to support their expansion plans, which could lead to a higher debt-to-equity ratio. On the other hand, low-growth companies may have less need for external financing and may therefore have a lower debt-to-equity ratio.

The same holds for company size as well, since larger companies may have easier access to financing, which could lead to a higher debt-to-equity ratio, while smaller companies may have less access to financing and may therefore have a lower debt-to-equity ratio.

Younger firms may have less financial history and a shorter track record of profitability, making it harder for them to access financing (Bougheas *et al.* (2006)). This could result in a lower debt-to-equity ratio. Conversely, older firms with a longer history of financial stability may have an easier time accessing financing and could have a higher debt-to-equity ratio (Petersen & Rajan (1994)).

Companies with more tangible assets (e.g. property, equipment, inventory) may be able to use these assets as collateral to secure financing, which could lead to a higher debt-to-equity ratio. Conversely, companies with fewer tangible assets may have a harder time accessing financing and could have a lower debt-to-equity ratio.

Companies with higher liquidity may have less need for external financing and could therefore have a lower debt-to-equity ratio. Conversely, companies with lower liquidity may have a greater need for external financing and could have a higher debt-to-equity ratio.

2.4 Contribution

While the literature on the topic of debt financing is not scarce, especially in the context of the global economy, there aren't many studies that focus exclusively on the debt economy in the Czech Republic. This thesis seeks to contribute to the existing knowledge by analyzing debt financing patterns and trends among Czech firms, specifically in the period leading up to and during the COVID-19 pandemic. Through this analysis, the paper aims to identify the factors that shape debt financing, including the impact of economic conditions and industry-specific factors, while providing a better understanding of the complex relationship between debt financing and various economic factors.

Chapter 3

Theoretical Framework

The scope of this chapter provides a comprehensive overview of the theoretical concepts and ideas behind the research analysis of the paper.

3.1 Research Objectives and Hypothesis

Our analysis shows that as debt accumulates and trust in the financial system declines, capitalism could face a crisis. Trust and debt play an important role in the capitalist system, as it is literally built on trust, and debt accumulation enables individuals and businesses to access the capital needed to invest and grow. Although, as trust in the financial system decreases, individuals and businesses might be more hesitant to invest, which would lead to a decrease in economic growth. For instance, during the European debt crisis, Czech banks faced difficulties in obtaining funding from international markets, which led to a credit crunch. As a result, many firms had to cut back on production and lay off workers, leading to a rise in unemployment and a slowdown in economic growth (European-Commission (2009)).

Additionally, we expect to find that the accumulation of debt and declining trust in the financial system may contribute to social and political unrest, as well as worsen existing inequalities (Chowdhury & Żuk (2018)). This could ultimately lead to a crisis of confidence in the capitalist system and possibly even its end (Reinhart & Rogoff (2011)).

In our analysis of four hundred Czech firms from 2018 to 2021, we explore the relationship between debt and trust in the financial system and its potential impact on the capitalist system. More specifically, we investigate how inflation, capital structure, firm age, firm sector, and firm size impact the debt-to-equity

ratio (D/E) of Czech firms and how this ratio may be influenced by trust and debt accumulation.

Furthermore, we expect to find that certain variables, such as inflation and capital structure, may have a significant impact on the D/E ratio, while other variables, such as firm age and sector, may have a less pronounced effect (Shah & Khan (2007)).

Our thesis focuses on how debt and trust affect the capitalist system and aims to uncover the relationship between these factors and the D/E ratio of Czech firms.

3.2 Debt-to-equity ratio

The debt-to-equity ratio (further listed as D/E ratio) reveals how much of a company's financing comes from debt versus equity and can indicate a company's reliance on borrowing to finance its operations. In this section, we'll explain why analyzing the D/E ratio is important, why we choose it, and how it's commonly used in existing literature.

Analyzing the D/E ratio is crucial in the context of a capitalism crisis. By studying how companies finance their operations and whether they rely more heavily on debt or equity, we can gain valuable insights into their financial positioning. This is essential, since in a debt and trust economy, the use of debt financing is scrutinized more heavily, and trust with stakeholders is crucial. Therefore, conducting a D/E ratio analysis of different companies can give us more insight into their financial position.

In existing literature, the D/E ratio is a widely used measure to assess a company's financial risk and overall financial health. A higher D/E ratio indicates that a company has more debt relative to its equity, signifying an increased level of financial risk. On the other hand, a lower D/E ratio suggests that a company has more equity relative to its debt, indicating a stronger financial position. The D/E ratio is commonly used to compare companies within the same industry or sector to identify potential outliers or companies with a more aggressive debt-financing strategy. This enables the identification of companies that are more likely to experience financial difficulties during economic downturns or periods of rising interest rates. Furthermore, the D/E ratio is frequently used in financial analysis to evaluate a company's ability to meet its financial obligations, such as interest payments on debt. A high D/E ratio can imply that a company is having difficulty meeting its debt obligations,

while a lower D/E ratio can indicate that a company is in a stronger financial position and more capable of meeting its financial obligations.

An additional important reason for examining the D/E ratio is its function as an indicator of a company's solvency. If a company has a high D/E ratio, it may experience difficulties meeting its debt obligations, which could potentially lead to bankruptcy.

The importance of the D/E ratio can vary depending on the size, age, and sector of the company. Generally, larger companies can handle more debt than smaller companies due to their larger cash flows and access to capital markets. Younger companies may have higher D/E ratios as they seek to finance their growth, while more mature companies may have lower ratios as they focus on paying down debt and returning value to shareholders.

