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Government provided subsidies

And their effect on the number of bankruptcies and zombie companies in the Netherlands during the COVID-19 pandemic

Name student: Max Korteweg
Student number: 480538
Thesis supervisor: prof. dr. (Jeroen) JPM Suijs
Second assessor: dr. (Ferdinand) FM Elfers
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Abstract

At the beginning of 2020, the world was introduced to a virus named COVID-19. Countries worldwide announced lockdowns and because of this, economies shut down. To compensate companies for the negative consequences of the COVID-19 pandemic, the Dutch government provided multiple financial support measures. The total costs of these measures for the years 2020 and 2021 amount to 62.2 billion euros. The three most considerable subsidies by size are the NOW, TVL, and Tozo subsidies. This study examines the effect of these subsidies on the number of bankruptcies in the Netherlands. Furthermore, I test whether the number of bankruptcies and zombie companies in the Netherlands during the crisis years were lower than normal or not. Using OLS regression models, I find that the cumulative amount of Tozo subsidy provided is positively associated with the number of bankruptcies in the Netherlands. But overall, the number of bankruptcies in the Netherlands was significantly lower during the crisis years 2020 and 2021 than in normal years. Also during the previous crisis of 2007-2009, bankruptcies were lower than normal. The number of zombie companies in the Netherlands during the COVID-19 pandemic showed no significant change compared to normal years.

Keywords: subsidies, bankruptcies, zombie companies, crises

Index

Chapter 1: Introduction

In December 2019, the Chinese city Wuhan reported multiple cases of pneumonia. At first, it was unknown what caused the pneumonia, but it quickly spread across China. The normally so busy Chinese streets were empty and men in white protective suits disinfected whole cities. These images from China were unreal to the western world. In January 2020, the head of the Dutch Rijksinstituut voor Volksgezondheid en Milieu (RIVM) Jaap van Dissel calmed Dutch citizens down and mentioned that 'if the virus appears in the Netherlands, it will probably be limited to a few infections' (Burgers, 2020). But things evolved quickly: at the beginning of February 2020, the World Health Organization (WHO) named the virus 'COVID-19'. And on the 27th of February 2020, the first COVID-19 infection in the Netherlands was detected. Contrary to what Jaap van Dissel said, the virus also quickly spread across the Netherlands. Due to the worldwide rising COVID-19 infections, the WHO announced that the virus was officially a pandemic. Hospitals overflowed with COVID-19 patients and to prevent care shortages, the Dutch government introduced a nationwide lockdown.

One of the measures was that all non-essential stores had to close. But entrepreneurs still had to pay their rent expenses and employee salaries, which was a problem given the fact that revenues had dropped. To support companies that were obliged to close, the Dutch government provided subsidies. Firms could apply for different kinds of subsidies, to deal with the negative consequences of the COVID-19 pandemic. Because most of the corona restrictions were lifted at the beginning of 2022, the Dutch government ended all their support measures on the 1st of April 2022. In the Netherlands, the realized expenditure on corona crisis measures in 2020 and 2021, and the expected expenditure for 2022 amount to a total of 85.9 billion euros. The Dutch government has borrowed money to finance these expenses. Therefore, the government debt increased from 48.7% of the Dutch GDP in 2019 to 52.1% of the Dutch GDP in 2021 (CBS, 2022a). But what happened with these subsidies? And did they achieve their goal? Or did it result in more zombie companies? These question marks lead to the following research question:

> *"How much did the received corona subsidies affect the financial health of Dutch companies during the COVID-19 pandemic?"*

This study is scientifically relevant because it contributes to the existing literature regarding subsidies. There has not been any research on the effect of the Dutch subsidies on financial health of Dutch companies during the COVID-19 pandemic yet. This study tries to get an answer to that question. If it turns out that subsidies increased the number of bankruptcies in the Netherlands, and thus decrease the financial health of companies, it is better to change subsidy policies in the future.

This research question is also socially relevant. The Dutch government borrowed a lot of money to finance the corona subsidies. This money has to be paid back in the future. It is likely that the costs of the corona crisis end up at the younger generation. To justify these

extra costs for the younger generation, it is important to know to what extent the support measures had an effect on the economy.

The paper is organized as follows. Chapter 2 will summarize the most important subsidies provided by the Dutch government, and the relevant existing literature about subsidies and zombie companies. Chapter 3 describes the methodology and tests that are used for this research. Then in chapter 4, I explain how the data for this research are collected. The fifth chapter discusses the main results. Lastly, the conclusion and discussion are described in chapter 6. The research question is answered based on the following five sub-questions:

1. Which subsidies did the Dutch government provide to deal with the negative effects of the COVID-19 pandemic?
2. What are the criteria for companies to receive these subsidies?
3. How much did the Dutch government spend on each subsidy?
4. How much did the received subsidies affect the number of bankruptcies in the Netherlands?
5. How do subsidy programs affect the number of zombie companies?

The financial health of companies in this research is measured in two ways: the number of bankruptcies and the percentage of zombie companies. I find that the number of bankruptcies in the Netherlands during the COVID-19 pandemic crisis years was lower than in normal years. This indicates that the financial health of Dutch companies increased during the COVID-19 pandemic. According to the existing literature, subsidies decrease the number of bankruptcies. And the Dutch government provided several subsidies for companies to deal with the negative consequences of the COVID-19 pandemic. The three most considerable subsidies by size are NOW, TVL, and Tozo. I find no significant relation between the cumulative amount of NOW and TVL subsidy provided and the number of bankruptcies in the Netherlands. And contrary to the existing literature, there is a positive relation between the amount of Tozo subsidy provided and bankruptcies. Thus, the increase in financial health of Dutch companies was not caused by the subsidies provided. Regarding the percentage of zombie companies in the Netherlands, there was no significant change in the COVID-19 pandemic compared to normal years.

Chapter 2: Literature review

2.1 Subsidies in the Netherlands during the COVID-19 pandemic

The Dutch government provided multiple subsidies for companies to deal with the negative effects of the COVID-19 pandemic. On the official site of the Dutch government, an overview of all the support measures is available (Rijksoverheid, 2022a). This section explains the three most important ones. It also mentions the application criteria for each subsidy and the total costs per year.

The biggest supporting measure is the Noodmaatregel Overbrugging voor Werkgelegenheid (NOW). The purpose of the temporary emergency bridging measure for sustained employment subsidy is to support companies whose revenues declined due to the COVID-19 pandemic (UWV, 2022). With the received money, entrepreneurs can continue to pay employees with fixed or flexible contracts. In this way, as many jobs as possible are preserved. There were eight application rounds in total for this support measure. To receive the subsidy, a company must meet some criteria. The most important requirements are: an expected decrease in revenue of 20% in the next quarter, the employer continues to pay the employees in full, and the employer does not request redundancy for its employees. To apply for NOW, a company first requests an advance based on an expected decrease in revenue. When the actual loss of turnover is higher than the expected loss, the company receives an extra subsidy. Otherwise, the company has to refund the excess amount. The Dutch government spent around 23.29 billion euros on the NOW subsidy (Algemene Rekenkamer, 2022) during the crisis years 2020 and 2021. More than half of this (13.18 billion) is attributable to 2020, and 10.11 billion to 2021.

The second-largest subsidy is the Tegemoetkoming Vaste Lasten (TVL), which in English is known as the reimbursement of fixed costs. The subsidy helps companies to pay their fixed costs such as rent, insurance, lease contracts, and subscriptions (Rijksdienst voor Ondernemend Nederland, 2022). But this support measure is not intended for wage costs, because that is what NOW is for. There were seven application rounds for this subsidy. The first two rounds were provided to small and medium-sized enterprises that had more than a 30% loss of turnover. In later rounds, large companies could also apply for the subsidy and the benchmark of a decline in revenue was lowered to 20%. From the third round onwards, the applicants should have minimum calculated fixed costs of 1,500 euros per quarter. In the first two rounds, this amount was respectively 4,000 and 3,000 euros per quarter. The Dutch government spent around 1.07 billion euros on this subsidy in 2020, and 6.49 billion in 2021. This means that the TVL cost the Dutch government approximately 7.56 billion euros during the crisis years 2020 and 2021.

A third subsidy entrepreneurs could apply for, is the Tijdelijke overbruggingsregeling zelfstandig ondernemers (Tozo). This regulation was provided to support self-employed people with extra income and extra working capital (Ministerie van SZW, 2022). The Tozo regulation consists of two parts: a benefit that supplements the income of a self-employed person and a loan. There were five application rounds for this subsidy. To receive the Tozo benefit, a person's income from his own company should be lower than the social minimum

income. In that case, the government subsidizes the gap between the income and the social minimum income. People who experienced liquidity problems could request a Tozo loan. The subsidy was available from October 2020 until September 2021. During that period the Dutch government spent 4.33 billion euros on Tozo.

