Roots and Consequences of Financial Distortions

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Chapter 1

Introduction

Debt is vital for economic prosperity. It enables households to smooth their consumption and companies to finance large investment projects. Furthermore, debt can solve important agency conflicts and delivers investors an fixed income asset. In the development literature, financial development is identified as a key driver of economic growth. Seminal contribution by King and Levine (1993), Rajan and Zingales (1998) and Levine and Zervos (1998) demonstrate that well-functioning financial markets benefit economic prosperity and that especially industries with higher needs of external finance benefit from financial development. While these contributions abstract from the type of external financing that is provided, many authors (Titman and Wessels (1988); Rajan and Zingales (1995); Lemmon et al. (2008)) have studied the capital structure of firms and uncovered that the use of debt varies substantially over companies from different sectors of the economy.

However, debt financing comes with adverse effects that are especially harmful in times of crisis. Companies, as well as households, have an incentive to be highly levered as they gain the benefit of higher consumption and investment but are protected by limited liability in case of bankruptcy. In times of economic turmoil, high levels of debt can accelerate a downswing as repayment forces agents to postpone beneficial investments to secure debt repayment and deleveraging. Furthermore, defaults resulting from debt overload in the upswing cause turmoil in the financial system as intermediaries are typically highly levered and unable to absorb large shocks. This detains rapid recoveries, as bank balance sheets have to repaired, which can cost a substantial amount of time.

In this thesis, I want to link the roots and the consequences excess debt can have for an economy. Chapter 2 studies the impact financial frictions, caused by high debt levels, have on the business cycle. This helps understanding what the consequences of high debt levels are and how they translate to the real economy through business cycle fluctuations. The third chapter stands out as it does not study financial distortions directly but financial intermediation. Nevertheless, it is an important component in the debt and distortions nexus as an enormous share of external finance used by companies is provided by banks. Furthermore, the study sheds light on the question how the banking system is effected by measures introduced in the aftermath of the recent financial crisis, which was caused by financial distortions in the first place. The fourth and last chapter tries to uncover the roots of indebtedness of firms and studies the external finance preferences of European companies. They rely less, in comparison to their American counterparts, on external equity financing and the goal of this chapter is to analyze whether this is rooted in their preferences.

The first chapter of my thesis entitled *The Effect of Financial Frictions over the Business Cycle: The Role of Net Worth* identifies a direct channel from the health of the balance sheet of different industries in an economy to the volatility of business cycles. Understanding economic fluctuation has long been a central goal of macroeconomic research. Especially, the prevention of depressions has been named as the central problem.[1] Recent events, like the Great Recession and the Euro-Crisis, have revitalized the debate about the causes and consequences of depressions. Especially, the financial crisis has indicated that financial frictions can have disastrous consequences for the economy.

Economic cycles are more volatile than the underlying shocks, like oil price or credit shocks, would predict. To close this gap, RBC-models with financial frictions

[1]Lucas (2003) suggested that depression prevention is the central problem of macroeconomics

have been developed, which create larger fluctuations. Recent insights by Brunnermeier and Sannikov (2014) suggest that financial frictions have an asymmetric impact on economic output since agents self-insure against small shocks. Using net worth, which is the difference between the pledgeable assets and liabilities a company has, as a proxy for financial frictions, I study the effect of these frictions in different states of the business cycle. To estimate the causal effect of financial frictions on economic growth, I use an identification strategy similar to Rajan and Zingales (1998). This difference-in-differences approach allows me to control for unobserved country-industry, country-time, and industry-time specific effects through a rich set of fixed effects.

My results reveal that financial constraints are especially harmful in times of poor economic performance and that their impact is asymmetric. While positive and small negative deviations from trend are not amplified, large adverse shocks lead to a strong amplification of the initial shock. The growth difference between industries with low net worth compared to industries with high net worth is around 2pp, which is higher than average annual value added growth. This result is not caused by other industry characteristics or differences in the types of products the different industries produce. Furthermore, this amplification leads to a decline in capital formation and employment detaining a rapid recovery.

The second chapter of my thesis entitled *The net interest margin and the bank branch network* studies the the relationship between the net interest margin and the size of the branch network banks operate with. It is joined work with Zeki Kocaata. In the aftermath of the financial crisis, central banks over the globe have sharply reduced interest rates to counter the adverse effects of the slowdown of the economy. While this leads to an increase in the net interest margin in the first instance, as asset yields of longterm assets were fixed and refinancing costs dropped instantly, the net interest margin of banks began to decline in the following years as assets needed to be rolled over and newly granted loans and purchased securities yielded substantially lower interest than before, while refinancing costs were bounded by the zero lower bound.

This pressures banks to cut operating costs especially in deposit funding as branches and employees in branches have costs that are independent of the interest rate. This makes deposit funding particularly expensive in times of low for long interest rates.

Using the abandonment of Regulation Q (i.e. the ban on interest payments on commercial checking accounts) as a natural experiment, we study the causal relationship between banks' net interest margins and the amount of branches banks operate with. In the United States, interest payments were harshly regulated in the aftermath of the great depression. Interest payments on the time and savings deposits were bounded by ceilings until 1986 and interest payments on demand deposits were banned altogether until 2011. We use the later change as a natural experiment as it increased the interest expenses for banks that relied heavily on funding through demand deposits more than for banks that relied to a lesser extent on demand deposits. The reform lead to a decrease of the net interest margin of effected banks by around 0.4pp annually, which corresponds roughly to the decline in the net interest margin between 2009 and 2015.

We observe that banks that relied to a greater extend on demand deposits before Regulation Q was lifted decrease the amount of branches they operate with substantially by around a third of a branch per bank. The overall effect is around 670 branches, which corresponds 10% of their aggregated branch network. If we extrapolate our results to the aggregate decline in the net interest margin in the aftermath of the financial crisis, our results can explain a decline in the aggregated branch network of around 1600 branches, which corresponds to a quarter of the aggregated decline in the branch network since 2009. Furthermore, we observe that the affected banks manage to reduce asset risk. This is achieved by the reduction of business in areas with poorer economic performance. However, banks also increase their leverage ratios in the aftermath of the reform, which makes an overall risk assessment troublesome. The banks' Z-Scores indicate that banks have indeed become safer after the reform. This indicates that a larger geographical diversification is not associated with a decline in bank risk.

The third chapter of my thesis entitled *The corporate debt premium* analyzes the preferences of firms regarding debt and equity financing in a causal way. It is joined work with Phillip-Bastian Brutscher from the European Investment Bank. Following the great recession, firms in Europe suffered from a debt overhang, which depressed investment and growth for several years. In addition, there is a long-term trend for corporate investment to become less tangible, which makes the usage of bank debt more troublesome as bank credit often has to be backed by collateral.

Using novel data on European companies collected by an online experiment, we are able to quantify the difference in the willingness to pay between debt and equity financing. In particular, we are able to abstract from market side constraints and can observe if companies would take equity if it would be comparably cheap to debt. In addition, we can analyze if preferences for different types of external finance are sticky, i.e. whether firms that relied on debt finance in the past are willing to pay more to secure future debt financing.

Our results suggest that companies are willing to pay an up to 880bp higher interest rate to achieve debt instead of equity finance. Corporate control rights, the tax shield of debt and growth prospects of companies can explain a share of 72%, leaving an unexplained debt premium of 250bp. These results suggest that companies prefer debt financing over equity financing even if the cost of equity offered is substantially lower than the interest rate offered on the corresponding loan offer. Furthermore, we observe a larger premium for those firms that are more suited to receive bank loans. This suggests that, at least to some extent, a financial sector dominated by bank finance has spurred a culture of debt. This in turn has led to a strong selection towards those firms that are most capable to flourish under debt financing and, thus, have the strongest preference for this type of finance.

Chapter 2

The Effect of Financial Frictions over the Business Cycle: The Role of Net Worth

1 Introduction

Financial distortions have traditionally been attributed an important role in the formation of cyclical fluctuations. Classical scholars, like Fisher (1933) and Keynes (1936), argue that debt plays an important role in explaining cyclical fluctuations and the recent events of the great recession and the Euro-crisis have brought financial frictions back into the focus of macroeconomic research and policy. While there is a consensus that financial development enhances economic growth in the long run (Rajan and Zingales (1998); Levine and Zervos (1998); Levine et al. (2000), Beck et al. (2000)), recent research demonstrates that financial markets and especially high levels of debt might cause huge imbalances and accelerate downturns in the short run (Schularick and Taylor (2012); Jordà et al. (2013); Kumhof et al. (2015)).

Explaining business cycle fluctuations is and has been a major goal of economics.[1]

[1]Lucas (2003) in his presidential address at the 115 meeting of the American Economic Association claimed: *My thesis in this lecture is that macroeconomics in this original sense has succeeded: Its central problem of depression prevention has been solved, for all practical purposes, and has in fact been solved for many decades.*

However, classical real business cycle models (E.g. Kydland and Prescott (1982); King et al. (1988a); King et al. (1988b)), that were developed to explain cyclical fluctuations, need large shocks to explain the volatility seen in the data. Summers (1986) and Cochrane (1994) argue that those models, calibrated with realistic shocks, would predict a much lower volatility as the main ingredients of these models (capital, labor force and total factor productivity) are less volatile than GDP.[2]

Financial frictions are proposed as an explanation for the large volatility of business cycles. Starting with the seminal contributions of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), amplification models have risen that try to explain how small shocks can be amplified and cause larger fluctuations. However, Kocherlakota (2000) argues these models are not able to create large enough amplification for reasonable assumptions on the parameter. Recent work by Brunnermeier and Sannikov (2014) (BS) picks up this criticism by building a model that is able to create large fluctuations. Furthermore, they claim that financial frictions are especially harmful in times of crisis and can trigger persistent times of economic depression. In contrast, small shocks are not amplified at all. The amplification of business cycles is asymmetric.

In this chapter, I present evidence for an amplification mechanism arising from financial frictions, which can explain a substantial part of intra-industry differences in growth rates. I test the theoretical predictions of BS using a methodology similar to the Rajan and Zingales (1998) (RZ) difference-in-difference approach using cross-country cross-sectoral data. The idea behind this identification strategy is that industries have inherent characteristics due to their industry-specific technology. These characteristics do not differ over time and between different countries. Using the United States as a benchmark, I construct a measure of industry net worth. This allows analyzing whether financial frictions lead to strong amplification if shocks are sufficiently large as it is proposed by BS.

[2]Summers (1986) argues that it is hard to find large technological shock and Cochrane (1994) points out that neither oil price nor credit shocks can explain economic fluctuation

I find a strong amplification effect of net worth channel. Sectors with low median net worth suffer more in an economic downturn than industries with a larger median net worth. Furthermore, there is an asymmetry between small and large downturns, which is in line with the prediction of BS. In recessions above 3% deviation from the trend, the estimated coefficient is large and significant while the effect for smaller deviations is small and insignificant. In addition, the effect translates into lower employment growth and less gross fixed capital formation. This prevents a fast recovery in low net worth sectors after a large recession hits.

Related Literature. This study contributes to two main branches of the literature. On one hand, I test theoretical predictions financial friction models have provided. On the other hand, it contributes to the empirical financial development literature and more specifically to the issue of financial markets as a source of volatility and disturbance in the short-run.

Financial accelerator models (Bernanke and Gertler (1989); Carlstrom and Fuerst (1997); Kiyotaki and Moore (1997); Bernanke et al. (1999)) try to explain business cycle fluctuation by the introduction of credit constraints for productive agents. However, these kind of models suffer from the critique of Kocherlakota (2000), who points out that for reasonable calibration the amplification arising from these models is rather small.

Brunnermeier and Sannikov (2014) pick up this criticism and develop a model with the features of Kiyotaki and Moore (1997) but solve it for its equilibrium without approximation. Their model suggests that financial frictions are especially important in times of crises and can drive the economy away from its natural steady state for a substantial time. On the other hand, small shocks do not drive the economy away from the steady state much at all. In this way, they address the Kocherlakota (2000) critique, arguing that the amplification induced by financial frictions is too small to explain observed business cycle volatility. Several other authors (Gerali et al. (2010); Kollmann et al. (2011); Iacoviello (2015)) suggest that financial shocks played a large role in the recent great recession.

Rajan and Zingales (1998) analyze the long-term effect of financial development on economic growth and highlight that financial development has a positive impact on the long-term economic growth of industries heavily dependent on external finance. Their identification strategy relied on the assumption that capital markets in the United States are among the most advanced in the world and thereby, the demand of external financing of these U.S. firms can be used as a proxy for the demand of firms in the same sector in other countries.

Braun and Larrain (2005) analyze the effect of financial frictions in recessions using external financing dependence as a proxy. Their results suggest that more externally dependent industries suffer more during a recession. This is more severe for industries with less tangible assets and in countries that have a worse accounting standard. However, for countries with high accounting standards and highly effective creditor rights, the effect turns positive. External dependence is a troublesome indicator of financial frictions. In the short-run, it might be easier to finance internally than in the long-run while the roll-over of debt might be a more critical issue. Therefore, I make use of the net worth proxy instead of external financing dependence and I find a negative effect of financial frictions for a sample of more developed countries as I use OECD countries, whereas Braun and Larrain (2005) relied on the UNIDO database, which contains both developed and developing countries. Furthermore, I am able to demonstrate that the amplification effect is asymmetric.

Further research has analyzed how financial frictions affect the economy through other events. Kroszner et al. (2007) and Dell'Ariccia et al. (2008) use the RS identification strategy to find the effect of banking crisis on economic growth. They find strong negative effects of banking crisis for economic sectors strongly depending on external financing. Aghion et al. (2014) apply RS procedure to estimate the effect of countercyclical fiscal policy. Their findings show that these policies enhance value-added and productivity growth in more financial constrained sectors. I contribute to these findings as I am the first to uncover the asymmetric effect of financial frictions.