Furthermore, debt financing typically comes with a lower cost of capital than equity financing, but it also has the risk of default. Therefore, the D/E ratio can impact the cost of capital for a company. A higher D/E ratio typically indicates a higher cost of capital, as investors demand a higher return to compensate for the increased risk of default.

Different sectors may also have different optimal D/E ratios due to differences in cash flow, asset base, and risk. For example, capital-intensive industries such as manufacturing may have higher D/E ratios than service-based industries such as consulting.

We will further analyze the D/E ratio using panel data analysis to determine how the D/E ratio changes over time across different firm sizes and sectors. This will help us identify the factors that influence a company's use of debt financing.

3.2.1 Implications of a decrease in D/E ratios for Capitalism

If D/E ratios of firms were to steadily decrease over the next years, it could have significant implications for capitalism as a system.

Firstly, a decrease in D/E ratios could mean that firms are becoming more risk-averse and conservative in their financial strategies. This could lead to a decrease in investments, which could in turn impact economic growth.

Secondly, a decrease in D/E ratios could also indicate a shift towards a more equity-based financing system. This could mean that firms are relying more on equity investments rather than debt financing. However, it could also

mean that larger firms with access to equity markets may have a competitive advantage over smaller firms that rely more on debt financing.

Finally, a decrease in D/E ratios could also impact the role of banks and financial institutions in capitalism. If firms rely less on debt financing, banks may lose their traditional role as intermediaries between savers and borrowers, which could lead to a fundamental shift in the financial industry.

3.2.2 Impact of the COVID-19 pandemic

The COVID-19 pandemic had a significant impact on D/E ratios of firms. Many firms experienced a decline in revenue and cash flow during the pandemic, leading to a greater need for debt financing to cover expenses and maintain operations. As a result, many firms increased their borrowing during the pandemic (Francis *et al.* (2020)). Moreover, the pandemic led to changes in the D/E ratios of many firms. For some, the increase in debt financing led to a higher D/E ratio, while for others, the decrease in equity value due to the pandemic led to a higher ratio.

It is believed, that firms in industries hit hard by the pandemic, have struggled to keep up with debt payments, leading to higher default rates. This has led to increased risk for lenders and investors.

Governments around the world have implemented various programs to support businesses during the pandemic, including loan guarantees, grants, and other forms of financial assistance. These programs have helped many firms access financing and avoid default, but they have also increased government debt levels.

3.2.3 Impact of firm characteristics on D/E Ratio

In this subsection, we will analyze the impact of various firm characteristics on the D/E ratio of firms. The variables considered in our analysis are inflation, capital structure, firm age, firm sector, and firm size.

Inflation is an important factor that can affect a firm's D/E ratio. We expect to find a positive relationship between inflation and the D/E ratio, as inflation can increase the cost of debt and reduce the value of cash reserves, making firms rely more on equity financing. We will use inflation rates obtained from the Czech Statistical Office to investigate this relationship.

Another important determinant of a firm's D/E ratio is its capital structure. We expect to find a negative relationship between the D/E ratio and a

firm's capital structure, as firms with higher levels of debt may have lower D/E ratios. We will use capital structure values obtained from the firms' financial statements found on the MagnusWeb website.

Firm age is another factor that can affect a firm's D/E ratio. We expect to find a negative relationship between firm age and the D/E ratio, as older firms may have established credit histories and access to cheaper debt financing, leading to lower reliance on equity financing. We will measure firm age as the number of years since the firm's founding.

Different sectors may have varying levels of financial risk and capital requirements, which can affect a firm's D/E ratio. In the analysis of our panel data, we will include a set of dummy variables for firm sectors to investigate their relationship with the D/E ratio.

Firm size may also have an impact on a firm's D/E ratio. Larger firms may have more access to debt financing and lower financial risk, which can lead to lower D/E ratios. We will use financial turnover ranges found on the MagnusWeb website as a proxy for firm size.

3.3 Economic Crises and Their Implications for Capitalism

Economic crises can have a significant impact on a country's economy, leading to a recession and a decline in GDP growth. The Czech Republic has experienced several economic crises over the years.

The Asian financial crisis and the Russian debt crisis of 1997-1998 had a significant impact on the Czech Republic's economy, by resulting in a sharp decline in exports, depreciation of the Czech crown, and a decrease in foreign investment. The 2008-2009 global financial crisis also severely impacted the Czech Republic's economy, as it was heavily dependent on exports. The decline in global demand led to a significant drop in exports and therefore a decline in GDP growth. In the 2012-2013 period, the Czech Republic went through a recession, with negative GDP growth values in both years. Finally, the recent 2020-2021 period saw the COVID-19 pandemic, which had a significant impact on the Czech Republic's economy, once again leading to a recession and a decline in GDP growth.

Each of these past economic crises has highlighted the vulnerabilities of capitalism and the global financial system. The way economies are interconnected

means that a crisis in one single country may signal danger to the whole world. Moreover, the crises have exposed the flaws in the dominant economic model of capitalism, which prioritizes short-term profit maximization over long-term sustainability.

Chapter 4

Data

This chapter delves into the data used in our research, discussing how it was acquired and prepared for analysis. Additionally, it provides a detailed specification of the models and variables used in the study.