2.2 Effect of subsidies

The previous big crisis was the financial crisis of 2007-2009 (Boyle, 2022). In the years before, mortgage brokers and lenders offered subprime mortgages and individuals were able to borrow more than they could afford. The subprime loans were repackaged and sold as mortgage-backed securities and collateralized debt securities. This caused a housing bubble and when this bubble burst, financial institutions were stuck. But because these institutions were considered 'too big to fail', governments bailed them out. Around the world, 6 trillion dollars were spent on economic stimulus programs and 11 trillion dollars of assistance to financial institutions (Wilmart, 2011). But the too big to fail subsidies undermine market discipline since large financial institutions expect to receive comparable subsidies during future crises.

Subsidies during the financial crisis of 2007-2009 prevented financial institutions from going bankrupt. But subsidies are also provided for other reasons: they increase the efficiency, profitability, capital structure, and growth of firms (Tzelepis & Skuras, 2004). The authors examine the extent to which capital subsidies affect these factors. Capital subsidies are discretionary and selective, they are paid to firms that have applied for aid and meet criteria, and target certain industries or regions. Tzelepis & Skuras (2004) find a positive correlation between subsidy and growth. In the short run, subsidized firms may see a decline in profits. But in the long run, subsidies tend to improve the growth rate of companies. On the other hand, the authors find a negative correlation between the number of subsidies and return of assets, profitability, and leverage. So capital subsidies are ineffective in improving a firm's efficiency, profitability, and capital structure.

Subsidies improve the economic growth of a society, another component that can be seen as a public good and generates positive external effects are research and development (R&D) investments. Hud & Hussinger (2015) investigated the impact of R&D subsidies on the R&D investment behaviour of firms. According to the authors, the level of R&D investments is lower than desirable in crisis years. R&D generates positive external effects for society, but in crisis years, the private costs are not covered by the benefits for society. When the financial crisis started in 2007, industrialized countries increased the number of R&D subsidies. Hud & Hussinger (2015) found a positive correlation between R&D subsidies and R&D investment behaviour. The authors analyzed both pre-crisis years and crisis years, and they found that the effect of subsidies is greater in pre-crisis years than in recovery years.

While Tzelepis & Skuras (2004) and Hud & Hussinger (2015) found positive effects of government-provided subsidies, it is not clear how subsidies affect long-term growth according to Bergström (2000). Therefore, he compares the total factor productivity between subsidized and unsubsidized firms over the period 1987 up to 1993. In the first year, subsidies

tend to be positively correlated with growth and cause an increase in the productivity of firms. But in the long run, subsidies are negatively correlated with total factor productivity growth. The more subsidies a firm receives, the worse the future economic growth in the long run. An implication of Bergström's (2000) study is that resources might be allocated inefficiently, which leads to the subsidization of less productive firms. These less productive firms are also called 'zombie companies'.

2.3 The rise of zombie companies

The term zombie company originates from the bursting of the Japanese asset price bubble in the 1990s (Kenton, 2021). During the financial crisis that started in 2007, the term was picked up again: some financial institutions became zombie companies. But since they employed many people, the institutions were considered 'too big to fail'. Therefore, governments intervened to prevent financial institutions from going bankrupt. But how do zombie companies arise?

There are different definitions of zombie companies. According to De Martiis, Heil & Peter (2020), zombie companies are companies that survive despite their inability to cover debt servicing costs from their current profits. Hoshi (2006) agrees that zombies are firms that have extremely low interest expenses relative to their level of debt. He thinks that these firms survive because they are helped by creditors through low interest rates. Banerjee & Hofmann (2018) define a zombie company more specifically: as a firm which is at least 10 years old and has an interest coverage ratio lower than one for three consecutive years. On top of that, the expected future growth potential of the firm should be low. But Caballero, Hoshi & Kashyap (2008) classify zombie companies only on whether firms are receiving government-subsidized credit from banks.

The Japanese asset price bubble was caused by lax inspections of regulators, therefore banks could lend money to insolvent companies (Caballero, Hoshi & Kashyap, 2008). Banks gambled that these insolvent firms would somehow recover. If they did not lend money, loans had to be written off which pushed banks against the international standard minimum capital levels. But by providing loans to unprofitable firms, banks allowed them to distort competition because zombies were able to retain their employees and market share. Hoshi (2006) compares the characteristics of zombie and non-zombie firms. He finds that zombies are more likely to be found outside metropolitan areas and in non-manufacturing industries. Furthermore, zombie firms have high debt to asset ratios, low profitability, and are dependent on the main banks. And firms with large asset sizes or employment sizes are less likely to become zombies. Banerjee & Hofmann (2018) add some causes and consequences of zombie companies to the existing literature. They also see banks as one of the factors that cause zombie companies, because banks have incentives not to write loans off but rather provide new loans to non-viable firms. Banks gambled that these insolvent firms would recover, in this way banks keep zombie companies alive.

Another cause of zombie companies is the downward trend in interest rates since the late 1980s (Banerjee & Hofmann, 2018). Lower rates result in fewer incentives for creditors

to clean up their balance because the interest expenses of having debt are lower. Because they can earn more with evergreening loans to zombies. Evergreening loans do not require the repayment of principal during the life of the loan (Kagan, 2021). Zombie companies have both lower labour and lower total factor productivity than healthy firms. Therefore, zombie companies may weaken economic performance. Besides that, an increase in zombie companies also increases the crowding out of the growth of productive firms. For example, the number of zombie firms is negatively correlated with capital expenditure and employment growth of non-zombie companies.

Banerjee & Hofmann (2018) name economic factors that cause the rise of zombie firms, but De Martiis, Heil & Peter (2020) are the first to dive deeper into firm-specific characteristics of zombie companies using machine learning techniques. They use binary and multi-classification trees for their research. Based on the binary decision tree, the most important determinants of zombie companies during crisis years in Europe are income and stock variables. Firms with lower operating income after depreciation are more likely to be zombie companies. An increase in stock variables, such as risky assets, also increases the likelihood that the company is a zombie. The multi-class decision tree states that income variables, such as operating income after depreciation, pretax income and retained earnings, can separate healthy and zombie companies from each other.

2.4 The effect of subsidies on zombie companies

The causes and consequences of zombie firms are explained, but what is the effect of subsidies on zombie companies? Nurmi, Vanhala & Virén (2020) researched the link between zombie companies and government subsidies. They are one of the first that study the role of subsidies in the survival of zombies. Their results suggest that the proportion of zombie firms in a sector increases with an increase in the share of subsidies allocated to zombies. This indicates that subsidy-receiving firms are more likely to be zombie companies. Nurmi, Vanhala & Virén (2020) find that subsidies are not decisive in the recovery of weakly performing firms. But the death rate of subsidized firms is lower than that of firms that do not receive subsidies. A consequence of the lower death rate is that zombie companies are kept alive because of subsidies.

China sees zombie companies as pain points for economic development because they use valuable human resources, financial resources, and material resources (Chang, Zhou, Liu, Wang & Zhang, 2021). The authors test whether government intervention has a positive or negative effect on the number of zombies in the economy. One of the most important tools for government intervention in markets is subsidies. The authors find that governments create zombie firms through government subsidies, financial support, resources support and tax support. According to Chang et. al. (2021), the risk that a firm becomes a zombie increases with an increase in the degree of government intervention. One possible solution to the zombie company problem in China is the reduction of market entry and exit costs. In that way, small companies can compete with incumbent firms. Unhealthy firms would go bankrupt instead of becoming a zombie.

Based on the Japanese asset price bubble, other possible solutions to the zombie company problem are identified by Fukunda & Nakamura (2011). A large part of the Japanese zombie firms recovered during the 2000s. This was possible because of a reduction in employment strength and the selling of unutilized fixed assets. Furthermore, the recognition of special losses accelerated the recovery of zombie companies. On the other hand, selling profitable prime assets worked against the recovery. Fukunda & Nakamura (2011) also found that capital reduction and debt relief were important factors in the asset price bubble recovery.

2.5 Hypotheses

To answer the research question, three hypotheses are developed. The first hypothesis builds on Nurmi, Vanhala & Virén (2020), who found that subsidies decrease the death rate of firms. During the COVID-19 pandemic, over 80 billion euros has been spent on corona-related costs and subsidies in the Netherlands. Based on Nurmi, Vanhala & Virén (2020), the number of bankruptcies should have decreased since March 2020 relative to the period before March 2020. This leads to the first hypothesis, which will be tested for the three most important subsidies:

- H1a: The NOW subsidy decreased the number of bankruptcies in the Netherlands during the COVID-19 pandemic.
- H1b: The TVL subsidy decreased the number of bankruptcies in the Netherlands during the COVID-19 pandemic.
- H1c: The Tozo subsidy decreased the number of bankruptcies in the Netherlands during the COVID-19 pandemic.

During the financial crisis of 2007-2009, governments around the globe spent 6 trillion dollars on economic stimulus programs and 11 trillion dollars of assistance to financial institutions (Wilmart, 2011). In the Netherlands, 6 billion euros were spent to stimulate employment, the building sector, and the housing market (Rijksoverheid, n.d.). This crisis is different compared to the COVID-19 pandemic. But since existing literature (Nurmi, Vanhala & Virén, 2020) states that subsidies decrease the number of bankruptcies, this should be the case for both the 2007-2009 financial crisis and the COVID-19 pandemic. Therefore, the second hypothesis is as follows:

- H2a: Bankruptcies in the Netherlands during the financial crisis were lower than normal.
- H2b: Bankruptcies in the Netherlands during the COVID-19 pandemic were lower than normal.