The remaining article is organized as follows: Section 2 explains the link between the theoretical predictions and the empirical test, Section 3 describes the econometric methodology and the data, Section 4 presents the baseline results, Section 5 presents additional robustness checks, and Section 6 concludes.

2 Hypothesis Development

Real business cycle models need large shocks to replicate business cycle volatility. However, events of this magnitude can be rarely quantified using econometric methods (Cochrane (1994)). To close this gap, financial accelerator models have been developed, which create larger fluctuations through collateral constraints. The main features of these models are the following: First, there exists a productive class of agents, which are labeled farmers or borrowers. These agents have productive investment opportunities. However, they are impatient and therefore, lack the funds to carry out their investments. The second class of agents, which is labeled gatherer or savers, is more patient but is unable to use asset productively and therefore, lack projects to invest in. This leads to credit provision from the savers to the borrowers. Under the assumption of complete financial markets, there is no inefficiency in the system, as the productive agents will always hold all (or the largest part of) asset and rents would be split as agreed upon. On the other hand, if markets are incomplete and borrowers face a borrowing constraint, the situation changes dramatically.

In a setup with incomplete markets, a shock is amplified because agents need to change their asset position if their collateral constraint is binding. If a negative shock realizes, agents have to sell productive capital, which reduce prices leading to fire sells and further depression of prices and output. New insides of BS indicate that this mechanism is asymmetric. A small shock merely affects the entrepreneur's payoff while a large shock vanishes the borrower's profits, increases his debt and therefore, pushes him towards his collateral constrained. The constraint becomes binding and forces him to sell assets. On the other hand, positive shocks only lead to larger payoffs while asset positions remain unchanged. The level of net worth is only determined by the level of uncertainty the entrepreneur faces.

In this context, entrepreneurs are homogeneous and face the identical problems. However, I observe that net worth differs significantly over different industries. As idiosyncratic firm-specific reasons are netted out by looking at sectors over a longer time horizon, the question remains what might cause these differences. A possible explanation would be that the collateral constraints in these industries differ, i.e. investors demand different amounts of collateral of firms in different industries. If that would be the case and the excess net worth would be the same for all industries, net worth should not explain differences in industry growth rates. In this case, the collateral constraints of all firms would become binding simultaneously in a downturn. Alternatively, firms in different industries hold different amounts of net worth because there are innate characteristics of the businesses in this sector that make it optimal for them to hold a higher share of excess pledgeable assets. Companies from different sectors might choose different levels of net worth due to different capital intensity, different preferences for indebtedness due to differing bankruptcy costs and differences in the liquidity of their assets. A large body of the literature (Remmers et al. (1974); Bradley et al. (1984); Titman and Wessels (1988)) observes that leverage has a strong industry-specific component and this effect is independent of other firm characteristics like profitability, asset tangibility, and firm uniqueness.

Assuming that differences in industry net worth are caused by innate characteristics and not industry-specific collateral constraints, industries with lower net worth should suffer greater output losses during recessions than industries with higher net worth. This leads to the following hypotheses:

Hypothesis 1. Industries with lower net worth experience temporary lower growth if a larger negative economic shock hits them.

Further, BS predict that the net worth effect amplifies negative but not positive shocks, as asset position do not change if shocks are positive. Therefore:

Hypothesis 2. Positive and small negative shocks are not amplified.

How can these Hypotheses be tested? Using a proxy for industry net worth based on U.S. data, I apply the Rajan and Zingales (1998) diff-in-diff procedure to measure the differential effect of the differences in value-added growth rates for industries with different net worth during recessions. Following the logic of financial accelerator models, credit constraints should be binding in recessions and if these constraints are binding, industries with lower net worth should experience lower value-added growth rates than industries with greater net worth.

3 Methodology and Data

This section outlines the empirical strategy to test the hypotheses. A proxy for the industry net worth is needed to identify the net worth channel. Following RS, the measure is constructed using data for U.S. companies, which are obtained from Datastream. Financial accelerator models differentiate between two assets: (1) A one period bond that is risk-free and (2) productive capital, which can be used as collateral. In this setting, net worth is defined as the difference between capital and debt the entrepreneur holds. However, this easy classification is unsatisfactory to deal with company balance sheet data. A firm can, in addition to fixed capital, pledge against inventories and cash to secure credit. Therefore, I construct net worth, using data from Datastream for 1990-2009, in the following way: Net worth of firm i at time t is the sum of its property, plant, and equipment, inventory and cash subtracted by total liabilities, divided by its total assets. In the next step, the average for every firm is calculated over the complete sample and the median of all firms is chosen for an industry. This measure proxies the ratio of pledgeable assets to the debt a company has. This definition of pledgeable assets is in line with the measure used in Titman and Wessels (1988).[3] As companies in Datastream are not classified into different industries by the ISIC (International Standard Industrial Classification) methodology, which is the methodology the industry growth data is classified, but with the ICB (Industry Classification Benchmark) methodology, a correspondence between the two

[3]The industry classification can be found in the appendix.

classification is needed. Both classification have a decent match on the 2 digit ISIC level. The exact correspondence is shown in Table 2.1.

Table 2.1: Industry Classification

ISIC 3.1	Industry	ICB
15	Manufacture of food products and beverages	Food Products
15	Manufacture of food products and beverages	Distillers & Vintners
15	Manufacture of food products and beverages	Soft Drinks
15	Manufacture of food products and beverages	Brewers
16	Manufacture of tobacco products	Tobacco
17	Manufacture of textiles	Clothing & Accessory
19	Tanning and dressing of leather etc.	Footwear
20	Manufacture of wood and of products of wood etc.	Forestry
21	Manufacture of paper and paper products	Paper
22	Publishing, printing and reproduction of recorded media	Publishing
23	Manufacture of coke, refined petroleum and nuclear fuel	Exploration & Prod.
23	Manufacture of coke, refined petroleum and nuclear fuel	Integrated Oil & Gas
24	Manufacture of chemicals and chemical products	Commodity Chemicals
24	Manufacture of chemicals and chemical products	Specialty Chemicals
24	Manufacture of chemicals and chemical products	Biotechnology
24	Manufacture of chemicals and chemical products	Pharmaceuticals
24	Manufacture of chemicals and chemical products	Personal Products
26	Manufacture of other non-metallic mineral products	Building Mat.& Fix.
27	Manufacture of basic metals	Iron & Steel
27	Manufacture of basic metals	Nonferrous Metals
27	Manufacture of basic metals	Plat.& Precious Metal
27	Manufacture of basic metals	Aluminum
28	Manufacture of fabricated metal products	Industrial Suppliers
29	Manufacture of machinery and equipment n.e.c.	Industrial Machinery
29	Manufacture of machinery and equipment n.e.c.	Renewable Energy Eq.
30	Manufacture of office, accounting and computing machinery	Computer Hardware
30	Manufacture of office, accounting and computing machinery	Elec. Office Equip.
31	Manufacture of electrical machinery and apparatus n.e.c.	Electrical Equipment
31	Manufacture of electrical machinery and apparatus n.e.c.	Electronic Equipment
32	Manufacture of radio, television and communication equipment	Telecom. Equipment

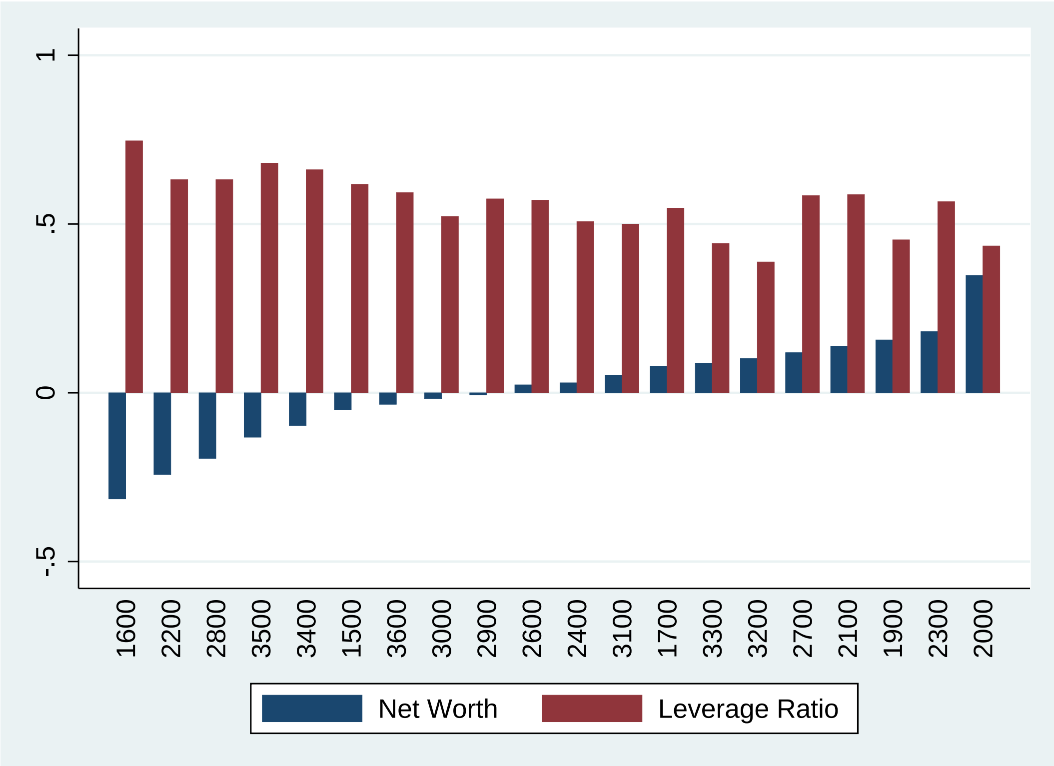
Table 2.1: Industry Classification

ISIC 3.1	Industry	ICB
32	Manufacture of radio, television and communication equipment	Consumer Electronics
32	Manufacture of radio, television and communication equipment	Semiconductors
33	Manufacture of medical, precision and optical instruments	Medical Equipment
33	Manufacture of medical, precision and optical instruments	Medical Supplies
35	Manufacture of motor vehicles, trailers and semi-trailers	Comm. Vehicles
34	Manufacture of motor vehicles, trailers and semi-trailers	Auto Parts
34	Manufacture of motor vehicles, trailers and semi-trailers	Tires
34	Manufacture of motor vehicles, trailers and semi-trailers	Automobiles
35	Manufacture of other transport equipment	Aerospace
36	Manufacture of furniture; manufacturing n.e.c.	Furnishings
36	Manufacture of furniture; manufacturing n.e.c.	Toys
36	Manufacture of furniture; manufacturing n.e.c.	Recreational Products

Notes. This Table displays the correspondence between ISIC 3.1 industries and industries in the ICB classification.

The values of my net worth measure for different industries can be found in Figure 2.1. On the x-axis, there is the ISIC 3.1 classification of industries, on the y-axis, there is the level of net worth as well as leverage ratio. It can be observed that both measures show some level of correlation. The highest value of net worth belongs to the wood processing industry, while the lowest level of net worth is associated with the Tobacco processing industry. Median net worth for all firms is around 0.029, i.e. firms hold around 3% of their assets as excess net worth. A more naive measure of net worth, which only take the difference between net property, plant and equipment and debt into account, would result in a substantially negative median net worth across all industries. This illustrates the importance of inventories and cash in the net worth measure.

Figure 2.1: Value Added Growth and GDP Growth



*Notes.*This Figure shows industry net worth and industry leverage ratios for industries used in the analysis. Net worth is defined as the difference between the sum of property, plant, and equipment, inventories, and cash and total liabilities divided by total assets. Leverage ratio is defined as the ratio of total liabilities to total assets. The industries are: 1500 Manufacture of food products and beverages; 1600 Manufacture of tobacco products; 1700 Manufacture of textiles; 1900 Tanning and dressing of leather etc.; 2000 Manufacture of wood and of products of wood etc.; 2100 Manufacture of paper and paper products; 2200 Publishing, printing and reproduction of recorded media; 2300 Manufacture of coke, refined petroleum products and nuclear fuel; 2400 Manufacture of chemicals and chemical products; 2600 Manufacture of other non-metallic mineral products; 2700 Manufacture of basic; 2800 Manufacture of fabricated metal products Industrial Suppliers; 2900 Manufacture of machinery and equipment n.e.c.; 3000 Manufacture of office, accounting and computing machinery; 3100 Manufacture of electrical machinery and apparatus n.e.c.; 3200 Manufacture of radio, television and communication equipment; 3300 Manufacture of medical, precision and optical instruments; 3500 Manufacture of motor vehicles, trailers and semi-trailers; 3500 Manufacture of other transport equipment; 3600 Manufacture of furniture; manufacturing n.e.c.