4.1 Data description - FE regression

Following our initial analysis, we will further observe these trends in a panel data regression analysis. We chose D/E ratio as our response variable. For our explanatory variables, we use the following. Firm size, to account for the fact that larger firms may have different debt-to-equity ratios than smaller firms. Industry, to account for differences in debt-to-equity ratios across different sectors of the economy. Inflation, to control for macroeconomic conditions that may impact the debt-to-equity ratio, and lastly capital structure. We obtained data for D/E ratio and capital structure from the MagnusWeb website and for inflation rates from the National Bureau of Statistics. We measured firm age as the number of years since the firm's founding and we used financial turnover ranges found on the MagnusWeb website as a proxy for firm size. Additional variables used in the analysis, like time dummies, will be discussed in the specification of the fixed effects (FE) model further in this section. We chose a FE model with individual fixed effects rather than the random effects (RE) model for a number of reasons. In a FE model, we can control for all time-invariant variables that may affect the outcome variable, whereas in an RE model, these variables are assumed to be uncorrelated with the individual effects. Furthermore, the FE model is a suitable choice for our panel data since we want to estimate the causal effect of independent variables on the dependent

variable while controlling for time-invariant unobserved heterogeneity across firms. This means that the estimated coefficients reflect the average effect of the independent variables on the dependent variable across the population of firms. In addition, the nature of our data, with a relatively small number of time periods and a large number of individuals, suggests that the FE model is more appropriate than the RE model.

4.1.1 MagnusWeb

MagnusWeb is a website that provides financial information on Czech and Slovak companies. It is a product of Dun & Bradstreet, a leading global business data and insights provider. MagnusWeb offers a wide range of financial data including balance sheets, income statements, cash flow statements, and ratios for over 800,000 Czech and Slovak companies. The website provides access to financial information that can be used for credit assessments, market research, and other business purposes.

4.2 Data description - Logistic Regression and crisis selection

We downloaded data for Debt-to-GDP ratio, Interest Rates, and GDP (Figure 4.1) from the Czech National Bank and the Czech Statistical Office. We further investigated the relationship between the three predictor variables and the occurrence of economic crises by using a logistic regression model (logit). The model was estimated using a dataset from 1995 to 2022, with crisis years defined as 1997, 1998, 2008, 2009, 2012, 2013, 2020, and 2021 (Figure 4.2). We chose these specific years because they are associated with significant economic crises in the Czech Republic, as was discussed earlier in chapter Methodology.