Subsidies may decrease the number of bankruptcies, but according to Nurmi, Vanhala & Virén (2020) and Chang, Zhou, Liu, Wang & Zhang (2021), subsidies are the main cause of zombie companies. Firms that do not receive subsidies have a higher death rate than firms that do receive subsidies. Subsidized firms are kept alive as zombie companies. When the government intervenes in a market, the risk that firms become zombie companies increases. Government

intervention was high during the COVID-19 pandemic, therefore the number of zombie companies should have increased. This leads to the third hypothesis:

H3: Subsidies increased the number of zombie companies in the Netherlands during the COVID-19 pandemic.

Chapter 3: Methodology

3.1 Effect of subsidies on bankruptcies during the COVID-19 pandemic

To test H1 which states that subsidies decreased the number of bankruptcies in the Netherlands during the COVID-19 pandemic, I use ordinary least squares (OLS) regressions. This is a statistical method that estimates the relation between bankruptcies and the respective subsidy. The OLS regressions are performed for the period 2009-2021. 2009 is the last financial crisis year, so the subsidies provided during the financial crisis do not play a role in this research. Since there are only 2 subsidy years in the regressions, I use a significance level of 10% for these one-sided tests. In other words, if the B1 coefficient has a p-value below 0.10, the coefficient is considered to be statistically significant.

To capture the effects of other variables, I add control variables to the OLS regressions. These are variables that could influence the number of bankruptcies. Hansson & Lindvall (2020) researched macroeconomic factors that affect the number of bankruptcies in Sweden. They find that the variables *months, consumer price index (CPI), retail sales, stock market index, total enterprises*, and *liquidated enterprises* explain the number of bankruptcies to an extent of 64.49%. *Months* is a categorical variable that has 12 categories, for each month of the year. *CPI* is the change in the price of a basket of goods compared to a year ago. *Retail sales* is the number of total consumer goods sales to consumers. *Stock market index* is a stock market regressor variable. The variable *total enterprises* is the total number of enterprises at year end. *Liquidated enterprises* include the total number of enterprises liquidated. Liquidation is a process before bankruptcy where a firm's assets are liquidated. Based on Hansson & Lindvall (2020), *CPI*, *total enterprises*, and *AEX* are used as control variables for bankruptcies. For H1a, the effect of NOW on the number of bankruptcies during the COVID-19 pandemic is calculated as follows:

$$BANKRUPTCIES_t = \beta_0 + \beta_1 \times NOW_t + \beta_2 \times CPI_t + \beta_3 \times TOTAL_t + \varepsilon_t$$

where $BANKRUPTCIES_t$ is the number of bankruptcies in year t. NOW_t is the cumulative amount of NOW subsidy provided by the Dutch government up until year t. CPI_t is the consumer price index in the Netherlands at the end of year t. 2015 is used as base year, which means that the CPI equals 100 in 2015. $TOTAL_t$ is the total number of enterprises in the Netherlands at the end of year t. And AEX_t is the close price of the AEX at the end of year t. If β_1 is negative and significant, H1a is accepted. For H1b, the effect of TVL on the number of bankruptcies during the COVID-19 pandemic is calculated as follows:

$$BANKRUPTCIES_t = \beta_0 + \beta_1 \times TVL_t + \beta_2 \times CPI_t + \beta_3 \times TOTAL_t + \varepsilon_t$$

where $BANKRUPTCIESt$ is the number of bankruptcies in year t. $TVLt$ is the cumulative amount of TVL subsidy provided by the Dutch government up until year t. If β_1 is negative and significant, H1b is accepted. For H1c, the effect of Tozo on the number of bankruptcies during the COVID-19 pandemic is calculated as follows:

$$BANKRUPTCIES_t = \beta_0 + \beta_1 \times TOZO_t + \beta_2 \times CPI_t + \beta_3 \times TOTAL_t + \varepsilon_t$$

where $BANKRUPTCIES_t$ is the number of bankruptcies in year t. $TOZO_t$ is the cumulative amount of Tozo subsidy provided by the Dutch government up until year t. If β_1 is negative and significant, H1c is accepted.

3.2 Change in bankruptcies during crisis years

The second hypothesis states that bankruptcies in the Netherlands during the financial crisis and COVID-19 pandemic were lower than normal. First, I use a vector autoregressive (VAR) model to perform the multivariate time series forecast to make predictions on the yearly number of bankruptcies for the years 2000-2021. The model consists of one lag of each variable but is estimated based on 10 years of observations. Such that the model forecasts the number of bankruptcies in the year 2000 on the number of bankruptcies, yearly CPI mutation, and the close price of the AEX in the year 1999. It uses data from the period 1988-1998 to estimate this relation. The forecast is done as a rolling forecast: data from the period 1989-2000 is used to forecast the number of bankruptcies in the year 2001. This 'roll' continues until a forecast is made for 2021, based on the data from the years 2009-2020. Because the rolling forecast regards such a longer period, the control variable CPI that is used for the first hypothesis is changed to yearly CPI mutation for hypothesis 2. The VAR model that is used looks as follows:

$$FN\_BANKRUPTCIES_t = \beta_0 + \beta_1 \times BANKRUPTCIES_{t-1} + \beta_2 \times CPI\_MUT_{t-1} + \beta_3 \times AEX_{t-1} + \varepsilon_t$$

where $FN\_BANKRUPTCIES_t$ is the forecasted number of bankruptcies in year t, and $BANKRUPTCIES_{t-1}$ the actual number of bankruptcies in year t-1. CPI_MUT_{t-1} is the yearly CPI mutation in year t-1, and AEX_{t-1} the close price of the AEX in year t-1. The forecast results are considered the 'normal' number of bankruptcies and are compared to the actual number of bankruptcies in the years 2000-2021. I use an OLS regression model to regress the time series forecast errors on a crisis-dummy and control variables. Forecast errors are measured as follows:

$$FE_t = Y_t - F_t$$

where FE_t is the forecast error in year t. Y_t is the actual value in year t, and F_t is the forecasted value in year t. The forecast errors are calculated for the periods 2000-2021. To test whether bankruptcies in the Netherlands during the financial crisis were lower than normal, I use the following regression model for the years 2000-2009:

$$FE\_BANKRUPTCIES_t = \beta_0 + \beta_1 \times CRISIS + \beta_2 \times CPI\_MUT_t + \beta_3 \times AEX_t + \varepsilon_t$$

where $FE\_BANKRUPTCIES_t$ is the forecast error of the number of bankruptcies in the Netherlands in year t. $CRISIS$ equals 1 in a crisis year, and 0 otherwise. If β_1 is negative and significant, H2a is accepted. H2b test whether the bankruptcies in the Netherlands during the COVID-19 pandemic were lower than normal. To test the hypothesis, the following regression model is used for the years 2009-2021.

$$FE\_BANKRUPTCIES_t = \beta_0 + \beta_1 \times CRISIS + \beta_2 \times CPI\_MUT_t + \beta_3 \times AEX_t + \varepsilon_t$$

where $FE\_BANKRUPTCIES_t$ is the forecast error of the number of bankruptcies in the Netherlands in year t. $CRISIS$ equals 1 in a crisis year, and 0 otherwise. If β_1 is negative and significant, H2b is accepted. The control variable $TOTAL$ that is used for the first hypotheses is excluded from the forecast and the regressions of H2a and H2b, because there are no data available over the period 1988-2006. Therefore, it is not possible to perform the rolling forecast with this control variable.

3.3 Change in zombie companies during COVID-19 pandemic

The third and last hypothesis states that subsidies increased the number of zombie companies in the Netherlands during the COVID-19 pandemic. My definition of zombie companies is equal to De Martiis, Heil & Peter (2020), who identify a firm as a zombie when it is able to survive despite its inability to cover debt servicing costs from its current profits. So, firms with an interest coverage ratio (ICR) lower than one are classified as zombies. The ICR is calculated as follows:

$$ICR_t = EBIT_t \div IE_t$$

where ICR_t is the ICR in year t, $EBIT_t$ the earnings before income and tax in year t, and IE_t is the interest expense in year t. For each year of data, the number of zombie companies is expressed as a percentage of total companies in the dataset. This is done to avoid absolute difference between the years, and only take the relative difference into account. The percentages of zombie companies are calculated as follows:

$$\%ZOMBIES_t = (ZOMBIES_t \div TOTAL\_ZOMBIES_t) \times 100$$

where $\%ZOMBIES_t$ is the percentage of zombie companies in the dataset in year t. $ZOMBIES_t$ is the absolute number of zombie companies in the dataset in year t, and $TOTAL\_ZOMBIES_t$ is the total number of companies in the dataset in year t. For this research, the percentage of zombie companies in the Netherlands is equal to the percentage of zombies in the dataset. Then again, I perform a rolling forecast based on a VAR multivariate time series forecasting to make predictions on the yearly percentage of zombie companies in the Netherlands. According to Banerjee & Hofmann (2018), the interest rate is a factor that influences the number of zombie companies. Therefore, I consider the 10-year interest rate in the Netherlands as a control variable. The VAR model consists of one lag of each variable, but the model is estimated based on 5 years of observations. Such that the model forecasts the percentage of zombie companies in the year 2017 based on the percentage of zombie companies and the 10-year interest rate in the year 2016. The model uses data from 2011-2015 to estimate this relation. The forecast is done as a rolling forecast: data from the period 2012-2017 is used to forecast the percentage of zombie companies in the year 2018. This 'roll' continues until a forecast is made for 2021, based on data from the years 2015-2020. The VAR model looks as follows:

$$F\_\%ZOMBIES_t = \beta_0 + \beta_1 \times \%ZOMBIES_{t-1} + \beta_2 \times INTEREST_{t-1} + \varepsilon_t$$

where $F\_\%ZOMBIES_t$ is the forecasted percentage of zombie companies in the Netherlands in year t. $\%ZOMBIES_{t-1}$ is the actual percentage of zombie companies in the Netherlands in year t-1, and $INTEREST_{t-1}$ is the 10-year interest rate in the Netherlands in year t-1. The forecast results are compared with the actual yearly percentage of zombie companies in crisis years. To test whether subsidies increased the number of zombie companies in the Netherlands during the COVID-19 pandemic, I use the following OLS regression:

$$FE\_\%ZOMBIES_t = \beta_0 + \beta_1 \times CRISIS + \beta_2 \times INTEREST_t + \varepsilon_t$$

where $FE\_\%ZOMBIES_t$ is the forecast error of the percentage of zombie companies in the Netherlands in year t. $CRISIS$ equals 1 in a crisis year, and 0 otherwise. $INTEREST_t$ is the 10-year interest rate in year t. If β_1 is positive and significant, H3 is accepted.

Chapter 4: Data

4.1 Dataset 1

For each hypothesis, I use a different dataset. To test the first hypothesis, I need data on the number of bankruptcies, NOW subsidy provided, TVL subsidy provided, Tozo subsidy provided, CPI at year end, total number of companies at year end, and standing of the AEX at year end for the period 2009-2021. Accurate historical data on the number of bankruptcies in the Netherlands are easy to obtain. Via the database of the CBS (CBS, 2022b), I downloaded the desired data on bankruptcies in the Netherlands. The initial dataset consists of the yearly number of bankrupted natural persons with sole proprietorship and the yearly number of bankrupt companies and institutions. A third type of bankruptcy is left out of the initial sample because it regards bankrupted natural persons without sole proprietorship which is not relevant for this research. The subsidies are only provided to natural persons with sole proprietorship and companies and institutions. This results in an initial sample of 26 yearly observations. The firms in this dataset are considered bankrupt when they are declared bankrupt by a Dutch court. Based on the two types of bankruptcies, I create a third column which is the sum of the yearly number of bankrupted natural persons with sole proprietorship and the yearly number of bankrupted companies and institutions. Therefore, the final sample consists of 39 yearly bankruptcy observations. I only use the sum of the yearly number of bankrupted natural persons with sole proprietorship and the yearly number of bankrupted people for the regressions.

Besides data on the yearly number of bankruptcies in the Netherlands, I need accurate data on the provided NOW, TVL, and Tozo subsidies. Each year, all ministries must account to the Algemene Rekenkamer for the tax money they have received and spent that year. The Algemene Rekenkamer is a controlling organization that checks whether the expenses of the Dutch government are effective and lawful. Since the beginning of the COVID-19 pandemic, the Algemene Rekenkamer keeps track of the budgeted and realized corona-related expenses of the Dutch government. In total, there are seven editions of the so-called 'coronarekening' provided by the Algemene Rekenkamer. The last update was published on the 18th of May 2022 (Algemene Rekenkamer, 2022). The information in this 'coronarekening' about the amount of subsidy provided by the Dutch government is used for this research. In 2020, the total realized corona-related expenses were 29.03 billion euros. The realized expenses for 2021 were 33.17 billion euros. I collected the subsidy data for 2020 and 2021. For the period 2009-2019, the subsidy data are set to 0. This results in 39 provided subsidy observations in the final sample.

Data for the control variables total number of companies and CPI are also available via the CBS. I downloaded the total number of companies at the end of the fourth quarter for the period 2009-2021. The final sample consists of 13 yearly total number of companies observations. Regarding the CPI, I downloaded the CPI at the end of December for the period 2009-2021. This also results in 13 yearly CPI observations in the final sample. The last control variable is AEX. The standings at year end are collected manually via Het Financieele Dagblad (2022) for the period 2009-2021. The final sample consists of 13 AEX observations.

4.2 Dataset 2

For hypothesis 2, I expand the dataset that is used for the first hypothesis. H2a tests whether the number of bankruptcies in the Netherlands was lower during the financial crisis. H2b tests whether the number of bankruptcies was lower during the COVID-19 pandemic. To test these hypotheses, I use a rolling forecast based on a multivariate time series forecasting model. The number of bankruptcies is retrieved from the CBS again, in the same way as for the first hypothesis. But for the second hypothesis, I collected data for the period 1988-2021. This results in 102 yearly bankruptcy observations in the final sample (34 natural persons with sole proprietorship, 34 companies and institutions, and 34 total). For hypothesis 2, I use data of the yearly CPI mutation as a control variable instead of the CPI. These data are collected via the CBS. I downloaded the yearly CPI mutation in the Netherlands for the period 1988-2021. This results in 34 yearly CPI mutation observations. Data for the control variable AEX are collected in the same way for hypothesis 1 but for the years 1988-2021. Therefore, the final sample consists of 34 AEX observations. The control variable $TOTAL$ is left out of the forecast due to a lack of data. Data regarding the amount of subsidy provided are not relevant anymore and therefore left out of dataset 2. Instead, I add a dummy variable $CRISIS$ which equals 1 in crisis years and 0 otherwise. So, dataset 2 consists of 22 CRISIS observations (2000-2021).

4.3 Dataset 3

To test the third hypothesis, I need historical data on the number of zombie companies and the interest rates in the Netherlands. The data on zombie companies are difficult to obtain. One of the databases that consist of different kinds of data about both public and private companies is Bloomberg Terminal. But this computer system is much more than a database. It brings together breaking news, real-time data, powerful analytics, and in-depth research. The computer system is mainly used by institutional investors, financial analysts, and portfolio managers. For this research, I also use Bloomberg Terminal. Via the Equity Screener, it is possible to find different kinds of data about Dutch companies, both public and private. Bloomberg Terminal provides data on 7,540 Dutch firms. I filter these companies based on name and EBIT/Interest Expense. EBIT/Interest Expense is the ICR, where the third hypothesis is about. I downloaded all the data from 2011 since data before 2011 are not available. This results in an initial sample of 82,940 observations. But not all of the 7,540 companies consist of the necessary data. Therefore, the observations with missing values are removed from the initial sample. This results in a sample of 3,384 ICR observations. So, 79,556 observations are dropped. Most of them are dropped because data on the interest expense were not available. The historical data on the interest rates in the Netherlands are collected from IEX (2022) for the period 2011-2021. For this research, the 10-year interest rate in the Netherlands is used for the rolling forecast and to control for the percentage of zombie companies.

Chapter 5: Results

5.1 Descriptive statistics

The descriptive statistics of the variables that are used for hypotheses 1, 2, and 3 are shown in Table 1. For all the variables, the mean and median are relatively close to each other. This indicates that the observations are symmetrically distributed. Time series figures of the variables are presented in Appendix A, except for NOW, TVL, Tozo and the forecast errors.

Table 1:

Descriptive statistics

Variable	Period	Mean	Median	Min	Max	σ
$BANKRUPTCIES$	1988-2021	5,049.44	4,619	1,818	9,431	1,770.61
NOW (x 1,000,000)	2020-2021	18,235	18,235	13,180	23,290	7,148.85
TVL (x 1,000,000)	2020-2021	4,315	4,315	1,070	7,560	4,589.12
$TOZO$ (x 1,000,000)	2020-2021	3,765	3,765	3,200	4,330	799.03
CPI (2015 = 100)	2009-2021	99.94	100	90.44	110.39	6.03
AEX	1988-2021	385.44	374.94	109.61	797.93	178.4
$TOTAL$	2009-2021	1,558,430	1,523,635	1,211,460	2,046,055	259,075
$FE\_BANKRUPTCIES$	2000-2021	-70.08	-9.45	-1,898	1,590	888
CPI_MUT	1988-2021	2.04	2.10	0.30	4.50	0.95
$\%ZOMBIES$	2011-2021	28.40%	27.73%	23.00%	37.53%	4.83%
$FE\_\%ZOMBIES$	2017-2021	-0.78%	-2.19%	-5.64%	4.92%	5.15%
$INTEREST$	2011-2021	0.73%	0.53%	-0.49%	2.24%	0.89%

Note: This table presents the descriptive statistics for all the variables used in the analyses.