Net worth is an industry-specific, time-invariant measure. Following an economic downturn, firms in sectors with lower median net worth should face a binding collateral constraint more likely and therefore, will be unable to borrow, which will depress the value-added growth of this sector compared to other sectors. As firms in the Datastream database are large and public, their median net worth is an approximation for the desired net worth a firm under the lowest level of financial frictions would have. If additional country-specific financial constraint would be in place, these

Table 2.2: Summary Statistics - Industry Characteristics

Variable	Median	Std. Dev.	Min	Max	Corr
Net worth	2.36	15.40	-31.46	34.78	1
Leverage ratio	57.45	9.33	38.75	74.63	-0.77
Tangible assets	54.30	10.58	33.51	80.07	0.58
External dependence	-4.32	120.71	-133.69	471.84	0.17
Liquidity	13.07	5.47	0.00	20.39	-0.02
Investment ratio	27.70	11.15	13.99	51.06	0.04
R&D	0.49	7.42	0.00	30.42	0.10
Growth total assets	10.62	6.26	3.80	26.84	0.00
Capital expenditures to total assets	3.92	2.45	2.29	14.51	0.41
Investment good	0.87	31.95	0.00	95.25	-0.08
Tradable Good	58.25	17.77	21.85	99.15	0.36
Durable good	1.00	0.51	0.00	1.00	0.08
Order back log	0.00	1.92	0.00	6.16	-0.31

Notes. Industry Characteristics are calculated with the Datastream Database for U.S. firms or using aggregated U.S. data from Census and BEA. Every variable, which is not calculated using aggregate data from BEA, is the median of the firms' average of the variable.

should only affect the levels but neither the differences between or the order of the industries. The necessary assumption made is that the differences in net worth from U.S. industries translate to differences in net worth of industries in other countries and that these differences do not change over the business cycle. To prove the robustness of the measure, I consider the correlation between U.S. industry net worth and the net worth of industries in other G7 countries. The results suggest that there is a strong correlation between industry net worth. The correlation is positive and significant for Canada, France, Germany, Italy and the United Kingdom and insignificant for Japan. Table 2.2 displays the summary statistics for net worth and other industry specific control variables used in the analysis. Net worth is only weakly correlated with other industry characteristics apart of tangible assets and the leverage ratio. However, this relationship is purely mechanical as the difference between these two variables define net worth. The Variable definitions of other control variables can be found in Table 2.3.

Table 2.3: Variable Definition

Variable	Definition
Industry growth rate	The industry growth rate is the growth rate of real value added for a given industry at a given point in time. The value added data is obtained from OECD (STAN) and inflation data from World Bank.
Investment good	An industries share of investment goods is calculated the following. I take the BEA input out-put data from 1997-2009 and calculate consumption and investment. Investment is the sum of all columns labeled as investment while consumption is every column labeled consumption. Then the variable *Investment good* is Investment/(Investment+ consumption) as in Braun and Larrain (2005) and the median value over the years is taken.
Tradable Good	The tradability of a good is measured in the following way. Using the Input output accounts of the BEA I construct trade as the sum of exports plus imports and then tradability is trade/(trade+domestic), where domestic is consumption+investment.
Durable Good	A good produced is classified as durable if the BEA classifies it as durable.
Back log	A good has a higher backlog ratio if its unfulfilled orders are greater than their shipments. Unfulfilled orders and shipment data is obtained from M3 monthly from U.S. census. Backlog is the median ratio of unfulfilled orders to shipment from 1992 to 2009.
R&D	The research and development dependence of an industry is the median industry value of the mean of firms Research and development expenses divided by total sales.
Growth total Assets.	An industries growth of total assets is the median of the firms' average growth of total assets.
rcapx	rcapx is the industry median of the mean of capital expenditures to total assets.
Capital	Capital is the industry median of firms mean of the sum of property plant and equipment, inventories and cash) divided by total assets.
Leverage ratio	The leverage ratio is defined as the industry median of firms mean of total liabilities divided by total assets.
Liquidity	Liquidity is the measure proposed in Raddatz (2006). It is the industry median of firms mean inventories to sales.
Investment	Investment is defined as an industries median of firms mean capital expenditures divided by the last period's net property plant and equipment.
External dependence	External dependence is calculated using the same procedure as in Rajan and Zingales (1998).

To study the effect of net worth over the business cycle, shocks to GDP have to be identified. Business cycle shocks are defined as deviations from a country's GDP trend measured by the HP-Filter (Hodrick and Prescott (1997)). For the test of the first hypothesis, I construct the following treatment variable T: It is equal to the deviation from the HP-filtered trend when the deviation is negative and 0 otherwise. To be able to test the second hypothesis, I construct a second treatment variable B, which considers the positive deviations from the trend only. In the following, I will use shocks and recessions synonymously. As the goal is to test for asymmetries in the amplification mechanism, I split the treatment variable for the positive and the negative case into two variables in the following way: T_small are small and T_large are large deviations from trend. I choose the following split: Small recessions are negative deviation up to 3% and large recessions are deviation of more than 3%. [4] The variable B for positive deviations is split in the same way.

My dependent variables are the value-added, employment, and gross fixed capital formation growth rates of various manufacturing industries in OECD countries. The data is taken from the STAN Database (STructural ANalysis Database ISIC Rev. 3), which provides yearly manufacturing data at the sector level from 1980 to 2009.[5] The sample I am using contains 12335 observations for 32 countries, 29 years and 20 industries.[6] Table 2.4 displays the summary statistics of the industry value added growth over the business cycle. I observe that sectors experience on average a 1,8% growth per year. Furthermore, there are differences between low and high net worth industries over the business cycle. While both grow equally strong in expansions, low net worth industries grow slower in recessions. This is a first indication that net worth might be an important indicator of industry value-added growth in recessions.

[4] The 3% cutoff is chosen small enough such that enough data points remain above it to estimate the coefficient. However, the results are robust to changing the cut-off to 2% or 4%.

[5] Wearing apparel (1800), rubber and plastics (2500), and recycling (3700) were excluded as no matching with the ICB classification could be done.

[6] The U.S. is excluded because the industry variables were calculated using U.S. company data.

Table 2.4: Summary Statistics - Industry Growth Rates

	High nw normal		High nw recession		Low nw normal		Low nw recession	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Value added growth	.0340	.275	-.0354	.273	.0348	.232	-.0527	.177
Observations	7415		902		5633		691	

Notes. Industry's real value added growth rates over the different stages of the business cycle. Positive gdp-growth are labeled normal, negative gdp-growth is labeled as recessions.

The final econometric models are

$$g_{c,i,t} = \gamma * \phi_{c,i,t-1} + \alpha_{c,t} + \alpha_{i,t} + \alpha_{c,i} + \beta_1' X_i D_{c,t} + \epsilon_{c,i,t} \tag{2.1}$$

$$g_{c,i,t} = \gamma * \phi_{c,i,t-1} + \alpha_{c,t} + \alpha_{i,t} + \alpha_{c,i} + \beta_1' X_i D^S_{c,t} + \beta_2' X_i D^L_{c,t} + \epsilon_{c,i,t} \tag{2.2}$$

The dependent variable is growth in yearly value-added measured on the industry level. $\phi_{c,i,t-1}$ is the lagged share of value-added to total value-added. This independent variable is important, as larger industries tend to grow slower than smaller sectors. α_i are country-time, industry-time and country-industry fixed-effects. X_i is the vector of the independent variables and T the treatment variable described above. In the second specification, the treatment variable is split as described above.

4 Results

The results of the empirical exercise are discussed in this section.

1. Baseline

The baseline results can be found in Table 2.5. The main variable of interest is $Nw * T$, which measures the difference between growth rates of different industries with different net worth for different values of negative deviations from HP-filtered trend.

Column (1), which presents the results only including the variable of interest, supports the hypothesis of a amplification channel emerging from different net worth levels of industries. The coefficient is negative as expected and significant at the 5 % level. The interpretation of this coefficient is the following: While hit by a negative shock, industries with lower net worth grow slower than industries with higher net worth. Earlier work of Braun and Larrain (2005) focused on the effect of external financing dependence on economic growth in economic downturns. To make sure that net worth is not capturing the same effect, external financing dependence is included in the regression. The net worth effect is robust to including external financing dependence (Table 2.5 column (2)). The results of Dell'Ariccia et al. (2008) suggest that banking crisis have an effect on industry growth differences through the external dependence channel as well. The great depression, which took place in 2008 and 2009 takes place during our sample period. To rule out possible contamination of the result by the worldwide banking crisis, I exclude the years after 2006 such that the financial crisis is not part of the sample anymore. Column (3) shows the results, the effect remains significant.

In the next step, I will test whether the amplification mechanism is asymmetric, i.e. only shocks of sufficient magnitude amplify the value added loss. Therefore, the treatment variable is split by the cut-off of 3%. The baseline with split coefficients (Table 2.5 column (4)) supports the Hypothesis of an asymmetric amplification mechanism. The coefficient interacted with large shocks is sizable and significant while the coefficient interacted with small shocks is tiny and insignificant. This result still holds when external dependence is included (Column (5)) and the financial crisis is excluded (Column (6)). This is in line with the predictions of BS who claimed amplification should be asymmetric. The difference in growth rates is economically significant as well. While hit with a 4% negative deviation the growth difference between an industry at the 25% percentile of net worth and an industry at the 75% percentile is 2,04 pp. To put this number into perspective, the average growth rate is around 1,89 % over the complete timespan, all countries, and industries. Therefore,

Table 2.5: Baseline

	(1) Full sample	(2) Full sample	(3) No crisis	(4) Full sample	(5) Full sample	(6) No crisis
Lagged Share	-1.053***	-1.054***	-1.207***	-1.052***	-1.056***	-1.202***
	(0.318)	(0.318)	(0.394)	(0.317)	(0.316)	(0.393)
Nw ∗ T	-2.129**	-2.084**	-1.962**			
	(0.833)	(0.850)	(0.932)			
Exd ∗ T		-0.0414	-0.0189			
		(0.0720)	(0.0718)			
Nw ∗ T_small				-0.265	0.0601	0.492
				(1.198)	(1.202)	(1.147)
Nw ∗ T_large				-2.529***	-2.550***	-2.540**
				(0.867)	(0.867)	(0.960)
Exd ∗ T_small					-0.315*	-0.180
					(0.161)	(0.127)
Exd ∗ T_large					0.0125	0.0176
					(0.0612)	(0.0636)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12335	12335	11102	12335	12335	11102
R^2	0.331	0.331	0.321	0.331	0.332	0.322

Notes. Dependent variable is annual real growth rate of real value added at time t for industry i in each country c. It is winsorized at the 1 % level. T is the negative deviation from HP-filtered trend. T_small is the negative deviation up to 3%. T_large is the negative deviations above 3%. Nw is industry net worth, Exd industry external dependence. All estimations include country-industry, country-time and industry-time fixed effects. Standard errors clustered at industry and country level. *,** and *** indicate significance at the 10 ,5 % and 1 % level, respectively.

the net worth channel has the size of one year's average value-added growth rate.

The second hypothesis suggests that negative shocks are amplified, while positive shocks are not. To test this claims, the treatment variable B is used which equals the positive deviations from HP-filtered trend and 0 otherwise. These results can be found in Table 2.6. Column (1) presents a specification of net worth interacted with positive and negative growth rates. Only the coefficient interacted with negative growth rates is significant, which supports the hypothesis that only negative shocks can be amplified. This result is robust to the inclusion of external dependence (Table 2.6 Column (2)) and the exclusion of the financial crisis period (Table 2.6 Column (3)). To exclude that booms might have asymmetric effect as well, I split the treatment variable B with respect to the 3% cutoff. The results continue to support the hypothesis. Column (4) presents net worth interacted with the four deviation intervals. Only the effect of large negative downturns is significant while all others are both smaller and insignificant. The result is still robust when external financing dependence is included (Table 2.6 Column (5)) and if the financial crisis is excluded (Table 2.6 Column (6)). Further, the coefficients of large booms and small recessions are statistically different to the coefficient of large booms at the 1% and 10% level, respectively. The results support the hypothesis of an asymmetric amplification mechanism arising from financial frictions only present in sufficiently bad economic times.

2. Industry Characteristics

While the fixed effects used in the identification strategy can rule out that omitted variables at the country, industry, and time dimension cause the effect, a concern remains that net worth is driven by another industry characteristic. To avoid such concerns, I perform several robustness checks with respect to other industry characteristics. Especially, net worth might be higher in industries that grow faster, do more research, and therefore use more external and internal equity financing as their bankruptcy cost are higher. Table 2.7 presents the results. The net worth channel is ro-

Table 2.6: Boom

	(1) Full sample	(2) Full sample	(3) No crisis	(4) Full sample	(5) Full sample	(6) No crisis
Lagged Share	-1.054***	-1.055***	-1.205***	-1.053***	-1.058***	-1.204***
	(0.318)	(0.318)	(0.395)	(0.317)	(0.315)	(0.394)
Nw ∗ T	-2.024**	-1.960**	-2.155**			
	(0.883)	(0.912)	(0.972)			
Nw ∗ B	-0.279	-0.326	0.572			
	(0.832)	(0.834)	(0.916)			
Nw ∗ T_small				-0.00647	0.352	0.512
				(1.509)	(1.542)	(1.533)
Nw ∗ T_large				-2.377**	-2.376**	-2.539**
				(0.882)	(0.894)	(0.975)
Nw ∗ B_small				-0.366	-0.412	-0.139
				(1.411)	(1.411)	(1.557)
Nw ∗ B_large				-0.525	-0.600	0.144
				(0.848)	(0.856)	(1.045)
Exd	No	Yes	Yes	No	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12335	12335	11102	12335	12335	11102
R^2	0.331	0.331	0.321	0.331	0.332	0.322

*Notes.*Dependent variable is annual real growth rate of real value added at time t for industry i in each country c. It is winsorized at the 1 % level. B is the positive deviation from HP-filtered trend. B_small is the positive deviation up to 3%. B_large is the positive deviations above 3%. Nw is industry net worth, Exd industry external dependence. All estimations include country-industry, country-time and industry-time fixed effects. Standard errors clustered at industry and country level. *,** and *** indicate significance at the 10 ,5 % and 1 % level, respectively.

bust to including R&D expenditures to sales (Column (1)) and average growth of total assets (Column (2)) both interacted with the negative treatment variable as a robustness check. Ergo, the effect of net worth is not caused by firm's innovativeness nor firms that grow faster. Furthermore, firms with lower net worth might be firms that have higher investment needs and making necessary investment might be more difficult in a recession. Therefore, I control for capital expenditures to total assets (Column (3)) and the investment intensity, which is the fraction of capital expenditure to lagged net property, plant, and equipment (Column (4)). Net worth stays significant in both specifications and explains significantly growth differences between industries in recessions. Finally, I control for the liquidity of the balance sheet by using the liquidity measure proposed by Raddatz (2006) (Column (5)). It measures the median ratio of inventory to sales. Net worth is robust to the inclusion of liquidity need of companies as well. In Column (6) all measures are included and net worth becomes insignificant, which is due to the noisiness of the effect during small negative deviations.[7]

Furthermore, I split my net worth variable into a debt ratio, measuring total liabilities to total assets and a capital ratio, measuring the sum of property, plant, and equipment, inventory, and cash to total assets. The results (Table 2.8 Column (1)) demonstrates that the debt ratio is the driving force of the results. This indicates the importance of debt for the volatility of business cycles. While earlier work has mainly analyzed asset tangibility (e.g. property, plant, and equipment to total assets ratio), this is not sufficient to understand the role the capital structure plays in the business cycle. Sectoral leverage is an important source of cyclicality these studies have missed so far.

