



# Has the negative interest rate environment changed the financing structure of firms?

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## **ABSTRACT:**

In June 2014, the European Central Bank (ECB) cut its deposit facility rate by 10 basis points, setting it into negative territory in an attempt to stimulate economic growth. This new unconventional monetary policy tool's effectiveness is being extensively studied, mostly focused on the impact on banks, without reaching a consensus yet. In contrast, this dissertation focuses on non-financial firms, aiming to understand the potential impact of the negative interest rates environment on their financing structure. Taking a methodological approach similar to Bougheas et al. (2006), we confirm that constrained firms (smaller, riskier, and with less collateral) are more vulnerable (have more short-term debt) to a monetary policy tightening. The negative rates environment's impact is modest, with riskier firms containing their level of external finance relative to other periods.

**Keywords:** Negative interest rates; Monetary policy transmission; External finance

# **O ambiente de taxas de juro negativas alterou a estrutura de financiamento das empresas?**

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## **RESUMO:**

Em Junho de 2014, o Banco Central Europeu (BCE) diminuiu a taxa de juro que cobra aos bancos nos seus depósitos em 10 pontos base, atingindo pela primeira vez valores negativos, com o objectivo de estimular o crescimento económico. A eficácia deste novo mecanismo de transmissão de política monetária tem vindo a ser extensivamente estudada, principalmente na perspectiva dos bancos, sem que se tenha chegado a um consenso. No entanto, esta dissertação tem como foco empresas não financeiras, com o objectivo de entender se a introdução de taxas de juro negativas teve algum impacto nas suas decisões de financiamento. Utilizando uma metodologia semelhante à de Bougheas et al. (2006), concluímos que empresas mais constrangidas (mais pequenas, com mais risco, e com menos colateral), estão mais susceptíveis (têm mais dívida de curto prazo) a uma política monetária mais restritiva. O ambiente de taxas de juro negativas tem um impacto reduzido, sendo que as empresas mais arriscadas contêm o seu financiamento externo relativamente a outros períodos.

**Palavras-chave:** Taxas de juro negativas; Transmissão de política monetária; Financiamento Externo



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### **III – LIST OF ABBREVIATIONS**

- APP** – Asset purchase programme
- CSPP** – Corporate sector purchase programme
- D/E** – Debt over equity
- EA** – Euro Area
- EBIT** – Earnings before interests and taxes
- ECB** – European Central Bank
- EONIA** – Euro Overnight Index Average
- L** – Listed
- LTRO** – Long term refinancing operations
- NIRP** – Negative interest rate policy
- NL** – Non-listed
- PSPP** – Public sector purchase programme
- ROE** – Return on equity
- SIC** – Standard industry code
- US** – United States
- UK** – United Kingdom
- WS** – Worldscope
- ZLB** – Zero lower bound

## 1. INTRODUCTION

The 2007-09 financial crisis had severe consequences all around the world. By the summer of 2007, global financial markets were beginning to show signs of financial distress. To increase market liquidity, the European Central Bank (ECB) increased liquidity provisions via a new facility, Long Term Refinancing Operations (LTRO's), and new special operations. Although the global financial crisis was mostly resolved by 2009, Europe was then hit with a severe sovereign debt crisis. Portugal, Ireland, Italy, Greece, and Spain were the most affected countries, as they had serious difficulties in repaying or refinance their government debt.

Additionally, to counteract the deflationary and low economic growth environment that Europe was experiencing, in June 2014, the ECB cut its deposit facility rate by 10 basis points, lowering it to -0.1%. For the first time, the Euro Area (EA) was experiencing negative nominal interest rates. To support and amplify the consequences of the negative interest rate policy (NIRP), the ECB launched several assets purchase programs (APP), such as the corporate sector purchase programme (CSPP), the public sector purchase programme (PSPP), among others, amounting to a total of over 240 billion euros. In their study to assess the consequences of negative interest rates in the banking sector, Demiralp et al. (2017) found that these two unconventional monetary policy tools of the ECB complement each other in stimulating economic growth.

Before the ECB and other central banks' decrease of interest rates into negative territory, the conventional wisdom was that there was a zero lower bound (ZLB) on nominal interest rates. Given that you can store your money as currency and not having it lose value (in nominal terms), why would you lend it at a cost for you? However, Kiley and Roberts (2017) estimate that from now on, the ZLB will only be binding 30-40 percent of the time.

The main transmission mechanism of monetary policy analyzed under negative interest rates is the banking channel: central banks decrease the policy rate, which in turn reduces the cost of funding for banks, decreasing the interest rate banks charge on loans and thus increasing credit supply and economic growth. Does this transmission mechanism prevail in a negative interest rate environment? Eggertsson et al. (2017) and Heider et al. (2019) find that it has limited effect, but Altavilla et al. (2019) states it becomes stronger as interest rates decrease into more negative territory.

There is no consensus yet in the literature on whether negative interest rates have an expansionary effect on the economy. However, most literature focuses on the bank side of the

equation. This dissertation aims to analyze the consequences of negative interest rates in non-financial firms' debt structure.

The finance theory is not clear on what the relationship is between interest rates and leverage. Market timing theory argues that there is a negative relationship, as it states that firms issue debt when interest rates decrease. However, the trade-off theory does not provide such a clear answer, as it argues that it depends on whether the firm is targeting a debt level or a leverage ratio.

As for the finance theory, empirical evidence is not clear on this topic. Karpavičius and Yu (2017) and Frank and Goyal (2004) find no relationship between interest rates and leverage, but Graham and Harvey (2001) find that managers take into account interest rates when deciding the level of debt.

This dissertation tries to combine these two themes of the literature under a specific circumstance: what are the consequences of negative interest rates in a firm's debt structure? To answer this question, we somewhat replicate the methodology of Bougheas et al. (2006) and extend it to account for possible changes in relationships with the negative interest rate environment.

We created a database with non-financial firms from all nineteen countries in the EA from 2010 to 2020. The sample was divided into listed (L) and non-listed (NL) firms, and we ran the regressions for the entire sample and only the listed firms separately.

We set two different dependent variables: *short-term debt to total debt* and *total debt to total liabilities*. The first variable captures the relationship between market and bank finance, whereas the second captures the extent of firms' external finance.

Then, we set multiple independent variables: *Level* (Euro Overnight Index Average, EONIA) and *Slope* (the difference between the 10-year overnight indexed swap and the 3-month Euribor) to capture the impact of interest rates; and multiple firm-specific characteristics, such as *Size* (logarithm of total assets) and *Collateral* (tangible assets over total assets), that can explain some of the differences in debt levels for different firms. To assess a firm's risk level, we created two variables, *Risk (NL)* (Altman, 1968), which we used for the entire sample, and *Risk (L)* (Altman, 2013), which we only used for the listed firms, using the Altman Z-Score. We also introduced four different sets of controls with fixed effects.

We used panel regression methods, first with all explanatory variables alone for both dependent variables with the four different sets of controls. Then, to better understand the impact of

interest rates on a firm's debt structure, we added interaction terms between all firm-specific characteristics and *Level*. Finally, to further assess the effects of negative interest rates, we added a second interaction term between all firm-specific characteristics, *Level* and *NIRP*, a dummy variable set equal to 1 for the period after June 2014, when the ECB reached negative policy rates, and 0 otherwise.

Overall, in line with previous studies, we find that more constrained firms (smaller, riskier, and with less collateral) are more susceptible to a tightening monetary policy. However, the negative interest rate environment does not significantly impact firms' financing decisions.

We found that both *Size* and *Collateral* are the firm's characteristics that better explain the changes in the financing structure. In line with the literature (Bougheas et al. 2006), we found that bigger firms finance themselves using longer-term debt (lower *short-term debt to total debt* ratio), but that effect is weakened as interest rates decrease. This is in line with several studies suggesting that more constrained firms (smaller and with less collateral) are more vulnerable to a monetary policy tightening.