In the period 1988-2021, the average number of bankruptcies in the Netherlands was 5,049 per year. The minimum value regards the year 2021, in which 1,818 companies and natural persons with sole proprietorship were declared bankrupt. The year with the most bankruptcies was the year 2013, with 9,431 bankruptcies. Since 2013, the number of bankruptcies in the Netherlands decreased every year, except for 2019. The total amount of NOW, TVL, and Tozo subsidies provided by the Dutch government are already mentioned in section 2.1. The cumulative amounts are 23,290 million euros, 7,560 million euros, and 4,330 million euros respectively. Again, for the years 2009-2019, the amounts of subsidy are set to 0. The control variable CPI that is used for H1a, H1b, and H1c is set to 100 for the year 2015. The CPI in the Netherlands increased every year since 2009, there was no deflation. The control variable total number of enterprises in the Netherlands also shows a constant increase over the years 2009-2021. AEX is used for both H1 and H2, therefore the descriptive statistics

are presented over the period 1988-2021. In this period, the AEX averaged 385.44 points. From 1996-1999, the Dutch stock market index rallied by 133% to almost 700 points. The reason for this rally was the dot-com bubble. This bubble burst at the beginning of the 21st century. For H2a and H2b, the yearly CPI mutation is used as a control variable instead of CPI. Since 1988, the average yearly CPI mutation is 2.04. This is close to the target inflation of 2% in the eurozone (ECB, 2022). The average forecast error of the number of bankruptcies in the Netherlands was -70.08. For the third hypothesis, the percentage of zombie companies in the Netherlands, the forecast errors, and the 10-year interest rate are relevant. Over the period 2011-2021, the average percentage of zombie companies in the Netherlands was 28.40%. In 2011, only 23% of the companies in the Netherlands had an ICR below one. At the end of 2020, the first COVID-19 pandemic crisis year, 37.53% of the companies were considered zombies. In the years 2011-2021, the average 10-year interest rate in the Netherlands was close to zero. Since 2019, the rate is negative. A reason for the low interest rates is the inflation in the European Union. Due to the low inflation, the ECB has decreased the interest rates since 2013 to stimulate the economy (DNB, 2022). Low interest rates stimulate people to spend their savings. Because when interest rates are lower than inflation, money loses its value.

5.2 Effect of subsidies on the number of bankruptcies

The last financial support measures by the Dutch government ended on the 1st of April 2022. In the years 2020 and 2021, companies in the Netherlands received a total of 23,290 million euros of NOW subsidy, 7,560 million euros of TVL subsidy, and 4,330 million euros of Tozo subsidy. The goal of these subsidies was to support companies that had to deal with the negative effects of the COVID-19 pandemic. A previous study by Nurmi, Vanhala & Virén (2020) showed that subsidies decrease the death rate of firms. To test whether the NOW, TVL, and Tozo subsidies decreased the death rate of firms, I performed an OLS regression for each subsidy separately. I added three control variables to the regression models: CPI, $TOTAL$, and AEX. The regression results for H1a are shown in Table 2.

Table 2:

Regression results NOW subsidy on bankruptcies

	(1) Without control variables		(2) With control variables	
Variable	**Coefficient**	**T-stat (p-value)**	**Coefficient**	**T-stat (p-value)**
$Intercept$	6,320.83	10.93 (0.000)***	-30,880.30	-3.49 (0.008)***
NOW	-0.20	-2.62 (0.024)**	0.07	1.80 (0.110)
CPI			799.45	5.77 (0.000)***
$TOTAL$			-0.03	-6.77 (0.000)***
AEX			0.08	0.02 (0.988)**
R^2 (Adjusted R^2)	0.3848 (0.3289)		0.9659 (0.9488)	
Observations	13		52	

Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the NOW variable on the number of bankruptcies in the Netherlands, without and with control variables. The NOW variable consists of 13 observations of which 11 are set to 0 (the non-crisis years). This variable is regressed on the sum of the number of bankrupted natural persons with sole proprietorship and companies and institutions. *, **, *** denotes statistical significance at the 10%, 5%, 1% level respectively (one-tailed).

Only looking at the effect of the NOW subsidy on the number of bankruptcies in the Netherlands, every extra million euro NOW subsidy provided by the Dutch government is associated with a lower number of bankruptcies of 0.20. The NOW coefficient has a p-value of 0.024 which is significant at 5%. But with an adjusted R-squared of 0.3289, the regression model does only explain 32.89% of the observations. When adding the control variables, the adjusted R-squared of the model increases to 0.9488. All of the three control variables drive this high adjusted R-squared. Only adding CPI to the initial model increases the adjusted R-squared by 0.3, only adding $TOTAL$ leads to an increase of 0.46, and only adding AEX increases the adjusted R-squared by 0.4. The coefficient of the NOW variable becomes positive. But since the p-value of the coefficient changes to 0.110, NOW has no significant effect on the number of bankruptcies in the Netherlands anymore. On the other hand, the control variables CPI, $TOTAL$, and AEX indeed have a significant effect on the number of bankruptcies in the Netherlands. An increase in the CPI by 1 percentage point, increases the number of bankruptcies by approximately 800. An increase in the total number of companies decreases the number of bankruptcies by 0.03. And an increase in the closing price of the AEX by 1 point, increases the number of bankruptcies by 0.08. The results for H1b are shown in Table 3.

Table 3:

Regression results TVL subsidy on bankruptcies

	(1) Without control variables		(2) With control variables	
Variable	**Coefficient**	**T-stat (p-value)**	**Coefficient**	**T-stat (p-value)**
$Intercept$	6,157.59	10.25 (0.000)***	-29,774.36	-3.03 (0.016)**
TVL	-0.62	-2.18 (0.052)*	0.15	1.06 (0.320)
CPI			772.17	5.07 (0.001)***
$TOTAL$			-0.03	-5.80 (0.000)***
AEX			0.53	0.08 (0.936)*
R^2 (Adjusted R^2)	0.3010 (0.2375)		0.9580 (0.9370)	
Observations	13		52	

Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the TVL variable on the number of bankruptcies in the Netherlands, without and with control variables. The TVL variable consists of 13 observations of which 11 are set to 0 (the non-crisis years). This variable is regressed on the sum of the number of bankrupted natural persons with sole proprietorship and companies and institutions. *, **, *** denotes statistical significance at the 10%, 5%, 1% level respectively (one-tailed).

The regression model without control variables results in a negative TVL coefficient of minus 0.62, which is significant at a 10% significance level. This indicates that every extra million euro of TVL subsidy the Dutch government provides, is associated with a lower number of bankruptcies in the Netherlands of 0.62. But again, this model has a low adjusted R-squared and does explain a small part of the observations: only 23.75%. The regression model with control variables has a higher adjusted R-squared of 0.9370. Just like with the NOW variable, the TVL coefficient becomes positive and insignificant. And again, the significant variables are the control variables CPI, $TOTA$L, and AEX. The coefficient of AEX is approximately 7 times bigger in the TVL regression model compared to the NOW regression model. But for H1b the AEX coefficient is significant at a 10% significance level, while the coefficient is significant at 5% for H1a. The output of the Too regression model is shown in Table 4.

Table 4:

Regression results Tozo subsidy on bankruptcies

	(1) Without control variables		(2) With control variables	
Variable	**Coefficient**	**T-stat (p-value)**	**Coefficient**	**T-stat (p-value)**
$Intercept$	6,341.38	10.95 (0.000)***	-30,631.36	-3.52 (0.008)**
$TOZO$	-1.03	-2.64 (0.023)**	0.33	1.87 (0.098)*
CPI			800.08	5.85 (0.000)***
$TOTAL$			-0.03	-6.96 (0.000)***
AEX			0.98	0.21 (0.840)
R^2 (Adjusted R^2)	0.3886 (0.3330)		0.9667 (0.9501)	
Observations	13		52	

Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the Tozo variable on the number of bankruptcies in the Netherlands, without and with control variables. The Tozo variable consists of 13 observations of which 11 are set to 0 (the non-crisis years). This variable is regressed on the sum of the number of bankrupted natural persons with sole proprietorship and companies and institutions. *, **, *** denotes statistical significance at the 10%, 5% 1% level respectively (one-tailed).

The Tozo variable has a coefficient of -1.03 and is significant in the model without control variables. So, also the Tozo variable is negatively correlated with the number of bankruptcies in the Netherlands. Every extra million euros Tozo subsidy provided by the Dutch government results in a decrease of 1.03 in the number of bankruptcies. But with an adjusted R-squared of 0.3330, the model without control variables does explain the observations for only 33.30%. Adding the control variables to the model increases the adjusted R-squared to 0.9501. $TOZO$ becomes positively correlated with the number of bankruptcies and is significant with a significance level of 10%. So, the Tozo coefficient is significant while the NOW and TVL coefficients are insignificant. One of the differences between these three subsidies is the increase in the cumulative amount of subsidy provided between 2020 and 2021. Only 14% of the cumulative amount of TVL subsidy provided is attributable to 2020, and 57% of the cumulative amount of NOW subsidy is accounted in 2020. Regarding the Tozo subsidy, almost 74% of the cumulative amount is provided by the Dutch government in 2020. This might be an explanation for the differences in significance. As for H1a and H1b, the CPI coefficient is positive and significant, and the coefficient of $TOTAL$ is negative and significant. The AEX variable has a coefficient of 0.98, but opposite to H1a and H1b, the coefficient is not significant.