3. Product Characteristics

The effect of net worth could capture differences in product groups that might experience different effects over the business cycle. Durable goods producers might

[7] If the variables are split with respect to the 3% cutoff the coefficient interacted with net worth for large downturns is still significant

Table 2.7: Robustness Industry

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Share	-1.053***	-1.054***	-1.054***	-1.053***	-1.054***	-1.053***
	(0.317)	(0.318)	(0.318)	(0.317)	(0.318)	(0.326)
Nw ∗ T	-2.211**	-2.214**	-2.456***	-2.229**	-2.035**	-2.052
	(0.848)	(0.953)	(0.837)	(0.862)	(0.873)	(1.293)
Exd ∗ T	0.356**	0.0137	-0.0431	0.0266	-0.0586	0.0480
	(0.173)	(0.138)	(0.0728)	(0.0792)	(0.0841)	(0.271)
RnD ∗ T	-7.173**					-2.088
	(3.499)					(4.749)
Gr_at ∗ T		-1.663				3.509
		(3.117)				(6.438)
Rcapx ∗ T			6.726			0.304
			(7.855)			(9.570)
Investment ∗ T				-2.107***		-2.950
				(0.731)		(1.897)
Liquidity ∗ T					-1.876	-0.564
					(3.153)	(2.631)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12335	12335	12335	12335	12335	12335
R^2	0.331	0.331	0.331	0.331	0.331	0.332

*Notes.*Dependent variable is annual real growth rate of real value added at time t for industry i in each country c. It is winsorized at the 1 % level. Nw is industry net worth, Exd industry external dependence, RnD is R&D dependence, Gr_at si the growth of total assets, Rcapx is the capital expenditures to total assets, Investment is the capital expenditures to lagged net property, plant, and equipment and Liquidity is the ratio of inventory to sales. All estimations include country-industry, country-time and industry-time fixed effects. Standard errors clustered at industry and country level. *,** and *** indicate significance at the 10 ,5 % and 1 % level, respectively.

Table 2.8: Robustness Goods

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Share	-1.051***	-1.059***	-1.051***	-1.053***	-1.053***	-1.058***
	(0.317)	(0.320)	(0.317)	(0.318)	(0.318)	(0.320)
Debt ratio ∗ T	3.885***					
	(1.330)					
Capital ∗ T	-0.207					
	(0.903)					
Nw ∗ T		-2.151**	-2.358**	-2.102**	-2.036**	-2.639**
		(0.837)	(0.912)	(0.862)	(0.876)	(0.959)
Exd ∗ T		-0.0348	-0.0445	-0.0421	-0.0430	-0.0383
		(0.0720)	(0.0714)	(0.0715)	(0.0776)	(0.0775)
Durable_good ∗ T		0.252*				0.986**
		(0.136)				(0.360)
Back_log ∗ T			-0.0642			-0.135
			(0.0539)			(0.0939)
Investment_good ∗ T				-0.102		-0.560
				(0.251)		(0.378)
Tradable_good ∗ T					-0.124	-0.993
					(0.896)	(1.133)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12335	12335	12335	12335	12335	12335
R^2	0.331	0.331	0.331	0.331	0.331	0.332

*Notes.*Dependent variable is annual real growth rate of real value added at time t for industry i in each country c. It is winsorized at the 1 % level. Nw is industry net worth, Exd industry external dependence. All estimations include country-industry, country-time and industry-time fixed effects. Standard errors clustered at industry and country level. *,** and *** indicate significance at the 10 ,5 % and 1 % level, respectively.

find it more difficult to sell their products during bad economic times, as people use the stock of durables, while they need to buy new non-durable goods and durability might cause different net worth, as net worth includes inventory and durable goods producer can store their products easier. To counter these concerns, I control for durability (Table 2.8 Column (2)). The results show that the durability of the goods produced is not driving the results but the differences in net worth. Some durable goods are produced on stock, while others are only produced when orders arrive. To check whether this order backlog has an effect on the net worth channel, I control for backlog the following way: backlog is measured as the median of unfulfilled orders to shipment. Column (3) presents the results. They show that order backlog has no effect on the net worth channel.

In addition, the use of the product might drive our results. I will consider whether goods are easily tradable or if goods are used for consumption or investment purposed. The share of the good that is used for investment purposes is measured in the following way: I use the BEA input-output statistics and calculate investment as the share of all sectors output that is used for investment purpose divided by the total output. The results in Column (4) indicate that net worth is robust for controlling the investment share of the good. Furthermore, net worth might be capturing an effect that firms, which produce goods that are easier to trade, suffer less during downturns. Tradability is measured using the input-output data from BEA in the following way: It is the ratio of imports plus exports divided by exports plus imports plus domestic use. The results in Column (5) suggest that net worth is not capturing an effect of the tradability of goods. Column (6) includes all product characteristics. The net worth channel is robust in this specification.

4. Additional Robustness Checks

BS propose, that the economy might not return to its steady state in the medium-run, while earlier financial frictions models (e.g. Kiyotaki and Moore (1997)) predict that the economy will return to its steady state quickly. To analyze whether constraint sectors catch up or lag behind, I include the one period lead of the interaction of net worth with recessions. The result can be found in Column (1) of Table 2.9. The lead remains insignificant, i.e. industries grow neither significantly faster or slower after the recession and therefore, no rapid recovery takes place. In the next step, I split the coefficients by the 3% cutoff as before to analyze, whether after a large recession there might be a more significant upturn. The results can be found in Column (2). Sectors with lower net worth do not experience a significant catch up after a large recession neither. In fact, both coefficients (for small and large recessions) are insignificant and show a negative sign. Therefore, the growth loss after these recessions is either permanent or smoothed out. As I observe that low net worth industries grow slower on average, these results indicate that the high growth loss in a recession is partially responsible for the overall slower growth of industries with low net worth.

What drives the persistent reduction in sector output? To answer this question, I analyze the effect of net worth in recessions on gross fixed capital formation and employment. First, I observe that gross fixed capital formation decreases sharply for industries that are more likely financially constraint compared to sectors that are less financially constraint during a recession (Column (3) and (4). This effect is driven by large recessions while the effect of small recessions is insignificant and positive. The magnitude is large. Using the same shock and industry difference as before (a 4% recession and the difference between an industry in the first and an industry in the last quartile in the distribution of net worth), there is a reduction in the gross fixed capital formation of around 3pp. Second, employment growth is depressed. Industries with lower net worth decrease their workforce in recessions more sharply than other industries and again this effect is particularly strong and significant for large recessions. The difference in employment growth between an industry in the first compared with an industry in the last quartile in the distribution of net worth in a recession of 4pp is around 3pp. These results provide an explanation for the absence of a fast recovery of low net worth sectors after large downturns. As employment and

Table 2.9: Additional Robustness Checks

	(1) rgrowth	(2) rgrowth	(3) gfcf_growth	(4) gfcf_growth	(5) emp_gr	(6) emp_gr
Lagged Share	-1.149***	-1.144***	-0.827**	-0.811**	-0.690***	-0.688***
	(0.336)	(0.336)	(0.367)	(0.358)	(0.239)	(0.239)
Nw * T	-1.629		-2.863		-3.521***	
	(1.040)		(1.803)		(0.226)	
Nw * lead_T	-0.751					
	(0.785)					
Nw * T_small		0.149		1.834		-2.389**
		(1.611)		(3.473)		(1.128)
Nw * T_large		-2.048*		-3.913**		-3.724***
		(1.055)		(1.485)		(0.370)
Nw * lead_T_small		-0.205				
		(1.595)				
Nw * lead_T_large		-0.874				
		(0.692)				
Exd	Yes	Yes	No	Yes	No	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12129	12129	6539	6539	7800	7800
R^2	0.336	0.337	0.343	0.344	0.406	0.407

*Notes.*Dependent variable is annual real growth rate of real value added, gross fixed capital formation or employment at time t for industry i in each country c. They are winsorized at the 1 % level. All estimations include country-industry, country-time and industry-time fixed effects. Standard errors clustered at industry and country level. *,** and *** indicate significance at the 10 ,5 % and 1 % level, respectively.

capital decline in line with value-added, future production is depressed and hinders a catch-up between the different sectors.

5 Conclusion

I studied the effect of industry net worth over the business cycle and find that industry level credit constraints, caused by different levels of net worth, explain differences in sectoral growth rates. Sectors with lower net worth experience lower value-added growth in recessions than sectors with larger net worth. This effect is present for large but not for small recessions and not for booms or small positive deviations, neither, which supports the theoretical predictions of BS. Furthermore, there are long-term implications of this amplification as employment growth and gross fixed capital formation is depressed at the same time.

These results, supporting the theoretical predictions in the financial friction literature, help to explain why business cycles are as volatile as they are. In addition, the asymmetries identified in this study allow for better-targeted macroeconomic stabilization policy. Government interventions are most effective when constraints are binding and have no effect when constraints are loose. Following this logic, policies, that aim to stabilize the business cycle, should be used in a severe crisis, while no actions should be taken in less severe downturns and the economy is better off if she recovers by herself. Moreover, interventions in depressions should be targeted towards low net worth sectors, as the additional value added is greatest in those sectors and this leads to a higher fiscal multiplier.

Future research, both theoretical and empirical, is needed to determine how the effect of monetary and fiscal policy depends on financial constraints. It is beyond the aim of this chapter to take a stand on the question, which policy is the most effective in crisis based on the analysis presented. Direct transfers to constraint agents, that would be very effective in financial accelerator models (like government transfers to the entrepreneur), might be infeasible in practice, as it is unobservable, who is a capable entrepreneur and insolvencies of unproductive firms might be prolonged through transfers. Future research on the heterogeneous impact of economic policy in different stages of the business cycle might be advantageous.

Chapter 3

The Net Interest Margin and the Branch Network

[1]

1 Introduction

> *A permanent reduction in interest rates reduces for example the gross value of core deposits, and given that branches still have non-interest expenses, maintaining deposit relationships could become a negative present value business.*
>
> Claessens et al. (2017)

The bank branching network is of crucial importance for the flow of credit from savers to borrowers. The seminal contribution of Jayaratne and Strahan (1996) shows that bank branching deregulation in the United States benefited economic development through more efficient lending practices. Furthermore, the deregulation benefited disproportionately poorer households and minorities (Beck et al. (2007); Beck et al. (2010); Levine et al. (2014)). Recent research (Gilje et al. (2016); Berrospide et al. (2016); Gilje (2017); Cortés and Strahan (2017)) demonstrate that the bank branching

[1]This chapter is joint work with Zeki Kocaata.

network is still at the core of distribution of funds, particularly for areas with a large market share of small banks.

However, the banking industry is in turmoil. Persistent low interest rates and new regulatory burdens make it difficult for banks to achieve sustainable profits. Figure 3.1 plots the net interest margin and the one-year treasury rate. While the short-term interest rates collapsed in the aftermath of the financial crisis, the net interest margin increased in the first instance. However, it decreased dramatically as interest rates remained low for long and fell subsequently below 3% in 2015. Recent studies (Genay et al. (2014); Busch and Memmel (2017); Claessens et al. (2017)) suggest that banks profitability is negatively affected by the persistent low interest rate environment. Altavilla et al. (2017) suggest that loose monetary policy has a negative effect on bank profitability but it takes up to a decade for this effect to materialize. Nevertheless, evidence how this affects the bank branching network and financial service offered by banks is marginal.