This study is organized into seven chapters. Chapter 2 introduces the literature review on negative interest rates and the impact of interest rates on firms' leverage. Chapter 3 describes the data and methodology used. In chapter 4, we discuss the results found and compare them to the literature. In chapter 5, we present our conclusions, limitations of this study, and potential further research. Finally, chapter 6 lists the references, and chapter 7 presents the appendix.

## **2. LITERATURE REVIEW**

This section introduces the relevant literature and theory in order to contextualize the present dissertation.

Following the more than one decade of economic and financial crisis, several central banks have set their policy rates below the zero lower bound for the first time in history. In June 2014, the ECB set its policy rate at -0.1% in an attempt to stimulate economic growth.

Before that, the conventional wisdom was that there was a zero lower bound on nominal interest rates: why would you lend for less return in the future if you can just save it as currency? However, Kiley and Roberts (2017) estimate that from now on, the ZLB will only be binding 30-40 percent of the time.

### **2.1 Negative Interest Rates**

Negative interest rates and their effectiveness as a policy tool, as well as their economic consequences, have been subjects of several studies in the past few years, with no consensus being reached yet. However, the literature is more focused on the impact of negative interest rates on banks and not on non-financial firms.

When looking for the effects of negative interest rates on banks, the bank lending channel is one of the focal points of the analysis. It is one of the most common transmission mechanisms of monetary policy in normal times, when policy rates are positive. The main idea is that central banks, by decreasing the policy rate, decrease the cost of funding for banks, which in turn decreases the interest rate charged on loans, increasing the credit supply and thus economic activity. However, in a scenario of negative interest rates, this may not hold. Eggertsson et al. (2017) state that once interest rates reach negative values, the bank lending channel has limited effect. A possible explanation for this channel's weakness is the fact that banks hesitate to pass on negative interest rates to deposits. Thus, banks that are more dependent on deposits will increase their financing costs and experience a consequent decrease in net worth compared to banks less dependent on deposit financing (Heider et al. 2019). Their results also show that different banks respond differently, with high-deposit banks reacting by decreasing loan supply and increasing their borrowers' risk profile, which potentially limits the financial stimulus. Another related explanation could be that there is a "reversal interest rate", a rate at which monetary policy becomes contractionary for lending, as Brunnermeier and Koby (2018) argue. Although they argue that this "reversal rate" does not necessarily have to be zero, potentially being higher or lower, once the policy rate is below that value, lending decreases.

Although banks are resistant to charge negative interest rates to household deposits, it seems that solid banks are able to charge negative interest rates on their corporate deposits (Altavilla et al. 2019). Given that household deposits tend to be lower in amount, it is easier to convert those deposits into cash if the banks were to charge negative rates on them. The same does not hold true when it comes to corporate deposits. Altavilla et al. (2019) also argue that this pass-through effect becomes stronger as rates decrease into more negative territory because firms tend to decrease their liquid asset holdings and increase their investment in tangible and intangible assets. In line with these findings, Eisenschmidt and Smets (2019) state that the interest rate pass-through mechanism remains unchanged with the introduction of negative policy rates and that banks increase lending in an attempt to reduce their excess liquidity holdings.

Considering that bank's liquidity seems to play a key role in assessing the effectiveness of the banking channel, Demiralp et al. (2017) include the bank's level of excess liquidity in addition to the bank's deposit intensity to assess the consequences of negative interest rates. They argue that the decrease in their interest rate margin, caused by the difficulty in transmitting negative rates to deposits, is complemented by their ability to convert their excess liquidity (that now earns negative interest rates) into higher yield assets, such as loans. With this, they argue that there is a strong complementarity between two of the central bank's policy tools: NIRP and asset purchase programs, given that the latter aims to increase liquidity in the banking system.

## **2.2 Firms' financing decisions**

As previously mentioned, the literature is mostly focused on the impact of negative interest rates on banks and not on firms directly. In this regard, a critical question has arisen: Is there any relationship between interest rates and the firm's leverage? Since there is no clear answer in finance theory, our analysis aims to assess if there is a correlation between this unconventional monetary policy and firms' financing structure.

Even though there is no clear answer in finance theory, some theories approach this topic.

Market timing theory states that firms should be willing to sell bonds when interest rates are low and reluctant to issue debt securities when interest rates are high to take advantage of market fluctuations. Both Huang and Ritter (2005) and Baker and Wurgler (2002) found evidence supporting this theory.

According to the trade-off theory, there are both benefits and costs of holding debt, and a firm sets a level such that the net benefits are maximized (Hackbarth et al. 2007). The benefits are

the interest tax-shield, and the costs are those associated with financial distress. Whether a firm targets a debt level or a debt-to-asset ratio will change the theory's implications. A firm that targets a debt level (i.e., debt is constant) has an interest tax-shield that does not depend on interest rates but only on the effective tax rate. Therefore, a change in interest rates would only impact the costs associated with financial distress. If a firm targets a debt ratio (i.e., constant leverage ratio), both benefits and costs of debt change with interest rates, so depending on their magnitude, the relationship between interest rates and leverage will vary.

So, a negative relationship between interest rates and leverage would mean that firms are timing the market and/or target a debt level or leverage ratio. A positive or no relation would imply that firms target a leverage ratio and do not time the market, or at least, the market timing is not dominant.

As the financial theory, the empirical evidence on this topic also presents mixed results. An analysis of the United States (US) industrial firms' capital structures by Karpavičius and Yu (2017) finds no relation or slightly negative relation between interest rates and leverage. The same result is not only found for debt but also equity in a study conducted by Frank and Goyal (2004) of all US public non-financial firms.

However, Graham and Harvey (2001) conduct a survey that found that managers take into account the level of interest rate when deciding the debt level. So, firms are more likely to issue debt in periods of low interest rates, consistent with market timing theory.

Also, Bougheas et al. (2006) find that the credit channel, together with the banking channel, are important mechanisms of transmission of monetary policy. Using a theoretical model, they show that a firm's debt structure varies not only with the monetary cycle but also with firm-specific characteristics. Smaller, younger, and riskier firms are more affected by a tight interest rate environment.

Furthermore, besides the fact that there is no consensus on literature, neither of the past studies or theories' analysis considers a scenario of negative interest rates.

### **3. DATA AND METHODOLOGY**

This section presents a discussion about the data, how it was collected, and its treatment, and it also presents the research methodology.

#### **3.1 Data**

The data on firms was collected from the Wharton Research Data Services' Worldscope (WS) database. Using the variable Nation, the Euro Area companies were filtered to form the dataset. Only private non-financial firms were considered for the analysis. Thus, from the previous dataset, financial and public administration firms were removed using the respective Standard Industry Code (SIC).

Data has a quarterly frequency, and the timespan used was from 2010Q1 to 2020Q3. Given that the first time the ECB decreased its policy interest rate to negative values was in June 2014, we get roughly the same number of observations before and after NIRP.

#### **3.2 Dependent Variables**

Following the same approach as Bougheas et al. (2006), two different dependent variables were defined: *short-term debt to total debt* and *total debt to total liabilities*. To compute these ratios, we used the WS variables *Short Term Debt & Current Portion of Long-Term Debt*, *Total Debt*, and *Total Liabilities*. The first one tries to capture the relationship between market and bank finance, as firms tend to issue longer-term bonds and the majority of short-term debt is bank finance. The second variable shows the extension of a firm's external finance.

#### **3.3 Independent Variables**

Consistent with Bougheas et al. (2006), multiple variables were set to capture firm-specific aspects presented below.

*Size* is the logarithm of Total Assets. Bougheas et al. (2006) try to give a more accurate measure of size by deflating the nominal total assets by the sectoral price index. However, the sample only included firms from the United Kingdom (UK). In this case, the sectoral price index would have to be discriminated by country as well, given that the sample includes non-financial firms from all nineteen countries of the EA. Given that there is no sectoral price index for every country, we were unable to follow the same methodological approach. To minimize the problem associated with different sectors' evolution, the results were controlled for both country and industry (using the SIC Code classification).