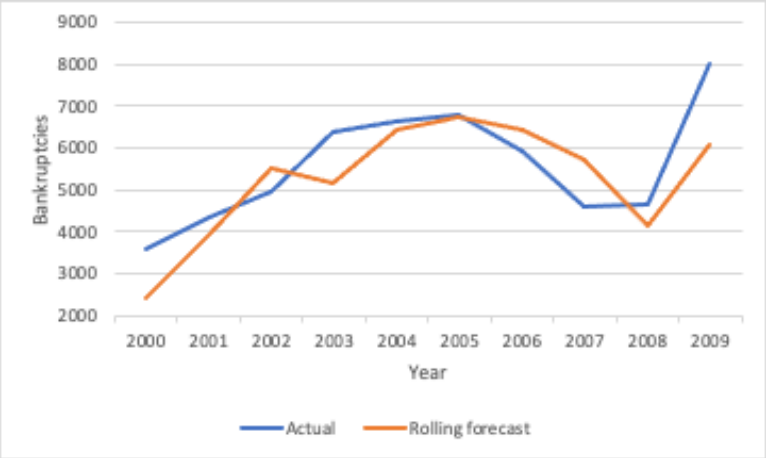
5.3 Forecasted versus actual number of bankruptcies during crisis years

I use a VAR multivariate time series forecasting model to predict the number of bankruptcies for the years 2000-2021. The results of this forecast and the forecast errors are shown in

Appendix B. In Figure 1, the actual number of bankruptcies in the Netherlands is compared with the rolling forecasted number of bankruptcies for the period 2000-2009.

Figure 1:

Forecasted versus actual number of bankruptcies during the period 2000-2009



The rolling forecast predicted 5,700 bankruptcies in 2007, followed by 4,126 bankruptcies in 2008 and 6,089 in 2009. In 2007 there were 4,602 actual bankruptcies in the Netherlands. In 2008 and 2009, the actual number of bankruptcies were 4,637 and 7,987 respectively. The question is whether these errors significantly differ from the forecast errors in the years 2000-2006. The forecast errors for the years 2000-2009 are regressed on a crisis-dummy and the control variables CPI_MUT and AEX. The regression results are shown in Table 5.

Table 5

Regression results bankruptcy forecast errors on financial crisis crisis-dummy

Variable	Coefficient	T-stat (p-value)
$Intercept$	-767.59	-0.46 (0.663)
$CRISIS$	-64.69	-0.08 (0.940)*
CPI_MUT	-5.85	-0.02 (0.987)**
AEX	1.11	0.34 (0.742)
R^2 (Adjusted R^2)	0.0250 (-0.4625)	
Observations	30	

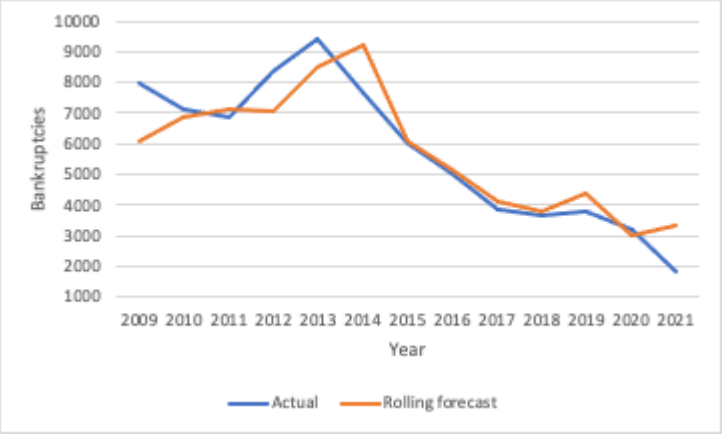
Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the crisis-dummy on the forecast errors. The crisis-dummy equals 1 in the years 2007-2009, and 0 in the years 2000-2006. See Appendix B for the forecast errors over these periods. *, **, *** denotes statistical significance at the 10%, 5% 1% level respectively (one-tailed).

As you can see, the coefficient of $CRISIS$ is negatively and significantly correlated with the forecast errors. A negative forecast error means that the forecasted value is higher than the

actual value. So, this indicates that the number of bankruptcies in the Netherlands was lower than normal during the financial crisis. An increase in CPI_MUT also led to a lower-than-normal number of bankruptcies during the financial crisis. Lastly, an increase in AEX resulted in a higher-than-normal number of bankruptcies during the financial crisis. The coefficient of CPI_MUT is statistically significant while AEX is not significant. The R-squared of the regression model is only 0.02, which results in an adjusted R-squared of -0.46. So, the independent variables in this regression model do not explain much in the variation of the forecast errors. The same rolling forecast method is used to predict the number of bankruptcies in the years 2010-2021. The forecasts and forecast errors are shown in Appendix B. In Figure 2 the actual number of bankruptcies in the Netherlands is compared with the rolling forecasted numbers of bankruptcies for the period 2009-2021.

Figure 2:

Forecasted versus actual number of bankruptcies during the COVID-19 pandemic



The rolling forecast predicted a total number of bankruptcies of 2,978 in 2020 and 3,352 in 2021. The actual number of bankruptcies in the Netherlands was 3,177 and 1,818 respectively. This results in a forecast error of 199 in 2020 and 1,534 in 2021. Based on Figure 2, it looks like the rolling forecast is pretty accurate. All the forecast errors for the years 2009-2021 are regressed on a crisis-dummy and the control variables CPI_MUT and AEX. These regression results are shown in Table 6.

Table 6

Regression results bankruptcies forecast errors on COVID-19 pandemic crisis-dummy

Variable	Coefficient	T-stat (p-value)
$Intercept$	-2,254.48	-2.60 (0.029)**
$CRISIS$	-1,080.01	-1.89 (0.091)*
CPI_MUT	-149.26	-0.53 (0.611)
AEX	5.81	3.22 (0.011)**
R^2 (Adjusted R^2)	0.5406 (0.3874)	
Observations	39	

Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the crisis-dummy on the forecast errors. The crisis-dummy equals 1 in the years 2020-2021, and 0 in the years 2009, 2020, and 2021. See Appendix B for the forecast errors over these periods. *, **, *** denotes statistical significance at the 10%, 5% 1% level respectively (one-tailed).

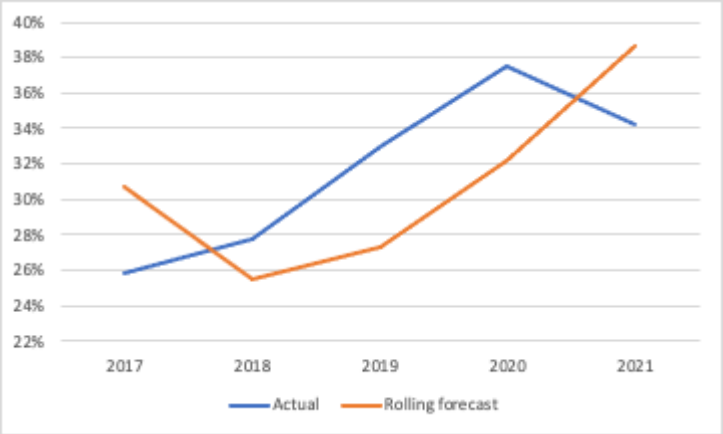
Again, the crisis-dummy coefficient is negative and significant at a 10% significance level. In the COVID-19 pandemic crisis years, the forecast error decreased by approximately 1,080. A negative forecast error means that the forecasted values are higher than the actual values. This indicates a lower-than-normal number of bankruptcies during the crisis years. CPI_MUT also has a negative value but is insignificant. On the other hand, the coefficient of AEX has a positive sign. The coefficient of AEX is also significant at a 5% significance level. So, an increase in the close price of the AEX at year end is associated with a higher forecast error. CPI_MUT is not significant, and therefore it is not clear what effect the yearly CPI mutation has on the forecast errors. While the R-squared and adjusted R-squared of the regression model for H2a are 0.02 and -0.46 respectively, the regression model for H2b has an R-squared of 0.54 and an adjusted R-squared of 0.39. So, the regression model for H2b explains the observed data by 39%.

5.4 Forecasted versus actual percentage of zombie companies during crisis years

To predict the percentage of zombie companies in the Netherlands, I use a VAR multivariate time series forecast model to perform a rolling forecast. The results of this rolling forecast and the forecast errors are shown in Appendix B. In Figure 3, the actual percentage of zombie companies in the Netherlands and the forecasted percentage of zombie companies in the Netherlands are presented.

Figure 3:

Forecasted versus actual percentage of zombie companies during the COVID-19 pandemic



For the COVID-19 pandemic crisis year 2020, the actual percentage of zombie companies in the Netherlands was 38%. The rolling forecast estimated a percentage of 32. For the other crisis year, the model predicted that 39% of the companies in the Netherlands were zombies. But only 34% of the companies were zombies. The forecast errors over the period 2017-2021 are regressed on a crisis-dummy and the control variable $INTEREST$. The results of this regression are shown in Table 7.