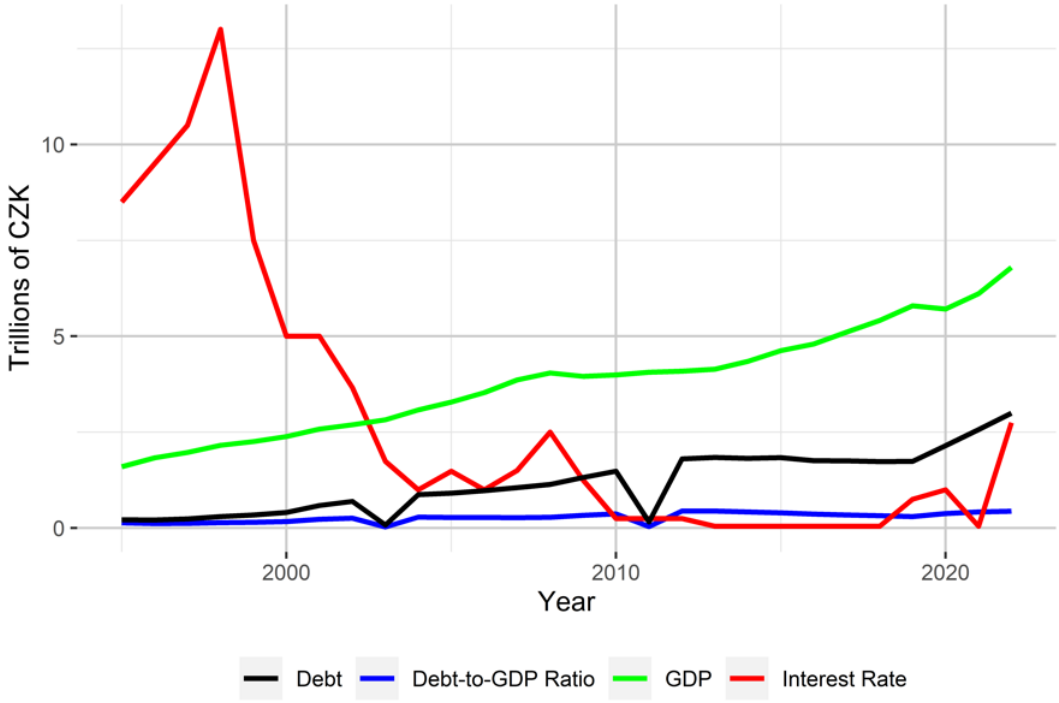

Figure 4.1: Trends in Economic Indicators in the Czech Republic 1995 - 2022

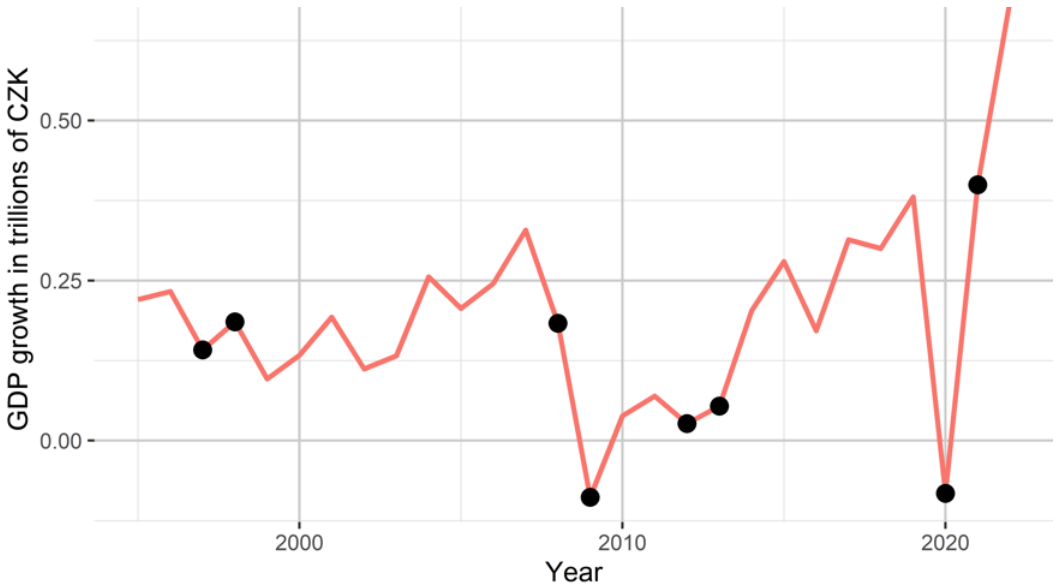

Figure 4.2: GDP growth and crises in the Czech Republic 1995 - 2022

4.3 Relationship between D/E ratio and Capital Structure

As we can see in Figure 4.3, there may be a non-linear relationship between the two variables, which can make it more challenging to accurately analyze the relationship between the variables. To address this issue, we will use the Generalized Additive Model (GAM) since it allows for non-linearities in the relationship. By using a GAM model, we can explore whether there is evidence of non-linearity in the relationship between D/E ratio and capital structure [1].

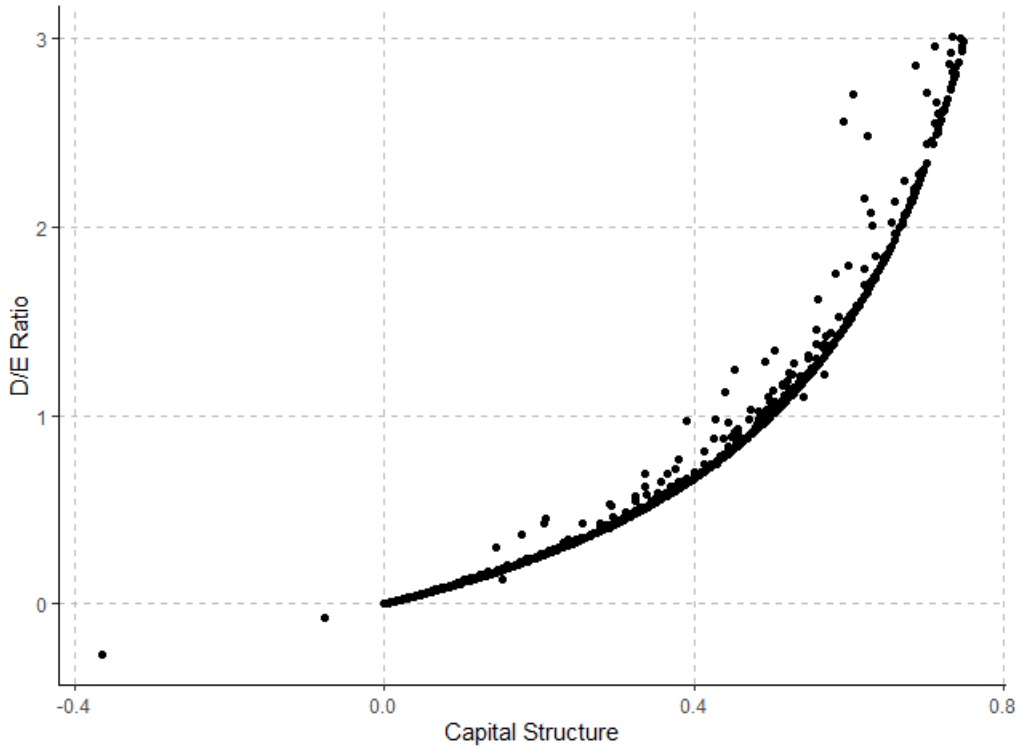

Figure 4.3: Relationship between D/E ratio and Capital Structure

4.4 Market segmentation by financial turnover

To better understand the characteristics of the firms in our dataset, we segment them into four categories based on their financial turnover. Financial turnover is a commonly used proxy for firm size, as it is closely related to the scale of the company's operations. We have chosen four ranges of financial turnover to represent our data, as can be seen in table 4.1.

[1] "capital structure" represents the proportion of debt and equity a company uses to finance its operations and growth

Size	Financial Turnover
Size 1	1-200 thousand CZK
Size 2	3 mil - 5 mil CZK
Size 3	60 mil - 99 mil CZK
Size 4	1 bln - 1.5 bln CZK

Table 4.1: Financial Turnover Ranges by Size

We chose these particular ranges to capture a diverse range of firms within the population. The first range of 1 - 200k CZK represents smaller companies, while the second range of 3mil - 5mil CZK represents small to medium-sized enterprises. The third range of 60mil - 99mil CZK captures medium to large-sized enterprises, and the fourth range of 1bln - 1.5bln CZK represents some of the largest companies in the population. There are 100 firms per size category in our panel data set.

Market segmentation by financial turnover allows us to compare and contrast the characteristics and financial performance of firms within each segment. It also allows us to investigate whether certain segments exhibit different patterns or trends in their debt-to-equity ratio over time. We will use this segmentation in our analysis to investigate the impact of different factors on the debt-to-equity ratio for firms of different sizes.