*Risk* measures a firm's likelihood of default. This probability is assessed using the Altman Z-Score (Altman, 1968). Given that the Altman Z-Score is calculated differently for listed (Equation 1) and unlisted (Equation 2) firms, and that both types are present in the sample, two measures of risk were created: one for the entire sample, where we use the unlisted equation, and another only for the listed firms using the respective Z-Score method (Altman, 2013).

$$zScore(L) = 1.2 * X_1 + 1.4 * X_2B + 3.3 * X_3C + 0.6 * X_4D + 1.0 * X_5E \quad (1)$$

$$zScore(NL) = 0.717 * X_1 + 0.847 * X_2 + 3.107 * X_3 + 0.420 * X_4' + 0.998 * X_5 \quad (2)$$

In both formulas,  $X_1$  is the ratio between working capital and total assets,  $X_2$  is retained earnings over total assets,  $X_3$  is the ratio between earnings before interests and taxes (EBIT) and total assets, and  $X_5$  is sales over total assets. For the listed (L),  $X_4$  is the market value of equity over total liabilities, whereas for the non-listed (NL),  $X_4'$  is the book value of equity over total liabilities. We computed all of these ratios using the variables available on the Worldscope database.

We used five more measures of firm-specific characteristics: *Age*, computed as the difference between the founding year, using WS variable *Date Company Founded* (if this field was missing, we used the first year available in the dataset as the founding year) and the year of the observed time period; *Profit*, measured by return on equity (ROE); *Collateral*, the proportion of total assets that are tangible, calculated using the sum of *Inventories* and *Property, plant and equipment* as a proxy for tangible assets, considering that WS did not have a specific variable for tangible assets; *Gearing*, a measure of the existing level of indebtedness measured by total debt over total equity (D/E); and *Listed*, a dummy variable that equals 1 if the firm was listed for the entire period, and 0 otherwise.

To assess the impact of interest rates, we added three explanatory variables: *Level*, captured by EONIA, *Slope*, defined as the difference between the 10-year overnight indexed swap and the 3-month Euribor, and *NIRP*, a dummy variable that is set equal to 1 if the *Level* is negative, and 0 otherwise. In practice, *NIRP* takes the value 1 from 2014Q4 onwards (inclusive). The values used to compute the variables *Level* and *Slope* were end of period values. All these values were collected from Thomson Reuters Datastream.

Below, Table 1 presents the summary statistics of our sample. It shows that the average *Size* of a firm in the sample is 5.2 billion euros. However, looking at the median value (335 million euros), we can see that the distribution is positively skewed. The majority of the firms in our

sample (75%) have an amount of total assets of less than 1.8 billion euros. *Collateral* has an unbiased distribution, with both the average and the median value of 0.4. This means that the sample's average firm has roughly 40% of tangible assets on its balance sheet.

Table 1 – Summary Statistics

	<b>Unit</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Q25</b>	<b>Median</b>	<b>Q75</b>
Risk (L)	score	35 389	4.850	346.583	0.564	1.266	2.236
Risk (NL)	score	36 649	0.139	408.635	0.414	0.799	1.237
Size	m€	43 344	5 169 394	22 279 443	83 955	335 278	1 800 998
Collateral	pp	43 290	0.399	0.250	0.195	0.400	0.588
Gearing	%	42 411	119.059	10 888	18.641	58.988	123.077
Profit	pp	44 781	-8.853	473.219	-2.622	7.002	14.644
Age	years	84 117	27	40.260	0	7	38
Level	%	84 079	0.081	0.396	-0.346	0.085	0.39
NIRP		84 079	0.440	0.496	0	0	1
Slope	%	84 079	1.248	0.593	0.814	1.216	1.588
Total debt to total liabilities	pp	42 228	0.944	1.445	0.316	0.531	0.737
Short-term debt to total debt	pp	40 656	0.400	0.307	0.142	0.331	0.612

### 3.4 Regression

In order to answer the research question, we followed a panel regression analysis. To estimate the relationship between the financial leverage of firms and their specific characteristics, the below regression was run:

$$y_{it} = \alpha + X_{it}\beta + \varepsilon_{it} \quad (3)$$

where *i* refers to the firm, *t* to the time period,  $y_{it}$  and  $X_{it}$  denote the dependent variable and vector of independent variables, respectively, and  $\varepsilon_{it}$  is the error term.

The regressions were run for the entire sample using the risk measure of non-public firms, and only for the public firms using the respective risk measure, and for the two different dependent variables. They were also run controlling for four different fixed effects: country and industry, given that they do not change over time for each firm; firm id, to try and capture unobservable characteristics of the firms that do not vary over time; country-year and industry; and finally, firm id and country-year. The objective of introducing a control of country-year was to capture

the economic cycle, given that we did not introduce a variable in the model that does that. The fixed effects are introduced in an increasing order of complexity and demand of the dataset.

Moreover, to better understand the impact of interest rates on non-financial firms' debt structure, we added interactions between all firm-specific characteristics (*Size, Risk, Age, Profit, Collateral, and Gearing*) and the level of the short-term interest rate, *Level*. The regressions were again run for both dependent variables and with the four different sets of control variables.

Then, to further capture the negative interest rate policy's impact, a triple interaction was added between the firm-specific variables, *Level* and *NIRP*. These regressions were also run for our two dependent variables and with the different controls.

We used standard tests to assess whether the coefficients are statistically different from zero. The results are presented in the next section.

## 4. RESULTS

In this section, we will analyze the regression results and compare them to the literature. First, we will look at the regressions without any interaction terms for both the entire sample and only listed firms. We will then study the results with just one interaction (*Level*) and with both interactions (*Level* and *Level-NIRP*) for the entire sample first and then only for the listed firms.

### 4.1 Full Sample without interactions<sup>1</sup>

The analysis will be split according to the firms' characteristics. We will start by analyzing the size and amount of collateral the firm has, which can be seen in Table 2 and in Table 3 for the share of *short-term debt* and *total debt* as the dependent variable, respectively. The full sample results without any interactions show that the bigger the firm or, the higher the amount of collateral they hold, the smaller the proportion of *short-term debt to total debt*. The results hold regardless of the controls that are included via the fixed effects. This means these firms can finance themselves with more longer-term debt than smaller firms or firms with less collateral. As a firm increases its size or the collateral over time, it can also finance itself for longer maturities. The result is in line with what is expected, as smaller and more constrained firms may tend to use more bank financing, which we proxy here by the short-term debt.

Table 2 – Size and Collateral for short-term debt to total debt without interactions.

Dependent variable: short-term debt to total debt				
	(1)	(2)	(3)	(4)
Size	-0.036*** (0.001)	-0.045*** (0.006)	-0.035*** (0.001)	-0.050*** (0.006)
Collateral	-0.038*** (0.008)	-0.073*** (0.020)	-0.038*** (0.008)	-0.082*** (0.020)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table 3 analyses the results of *Size* and *Collateral* on firms' *total debt*. The results are also in line with what could be expected, i.e., that the bigger the firms or, the higher the amount of collateral, the bigger this ratio is. That means that these firms have easier access to external finance and that as a firm grows or increases its collateral over time, so does its ability to get

<sup>1</sup> See full tables (Table A and B) in appendix.

external finance. These results are statistically significant for all specifications of controls and are in line with the findings of Bougheas et al. (2006).

Table 3 – Size and Collateral for total debt to total liabilities without interactions.

Dependent variable: total debt to total liabilities				
	(1)	(2)	(3)	(4)
Size	0.014*** (0.002)	0.076*** (0.004)	0.013*** (0.002)	0.067*** (0.004)
Collateral	0.180*** (0.018)	0.231*** (0.015)	0.180*** (0.018)	0.211*** (0.015)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Tables 4 and 5 show the coefficients for firm-specific characteristics *Gearing*, *Profit*, and *Age* for *short-term debt* and *total debt* as dependent variables, respectively. Firms' age has a small and negative impact on the *short-term debt* ratio (Table 4), and only when we include firm fixed effects (columns 2 and 4). The older the firm is, the lower the proportion of short-term debt. This result contradicts Bougheas et al. (2006) that find that older firms are able to have better access to bank finance (shorter-term debt tends to be bank as opposed to market financing). A potential explanation for this result is that an older firm reflects the surviving firms, thus better firms. A financially sound firm should have better access to market financing, being then less dependent on bank debt, decreasing its short-term debt ratio.