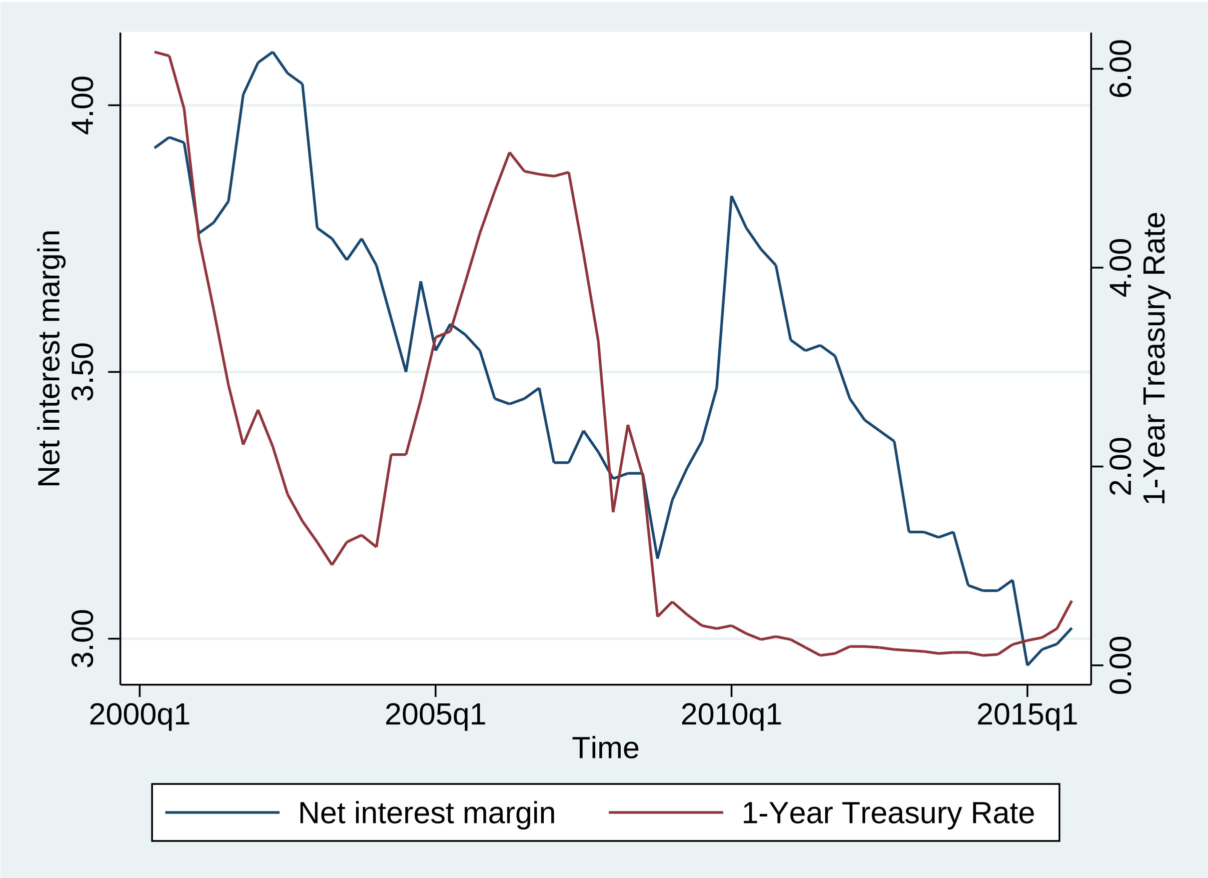
In the United States, the number of banks has been falling persistently in recent years. Furthermore, the slowdown accelerated in the aftermath of the financial crisis. Out of 10,170 banks that existed in 2000, 1700 disappeared until 2009 and further 2000 disappeared until 2016. [2] In contrast, the number of branches, which had been increasing to 100,695 in the last quarter of 2008, decreased to 93,366 in the last quarter of 2015.[3]

In this chapter, we study the effect of a persistent reduction in the net interest margin on the branching network using a natural experiment setting. We identify the exogenous reduction through the repeal of Regulation Q in the United States, I.e. the lift of the ban of interest payments on demand deposits in 2011. The abandonment provides a natural experiment for our setting as it increased funding costs for banks that finance their activities largely through demand deposits more strongly than for

[2]Bank failures account for 573 of the banks that disappear. The vast majority of these failures took place during the financial crisis.

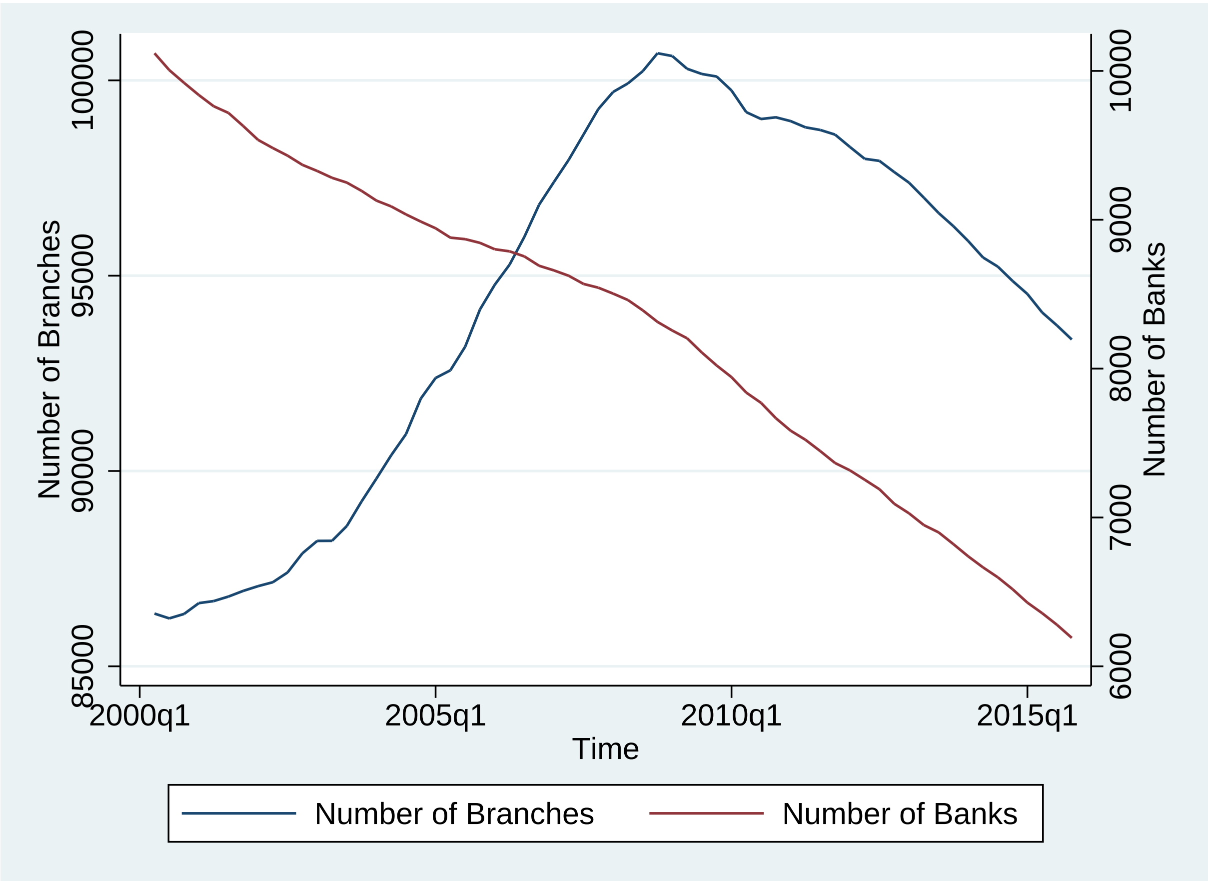
[3]The evolution of the number of banks insured by the FDIC and the number of branches of deposit insured banks can be found in Figure 3.2.

Figure 3.1: Net Interest Margin and 1-year Treasury Rate in the United States



This Figure shows the net interest margin and the 1-year constant maturity treasury rate quarterly from the first quarter of 2000 till the third quarter of 2015. The left y-axis shows the net interest margin in % and the right axis shows the 1-year treasury rate in %. Data is taken from the Federal Reserve Bank of St. Louise.

Figure 3.2: Number of Banks and Bank Branches in the United States



This Figure indicates the number of banks (right axis) and the number of bank branches (left axis) in the Untied States between 2000 and 2016. Data is taken from the FDIC call reports and aggregated by the authors.

banks that finance themselves to a lesser extent with demand deposits. As banks are not forced to pay interest on deposits, our results provide additional insights on the effect of deposit market competition on bank branching. Nevertheless, as some banks experience an exogenous shock to their funding costs we are able to study the question how the low interest rate environment, through the reduction of the net interest margin, affects bank branching. While interest rates at the zero lower bound increase the net interest margin of banks in the short run as asset yields are constant, the net interest margin declines in the medium-run as asset yields decline while interest rates on deposits are bounded at zero leading to a decline in the net interest margin of banks. This breaks the flat relationship between the net interest margin and the short-term interest rate observed by Drechsler et al. (2017).

To compensate for some of the newly imposed costs, banks might try to expand to new markets or expand market power by creating new branches in existing markets to decrease funding cost.[4] However, additional branching comes at a cost, which might surpass the benefit of market power. Further, some banking regulations like the Community Reinvestment Act (CRA) are tied to banks having a branch in a certain area. Therefore, banks might be willing to shrink the branch network to reduce costs of branching and further reduce exposure to clients who are residents in poorer areas, which are protected by these kind of regulations. In this study, we will test whether banks increase or decrease their branching network after the funding shock. Furthermore, we will analyze how banks' soundness is affected by this change in the branch network and whether differences in the income of potential clients are associated with the change in bank risk.

Following the Great Depression, the market for deposits in the United States was tightly regulated. The Banking Act of 1933 made it illegal to pay interest on demand deposits and ceilings were imposed on the interest that could be paid on time and savings deposits. The purpose of this reform was to strengthen the soundness of

[4] Drechsler et al. (2017) suggest that banks pay lower funding costs in their deposits if their market power is greater.

banks and to stop excessive competition. Furthermore, banks would save interest expenditures, which would make it easier to pay the cost of deposit insurance.[5] In the 1960s, Benston (1964) and Cox (1967) argued that the introduction of interest ceilings was unjustified in the first place since banks that paid higher interest on deposits were not riskier than other banks before the great depression.

Over the years, Regulation Q, which is the chapter of the financial regulation of the United States that dealt with the interest ceilings, was modified frequently. Until the 1980s, the interest ceilings on time and savings deposits were gradually increased and in the 1980s, these interest ceilings were finally abandoned. However, the ban on interest payments on demand deposits was kept in place until the recent financial crisis. In response to the crisis, the Dodd-Frank Act was passed, which lifted the ban on demand deposits for the first time in over 70 years. In the aftermath of the reform, the market for demand deposits expanded rapidly from 568.1 $ billion in the second quarter of 2011 to 1,024.4 $ billion in the fourth quarter of 2013.[6]

Our results suggest that banks that relied more heavily on demand deposits before the deregulation took place experienced an increase in their interest expenses and a reduction in their net interest margin. This was compensated by a reduction in their branch network by around 10% of affected banks' total branch network. This indicates that the funding shock caused by the new regulation induced the drop in branch network. As the aggregate number of branches falls, it is unlikely that other banks have filled the gap and opened new branches where affected banks closed down branches. Furthermore, banks' assets become safer and hold less capital, which is in line with the evidence that geographical diversification does not translate into lower risk for banks (Demsetz and Strahan (1997); Acharya et al. (2006); Berger et al. (2010)). In addition, the offices they build are located in richer neighborhoods and they give credit in areas that have a higher per capita income, while the individual income of the applicants does not increase. This indicates that banks react with a geographical

[5] Preston (1933)

[6] Figure 3.5 presents the development of the amount of demand deposits in the United States.

concentration towards safer markets.

Our findings contribute to several strands of the literature. First, we add to the literature on the effect of interest rate ceilings. The interest ceilings adopted after the Great Depression were frequently analyzed over the past decades. Benston (1964) and Cox (1967) were the first to analyze whether the banks that paid higher interest on deposits engaged in hazardous business practices before the Great Depression and both reject this hypothesis. Mingo (1978) studied the flexibility that financial institutions had under Regulation Q to rely on interest-bearing or non-interest-bearing liabilities and finds that there is a negative relationship between bank risk and interest payments, that is banks become safer if they have a higher share of interest expenses to total expenses. Taggart (1978) suggest that pricing controls make it possible for banks to extract monopoly rents by analyzing savings banks from Massachusetts. Dann and James (1982) and James (1983) analyze the effect of changes in the interest cap on savings deposits and find that banks' stock market value decreases when the caps are increased suggesting that banks gained rents from the caps. The interest ceilings had macroeconomic consequences. Mertens (2008) shows that deposit rate ceilings are in part responsible for the volatility of output and inflation and that the lift of deposit caps could be partially responsible for the great moderation. Koch (2015) studies the role of the interest ceilings in the United States on bank lending and he finds that whenever interest ceilings were binding lending by banks contracted sharply.

Second, we contribute to the literature on the real effects of bank branching in a developed economy. Gilje et al. (2016) show that the branch network of banks still plays an important role in the transmission of liquidity shocks to the real economy. Using the recent shell gas boom caused by hydraulic fracturing (fracking), they show that banks only expand their lending in areas where they had branches before the shell gas boom started, as these are the only areas where they have an informational advantage. Gilje (2017) analyzes the effect of the branching network on lending markets. He finds that local lending markets benefit from the internal capital market of banks that are connected through branches. Cortés and Strahan (2017) use property damage to show that banks redirect funds to other branches in the aftermath of natural disasters. This shows how important the branch network is in order to absorb shocks. Work by Benston (1965), Evanoff (1988) and Berger et al. (1997) mostly studied the efficiency of bank branching. Benston (1965) raised the question whether unit or branch banking is more efficient and found that banks with more branches have a higher operational cost arising from higher overhead expenses. Evanoff (1988) analyzes the effect of bank branches on the accessibility of banking service. He finds that accessibility is improved when branching is allowed. Berger et al. (1997) find that banks operate with too many branches and that it would be adequate to reduce branching service to minimize costs.

Third, we contribute to the literature on the real effects of low interest rates. Demirgüç-Kunt and Huizinga (1999) suggest that higher interest rates are associated with greater bank profits. Recently, several authors (Genay et al. (2014); Busch and Memmel (2017); Claessens et al. (2017); Borio et al. (2017)) confirmed this view and find evidence that the recent low interest rates environment depresses the net interest margin of banks. Further, their research suggests that very low interest rates are especially harmful. In contrast, Altavilla et al. (2017) find that the recent monetary policy expansion had only a small effect on bank profitability and it takes a long period until the effect of low interest rates effects the banks. The low interest rate environment is associated with an increase in bank risk-taking. Maddaloni and Peydró (2011) and Jiménez et al. (2014) suggest that banks increase their risk-taking if interest rates are low. Heider et al. (2016) suggest that negative interest rates increase risk in lending and reduce borrowing for banks with a large share of deposit funding while Kandrac and Schlusche (2016) suggest that bank lending increases due to unconventional monetary policy (in particular the large-scale asset purchase (QE) program of the FED). Results from Foley-Fisher et al. (2016) suggest that unconventional monetary policy (in particular the maturity extension program (MEP) from the FED) relaxed financing constraints for firms by allowing them to borrow with a longer maturity. The unconventional monetary policy has an effect on asset origination. Di Maggio et al. (2016)

suggest that the type of asset that is bought in asset purchase programs is crucial for the allocation of credit to the real economy. Di Maggio and Kacperczyk (2017) uncover that the risk appetite of money market funds increases in response to very low short-term interest rates.