4.5 Market segmentation by industry sector

In addition to segmenting the firms by financial turnover, we also divided the sample by sector to gain a deeper understanding of the relationship between the independent variables and the D/E ratio. The selected sectors were agricultural, construction, energy, financial, healthcare, manufacturing, public, service, and technology.

Segmenting the market by firm sector is important for several reasons. Firstly, it allows us to compare the financial characteristics of firms in the same industry and identify potential differences that may impact the D/E ratio.

Secondly, sector segmentation can also help us identify trends and patterns in the data that may not be apparent when analyzing the data as a whole. For example, if we find that firms in the financial sector have consistently high D/E ratios, this may indicate that the sector is more prone to leverage compared to other sectors.

Chapter 5

Methodology

This chapter covers the specifications and limitations of the models used in the analysis, as well as the panel data tests used.

5.1 Specification of the FE model

Since our panel dataset is segmented based on nine sectors and four firm size categories, we will be utilizing one fixed effect model on each of these segments.

$$\begin{aligned}(D/E\,ratio_{it}) &= \beta_1 Inflation_{it} + \beta_2(Capital\,structure)_{it} \\ &\quad +\beta_3(Firm\,Age)_{it-1} + \beta_4(Firm\,Sector)_{it-1} \\ &\quad +\beta_5(Firm\,Size)_{it-1} + \alpha_i + u_{it} \qquad (1)\end{aligned}$$

Where $D/E\,ratio_{it}$ refers to D/E ratio of firm i in year t, (α_i) is the individual fixed effect, which is included to control for unobserved time-invariant characteristics of each firm that may affect the dependent variable, and (u_{it}) represents the error term. The coefficients $(\beta_1 - \beta_5)$ represent the impact of each independent variable on the D/E ratio, holding all other variables constant.

5.1.1 Limitations of the FE model

Although FE models are a popular method for analyzing panel data, we must take into account the possible limitations. One important limitation of the FE model is unobserved heterogeneity (unexplained variation) caused by time-varying characteristics. While FE models are commonly used to control

for unobserved heterogeneity in cross-sectional data, they are only effective for time-invariant characteristics. If a variable changes over time, it may be difficult to separate the effect of this variable from the individual fixed effect, leading to biased estimates. Additionally, FE models may not capture all of the time-varying factors that can affect the outcome variable, which can result in omitted variable bias.

Finally, the FE model assumes that the individual fixed effects are uncorrelated with the independent variables. However, this assumption may not hold in some cases. For example, if firm size is used as a fixed effect and the independent variable is capital structure, it is possible that larger firms have different capital structures compared to smaller firms. In this case, the fixed effect is correlated with the independent variable, violating the assumptions of the FE model.

5.2 Specification of the Logit model

$$\begin{aligned} logit(P(Crisis)) &= \alpha + s(Debt\,to\,GDP\,ratio) + s(Interest\,rate) \\ &\quad + s(GDP) + \epsilon \qquad (2) \end{aligned}$$

The logit function is used to transform the dependent variable, P(Crisis), which is a probability between 0 and 1, into a continuous variable that ranges from negative infinity to positive infinity. The s() function represents a smoothing function that is used to capture nonlinear relationships between the independent variables and the dependent variable. The coefficients α, s(Debt-to-GDP ratio), s(Interest rate), and s(GDP) represent the estimated effects of each independent variable on the log odds of a financial crisis. The error term ϵ represents the random variation in the dependent variable that is not accounted for by the independent variables in the model.

5.2.1 Limitations of the Logit model

It is important that we acknowledge the limitations of the logit model before interpreting its results. One of the main assumptions of the logit model is that there is a linear relationship between the independent variables and the log-odds of the dependent variable. We used the GAM model to address the issue of a possible non-linear relationship, as was discussed in the previous chapter.

The second important assumption of the logit model is that the observations in the model are independent of each other. If this assumption is violated, the estimates of the coefficients can become biased.

The third limitation is the assumption of no interaction between the independent variables, which states that the effect of an independent variable on the dependent variable is not affected by the level of another independent variable.

5.3 Stationarity

Since we are doing a time-series analysis we need to ensure we have stationary data. A time series is stationary if it has no trend, shows constant variance over time, and has constant auto-correlation over time. Ensuring that the data used in time-series analysis is stationary is crucial. Stationarity, which refers to the stability of statistical properties such as mean, variance, and correlation over time, is a fundamental assumption in many models. By detecting the presence of non-stationarity through stationarity tests, such as the Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, appropriate transformations or models can be selected to achieve stationarity.

5.3.1 Kwiatkowski-Phillips-Schmidt-Shin tests

We'll use the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to determine if our time series is stationary. The null hypothesis of the KPSS test is that the time series is stationary.

5.3.2 Augmented Dickey-Fuller test

The Augmented Dickey-Fuller test (ADF) is another test of stationarity. The null hypothesis assumes a unit root is present in the time series. Rejecting this hypothesis indicates that the time series is stationary.

5.4 Panel data tests

5.4.1 Hausman Specification Test

The Hausman test helps to determine whether to use the FE or RE model by testing for endogeneity. The null hypothesis of the test is that there is no covariance between independent variables and α. If this is the case, the preferred model is RE. If the alternate hypothesis is true, then the preferred model would be FE.

5.4.2 Breusch-Pagan Lagrange multiplier test

The null hypothesis of the Breusch-Pagan Lagrange multiplier test (BPLM) states that the unobserved fixed effects variance is zero. If this is the case, the ordinary least squares (OLS) model is the preferred choice. However, if we reject the null hypothesis, the RE model is preferred.