Both *Profit* and *Gearing* are not statistically significant when explaining short-term debt.

Table 4 – Gearing, Profit, and Age for short-term debt to total debt without interactions.

Dependent variable: short-term debt to total debt				
	(1)	(2)	(3)	(4)
Gearing	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age	-0.000 (0.000)	-0.002*** (0.001)	-0.000 (0.000)	-0.006*** (0.002)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

However, when explaining *total debt to total liabilities*, *Age* has the expected behavior: the older the firm, the easier the access to external financing, as we can see in Table 5. As older firms have a greater track record, that translates into confidence for the investors, as they have more information available to make a decision.

Although statistically significant for some controls (columns 1 and 3), *Profit* has a minimal impact on *total debt to total liabilities* (Table 5). A firm with higher profits would have easier access to external finance, and so we would expect a positive coefficient. On the other hand, a firm with higher profits may have less need for external finance. This seems to be the most viable hypothesis for our sample of firms, given that we have a marginal reduction of total debt to total liabilities.

The same is true for *Gearing*, where we find that an increase in the existing level of debt as a proportion of total equity leads to a marginal increase in external financing (Table 5), only when we control for firm fixed effects (columns 2 and 4). This could seem counterintuitive, as an increase in debt would mean more risk, and so future investors should be more apprehensive about lending to that firm. Bougheas et al. (2006) reached a similar result, reasoning that an increase in debt could be seen as a signal to potential investors that others were willing to invest.

Table 5 – Gearing, Profit, and Age for total debt to total liabilities without interactions.

Dependent variable: total debt to total liabilities				
	(1)	(2)	(3)	(4)
Gearing	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.000* (0.000)
Profit	-0.000* (0.000)	-0.000 (0.000)	-0.000* (0.000)	-0.000 (0.000)
Age	0.000** (0.000)	0.000 (0.001)	0.000** (0.000)	0.003*** (0.001)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Unlike previous tables, Table 6 shows *Risk (NL)* alone, while rows are for the two dependent variables, to make it symmetrical with the analysis we will do in the next section for the listed firms only. Although *Risk (NL)* is not statistically significant for *short-term debt*, it is for *total debt* when we do not control for firm fixed effects (columns 1 and 3). These results show that

firms with more risk have less access to external finance, as evidenced by the negative coefficient.

Table 6 – Risk (NL) for regressions with no interactions

Dependent variable	Risk (NL)			
	(1)	(2)	(3)	(4)
short-term debt to total debt	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
total debt to total liabilities	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)
Fixed Effects	country + industry	firm id	country- year + industry	country- year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Tables 7 and 8 show the coefficients for the level of short-term interest rate and the slope of the euro's yield curve for *short-term debt* and *total debt*, respectively, as dependent variables.

Regarding *short-term debt* (Table 7), we find that the level of short-term rates is positively related to this ratio and is statistically significant when we control for country and industry (column 1) and when we control for both the economic cycle and firm id (column 4). These values show that, as interest rates decrease, a given firm finances itself more using long-term debt rather than short-term debt, after controlling for the economic cycle. These findings are contrary to the literature (Bougheas et al. 2006), and to what could be expected, given that *Level* is a measure of short-term interest rates. As it decreases, firms should take advantage of the decrease in the cost of financing and increase their proportion of short-term debt.

*Slope* is statistically significant only for the less demanding specification, i.e., when we control for country and industry (column 1). The positive sign on the coefficient means that as *Slope* increases, so does the proportion of *short-term debt to total debt*. Given that *Slope* measures investors' expectations for interest rates, an increase means that they are increasing the price of time risk, so short-term debt becomes comparatively less expensive. This result is consistent with market timing theory, as it states that firms issue debt when interest rates are low, and given that they expect them to increase, an increase in the short-term debt ratio shows that they are taking advantage of lower costs. However, this is a very weak result, given that as we go into more demanding specifications, it disappears.

Table 7 – Level and Slope for short-term debt to total debt.

Dependent variable: short-term debt to total debt				
	(1)	(2)	(3)	(4)
Level	0.032*** (0.005)	0.006 (0.005)	0.020 (0.012)	0.017** (0.008)
Slope	0.009*** (0.003)	0.003 (0.003)	-0.001 (0.005)	0.000 (0.004)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table 8 shows that the level of the short-term interest rate has a negative coefficient on *total debt* when controlling for the country and industry of the firm (column 1). A negative coefficient means that a decrease in interest rates leads to an increase in external finance. This result is expected and is in line with the literature, as a decrease in interest rates means a decrease in the cost of financing that firms should take advantage of. When we look only within firms, the coefficient turns positive (column 2). A positive coefficient means that as rates decrease, the firm's external finance also decreases. As was the case with short-term debt, this result is contrary to our expectations. The result does not hold when we control for the economic cycle (columns 3 and 4).

*Slope* is not statistically significant when explaining *total debt*.

Table 8 – Level and Slope for total debt to total liabilities.

Dependent variable: total debt to total liabilities				
	(1)	(2)	(3)	(4)
Level	-0.019* (0.011)	0.006* (0.003)	0.007 (0.026)	0.002 (0.007)
Slope	-0.008 (0.007)	0.000 (0.002)	0.003 (0.012)	0.004 (0.003)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level

## 4.2 Listed firms without interactions<sup>2</sup>

The results for only listed firms are very similar to those of the entire sample, other than the variable *Risk (L)*, which is statistically significant for some specifications (Table 9). This is the reason why we only highlight here the results on the risk of the firm for listed firms. Similar to Table 6, Table 9 shows the coefficient on this explanatory variable alone, while rows are for the two dependent variables.

The level of risk of the firm does not seem to be very relevant for the *short-term debt* ratio of firms. An increase in the riskiness of a firm decreases the proportion of short-term debt, as intuitively expected, and in line with the Bougheas et al. (2006), but the coefficient is not statistically significant in most specifications. However, it seems to be relevant to explain *total debt to total liabilities* within firms (columns 2 and 4), with an increase in the riskiness of the firm being related to an increase in the proportion of external finance. As the risk measure used in this analysis is mostly based on accounting ratios, the only market measure being the market value of equity, there could be a mismatch between the riskiness conveyed by the risk measure and the risk perception of the market participants.

Table 9 – Risk (L) for regressions with no interactions.

Dependent variable	Risk (L)			
	(1)	(2)	(3)	(4)
short-term debt to total debt	-0.000 (0.001)	-0.001* (0.000)	-0.000 (0.001)	-0.001 (0.000)
total debt to total liabilities	0.001 (0.002)	0.005*** (0.001)	0.001 (0.002)	0.006*** (0.001)
Fixed Effects	country + industry	firm id	country- year + industry	country- year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

The regressions that were just analyzed give us an idea of how some firm-specific characteristics impact firms' debt financing. The goal of this dissertation is to try to measure the impact that the negative interest rate policy has on the financing of firms. With that goal in mind, we added two interaction terms: one between each firm-specific characteristic and *Level*,

<sup>2</sup> See full tables (Table C and D) in appendix.

to capture the impact of interest rates, and one with the firm-specific characteristic, *Level* and *NIRP*, to capture the actual negative interest rate policy impact.

### 4.3 Full sample with interactions<sup>3</sup>

Tables 10 and 11 show both *Size* and *Collateral* when introducing the *Level* interaction alone and both *Level* and *Level-NIRP* interactions for *short-term debt* as the dependent variable, respectively. Both firm-specific characteristics maintain their statistical significance for all control specifications when introducing the *Level* interaction (Table 10). As it was the case before, bigger firms or firms with more collateral can finance themselves with longer-term debt, but this effect decreases as interest rates decrease. These firms are able to take advantage of the decrease in interest rates to decrease the maturity of their debt holdings. The results are in line with the literature in the sense that more constrained firms, in this case, smaller and with less collateral, are more vulnerable to a policy tightening, increasing, even more, their short-term debt.