Fourth, we contribute to the literature on the effect of distance in banking. Petersen and Rajan (2002) suggest that the distance between lenders and borrowers is an important determinate of the interest rate firms have to pay on their loans and whether or not a loan is approved by the lender. Degryse and Ongena (2005) observe that banks engage in spatial price discrimination. The distance from the borrower to the lender decreases the interest rate while the distance between the borrower and a competitor bank increases the interest rate. Butler (2008) observes that proximity between borrowers and financial intermediaries plays an important role in the bond market. His results suggest that local investment banks are able to offer lower fees and are able to place bonds with lower yields. The effect is particularly strong for firms without credit rating. Agarwal and Hauswald (2010) observe that physical distance is important for the lenders ability to gain private information about the borrower. This leads to a trade-off between the higher availability of credit for firms near by at the cost of higher interest rates. In contrast to the previous literature, Knyazeva and Knyazeva (2012) find that distance between borrower and lenders increase the lending spread. However, they use syndicated loans of large companies, which are less effected by spatial price discrimination and rent extraction of the lenders. Bellucci et al. (2013) present results that are in contrast to the results of Degryse and Ongena (2005). They suggest that the distance between lenders and borrowers increases the interest rate on loans. Herpfer et al. (2017) are the first to analyze how exogenous changes in the distance between lenders and borrowers affect the interest rate and availability of credit. They observe that a lower distance increases the interest rate in existing bank-borrower relationships but also increases the probability of initiating a new relationship between a lender and a borrower. We contribute to this literature as we show that banks transform their branch network strategically to be close to potentially saver borrowers after a shock to their profitability.

Finally, we add further evidence on the interaction of finance and inequality. The literature of finance and inequality was started with the seminal contribution of Beck et al. (2007), who showed that financial development benefits the poor overproportionally. The lowest quintile in the wealth distribution is responsible for more than 60 % of the impact of financial development. Beck et al. (2010) find that the income distribution of states, which started the financial deregulation between the 1970s and 1990s earlier, reduced income inequality, and financial deregulation especially benefited people in the lower part of the income distribution. Levine et al. (2014) show that banking deregulation in the same period especially improved the labor market opportunities of black workers by improving bank efficiency, lowering entry barriers for non-financial firms and the competition for labor. Using two new datasets on income inequality, Tan and Law (2012) study nonlinear dynamics between financial development and inequality. They find that financial deepening reduces income inequality at first. Following Greenwood and Jovanovic (1990) they test if the relationship is reversed U-shaped. However, they observe that the U-shaped is not inverted as Greenwood and Jovanovic (1990) proposed. So financial development leads to a wider income distribution when financial development increases above a certain threshold. Larrain (2015), using sectoral data, shows that opening capital accounts increases income inequality because capital and highly skilled labor are complements and capital inflows boost the income of high-skilled workers through this channel. Reilly et al. (2016) studies the effect of financial deregulation on high school graduation. They find that financial deregulation increases high school graduation rates but this effect is heterogeneous. White individuals were significantly affected while non-whites were not. We add further evidence to these results as we show that the deregulation of interest payment on deposits reduced the number of branches and the availability of credit differentially more in poorer neighborhoods.

The remaining article organizes as follows. Section 2 describes the institutional framework and the data, Section 3 presents the result on the bank level, the branch level, and the mortgage credit level, and Section 4 concludes.

2 Institutional Framework and Data

1. Relationship between Funding Cost and Bank Branches

Our primary object of interest is the effect of a funding shock on the branching network. To elaborate on this, one more general issue has to be clarified: Why do banks open branches and take retail deposits in the first place? Banks could finance themselves using capital markets paying the short-term interest rate and use these funds to lend to their customers. However, evidence by Drechsler et al. (2017) indicates that banks have market power in the deposit market and are therefore able to fund themselves more cheaply than using short-term bonds. Following the literature on the impact of distance in bank lending, we assume that at least part of this market power arises from the existing branch network. However, sustaining an elaborated network of bank branches is costly. Even in the absence of interest payments, which was the case as long as Regulation Q was in place, banks will compete for depositors but can only do so using non-financial measures. One possibility would be to offer cheaper service, i.e. lower fees while the alternative is to build more branches to be close to the customers. Once interest payments on deposits are permitted, this increases the costs of funding especially for banks that had a lot of demand deposits in their balance sheets, assuming that they want to sustain the same deposit base, while the operational costs remain unchanged.[7] Even if banks attract more depositors after they are allowed to pay interest on deposits and lend more to customers, their margin will decline as the interest rates on earning assets remain constant or even decline due to the higher supply of credit.

In the spirit of Drechsler et al. (2017), we consider a simple model of bank funding to study the reaction to the abandonment of Regulation Q. Banks can invest one dollar

[7] Banks had the choice of paying interest but were not forced. However, banks might obviously face problems attracting new and keep the old depositors if they decide not to pay any interest.

today and gain income y tomorrow. We fix asset returns as well as bank size as we want to highlight the effect on the funding side of the bank. This dollar has to be raised entirely through deposits as the bank does not own any equity.[8] There are two ways of raising deposits: (1) paying an interest rate equal to the short-term interest rate r, or (2) opening branches at the proportional cost $c(\gamma)$. The cost is increasing in γ, which is the share of deposits raised through branches. $\beta(\gamma)$ is the interest paid on deposits and it decreases in γ. As customers have to travel less far to the branch if it is closer to their location, they might be willing to accept lower deposits rates (Degryse and Ongena (2005)). The problem of the bank is therefore:

$$\underset{\gamma}{min} \;\; cost = \gamma(c(\gamma) + \beta(\gamma)) + (1-\gamma)r \;\;,\;\; \gamma \in [0,1]$$

If we assume that $c(0) = 0$ and $r > 0$, then there exists an interior solution in which banks use both deposit funding as well as market funding.

Let us now consider the two cases before and after the lifting of the deposit rate ceiling. Once the deposits ceiling is in place, the interest paid on deposits is $\beta(\gamma) = 0$. Therefore, it is optimal for the bank to build as many branches such that the marginal cost of branching is equal to wholesale funding and hence

$$\gamma c'(\gamma) + c(\gamma) = r$$

After the ceiling is lifted, the banks' problem changes. If the bank has higher market power (higher γ), its interest payments on deposits will decrease. [9] Therefore, the cost-minimizing amount of branches is given by

$$\gamma(c'(\gamma) + \beta'(\gamma)) + c(\gamma) + \beta(\gamma) = r$$

with $\beta(\gamma) > 0$ and $\beta'(\gamma) < 0$. This leads to the conclusion that depending on

[8] The income prospects, as well as the capital structure of the bank, are irrelevant for our argument as there is no risk in this model. Therefore, we abstract from them as the bank is entirely deposit funded and asset returns are fixed and independent from the banks funding structure.

[9] In this context, higher market power arises from the reduced distance to the customer.

whether $\gamma\beta'(\gamma) + \beta(\gamma) \lesseqgtr 0$, banks will build more or fewer branches after deregulation and interest rates depend on market power. If the interest rate paid on deposits is close to the market rate or the sensitivity to market power is low, the branching network will decrease in size, while banks will expand their branching network if interest rates are highly sensitive to market power.

2. Data

Our analysis makes use of three data sources. First, we use bank balance sheet information for all depository institutions in the United States, which we obtain from the Statistics on Depository Institutions (SDI), provided by the Federal Deposit Insurance Corporation (FDIC), for 8 quarters before (2009Q3) and after (2013Q3) the reform has taken place.[10] This gives us a sample of more than 7,000 banks over 16 quarters. A list of all variables used in the analysis can be found in Table 3.1. Following Kashyap et al. (2002), we do not account for bank mergers in our sample. However, dropping banks that engage in merger activities does not alter any of our principal results.

The summary statistics for the entire timespan can be found in Table 3.2, the summary statistics after winsorizing are presented in Table 3.3 and the summary statistics on the second quarter of 2011 (one quarter before Regulation Q was in place) can be found in Table 3.4. Our main dependent variable is the number of branches per $ billion of deposits. Additionally, we also look at the number of branches of a bank. The mean number of branches per $ billion of deposits is 32.0 and the median is 26.09 while the mean number of branches is 7.14 and the median is 3. Our treatment variable is the interaction of a reform dummy that is zero before the third quarter of 2011 and one afterwards and a dummy that is one if the bank's share of demand deposits to total assets banks have on their balance sheet in the second quarter of 2011 is in the upper quartile.[11] The median share of demand deposits to total assets is 11%

[10]As all banks that offer insured deposits are part of the sample, we also include banks with new business models like internet banks. However, they account for only a very small share of our banks

[11]As a robustness check, we interact the reform dummy with the continuous share of demand deposits to total assets.

Table 3.1: Variable Definition

Variable	Definition
Number of Branches	The number of physical domestic branches located in the United States a bank operates with.
Number of Branches per $ bil. of Deposits	The number of physical domestic branches located in the United States a bank operates with rescaled by the amount of deposits.
Share of Demand Deposits	The share of a bank's liabilities financed by demand deposits.
Share of Deposits	The share of a bank's liabilities financed by total deposits.
Number of Employees	The number of employees in FTE (Full Time Equivalent).
Number of employees per $ bil. of Deposits	The number of employees in FTE (Full Time Equivalent) rescaled by the amount of deposits.
Bank premises	Real estate and equipment owned by the bank and used for its operations as a share of total assets.
Interest Expenses	The ratio of interest expenses to total deposits.
Net interest margin	The ratio of net interest income to total assets.
Nonperforming assets	The ratio of nonperforming assets to total assets. Nonperforming assets are assets whose payment is more than 90 days overdue and real estate owned by the bank not used for operations, i.e. real estate from mortgage delinquencies.
Risk-weighted Assets	The ratio of risk-weighted assets to total assets.
Capital Asset Ratio	The ratio of total equity to total assets.
Average of Branch Median Income	The average over the median income of the zip code where the branch is located.
All loans - Areas	The average income of the areas in which loan applicants from the HMDA database resident in.
Bank Size	The log size of bank's total assets.
Profitability	Bank's return on assets.
Liquidity	Bank's ratio of securities to total assets.
Share of agricultural Loans	The ratio of loans financing agricultural production and loans secured by farm land to total assets.
Share of C&I Loans	The ratio of commercial and industrial loans and loans secured by nonfarm nonresidential owner occupied properties to total assets.
Share of mortgage Loans	The ratio of loans secured by single family and multifamily home to total assets.
Share of consumer Loans	The share of consumer loans to total assets.
Z-Score	The sum of banks return on assets and capital ratio divided by standard deviation of return on assets.

and banks are considered treated if their share is above 14.9%, which corresponds to the third quarter of the demand deposits to total assets ratio. The treated banks fund themselves with around 20% of demand deposits on average while the demand deposit share of the banks that are considered untreated is 8%.

Banks might compensate the increase in the interest rate on demand deposits by reducing interest rates on other deposits and therefore, they might not experience a funding shock and the net interest margin remains unchanged. For this reason, we analyze the ratio of net interest income to total assets and the ratio of interest expenses to deposits. The net interest margin should decrease while the interest expenses should increase more for banks with a large share of demand deposits in the aftermath of the reform. Mean net interest margin is 2.16% and mean interest expenses are 0.58%.

To analyze if banks reduce their risk after the reform, we consider two measures. First, we employ banks' nonperforming assets to total asset ratio. If banks change the composition of their branch network in the aftermath of the reform towards areas with better borrowers, we would expect to see a decline in the ratio of nonperforming assets to total assets. The mean share of nonperforming assets is 2.6%. In addition, we consider the ratio of risk-weighted asset to total assets as an additional risk measure to which should capture the riskiness of the bank as well. The mean share of risk-weighted assets over all banks is 65%. Additionally, we want to test if the treated banks reduce their capital in order to save costs. Therefore, we consider the capital asset ratio. The mean capital asset ratio is 11,2%. As nonperforming loans are a backward looking measure of bank risk and risk-weighted assets subject to manipulation concern, we consider a third risk measure which is the Z-Score. As it is necessary to calculate the standard deviation of earning to calculate the Z-score, we can only test for differences in the Z-score by collapsing the data before and after the reform.

All variables were winsorized at the 1% level. In some specifications we employ additional bank level controls such as the profitability of banks measured by the ratio of net income to total assets (Profitability), the size of the bank measured by the

Table 3.2: Summary Statistics - Bank Level - Complete Interval - Not Winsorized

	Obs.	Mean	Median	S.D.	Min	Max
Number of Branches	113146	13.09	3.00	138.17	0.00	6728.00
Number of Branches per $ bil. of Deposits	113122	62.27	26.03	3091.22	0.00	1.00e+06
Share of Demand Deposits	113011	11.37	10.25	8.13	0.00	97.64
Share of Deposits	113146	82.99	85.03	9.58	0.00	115.19
Number of Employees	113011	276.75	38.00	4624.24	0.00	231333.00
Number of Employees per $ bil. of Deposits	113011	272.96	247.00	440.73	0.00	77294.69
Bank premises	113011	1.78	1.48	1.45	0.00	28.37
Interest Expenses	112987	3.60	0.65	227.17	-0.00	35630.20
Net interest margin	113011	2.18	2.11	2.58	-1.61	759.90
Nonperforming assets	113011	2.68	1.52	3.56	0.00	49.07
Risk-weighted Assets	113011	65.33	66.58	13.93	0.00	199.67
Capital Asset Ratio	113011	11.37	10.25	6.63	-214.95	100.00
Average of Branch Median Income	107580	10.81	10.78	0.30	9.20	12.25
All loans - Areas	38206	11.06	11.06	0.18	9.97	11.61
Bank Size	113146	1211.25	1196.89	134.88	421.95	2139.01
Profitability	113011	0.24	0.33	15.52	-5084.11	202.89
Liquidity	113146	21.64	18.81	15.93	-0.02	99.51
Share of agricultural Loans	105728	8.14	2.37	12.01	0.00	85.93
Share of C&I Loans	113146	24.05	22.31	14.79	0.00	96.15
Share of mortgage Loans	113146	21.39	18.12	15.38	0.00	100.93
Share of consumer Loans	113011	3.69	2.23	6.40	0.00	105.69
Observations	113146					

This Table presents the summary statistics of the variables used in the analysis. Ratios are stated in percentage points, Bank Size is the logarithm of the bank size multiplied by 100. Number of branches and Number of branches per bil. $ of deposits are not rescaled.