Chapter 6

Empirical Results

6.1 Logistic Regression Analysis of Economic Crises

The results of the logistic regression model shown in table 6.1 indicate that both the Debt-to-GDP ratio and Interest Rates are significant predictors of economic crises, as evidenced by their respective z-values of 1.984 ($p < 0.05$) and 2.044 ($p < 0.05$). However, GDP does not appear to be a significant predictor of economic crises, as evidenced by its non-significant z-value of -0.224 ($p > 0.05$). The negative estimate of -9.1529 for the intercept term suggests that the log odds of a crisis occurring are significantly decreased when all other variables are held constant. Our findings suggest that an increase in the Debt-to-GDP ratio and Interest Rates may increase the risk of an economic crisis or recession, which can potentially lead to a capitalism crisis.

Table 6.1: Logistic Regression

	Coefficient	S.E.	z-value
(Intercept)	-9.1529	4.0327	-2.270**
Debt-to-GDP ratio	23.4048	11.7942	1.984**
Interest rate	0.6060	0.2965	2.044**
GDP	-0.1451	0.6484	-0.224

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

6.2 Linearity

As we can see in table A.1, our GAM model revealed that there is no evidence of non-linearity in the relationship between D/E ratio and capital structure. The p-value for the smooth term, s(DEratio), was 0.593, indicating that the relationship between these variables is linear and that there is no need to consider non-linearities in our subsequent analyses. By showing that there is no evidence of non-linearity, we can proceed with our FE regression analysis with greater confidence that the relationship between D/E ratio and capital structure is well-captured by our linear model.

6.3 Stationarity

We conducted the ADF and KPSS tests mentioned in the chapter Data to test stationarity of the variables D/E ratio, Inflation, Capital Structure, and Firm Age. As can be seen in table A.2, the ADF test resulted in the rejection of the null hypothesis in all cases, indicating stationarity. However, according to the KPSS test, Capital Structure and Firm Age are non-stationary, whereas D/E ratio and Inflation have p-values larger than 0.1, indicating that we cannot reject the null hypothesis of the test, which is that the series is weakly stationary.

In order to address the issue of possible non-stationarity of Capital Structure and Firm Age, we conduct residual-based ADF and KPSS tests on all thirteen fixed-effect regression models. This allows us to determine whether there is cointegration within our models. If we identify cointegration between two non-stationary variables, we can proceed with the regression analysis without generating spurious results. The results in table A.3 show that the residuals are stationary and we can therefore assume cointegration.

6.4 Descriptive statistics

In tables 6.1 and 6.2 we can see the descriptive statistics of D/E ratio by firm sizes and sectors. Based on the firm size categories, we can observe from the descriptive statistics in table 6.1 that the variance is relatively high compared to the mean for all firm sizes, which implies volatile series. For firms with financial turnover of 1 - 200 k CZK (Size 1), the D/E ratio has a negative skewness value, indicating that the returns tend to generate primarily small

negative returns. In contrast, the negative returns tend to be more extreme, as the distribution's left tail is longer. For firms with 1 bln - 1.5 bln CZK (Size 4), the skewness value is positive, indicating that the returns tend to generate primarily small positive returns. For firms with 3 mil - 5 mil CZK (Size 2) and 60 mil - 99 mil CZK (Size 3), the skewness values are negative, indicating that the returns tend to generate primarily small negative returns. For all firm size categories, the kurtosis values are relatively high, indicating more outliers in our series than we would find in a normal distribution.

Table 6.2: Descriptive statistics of D/E ratio by firm sizes

Sizes	N	Mean	Variance	Skewness	Kurtosis	Min	Max
Size 1	400	-1.607	92.3674	-5.8007	53.2386	-108.9074	38.0979
Size 2	400	6.2707	2268.669	6.2007	61.7410	-273.1429	558
Size 3	400	0.9398	174.3965	-7.2001	135.2864	-193.8354	96.6439
Size 4	400	2.2607	24.3162	4.8724	29.0114	-7.9679	43.0870

Where "Size 1" refers to the smallest size category and the other firm size categories follow in an ascending order.

Looking at table 6.2, it's important to note that the number of observations between sectors varies largely since we were collecting data based on firm sizes and not sectors. Thus, the sectors with a smaller number of observations may have more variability in their results and may be less representative of the larger population.

The public sector has a negative mean D/E ratio, indicating that the observed public firms have more equity than debt and the negative skewness implies that returns tend to generate primarily small negative returns. The Construction and Manufacturing sectors have the highest variance, implying volatile series. The Healthcare sector has the lowest variance, and the skewness and kurtosis values indicate a relatively symmetric distribution. The energy sector has a relatively low mean D/E ratio, but it has the highest negative skewness value, which indicates that this sector generates primarily large negative returns, making it riskier compared to other sectors. All sectors except public and energy have a positive skewness, indicating that the returns tend to generate primarily small positive returns. The high positive kurtosis values of the manufacturing, service, and energy sectors imply heavy tails and more outliers in these sectors' D/E ratios than we would find in a normal distribution.