Table 10 – Size and Collateral for short-term debt to total debt with interaction with Level.

Dependent variable: short-term debt to total debt				
	(1)	(2)	(3)	(4)
Size	-0.036*** (0.001)	-0.043*** (0.005)	-0.035*** (0.001)	-0.048*** (0.006)
Size*Level	-0.005*** (0.002)	-0.001 (0.001)	-0.010*** (0.002)	-0.003** (0.002)
Collateral	-0.036*** (0.008)	-0.074*** (0.020)	-0.036*** (0.008)	-0.081*** (0.020)
Collateral*Level	-0.036** (0.017)	-0.033** (0.015)	-0.033* (0.018)	-0.033** (0.015)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

When we introduce the second interaction *Level-NIRP*, the results lose some statistical significance and vary depending on the set of controls, as is shown in Table 11 below. When we control for both the economic cycle (country-year) and firm id (column 4), as the size of the firm increases, it finances itself with longer-term debt. However, when interest rates are negative, the proportion of short-term debt to total debt decreases with decreases in the short-

<sup>3</sup> See full tables (Table E, F, G and H) in appendix.

term rate. Regarding *Collateral*, the previous result holds in the most demanding specification (country-year and firm fixed effects), i.e., that firms with less collateral have more short-term debt, but this reverts partially when short-term interest rates decrease. There seems to be no significant change when we reach the negative interest rate territory. Therefore, we have no substantial evidence that the firms' vulnerability, measured by *Size* and *Collateral*, to monetary policy shocks, may have altered with the negative interest rate environment.

Table 11 – Size and Collateral for short-term debt to total debt with interactions with Level and Level-NIRP.

Dependent variable: short-term debt to total debt

	(1)	(2)	(3)	(4)
Size	-0.035*** (0.001)	-0.043*** (0.006)	-0.035*** (0.001)	-0.048*** (0.006)
Size*Level	-0.007*** (0.002)	-0.000 (0.002)	-0.009*** (0.002)	-0.002 (0.002)
Size*Level*NIRP	0.005*** (0.002)	-0.001 (0.001)	-0.001 (0.003)	-0.004* (0.002)
Collateral	-0.054*** (0.013)	-0.069*** (0.021)	-0.055*** (0.014)	-0.075*** (0.021)
Collateral*Level	0.005 (0.029)	-0.044** (0.022)	0.009 (0.031)	-0.046** (0.022)
Collateral*Level*NIRP	-0.115* (0.068)	0.035 (0.051)	-0.127* (0.072)	0.043 (0.053)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

As for *total debt to total liabilities*, only *Size* has statistical significance when we introduce the interaction with *Level* (Table 12). For all sets of control variables, bigger firms have more access to external finance, but as interest rates decrease, this result is weakened. This result is consistent with the findings of Bougheas et al. (2006). When we introduce the second interaction, although both *Size* and *Size\*Level* do not lose statistical significance, *Size\*Level\*NIRP* is not statistically significant for any set of control variables. This suggests that when we reach the negative interest rate environment, the relationship between firm size and total debt is not altered. Although *Collateral* alone keeps its statistical significance, it is not statistically significant for any of the controls when introducing the interaction.

Table 12 – Size and Collateral for total debt to total liabilities with interaction with Level.

Dependent variable: total debt to total liabilities

	(1)	(2)	(3)	(4)
Size	0.013*** (0.002)	0.077*** (0.004)	0.012*** (0.002)	0.067*** (0.004)
Size*Level	0.016*** (0.004)	0.003*** (0.001)	0.017*** (0.004)	0.004*** (0.001)
Collateral	0.175*** (0.018)	0.229*** (0.015)	0.175*** (0.018)	0.211*** (0.015)
Collateral*Level	0.047 (0.040)	0.001 (0.010)	0.039 (0.042)	-0.007 (0.011)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

From the previously analyzed firm-specific characteristics *Profit*, *Gearing*, and *Age*, when we introduce the interaction with *Level*, only *Age* and *Profit* have some explanatory power when explaining *short-term debt* and *total debt*, respectively.

Table 13 shows that, when we control for firm fixed effects (columns 2 and 4), older firms are able to finance themselves using longer-term debt and that as interest rates decrease, that effect is amplified, although with a small economic impact. These results are again contrary to Bougheas et al. (2006), but a potential explanation is that older firms depict surviving firms. Thus, older firms have better access to market financing, being less dependent on bank loans.

Table 13 – Age for short-term debt to total debt with interaction with Level.

Dependent variable: short-term debt to total debt

	(1)	(2)	(3)	(4)
Age	0.000 (0.000)	-0.002*** (0.001)	-0.000 (0.000)	-0.006*** (0.002)
Age*Level	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000** (0.000)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table 14 shows that, only when we control for both country and industry (column 1), as profits increase, firms' dependence on external finance decreases, but as interest rates decrease, this

effect is softened. Firms with higher profits are able to use them to finance their activities and so have a lower ratio of *total debt to total liabilities*, but as monetary policy loosens and interest rates decrease, they rely more on external finance. However, the size of the coefficient suggests that this effect is relatively small.

Table 14 – Size and Collateral for total debt to total liabilities with interaction with Level.

Dependent variable: total debt to total liabilities

	(1)	(2)	(3)	(4)
Profit	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000** (0.000)	0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

When we introduce the second interaction term, only *Gearing* has some (but small) explanatory power when explaining *total debt to total liabilities*. Table 15 shows that, when not controlling for firm-fixed effects (columns 1 and 3), the higher the current level of leverage, the lower the amount of external finance. As interest rates decrease, this result is softened, but as we reach negative territory, it reduces the amount of external debt.

Table 15 – Gearing for total debt to total liabilities with interactions with Level and Level-NIRP.

Dependent variable: total debt to total liabilities

	(1)	(2)	(3)	(4)
Gearing	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)
Gearing*Level	0.000*** (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)
Gearing*Level*NIRP	-0.000*** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	-0.000** (0.000)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Regarding the firms' risk measure, there seem to be some differences in behavior depending on the level of interest rates. The variable *Risk (NL)* now has some explanatory power, as the results

in Table 16 show for *total debt*. When we do not control for firm fixed effects (columns 1 and 3), we find that riskier firms have more external financing, and as interest rates decrease, that result is amplified, but when interest rates are negative, the proportion of external finance decreases. Although initially, this result may seem puzzling, a possible explanation is that with the decrease in interest rates, lenders' returns also decrease. A potential way for lenders to increase their revenues is to increase their risk profile: the bigger the risk, the bigger the return. So safer firms prefer to finance themselves with internal funds and avoid all the market risk and uncertainty. Still, riskier firms can take advantage of the lower interest rate environment and increase their external finance. However, this does not hold for the NIRP period. Nonetheless, the results could also reflect effects coming from the supply of funds from banks and investors, given that we are unable to distinguish these from the demand of funds from firms.

Table 16 – Risk (NL) for total debt to total liabilities with interaction with Level and Level-NIRP.

Dependent variable: total debt to total liabilities

	(1)	(2)	(3)	(4)
Risk (NL)	0.002** (0.001)	-0.000 (0.000)	0.002** (0.001)	-0.000 (0.000)
Risk (NL)*Level	-0.012*** (0.004)	-0.001 (0.003)	-0.012*** (0.004)	-0.000 (0.003)
Risk (NL)*Level*NIRP	0.017*** (0.005)	-0.036 (0.027)	0.017*** (0.005)	-0.039 (0.026)
Fixed Effects	country + industry	firm id	country-year + industry	country- year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

As for *short-term debt*, when we introduce the interactions with *Level*, the variable *Risk (NL)* becomes statistically significant for all specifications, as the results in Table 17 suggest. It tells us that riskier firms finance themselves using longer-term debt and that as interest rates decrease, that effect is strengthened. What could be expected is that riskier firms are less likely to fund through markets, and as monetary policy tightens, that result would be reinforced. Although we do not get the initial result that riskier firms use less market finance, this result is in line with Bougheas et al. (2006) findings. On the other hand, the interaction is in line with the theory, which suggests that more vulnerable firms are more susceptible to a tightening of monetary policy.