Table 3.3: Summary Statistics - Bank level - Complete Interval

	Obs.	Mean	Median	S.D.	Min	Max
Number of Branches	113146	7.15	3.00	13.85	1.00	102.00
Number of Branches per $ bil. of Deposits	113122	31.96	26.03	27.82	2.14	254.32
Share of Demand Deposits	113011	11.37	10.25	8.13	0.00	97.64
Share of Deposits	113146	82.99	85.03	9.58	0.00	115.19
Number of Employees	113011	109.52	38.00	280.37	4.00	2309.00
Number of employees per $ bil. of Deposits	113011	261.40	247.00	119.89	71.63	1080.14
Bank premises	113011	1.76	1.48	1.34	0.02	6.56
Interest Expenses	112987	0.84	0.65	0.70	0.07	5.81
Net interest margin	113011	2.16	2.11	1.10	0.49	5.37
Nonperforming assets	113011	2.46	1.52	2.65	0.00	10.23
Risk-weighted Assets	113011	65.35	66.58	13.56	26.07	96.34
Capital Asset Ratio	113011	11.20	10.25	4.43	5.13	42.24
Average of Branch Median Income	107580	10.81	10.78	0.30	9.20	12.25
All loans - Areas	38206	11.06	11.06	0.18	9.97	11.61
Bank Size	113146	1211.25	1196.89	134.88	421.95	2139.01
Profitability	113011	0.24	0.33	15.52	-5084.11	202.89
Liquidity	113146	21.64	18.81	15.93	-0.02	99.51
Share of agricultural Loans	105728	8.14	2.37	12.01	0.00	85.93
Share of C&I Loans	113146	24.05	22.31	14.79	0.00	96.15
Share of mortgage Loans	113146	21.39	18.12	15.38	0.00	100.93
Share of consumer Loans	113011	3.69	2.23	6.40	0.00	105.69
Observations	113146					

This Table presents the summary statistics of the variables used in the analysis. Ratios are stated in percentage points, Bank Size is the logarithm of the bank size multiplied by 100. Number of branches and Number of branches per bil. $ of deposits are not rescaled.

Table 3.4: Summary Statistics - Bank level - Second Quarter 2011

	Obs.	Mean	Median	S.D.	Min	Max
Number of Branches	7522	7.14	3.00	13.84	1.00	102.00
Number of Branches per $ bil. of Deposits	7520	32.00	26.09	27.48	2.14	254.32
Share of Demand Deposits	7513	11.16	10.11	7.86	0.00	87.41
Share of Deposits	7522	83.20	85.25	9.49	0.00	100.85
Number of Employees	7513	109.60	37.00	281.29	4.00	2309.00
Number of employees per $ bil. of Deposits	7513	262.75	249.48	119.35	71.63	1080.14
Bank premises	7513	1.76	1.49	1.34	0.02	6.56
Interest Expenses	7511	0.59	0.56	0.33	0.07	5.81
Net interest margin	7513	1.74	1.73	0.41	0.49	5.37
Nonperforming assets	7513	2.60	1.62	2.74	0.00	10.23
Risk-weighted Assets	7513	64.87	66.00	13.25	26.07	96.34
Capital Asset Ratio	7513	11.25	10.29	4.44	5.13	42.24
Average of Branch Median Income	7469	10.81	10.78	0.30	9.20	12.25
All loans - Areas	2518	11.06	11.06	0.18	10.04	11.60
Bank Size	7522	1210.37	1195.26	134.57	451.09	2130.61
Profitability	7513	0.27	0.34	2.00	-131.87	80.90
Liquidity	7522	22.36	19.68	16.01	0.00	99.28
Share of agricultural Loans	6805	8.35	2.70	11.98	0.00	81.53
Share of C&I Loans	7522	24.18	22.53	14.81	0.00	94.89
Share of mortgage Loans	7522	21.27	18.13	15.26	0.00	97.76
Share of consumer Loans	7513	3.67	2.22	6.50	0.00	100.45

This Table presents the summary statistics of the variables used in the analysis in the Quarter before the reform took place. Ratios are stated in percentage points, Bank Size is the logarithm of the bank size multiplied by 100. Number of branches and Number of branches per bil. $ of deposits are not rescaled.

logarithm of banks total assets (Bank Size), and the banks liquidity of the balance sheet measured by the ratio of securities to total assets (Liquidity).[12] All results are presented with or without controls.

Following Imbens and Wooldridge (2009), we test whether the normalized difference between our variables is small enough in order to employ standard regression approaches. The normalized differences in the second quarter of 2011 are reported in Table 3.5. We observe that the standardized differences are lower than the rule of thumb of ± 0.25 for most of our variables. However, banks have a substantial difference in their size, their share of demand deposits and their interest expenses. While it is obvious that banks that rely on a large share of demand deposits have lower interest expenses, as interest payment was prohibited on these kinds of deposits, the fact that banks in our control group are generally larger and have a lower share of deposit funding might be problematic in general. To avoid contamination of our results, we construct a new control group by matching banks that are treated to banks that are in the same state and have only one log difference in size. The normalized differences for the matched subsample can be found in Table 3.6. For this matched sample, the normalized differences are below the 0.25 cutoff for all variables apart from interest expenses and the share of funding achieved through demand deposits. Therefore, we are comparing banks of comparable size, with similar asset structures and comparable funding strategies.

In the next step, we exploit information on each branch a bank has using the FDIC Summary of Deposits. It provides a yearly panel of all branches of all depository institutions in the United States including the amount of deposits held in that branch, the establishing date, the acquisition date, and most important by branch's location. Using this data, we can analyze where treated banks build or acquire new branches. The summary statistics can be found in Table 3.7. The main variable of interest is the

[12] In this context, liquidity is supposed to capture the ability of the bank to restructure its balance sheet in the short-term. A large share of securities on the balance sheet (in contrast to loans) makes the bank more flexible if it observes a higher loan demand as the securities can be sold on the market and the liquidity can be used for new loan origination. It should not be associated with regulatory liquidity measures like the liquidity coverage ratio.

Table 3.5: Summary Statistics - Normalized Differences without Matching

	Mean		Normalized	Observations	
	Untreated	Treated	Difference	Untreated	Treated
Number of Branches	8.20	3.99	-0.24	5,635.00	1,887.00
Number of Branches per $ bil. of Deposits	30.07	37.76	0.19	5,633.00	1,887.00
Share of Demand Deposits	7.74	21.41	0.85	5,635.00	1,878.00
Share of Deposits	82.33	85.79	0.28	5,635.00	1,887.00
Number of Employees	128.61	52.54	-0.22	5,635.00	1,878.00
Number of employees per $ bil. of Deposits	249.26	303.25	0.31	5,635.00	1,878.00
Bank premises	1.75	1.78	0.02	5,635.00	1,878.00
Interest Expenses	0.65	0.40	-0.53	5,633.00	1,878.00
Net interest margin	1.72	1.80	0.13	5,635.00	1,878.00
Nonperforming assets	2.76	2.10	-0.18	5,635.00	1,878.00
Risk-weighted Assets	65.68	62.45	-0.17	5,635.00	1,878.00
Capital Asset Ratio	11.31	11.06	-0.04	5,635.00	1,878.00
Average of Branch Median Income	10.82	10.78	-0.10	5,598.00	1,871.00
All loans - Areas	11.07	11.03	-0.14	2,009.00	509.00
Bank Size	1,228.62	1,155.86	-0.39	5,635.00	1,887.00
Profitability	0.27	0.30	0.01	5,635.00	1,878.00
Liquidity	22.06	23.25	0.05	5,635.00	1,887.00
Share of agricultural Loans	8.19	8.80	0.04	4,954.00	1,851.00
Share of C&I Loans	24.18	24.20	0.00	5,635.00	1,887.00
Share of mortgage Loans	23.14	15.69	-0.36	5,635.00	1,887.00
Share of consumer Loans	3.52	4.14	0.08	5,635.00	1,878.00

This Table presents the mean and normalized differences of our treatment and control group of the variables used in the analysis in the Quarter before the reform took place. Ratios are stated in percentage points, Bank Size is the logarithm of the bank size multiplied by 100. Number of branches and Number of branches per bil. $ of deposits are not rescaled.

Table 3.6: Summary Statistics - Normalized Differences with Matching

	Mean		Normalized	Observations	
	Untreated	Treated	Difference	Untreated	Treated
Number of Branches	4.38	4.63	0.02	1,209.00	1,238.00
Number of Branches per $ bil. of Deposits	33.28	36.30	0.08	1,209.00	1,238.00
Share of Demand Deposits	9.03	20.97	0.82	1,209.00	1,230.00
Share of Deposits	83.77	85.61	0.17	1,209.00	1,238.00
Number of Employees	59.07	62.02	0.01	1,209.00	1,230.00
Number of employees per $ bil. of Deposits	260.38	296.96	0.22	1,209.00	1,230.00
Bank premises	1.75	1.78	0.02	1,209.00	1,230.00
Interest Expenses	0.62	0.42	-0.51	1,209.00	1,230.00
Net interest margin	1.73	1.78	0.09	1,209.00	1,230.00
Nonperforming assets	2.73	2.29	-0.11	1,209.00	1,230.00
Risk-weighted Assets	65.19	63.41	-0.10	1,209.00	1,230.00
Capital Asset Ratio	11.25	10.91	-0.06	1,209.00	1,230.00
Average of Branch Median Income	10.79	10.79	0.00	1,203.00	1,227.00
All loans - Areas	11.06	11.04	-0.09	372.00	367.00
Bank Size	1,172.82	1,171.78	-0.01	1,209.00	1,238.00
Profitability	0.24	0.28	0.03	1,209.00	1,230.00
Liquidity	22.89	22.26	-0.03	1,209.00	1,238.00
Share of agricultural Loans	9.60	8.50	-0.06	1,120.00	1,209.00
Share of C&I Loans	24.83	24.97	0.01	1,209.00	1,238.00
Share of mortgage Loans	19.23	16.71	-0.14	1,209.00	1,238.00
Share of consumer Loans	3.38	3.77	0.07	1,209.00	1,230.00

This Table presents the mean and normalized differences of our matched treatment and control group of the variables used in the analysis in the Quarter before the reform took place. Ratios are stated in percentage points, Bank Size is the logarithm of the bank size multiplied by 100. Number of branches and Number of branches per bil. $ of deposits are not rescaled.

Table 3.7: Summary Statistics - *continued*

(a) Summary statistics - Branch level

	Observations	Mean	S.D.	Min	Max
log Mean Income	106,228	11.16	0.38	9.15	12.65
Opened after Regulation Q	107,695	0.09	0.29	0	1

This Table presents the log mean income of all branches' zip codes and the amount of branches that were opened after Regulation Q has taken place.

(b) Summary Statistics - Mortgage Level

	Observations	Mean	S.D.	Min	Max
HUB Log Median Income	5,973,88	11.08	0.23	9.67	11.6
Applicant Income	6,306,67	4.24	0.74	0	9.21
Denied	5,452,182	0.19	0.40	0	1
Minority Status	5,457,268	0.17	0,38	0	1
Purchased Loan	6,454,147	0.45	0,50	0	1

This Table presents the area's log median income of all loan applications, the log of applicant's income, whether or not the loan was application was denied, the minority status, and whether the loan was purchased or not.

median income in the branch zip code location in the year 2010.[13] Furthermore, we only consider branches of type 11 (Full Service Brick and Mortar Office) and type 12 (Full Service Retail Office) because we want to exclude cyber offices and offices that have limited service, which might be much cheaper to run but do not provide the same benefits as full-service branches do, i.e. potentially not even take deposits and accept loan applications. In the next step, we calculate the average of all branches zip codes' median incomes for every bank in a year. If banks reduce branching activity especially in poorer neighborhoods or create branches in richer neighborhoods, we would expect that the average median income of all branches increases. We have around 106,228 different branches in the sample from which around 9.3% are established after the abandonment of Regulation Q.

Finally, we consider the mortgage loans originated by each bank. To do so, we make use of the Home Mortgage Disclosure Act (HMDA) database. The HMDA provides data on all loan applications, whether they were accepted or denied, applicants' income, loan size, minority status and location for mortgages. Using this data, we can

[13]Zip code level income is only available in Census years. However, as we are interested whether banks move to richer neighborhoods, it should not bias our results that income in a Zip code remains constant over time.

analyze whether banks that are more affected by the abandonment of Regulation Q give loans in better neighborhoods than before and even to richer households. The summary statistics can be found in Table 3.7. The main dependent variable is HUD-income which is the yearly median household income in the county of residence and the applicants' income.[14] We collapse the data on the bank and year level. Furthermore, we only consider observations if banks have at least 20 loan applications. In a further step, we only include loans that were not used for refinancing and loans that were granted. Excluding loans only made for refinancing, our sample has around 6.4 million observations, out of which around 19 % of the applications were denied, 17% of the loan applications were made by applicants belonging to a minority and around 44,5% of the loans were securitized.