Table 7

Regression results zombie companies forecast errors on COVID-19 pandemic crisis-dummy

Variable	Coefficient	T-stat (p-value)
$Intercept$	-0.06	-2.97 (0.097)*
$CRISIS$	0.10	2.87 (0.103)
$INTEREST$	17.90	3.67 (0.067)*
R^2 (Adjusted R^2)	0.8709 (0.7419)	
Observations	10	

Notes: This table shows the OLS regression coefficients, T-stats, and (in parentheses) p-values for the regressions of the crisis-dummy and control variable on the forecast errors. The crisis-dummy equals 1 in the years 2020-2021, and 0 in the years 2017-2019. See Appendix B for the forecast errors over these periods. *, **, *** denotes statistical significance at the 10%, 5% 1% level respectively (one-tailed).

The coefficient of the crisis-dummy has a positive value of 0.10. This indicates that in crisis years, the forecast errors are higher than in normal years. An increase in the forecast error means that the actual value becomes bigger relative to the forecasted error. The interest rate is also positively correlated with the forecast errors and has a coefficient of 17.90. The interest rate coefficient is significant at a 10% significance level. But on the other hand, the crisis-dummy has a p-value of 0.103. This is just outside the 10% significance margin. Thus, the coefficient is not significant and therefore it remains unclear whether the percentage of

zombie companies in the Netherlands was higher than normal or not. The R-squared and adjusted R-squared of the regression model are quite high. With an adjusted R-squared of 0.74, the model explains 74% of the forecast error observations.

Chapter 6: Conclusion & Discussion

6.1 Conclusion

On the 1st of April 2022, the Dutch government ended their last remaining subsidies that were provided to deal with the negative consequences of the COVID-19 pandemic. The Dutch Chamber of Commerce expected an increase in the number of bankruptcies for April and May (KVK, 2022). But the opposite happened. The number of bankruptcies in the Netherlands was never so low as in April 2022. May 2022 saw an increase in the number of bankruptcies, but the amount was still lower than before the COVID-19 pandemic.

The historical low number of bankruptcies is contrary to the existing literature on subsidies. According to Nurmi, Vahala & Virén (2020), the death rate of unsubsidized firms is higher than the death rate of subsidized firms. Since the government-provided subsidies have ended, the death rate of firms should increase which increases the number of bankruptcies. The three most considerable subsidies the Dutch government provided are the NOW, TVL, and Tozo subsidies. Companies that lost revenue due to the COVID-19 pandemic could apply for NOW subsidy. With this money, firms can continue to pay their employees. The TVL subsidy was provided to help companies with paying their fixed costs, such as rent expenses. The third biggest subsidy is Tozo which was provided to support self-employed people. In the crisis years 2020 and 2021, the Dutch government spent 23.29 billion euros on NOW subsidies, 7.56 billion euros on TVL, and 4.33 billion euros on Tozo. Further existing literature shows mixed results on the effect of subsidies on the economy. According to Tzelepis & Skuras (2004), subsidies improve the economic growth of the society. And Hud & Hussinger (2015) show that subsidies have a positive effect on R&D investment behaviour. But on the other hand, Bergström (2000) found that subsidies harm the total factor productivity growth of companies in the long term. Existing literature was conscientious regarding the effect of subsidies on the number of zombie companies. Both Nurmi, Vanhala & Virén (2020) and Chang, Zhou, Liu, Wang & Zhang (2021) found that subsidies are positively correlated with the number of zombie companies. If governments provide more subsidies, the number of zombie companies increases.

Based on the existing literature, I formulated three different hypotheses. The first hypothesis states that the NOW subsidy (H1a), TVL subsidy (H1b), and Tozo subsidy (H1c) decreased the number of bankruptcies during the COVID-19 pandemic. Against the expectations, the coefficients of NOW, TVL, and Tozo were positive. Besides that, only the Tozo variable was significant at a 10% significance level. Thus, H1a, H1b, and H1c are rejected. The second hypothesis states that the number of bankruptcies during crisis years is lower than in normal years. This hypothesis is tested for two periods: the financial crisis of 2007-2009 (H2a) and the COVID-19 pandemic years 2020-2021 (H2b). For H2a, the crisis-dummy coefficient was negative and significant at a 10% significance level. So, this hypothesis is accepted, the number of bankruptcies in the Netherlands during the financial crisis was lower-than-normal. The crisis dummy coefficient for H2b was also negative and statistically significant. So, H2b is also accepted. During the COVID-19 pandemic, the number of bankruptcies was lower than normal. The third hypothesis states that subsidies increased the

number of zombie companies in the Netherlands during the COVID-19 pandemic. This hypothesis is rejected. The crisis-dummy coefficient was positive, but insignificant. Based on the three hypotheses, an answer to the following research question can be given:

> *"How much did the received corona subsidies affect the financial health of Dutch companies during the COVID-19 pandemic?"*

The financial health of companies can be measured in two ways. A first measure of financial health is the number of bankruptcies. A decrease in bankruptcies indicates an increase in the financial health (Nurmi, Vanhala & Virén, 2020). During the COVID-19 pandemic crisis years, the number of bankruptcies in the Netherlands was lower than in normal years. This would be in line with the existing literature which states that subsidies decrease the number of bankruptcies. But the NOW and TVL subsidies did not significantly increase or decrease the financial health of Dutch companies during the COVID-19 pandemic. And the Tozo subsidy was positively and significantly correlated with the number of bankruptcies in the Netherlands. Thus, this subsidy had a negative effect on the financial health of Dutch companies during the COVID-19 pandemic. My findings regarding the Tozo subsidy are contrary to the existing literature. If the decrease in bankruptcies is not caused by the provided subsidies, there must be other economic explanations. For example, entrepreneurs could apply for a special tax deferral (Rijksoverheid, 2022b). Such a measure increases the profit after tax of companies, which affects the financial health of companies positively. Another measure of financial health is the number of zombie companies. If the number of zombie companies increased, the financial health of companies has decreased (Chang, Zhou, Liu, Wang & Zhang, 2021). Existing literature found that subsidies increase the number of zombie companies. But during the COVID-19 pandemic, the percentage of zombie companies in the Netherlands was not significantly different than in normal years. This is also conflicting with the existing literature. A possible explanation for this is the amount of subsidy provided. If the Dutch government had provided more subsidies, more companies would be able to survive despite their inability to cover debt servicing costs from their current profits. Another explanation could be the way companies report the subsidies. If they report it as a part of their revenue, or as a reduction in cost, the ICR is not affected.

6.2 Discussion

This research has some shortcomings. First of all, the operationalization of the concept financial health. The number of bankruptcies and percentage of zombie companies are reasonable variables to capture the underlying concept of financial health. But measures such as liquidity, solvency, or profitability might be better variables to capture the financial health of companies. Another limitation is the moment of doing this research. The COVID-19 pandemic has barely ended, thus it might be too soon to make conclusions. Credit insurers Atradius and Allianz Trade expect a surge in the number of bankruptcies in the Netherlands (Ouwerkerk, 2022a; Ouwerkerk, 2022b). Because the government-provided subsidies have

come to an end, Atradius foresees an increase of 101% in the number of bankruptcies for the year 2022 and an increase of 19% in 2023. If this is true, the results of this research might be different. A third limitation of this research is the amount of data used for hypothesis 3. Over the period 2011-2021, there were 3,384 ICR observations. That is data of approximately 308 companies per year. The lack of data is a limitation because it affects the validity of this study. To solve this problem, I used a relative number of zombie companies in the Netherlands. But since the total number of enterprises in the Netherlands was around 2 million at the end of 2021, a sample of 0.015% of the total amount might not be representative. Unfortunately, I was not able to find datasets with more ICR observations. Because the data were only available for such a short period, I considered a company as a zombie if it had an ICR below one in one of the 11 years. So, if a firm had sustainable profits in 10 of the 11 years and was not able to cover debt servicing costs from its profits in one of the 11 years, the company is still considered as a zombie. This might give a wrong view on the number and percentage of zombie companies.

These limitations lead to recommendations for future research. Because it might be too early to make conclusions about the effect of the government-provided subsidies during the COVID-19 pandemic, future research should take the subsidy costs and number of bankruptcies in 2022 and 2023 into account. Another recommendation for future research is to test what the effect of subsidies was on the number of bankruptcies and zombie companies during the COVID-19 pandemic in other countries. If it turns out that a different kind of subsidy decreased both the number of bankruptcies and zombie companies, governments can use that information for future crises. Lastly, the benchmark to be considered as zombie company could be changed to three or more years. This results in a more accurate view on the number and percentage of zombie companies in the Netherlands, because one-time special decreases in profits are left out of the research.