Table 17 – Risk (NL) for short-term debt to total debt with interaction with Level.

Dependent variable: short-term debt to total debt

	(1)	(2)	(3)	(4)
Risk (NL)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)
Risk (NL)*Level	0.009*** (0.002)	0.012*** (0.002)	0.010*** (0.002)	0.013*** (0.002)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

However, when we introduce the second interaction term, these results are no longer verified. One potential explanation is that when introducing the second interaction, the regression specification becomes too demanding. The estimated coefficients maintain their relationship with the dependent variable, only losing its explanatory power. Alternatively, this could suggest that the introduction of negative interest rates does not significantly impact the structure of firms.

#### 4.4 Listed firms with interactions<sup>4</sup>

If we look only for the sub-sample of listed firms, only *Size* has explanatory power when introducing the interaction with *Level* (Table 18). Bigger firms have more access to external finance, but as interest rates decrease, that effect is tightened, as Bougheas et al. (2006) found in their paper.

Table 18 – Size for total debt to total liabilities with interaction with Level.

Dependent variable: total debt to total liabilities

	(1)	(2)	(3)	(4)
Size	0.016*** (0.002)	0.077*** (0.005)	0.016*** (0.002)	0.070*** (0.005)
Size*Level	0.010** (0.004)	0.004*** (0.001)	0.012*** (0.004)	0.004*** (0.001)
Fixed Effects	country + industry	firm id	country-year + industry	country-year + firm id

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

<sup>4</sup> See full tables (Table I, J, K and L) in appendix.

When we introduce the second interaction term, there are no variables with persistent explanatory power.

*Size* and *Collateral* seem to be the variables with better explanatory power and more resilience when introducing both the interaction terms and stronger controls for the fixed effects. In the majority of our specifications, we found that bigger firms (or with more collateral) have better access to external finance (greater *total debt to total liabilities ratio*) and can finance themselves using longer-term debt. As interest rates decrease and reach negative territory, both *Size* and *Collateral* seem to be important characteristics in determining a firm's debt structure.

However, the negative interest rate environment does not significantly impact firms' financing decisions. Although there are some limitations to this model, which we will further discuss in the conclusion (section 5), the lack of statistical significance in most explanatory variables, particularly both the interaction terms with *Level* and *Level-NIRP*, points to that conclusion.

## 5. CONCLUSION

In 2014, the ECB's decision to cut its deposit facility rate by 10 basis points meant that for the first time, nominal interest rates reached negative territory. Until this time, the conventional wisdom was that there was a ZLB on interest rates. However, Kiley and Roberts (2017) estimate that from now on, the ZLB will only be binding 30-40 percent of the time.

Together with this new unconventional monetary policy tool, NIRP, the ECB conducted purchases of assets to increase liquidity in the financial system. Ultimately, both these measures aim to counteract the deflationary and low economic growth that Europe was experiencing at the time and continues to today.

An important question then arises: do negative interest rates have an expansionary effect on the economy? There is no consensus in the literature, as some find that it does increase lending from banks through the bank lending channel, such as Altavilla et al. (2019), but others argue that with the introduction of negative interest rates, this channel's effect is limited, like Eggertsson et al. (2017).

As the literature on this topic is more focused on the impact of banks, this dissertation aims at understanding if the introduction of negative interest rates affects firms' financing decisions. As far as we are aware there has not been so far any study on this issue.

We conducted a separate analysis for the entire sample and only the listed firms, but as a general result, there were no significant differences between the two groups.

Overall, in line with previous studies, we find that more constrained firms (smaller, riskier, and with less collateral) are more susceptible to a tightening of monetary policy.

We confirm some results already present in the literature, such that bigger firms, or firms with higher levels of collateral, are able to finance themselves using more longer-term debt (lower *short-term debt to total debt* ratio) and generally have better access to external finance (higher *total debt to total liabilities* ratio) and that this had no significant impact when in a negative interest rate environment.

We also find that riskier firms increase their external finance as interest rates fall, but less so when rates reach negative values. Although this result may seem contradictory, as a decrease in interest rates should benefit less risky firms more (Bougheas et al. 2006), it could mean that lenders increase the risk on their portfolio. Lending to riskier borrowers allows them to charge

higher interest rates, and increase their revenues, as lending to less risky borrowers might mean negative returns.

So, it seems that for non-financial firms, there is no significant change in the relationship between the level of interest rates and firms' financing structure in a negative interest rate environment.

## **5.1 Limitations**

This dissertation was done using accounting data from non-financial firms of all nineteen countries of the EA, from 2010 to 2020. This dataset was not very complete, with some firms having missing values in key variables or only having available some of the years in the time period chosen. Additionally, to assess the firms' riskiness, we used the Altman Z-Score (Altman, 2013), which requires multiple ratios that use accounting information. This increased the number of variables we needed, which meant that we lost many observations due to missing values. Another limitation was the fact that the dataset was not well distributed in terms of the time-period, meaning that we did not have a balanced number of observations per year. This could have impacted the results of the triple interaction regressions, as the introduction of NIRP means we ran a difference-in-difference regression with unbalanced observations.

In spite of these limitations, this dissertation has the benefit of using a still extensive dataset to study a relatively new and important issue. With negative interest rates being around for a long time now and showing no signs of leaving soon, its impact on non-financial firms' debt structure seems important.

## **5.2 Further research**

First, it would be interesting to see if, using a complete database, this dissertation's results change significantly. Given that it was the major limitation of this study, we could know if the lack of results is really a consequence of it or if there is actually no relationship between firms' financing decisions and negative interest rates.

Finally, looking at two similar countries, but one where there are negative interest rates and one where there are not. Denmark or Sweden and Norway could be an option, given that these Northern countries are quite similar, and Denmark and Sweden have had negative interest rates whereas Norway has not. Using a panel analysis and comparing the results of the two countries could help understanding if the NIRP policy is actually beneficial.

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## 7. APPENDIX

Table A – Short-term debt to total debt without interactions for full sample.

Dependent variable: short-term debt to total debt

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.032*** (0.005)	0.006 (0.005)	0.020 (0.012)	0.017** (0.008)
Slope	0.009*** (0.003)	0.003 (0.003)	-0.001 (0.005)	0.000 (0.004)
Risk (NL)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size	-0.036*** (0.001)	-0.045*** (0.006)	-0.035*** (0.001)	-0.050*** (0.006)
Collateral	-0.038*** (0.008)	-0.073*** (0.020)	-0.038*** (0.008)	-0.082*** (0.020)
Gearing	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age	-0.000 (0.000)	-0.002*** (0.001)	-0.000 (0.000)	-0.006*** (0.002)
Observations	31 936	32 016	31 936	32 015
R-squared	0.173	0.625	0.189	0.635

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table B – Total debt to total liabilities without interactions for full sample.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	-0.019* (0.011)	0.006* (0.003)	0.007 (0.026)	0.002 (0.007)
Slope	-0.008 (0.007)	0.000 (0.002)	0.003 (0.012)	0.004 (0.003)
Risk (NL)	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)
Size	0.014*** (0.002)	0.076*** (0.004)	0.013*** (0.002)	0.067*** (0.004)
Collateral	0.180*** (0.018)	0.231*** (0.015)	0.180*** (0.018)	0.211*** (0.015)
Gearing	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.000* (0.000)
Profit	-0.000* (0.000)	-0.000 (0.000)	-0.000* (0.000)	-0.000 (0.000)
Age	0.000** (0.000)	0.000 (0.001)	0.000** (0.000)	0.003*** (0.001)
Observations	33 111	33 187	33 110	33 185
R-squared	0.801	0.991	0.801	0.991

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table C – Short-term debt to total debt without interactions for listed firms.