Table 6.3: Descriptive statistics of D/E ratio by firm sectors

Sectors	N	Mean	Variance	Skewness	Kurtosis	Min	Max
agric.	92	1.0178	6.6481	3.0270	10.4601	-3.4457	13.7681
const.	116	4.9497	3950.097	1.8958	12.7784	-273.143	292.7959
energy	72	0.6121	35.5037	-6.773	51.5722	-46.5357	10.0448
financ.	64	3.2865	96.5210	2.7915	6.8173	-5.7969	43.0870
health.	76	0.6211	2.2916	0.8755	1.5405	-2.1989	5.5000
manuf.	564	3.1828	976.2725	12.187	200.984	-193.835	558
public	24	-0.616	3.5602	-0.159	-1.0560	-3.9716	2.9573
service	428	0.5722	29.6820	3.8468	41.8659	-22.9592	60.2500
tech.	160	0.9801	29.8909	1.5975	18.3702	-27.2727	38.0979

6.5 Correlation

As we can see in table 6.3, the correlation analysis indicates that there are weak associations between the independent variables (Inflation, Capital Structure, Firm Age) and the dependent variable (DEratio).

The results show that inflation may have a slight positive impact on the D/E ratio. Moreover, firms with higher D/E ratios are associated with lower capital structures. This result is consistent with the expectation that firms with higher debt-to-equity ratios may have difficulty accessing external capital and therefore rely more on internal financing (Kraus & Litzenberger (1973)). We can also see that older firms tend to have higher D/E ratios, which is consistent with the expectation that firms may accumulate more debt as they age and have greater access to external financing (Myers (1977)). Younger firms, on the other hand, tend to have higher capital structures, as is indicated by the weak negative correlation. This result is consistent with the expectation that younger firms may have greater access to external financing and therefore rely less on internal financing (Rajan & Zingales (1995)).

It is important to note that correlation does not necessarily imply causation and further analysis is required to establish any causal relationships between the variables.

6.6 Panel data tests

In this section, we will show and discuss the results of the Hausman test and the studentized Breusch-Pagan test of our regression models.

As can be seen in table A.4, the Hausman and BPLM tests conducted on

Table 6.4: Correlation

	D/E ratio	Inflation	Capital Structure	Firm Age
D/E ratio	1	0.0177	-0.0134	0.0374
Inflation	0.0177	1	0.0014	0.0611
Capital Structure	-0.0134	0.0014	1	-0.0693
Firm Age	0.0374	0.0611	-0.0693	1

variables Size 1 through Size 4 show that none of the variables have p-values less than five percent. This indicates that the null hypothesis of exogeneity and spatial correlation in the residuals cannot be rejected at the five percent significance level. Thus, these results suggest that the RE model is preferred for these variables.

The results of the Hausman and BPLM tests provided in table A.5 indicate that the null hypothesis of exogeneity is rejected for some variables and not rejected for others. The p-values for the agricultural, health, public, and service sectors are significant, indicating that the FE model is preferred for these variables. However, for the construction, energy, financial, manufacturing, and technology sectors, we cannot reject the null hypothesis of exogeneity, suggesting that the RE model is preferred.

In summary, while the agricultural, health, public, and service sectors, exhibit evidence of exogeneity and benefit from the FE model, the Size 1 through Size 4 variables, as well as the construction, energy, financial, manufacturing, and technology sectors are better suited for the RE model. It is important to note that for variables that do not exhibit evidence of exogeneity, we need to consider whether unobserved time-invariant characteristics may be correlated with the independent variables, potentially leading to omitted variable bias.

Given the significant individual fixed effects and the presence of heteroskedasticity in the RE model, the FE model is the better choice for our panel dataset, as it better captures the heterogeneity across firms and provides more reliable estimates.

6.7 FE regressions

Table 6.5: FE models based on firm size

	1 - 200 k CZK		3 mil - 5 mil CZK	
	Coefficient	S.E.	Coefficient	S.E.
Inflation	0.364	4.344	11.531	18.237
Capital Structure	0.004	0.072	-0.185	1.962
Firm Age	-0.178	2.402	-4.959	10.078

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

	60 mil-99 mil CZK		1 bln-1.5 bln CZK	
	Coefficient	S.E.	Coefficient	S.E.
Inflation	2.454	1.49	-1.241	1.579
Capital Structure	2.577**	1.162	7.328***	1.593
Firm Age	-1.385*	0.824	0.741	0.868

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

The results of the fixed effect models based on firm size show that the relationship between D/E ratio and inflation, capital structure, and firm age, varies heavily across different firm size categories. In the first and second models, for firms with size categories of 1 - 200 k CZK and 3 mil - 5 mil CZK, none of the independent variables were found statistically significant, which suggests that there is no significant relationship between these variables and D/E ratio in these firms. However, in the third model, for firms with size category 60 mil-99 mil CZK, capital structure is found to be statistically significant at the five percent level, indicating that there is a positive relationship between capital structure and D/E ratio. Firm age is also statistically significant at the ten percent level, suggesting that older firms may have lower D/E ratios compared to younger firms. Inflation remains statistically insignificant in this model. In the fourth model, for firms with size category 1 bln-1.5 bln CZK, capital structure is found to be statistically significant at the one percent level, indicating that there is a positive relationship between capital structure and D/E ratio. However, inflation and firm age are not statistically significant, suggesting that they do not have a significant effect on D/E ratio in firms of this category.

Table 6.6: FE models based on firm sector

	agric.		const.		energy	
	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Inflation	0.254	0.733	56.76	56.79	-18.152	11.29
Capital Structure	1.303***	0.311	8.285	41.923	-13.646*	8.369
Firm Age	-0.124	0.405	-27.748	31.39	10.222*	6.24

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

	financ.		health.		manuf.	
	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Inflation	-11.552	10.78	-0.249	1.362	-0.249	1.362
Capital Structure	-0.183	0.457	0.359**	0.164	0.359**	0.164
Firm Age	6.337	5.957	0.172	0.751	0.172	0.751

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

	public		service		tech.	
	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Inflation	0.291	0.503	0.459	3.104	0.341	6.573
Capital Structure	4.749***	0.452	0.0005	0.057	0.201	0.468
Firm Age	-0.112	0.278	-0.069	1.716	-0.19	3.633

Note: ***, ** and * mark level of significance at 1%, 5% and 10% .