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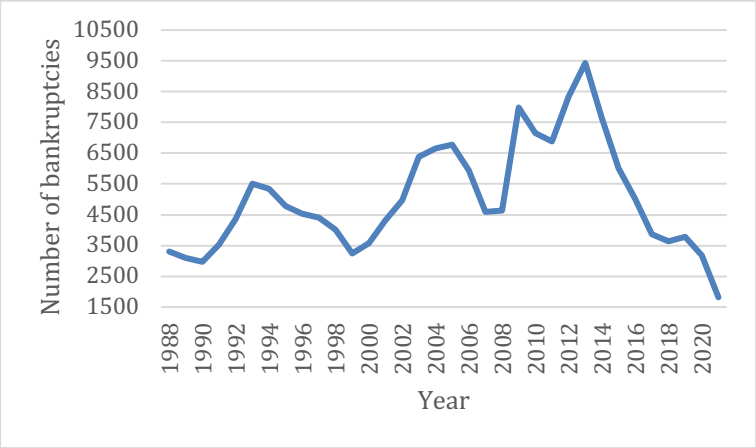
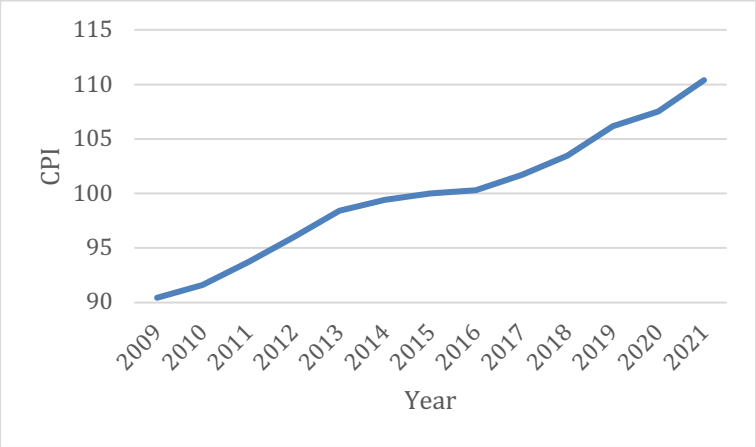
Appendix A:

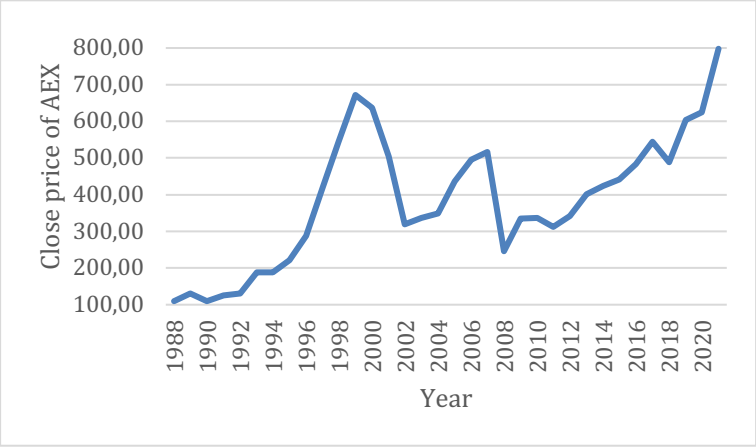
Yearly number of bankruptcies in the Netherlands over time



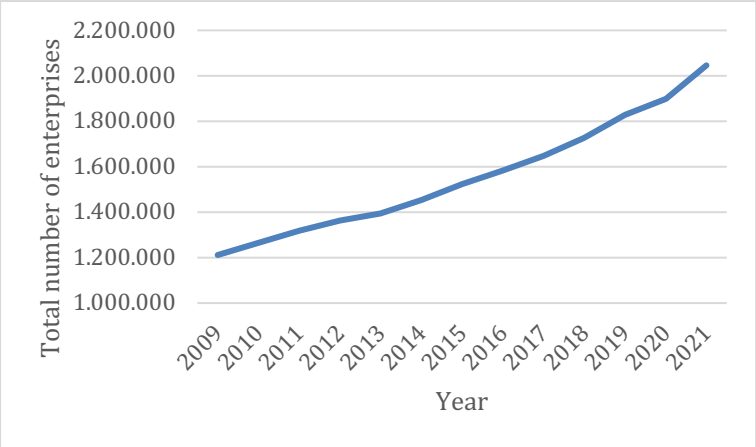
CPI in the Netherlands over time



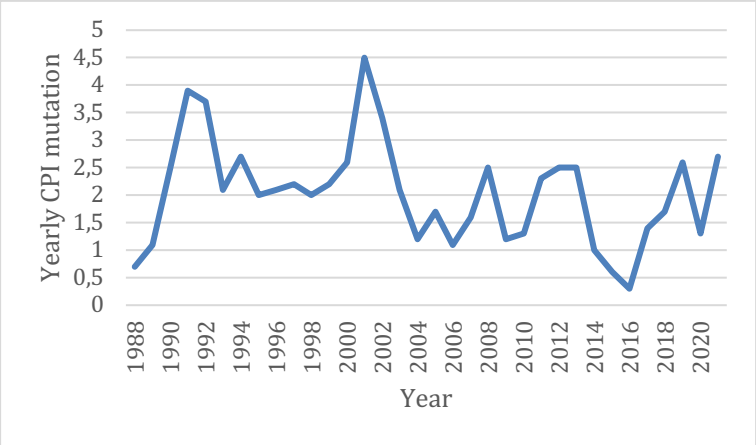
Close price of the AEX at year end over time



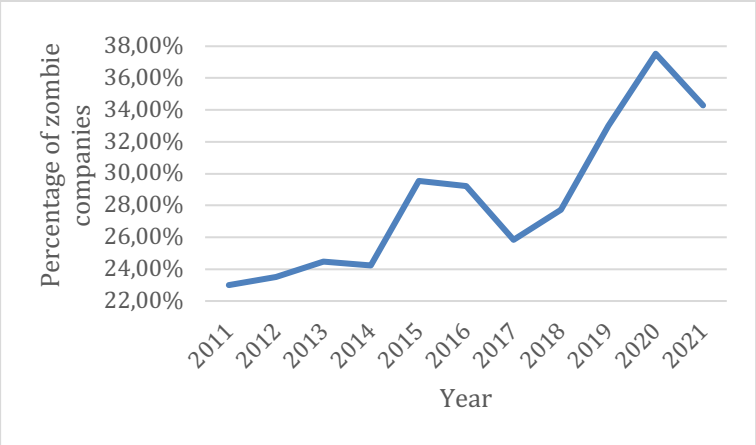
Total number of enterprises in the Netherlands over time



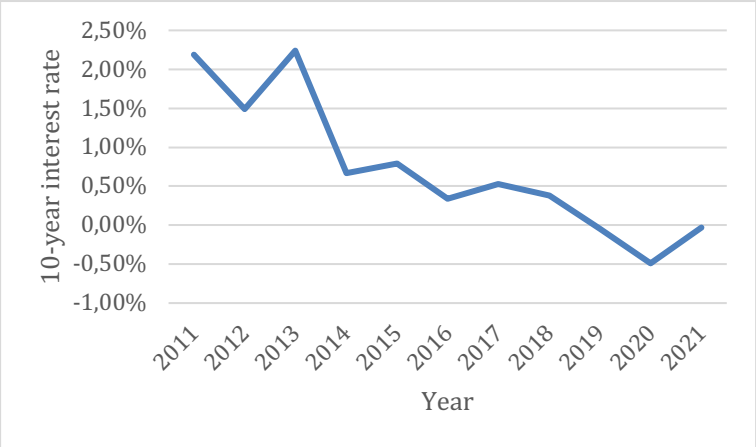
Yearly CPI mutation in the Netherlands over time



Percentage of zombie companies in the Netherlands over time



10-year interest rate in the Netherlands over time



Appendix B

Actual number of bankruptcies, forecasted number of bankruptcies, and forecast errors

Year	Actual	Forecast	Forecast error	Year	Actual	Forecast	Forecast error
2000	3,579	2,405	-1,174	2009	7,987	6,089	-1,898
2001	4,330	3,920	-410	2010	7,147	6,861	-286
2002	4,963	5,511	548	2011	6,883	7,122	239
2003	6,386	5,184	-1,202	2012	8,346	7,060	-1,286
2004	6,648	6,422	-226	2013	9,431	8,508	-923
2005	6,780	6,718	-62	2014	7,621	9,211	1,590
2006	5,941	6,412	471	2015	6,006	6,049	43
2007	4,602	5,700	1,098	2016	5,012	5,136	124
2008	4,637	4,126	511	2017	3,867	4,098	231
2009	7,987	6,089	1,898	2018	3,633	3,779	146
				2019	3,792	4,403	611
				2020	3,177	2,978	-199
				2020	1,818	3,352	1,534

Notes: This table shows the actual number of bankruptcies in the Netherlands, forecasted number of bankruptcies in the Netherlands and the forecast errors. The numbers on the left are used for the regression model of H2a. And the numbers on the right are used for the regression model of H2b.

Actual percentage of zombie companies, forecasted percentage, and forecast errors

Year	Actual	Forecast	Forecast error
2017	25.84%	30.75%	4.91%
2018	27.73%	25.55%	-2.18%
2019	32.99%	27.34%	-5.65%
2020	37.53%	32.17%	-5.36%
2021	34.27%	38.67%	4.40%

Notes: This table shows the actual percentage of zombie companies in the Netherlands, forecasted percentage of zombie companies in the Netherlands and the forecast errors. These numbers are used for the regression model of H3.