Dependent variable: short-term debt to total debt

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.023*** (0.006)	0.003 (0.006)	0.019 (0.014)	0.019* (0.010)
Slope	0.005 (0.004)	0.000 (0.003)	-0.002 (0.006)	-0.000 (0.005)
Risk (L)	-0.000 (0.001)	-0.001* (0.000)	-0.000 (0.001)	-0.001 (0.000)
Size	-0.038*** (0.001)	-0.045*** (0.006)	-0.037*** (0.001)	-0.055*** (0.007)
Collateral	-0.068*** (0.010)	-0.055** (0.024)	-0.069*** (0.010)	-0.064*** (0.024)
Gearing	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Age	0.000 (0.000)	-0.002** (0.001)	-0.000 (0.000)	-0.004* (0.002)
Observations	21 842	21 865	21 841	21 864
R-squared	0.186	0.607	0.204	0.620

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table D – Total debt to total liabilities without interactions for listed firms.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.002 (0.013)	0.009** (0.004)	-0.005 (0.030)	0.001 (0.009)
Slope	-0.004 (0.008)	-0.001 (0.002)	-0.001 (0.014)	0.002 (0.004)
Risk (L)	0.001 (0.002)	0.005*** (0.001)	0.001 (0.002)	0.006*** (0.001)
Size	0.017*** (0.002)	0.082*** (0.005)	0.017*** (0.002)	0.073*** (0.005)
Collateral	0.232*** (0.022)	0.270*** (0.018)	0.226*** (0.022)	0.246*** (0.018)
Gearing	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Profit	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age	0.000*** (0.000)	-0.001 (0.001)	0.000*** (0.000)	0.002 (0.001)
Observations	22 531	22 558	22 530	22 557
R-squared	0.795	0.988	0.796	0.988

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table E – Short-term debt to total debt with interaction with Level for full sample.

Dependent variable: short-term debt to total debt

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.147*** (0.039)	0.031 (0.031)	0.223*** (0.042)	0.095*** (0.034)
Slope	0.009*** (0.003)	0.003 (0.003)	0.000 (0.005)	0.000 (0.004)
Risk (NL)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)
Risk (NL)*Level	0.009*** (0.002)	0.012*** (0.002)	0.010*** (0.002)	0.013*** (0.002)
Size	-0.036*** (0.001)	-0.043*** (0.005)	-0.035*** (0.001)	-0.048*** (0.006)
Size*Level	-0.005*** (0.002)	-0.001 (0.001)	-0.010*** (0.002)	-0.003** (0.002)
Collateral	-0.036*** (0.008)	-0.074*** (0.020)	-0.036*** (0.008)	-0.081*** (0.020)
Collateral*Level	-0.036** (0.017)	-0.033** (0.015)	-0.033* (0.018)	-0.033** (0.015)
Gearing	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Gearing*Level	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age	0.000 (0.000)	-0.002*** (0.001)	-0.000 (0.000)	-0.006*** (0.002)
Age*Level	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000** (0.000)
Observations	31 936	32 016	31 936	32 015
R-squared	0.174	0.626	0.190	0.636

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table F – Total debt to total liabilities with interaction with Level for full sample.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	-0.366*** (0.086)	-0.047* (0.024)	-0.345*** (0.091)	-0.075*** (0.028)
Slope	-0.009 (0.007)	0.000 (0.002)	0.001 (0.012)	0.004 (0.003)
Risk (NL)	-0.000 (0.001)	0.001 (0.001)	-0.000 (0.001)	0.001 (0.001)
Risk (NL)*Level	-0.001 (0.001)	-0.008 (0.005)	-0.001 (0.001)	-0.008 (0.005)
Size	0.013*** (0.002)	0.077*** (0.004)	0.012*** (0.002)	0.067*** (0.004)
Size*Level	0.016*** (0.004)	0.003*** (0.001)	0.017*** (0.004)	0.004*** (0.001)
Collateral	0.175*** (0.018)	0.229*** (0.015)	0.175*** (0.018)	0.211*** (0.015)
Collateral*Level	0.047 (0.040)	0.001 (0.010)	0.039 (0.042)	-0.007 (0.011)
Gearing	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Gearing*Level	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000** (0.000)	0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)
Age	0.000** (0.000)	0.000 (0.001)	0.000** (0.000)	0.003*** (0.001)
Age*Level	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000* (0.000)
Observations	33 111	33 187	33 110	33 185
R-squared	0.801	0.991	0.802	0.991

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table G—Short-term debt to total debt with Level and Level-NIRP interactions for full sample.

Dependent variable: short-term debt to total debt				
	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.160*** (0.039)	0.033 (0.031)	0.201*** (0.044)	0.082** (0.035)
Slope	0.007** (0.004)	0.003 (0.003)	0.003 (0.006)	0.003 (0.004)
Risk (NL)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Risk (NL)*Level	0.005 (0.005)	0.008 (0.005)	0.006 (0.005)	0.009* (0.005)
Risk (NL)*Level*NIRP	0.008 (0.010)	0.010 (0.011)	0.008 (0.009)	0.011 (0.011)
Size	-0.035*** (0.001)	-0.043*** (0.006)	-0.035*** (0.001)	-0.048*** (0.006)
Size*Level	-0.007*** (0.002)	-0.000 (0.002)	-0.009*** (0.002)	-0.002 (0.002)
Size*Level*NIRP	0.005*** (0.002)	-0.001 (0.001)	-0.001 (0.003)	-0.004* (0.002)
Collateral	-0.054*** (0.013)	-0.069*** (0.021)	-0.055*** (0.014)	-0.075*** (0.021)
Collateral*Level	0.005 (0.029)	-0.044** (0.022)	0.009 (0.031)	-0.046** (0.022)
Collateral*Level*NIRP	-0.115* (0.068)	0.035 (0.051)	-0.127* (0.072)	0.043 (0.053)
Gearing	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Gearing*Level	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Gearing*Level*NIRP	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Profit*Level	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit*Level*NIRP	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age	0.000 (0.000)	-0.002** (0.001)	-0.000 (0.000)	-0.007*** (0.002)
Age*Level	-0.000 (0.000)	-0.000* (0.000)	0.000 (0.000)	-0.000 (0.000)
Age*Level*NIRP	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Observations	31 936	32 016	31 936	32 015
R-squared	0.174	0.626	0.191	0.636

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table H–Total debt to total liabilities with Level and Level-NIRP interactions for full sample.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	-0.379*** (0.087)	-0.035 (0.025)	-0.323*** (0.095)	-0.064** (0.027)
Slope	-0.006 (0.008)	0.000 (0.002)	-0.000 (0.013)	0.003 (0.003)
Risk (NL)	0.002** (0.001)	-0.000 (0.000)	0.002** (0.001)	-0.000 (0.000)
Risk (NL)*Level	-0.012*** (0.004)	-0.001 (0.003)	-0.012*** (0.004)	-0.000 (0.003)
Risk (NL)*Level*NIRP	0.017*** (0.005)	-0.036 (0.027)	0.017*** (0.005)	-0.039 (0.026)
Size	0.012*** (0.002)	0.075*** (0.004)	0.013*** (0.002)	0.065*** (0.004)
Size*Level	0.019*** (0.004)	0.002** (0.001)	0.016*** (0.004)	0.004*** (0.001)
Size*Level*NIRP	-0.006 (0.004)	0.000 (0.001)	0.001 (0.006)	0.001 (0.002)
Collateral	0.183*** (0.030)	0.244*** (0.017)	0.186*** (0.032)	0.221*** (0.017)
Collateral*Level	0.027 (0.063)	-0.020 (0.013)	0.013 (0.069)	-0.020 (0.015)
Collateral*Level*NIRP	0.053 (0.153)	0.071* (0.037)	0.073 (0.170)	0.045 (0.047)
Gearing	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)
Gearing*Level	0.000*** (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)
Gearing*Level*NIRP	-0.000*** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	-0.000** (0.000)
Profit	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000** (0.000)	0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)
Profit*Level*NIRP	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age	0.000 (0.000)	0.001 (0.001)	0.000 (0.000)	0.003*** (0.001)
Age*Level	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age*Level*NIRP	0.000 (0.001)	0.000 (0.000)	-0.000 (0.001)	0.000 (0.000)
Observations	33 111	33 187	33 110	33 185
R-squared	0.801	0.991	0.802	0.991

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table I – Short-term debt to total debt with interaction with Level for listed firms.