In the agricultural sector, the capital structure has a statistically significant relationship with the D/E ratio, but inflation and firm age do not. In contrast, in the construction, financial, service, and technology sectors, none of the independent variables have a statistically significant relationship with the D/E ratio. In the energy sector, both the capital structure and firm age have a statistically significant relationship with the D/E ratio. Similarly, in the healthcare, manufacturing, and public sectors, the capital structure is found to have a statistically significant relationship with the D/E ratio, but inflation and firm age do not.

Chapter 7

Conclusion

This thesis analyzes the relationship between D/E ratio and Inflation, Capital Structure, and Firm Age in Czech firms for the period 2018-2021. We segmented our panel data set based on four firm sizes and nine firm sectors and then employed the fixed effect regression on each segment of our data.

Based on the results of our analysis, it is clear that the accumulation of debt and trust in the financial system plays a significant role in the financing decisions of Czech firms. However, the results did not support the hypothesis that the accumulation of debt and declining trust in the financial system can lead to a crisis of capitalism. While inflation and capital structure were found to have a positive relationship with the D/E ratio, which indicates that firms may rely on debt to finance their operations, the lack of a significant relationship between inflation and the D/E ratio across all firm size and sector categories suggests that inflation does not have a significant impact on financing decisions in the firms we analyzed. Furthermore, the results indicate that older firms tend to have lower D/E ratios than younger firms, which suggests that older firms may have established more stable and secure financing sources over time. This finding may also reflect a greater level of trust in the financial system among older firms.

Moreover, utilizing the logistic regression model we identified significant predictors of economic crises, such as the Debt-to-GDP ratio and Interest Rates. This provides insight into the factors that contribute to the likelihood of economic crises and how they relate to D/E ratios. For instance, high interest rates may prompt firms to be more cautious about borrowing and seek alternative financing sources. Similarly, a high Debt-to-GDP ratio may indicate that the overall economic environment is riskier, which could encourage firms to take

on more debt to ensure they have access to funding if necessary.

While the results of this study suggest that debt plays a significant role in the financing decisions of Czech firms, these factors do not necessarily lead to a crisis of capitalism. Further research is needed to better understand the impact of debt and trust on the capitalist system as a whole and to explore the factors that may contribute to crises in the financial system. One avenue for future research could be to explore the relationship between D/E ratios and other macroeconomic variables, such as interest rates or economic growth, to further understand the factors that influence a firm's financing decisions. Additionally, the relationship between capital structure and firm performance could be examined to determine if there is a causal link between the two variables. Further, investigating how different industries are affected by macroeconomic variables and how this affects their capital structure could provide insight into the financing decisions of firms in different sectors. Finally, expanding the dataset to include more countries and firms could improve the generalizability of the results obtained in this study.

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Appendix A

Tables

Table A.1: GAM Results

Smooth terms	edf	Red.df	F	p-value
s(DEratio)	1	1	0.285	0.593

Note: estimated degrees of freedom (edf), reference degrees of freedom (Ref.df).

Table A.2: Stationarity tests

	ADF		KPSS	
	Level	p-value	Level	p-value
D/E ratio	-10.777	<0.01	0.303	>0.1
Capital Structure	-9.702	<0.01	1.699	<0.01
Inflation	-5.62e+14	<0.01	0.009	>0.1
Firm Age	-10.634	<0.01	6.217	<0.01

Table A.3: Residual-based stationarity tests

	ADF		KPSS	
	Level	p-value	Level	p-value
Size 1	-8.1798	<0.01	0.0141	>0.1
Size 2	-9.5131	<0.01	0.0109	>0.1
Size 3	-11.001	<0.01	0.0079	>0.1
Size 4	-9.5932	<0.01	0.0097	>0.1
agric.	-6.4952	<0.01	0.0238	>0.1
const.	-6.5907	<0.01	0.0220	>0.1
energy	-5.8049	<0.01	0.0283	>0.1
financ.	-6.0181	<0.01	0.0316	>0.1
health.	-4.5331	<0.01	0.0287	>0.1
manuf.	-11.307	<0.01	0.007	>0.1
public	-3.7483	0.0394	0.0564	>0.1
service	-11.851	<0.01	0.007	>0.1
tech.	-7.984	<0.01	0.0159	>0.1

Table A.4: Regression tests for size models

p-value	Size 1	Size 2	Size 3	Size 4
Hausman	0.0754	0.9039	0.4215	0.5784
BPLM	0.817	0.7631	0.7061	0.5591

Note: Hausman refers to the Hausman test, F refers to the F-test and BPLM refers to the Breusch-Pagan test.

Note: "Size 1" refers to the smallest size category (1 - 200 k CZK) and the other three size categories follow in an ascending order.

Table A.5: Regression tests for sector models

p-value	agric.	const.	energy	financ.
Hausman	0.0125	0.8339	0.1092	0.7655
BPLM	0.8186	0.7077	0.0221	0.8497

p-value	health.	manuf.	public	service	tech.
Hausman	0.0006	0.1509	<2.2e-16	0.9791	0.7381
BPLM	0.7653	0.7913	0.3023	0.6911	0.5511