Dependent variable: short-term debt to total debt

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.060 (0.046)	-0.015 (0.037)	0.106** (0.050)	0.053 (0.040)
Slope	0.006 (0.004)	0.000 (0.003)	-0.001 (0.006)	0.000 (0.005)
Risk (L)	0.000 (0.001)	-0.002* (0.001)	0.001 (0.001)	-0.001 (0.001)
Risk (L)*Level	0.002 (0.002)	-0.003 (0.002)	0.003* (0.002)	-0.001 (0.002)
Size	-0.037*** (0.001)	-0.047*** (0.007)	-0.037*** (0.001)	-0.054*** (0.007)
Size*Level	-0.001 (0.002)	0.001 (0.002)	-0.004* (0.002)	-0.002 (0.002)
Collateral	-0.066*** (0.010)	-0.061*** (0.024)	-0.068*** (0.010)	-0.066*** (0.024)
Collateral*Level	-0.025 (0.021)	0.006 (0.018)	-0.004 (0.022)	0.022 (0.018)
Gearing	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Gearing*Level	0.000** (0.000)	0.000 (0.000)	0.000** (0.000)	0.000 (0.000)
Profit	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age	0.000 (0.000)	-0.003*** (0.001)	0.000 (0.000)	-0.004** (0.002)
Age*Level	-0.000 (0.000)	-0.000*** (0.000)	-0.000* (0.000)	-0.000*** (0.000)
Observations	21 842	21 865	21 841	21 864
R-squared	0.186	0.607	0.205	0.620

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table J – Total debt to total liabilities with interaction with Level for listed firms.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	-0.194** (0.094)	-0.055** (0.025)	-0.239** (0.102)	-0.060** (0.029)
Slope	-0.005 (0.008)	-0.001 (0.002)	-0.001 (0.014)	0.003 (0.004)
Risk (L)	-0.000 (0.001)	0.003*** (0.001)	-0.001 (0.001)	0.003*** (0.001)
Risk (L)*Level	-0.012*** (0.004)	-0.009*** (0.003)	-0.013*** (0.004)	-0.009*** (0.003)
Size	0.016*** (0.002)	0.077*** (0.005)	0.016*** (0.002)	0.070*** (0.005)
Size*Level	0.010** (0.004)	0.004*** (0.001)	0.012*** (0.004)	0.004*** (0.001)
Collateral	0.221*** (0.022)	0.259*** (0.019)	0.217*** (0.023)	0.236*** (0.019)
Collateral*Level	0.066 (0.048)	-0.010 (0.012)	0.040 (0.050)	-0.012 (0.013)
Gearing	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.000* (0.000)
Gearing*Level	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Profit*Level	-0.000* (0.000)	0.000* (0.000)	-0.000** (0.000)	0.000 (0.000)
Age	0.000*** (0.000)	-0.001* (0.001)	0.000*** (0.000)	0.001 (0.001)
Age*Level	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Observations	22 531	22 558	22 530	22 557
R-squared	0.796	0.988	0.796	0.988

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table K–Short-term debt to total debt with Level and Level-NIRP interactions for listed firms.

Dependent variable: short-term debt to total debt

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.077* (0.046)	-0.199** (0.094)	0.001 (0.037)	-0.053** (0.025)
Slope	0.003 (0.004)	-0.005 (0.009)	0.000 (0.003)	-0.002 (0.002)
Risk (L)	-0.000 (0.002)	-0.006** (0.003)	0.001 (0.001)	-0.001 (0.002)
Risk (L)*Level	0.002 (0.004)	0.002 (0.006)	-0.008*** (0.003)	0.001 (0.003)
Risk (L)*Level*NIRP	-0.001 (0.008)	-0.033** (0.017)	0.013** (0.006)	-0.024* (0.013)
Size	-0.036*** (0.001)	0.016*** (0.002)	-0.044*** (0.007)	0.077*** (0.005)
Size*Level	-0.005** (0.002)	0.010** (0.004)	0.001 (0.002)	0.003** (0.001)
Size*Level*NIRP	0.008*** (0.002)	-0.000 (0.005)	0.001 (0.002)	0.003 (0.002)
Collateral	-0.100*** (0.016)	0.245*** (0.036)	-0.058** (0.026)	0.259*** (0.019)
Collateral*Level	0.053 (0.037)	0.006 (0.075)	0.000 (0.027)	-0.016 (0.019)
Collateral*Level*NIRP	-0.224*** (0.085)	0.183 (0.188)	0.017 (0.064)	0.030 (0.054)
Gearing	-0.000* (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000 (0.000)
Gearing*Level	0.000*** (0.000)	0.000** (0.000)	0.000*** (0.000)	0.000 (0.000)
Gearing*Level*NIRP	-0.000*** (0.000)	-0.000** (0.000)	-0.000** (0.000)	-0.000*** (0.000)
Profit	0.000 (0.000)	0.000* (0.000)	-0.000 (0.000)	0.000 (0.000)
Profit*Level	-0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)
Profit*Level*NIRP	0.000 (0.000)	0.000*** (0.000)	-0.000 (0.000)	0.000 (0.000)
Age	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)	-0.001 (0.001)
Age*Level	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Age*Level*NIRP	-0.000 (0.000)	-0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)
Observations	21 842	22 531	21 865	22 558
R-squared	0.187	0.796	0.607	0.988

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.

Table L– Total debt to total liabilities with Level and Level-NIRP interactions for listed firms.

Dependent variable: total debt to total liabilities

	country + industry	firm id	country-year + industry	country-year + firm id
Level	0.091* (0.052)	-0.243** (0.105)	0.047 (0.041)	-0.065** (0.027)
Slope	0.001 (0.007)	-0.001 (0.014)	0.002 (0.005)	0.002 (0.004)
Risk (L)	0.001 (0.002)	-0.006** (0.003)	0.002* (0.001)	-0.001 (0.002)
Risk (L)*Level	0.002 (0.004)	0.002 (0.006)	-0.008*** (0.003)	0.001 (0.003)
Risk (L)*Level*NIRP	0.003 (0.008)	-0.033** (0.017)	0.018*** (0.006)	-0.024* (0.013)
Size	-0.036*** (0.001)	0.016*** (0.002)	-0.054*** (0.007)	0.069*** (0.005)
Size*Level	-0.005* (0.003)	0.012** (0.005)	-0.000 (0.002)	0.003** (0.001)
Size*Level*NIRP	0.001 (0.003)	0.001 (0.007)	-0.004* (0.002)	0.002 (0.002)
Collateral	-0.100*** (0.017)	0.238*** (0.038)	-0.052** (0.026)	0.238*** (0.020)
Collateral*Level	0.067* (0.038)	-0.013 (0.080)	-0.005 (0.028)	-0.023 (0.021)
Collateral*Level*NIRP	-0.218** (0.088)	0.163 (0.200)	0.077 (0.064)	0.042 (0.063)
Gearing	-0.000* (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000 (0.000)
Gearing*Level	0.000*** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000 (0.000)
Gearing*Level*NIRP	-0.000*** (0.000)	-0.000** (0.000)	-0.000** (0.000)	-0.000*** (0.000)
Profit	0.000 (0.000)	0.000* (0.000)	-0.000 (0.000)	0.000 (0.000)
Profit*Level	-0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)	-0.000 (0.000)
Profit*Level*NIRP	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)
Age	-0.000 (0.000)	0.000 (0.000)	-0.004** (0.002)	0.001 (0.001)
Age*Level	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000** (0.000)
Age*Level*NIRP	-0.000 (0.000)	-0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)
Observations	21 841	22 530	21 864	22 557
R-squared	0.206	0.797	0.621	0.988

Notes: Robust standard errors in parentheses. Asterisks denote statistical significance at the \*\*\* 1 percent, \*\* 5 percent, and \* 10 percent level.