3. Deposit Legislation

The banking regulation in the United States acknowledges three types of deposits (Table 3.8), namely demand deposits, savings deposits and time deposits. The practical difference between the former and the two latter is that demand deposits are callable on demand while the bank has the right to wait until it pays out the funds invested in savings and time deposits.[15] Therefore, demand deposits were traditionally used for checking accounts, while time and savings deposits were used to invest and gain interest. In the 1970s and 1980s, two innovations took place that were able to substitute demand deposits: (1) money market funds emerged, which offered a higher interest rate than Regulation Q permitted and (2) NOW (Negotiable Order of Withdrawal) accounts, which are deposit accounts that pay interest and an unlimited amount of checks may be written upon and thereby circumvent the ban on interest payment on demand deposits.[16] However, banks had the right to take 7 days until they trans-

[14]Zip-Code information is not available for the HMDA data.

[15]The minimum time a bank had to demand such that the deposit was not considered a demand deposit was 7 days.

[16]See IMF (2010) for the explanation, why money market funds circumvented Regulation Q. See Gilbert et al. (1986) on the staggered introduction of NOW accounts and how they circumvent Regulation Q.

fer the payments and these accounts could only be used by consumers and not by companies. This forced companies to continue using demand deposits for their cash management.

The Glass-Steagall Act of 1933 eliminated interest on demand deposits and limited interest payments on other classes of deposits. The main reasons to do so was to prevent banks from taking excessive risk. Unfair competition in the deposit market was perceived as a reason for banks to engage investing in hazardous securities. However, other motives played a role as well. The elimination of interest was viewed as a tool to save banks a portion of the costs they had to bear for the newly introduced deposit insurance.[17]

Over the years, interest rate ceilings on time and savings deposits have increased and finally been abandoned completely through the Depository Institutions Deregulation and Monetary Control Act of 1980 by 1986. However, the ban on interest payments on demand deposits was kept in place. It stayed forbidden until the Dodd-Frank Wall Street Reform and Consumer Protection Act was passed that allowed but not forced banks to pay interest on demand deposits. A similar regulation was proposed in 2009 under the Business Checking Fairness Act. However, it was turned down by the Congress. While the Dodd-Frank Act was debated in the parliament, the abandonment was not yet part of the legislation. It was added at the end of the legislative process without further hearing of Congress. The federal authorities sought comments on the new rule until April 6, 2011, announced the change on July 14, 2011 and the reform was enacted on July 21, 2011. Banks were concerned about the effects of the reform. Several comments, which were made public, state concerns about the stability and earnings of banks, as well as potentially disastrous consequences for rural areas.[18] Companies were the direct beneficiary of the reform as cash management became much easier for them as they were not allowed to use NOW accounts to circumvent Regulation Q.

[17]For a more detailed discussion on the motivation of the Banking Act of 1933 see Preston (1933).

[18]The FDIC received 8 comments and many of those request to keep Regulation Q. The Fed received 55 comments. Again, the fast majority opposed the repeal.

Table 3.8: Type of Deposits

Deposit Type	Description	Account Type	Interest	Callable
Demand Deposits	A deposit that is payable on demand, or a deposit issued with an original maturity or required notice period of less than seven days, or a deposit representing funds for which the depository institution does not reserve the right to require at least seven days' written notice of an intended withdrawal	Checking accounts; Certified, cashier's, teller's, and officer's checks; Traveler's checks and money orders; Checks or drafts drawn by, or on behalf of, a non-United States office of a depository institution on an account maintained at any of the institution's United States offices; Letters of credit sold for cash; Withheld taxes, withheld insurance and other withheld funds; Time deposits that have matured	Forbidden until the abandonment of Regulation Q in the second Quarter of 2011	less than 7 days
Time Deposits	A deposit that the depositor does not have a right and is not permitted to make withdrawals from within six days after the date of deposit unless the deposit is subject to an early withdrawal penalty of at least seven days' simple interest on amounts withdrawn within the first six days after deposit	Certificate of deposit	Allowed	At least 7 days
Savings Deposits	A deposit or account with respect to which the depositor is not required by the deposit contract but may at any time be required by the depository institution to give written notice of an intended withdrawal not less than seven days before withdrawal is made, and that is not payable on a specified date or at the expiration of a specified time after the date of deposit. The term savings deposit includes a regular share account at a credit union and a regular account at a savings and loan association.	Passbook savings account; statement savings account; money market deposit account (MMDA); NOW accounts	Allowed	At least 7 days

This Table presents the different kind of deposits that exist under U.S. regulation. Information on the regulation is taken from Title 12: Banks and Banking, Part 204—Reserve Requirements of Depository Institutions (Regulation D) §204.2 Definitions.

As the legislation for the reform was already decided in 2010 but only implemented in 2011, one might question if this law change constitutes a funding shock. The abandonment of Regulation Q was decided jointly with other financial reforms in the Dodd-Frank Act. However, the regulatory implementation is not that straightforward. The Dodd-Frank Act should have implemented the Volcker Rule as well, which has not become part of the banking regulation until today[19]. This example should illustrate that, even though being politically decided, it might take an undetermined long time until the regulation is enacted.

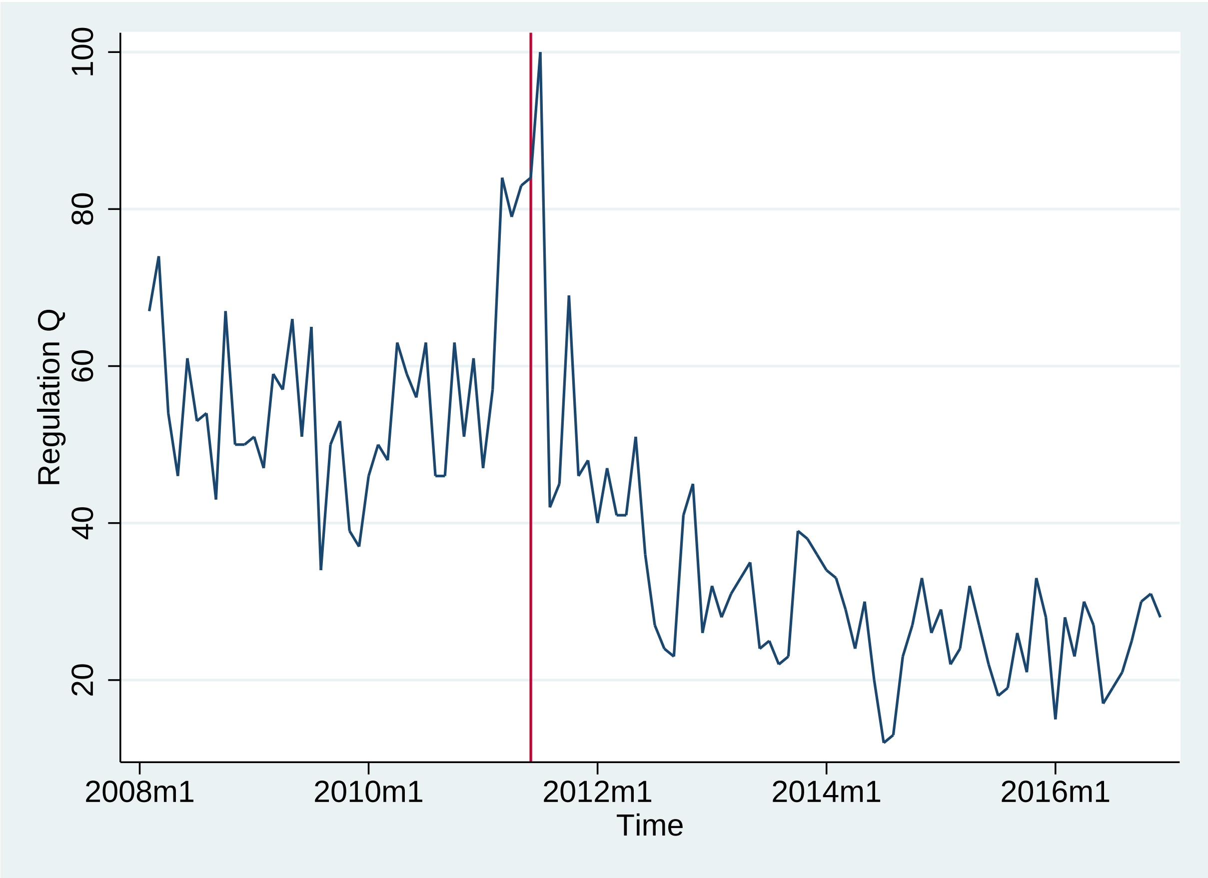
4. Anticipation Effects and Parallel Trends Test

Concerns in the diff-in-diff analysis are that treatment is anticipated and trends are not parallel. To counter these concerns, we employ two test. First, we test whether the reform was anticipated by analyzing the results of Google searches on Regulation Q around the time of the reform. Figure 3.3 shows the result. There is only a spike in attention to Regulation Q in April 2011, when the FED proposed the ruling first and sought for comments and interest peeked shortly after the reform was introduced in July 2011 (red line). Furthermore, the repeal of Regulation Q was added to the Dodd-Frank act without further hearing from congress while attempts to introduce interest bearing checking accounts have been turned down by congress over a time-period of thirty years. In comments to the regulating authorities, many bank managers demanded that the consequences of the reform should be analyzed before the implementation, which indicates that the consequences could not be foreseen even by agents active in the market. This indicates that the reform was a surprise and anticipation effects do not drive our results.

As a second test, we employ a parallel trend test. Figure 3.4 plots the mean number of branches per $ billion of deposits for banks in the upper quartile of the distribution of demand deposits to total assets against the mean number of branches of the

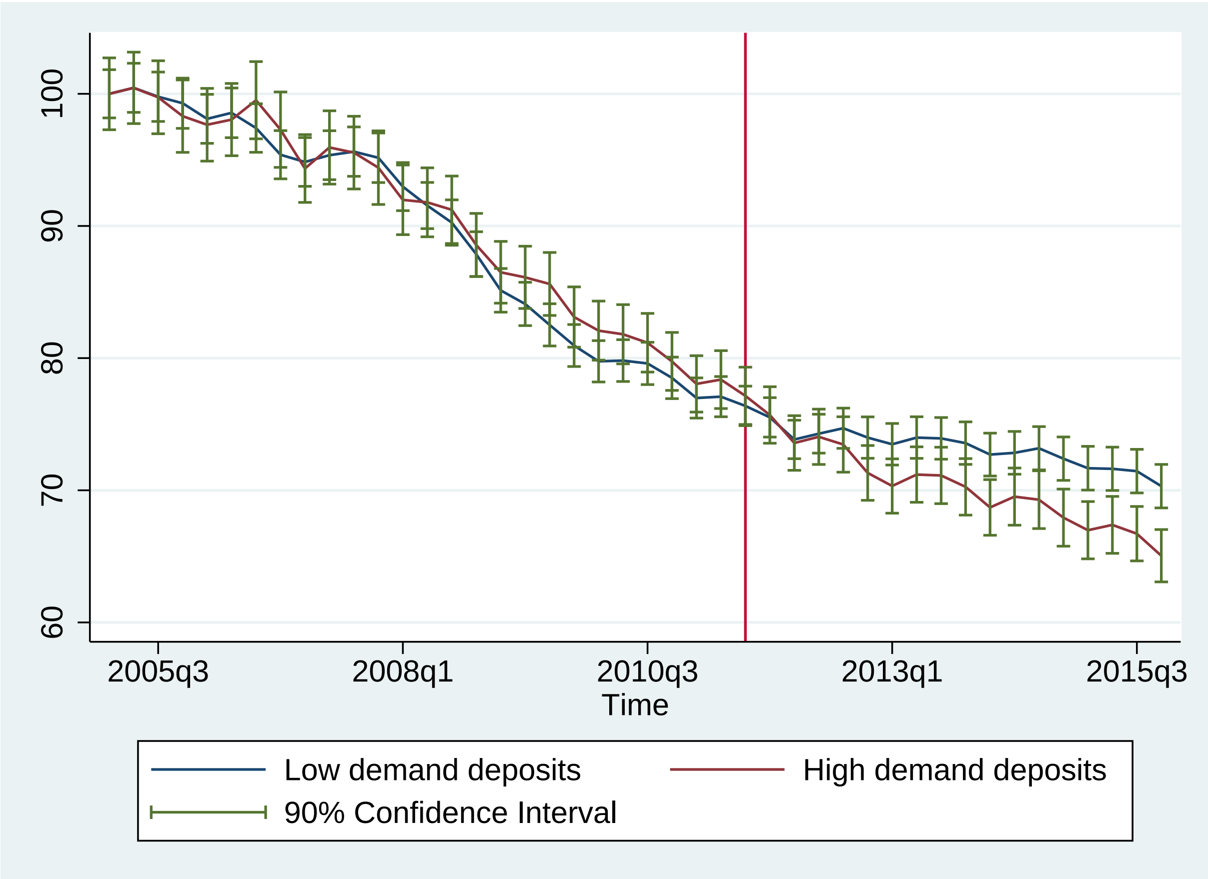
[19]The Volcker Rule bans proprietary trading by commercial banks. Even through implemented on July 21, 2015, the rule is still not effective today due to extensions granted by the FED.

Figure 3.3: Google Trend: Regulation Q



This Figure displays the results of Google Trend on the word "Regulation Q" from the first month of 2008 until end of 2016. Data is taken from Google Trends. The unit is the relative frequency with which the term has been searched for. 100 is the month with the largest amount of searches.

Figure 3.4: Number of Branches per $ Billion of Deposits for Treated and Untreated Banks over Time

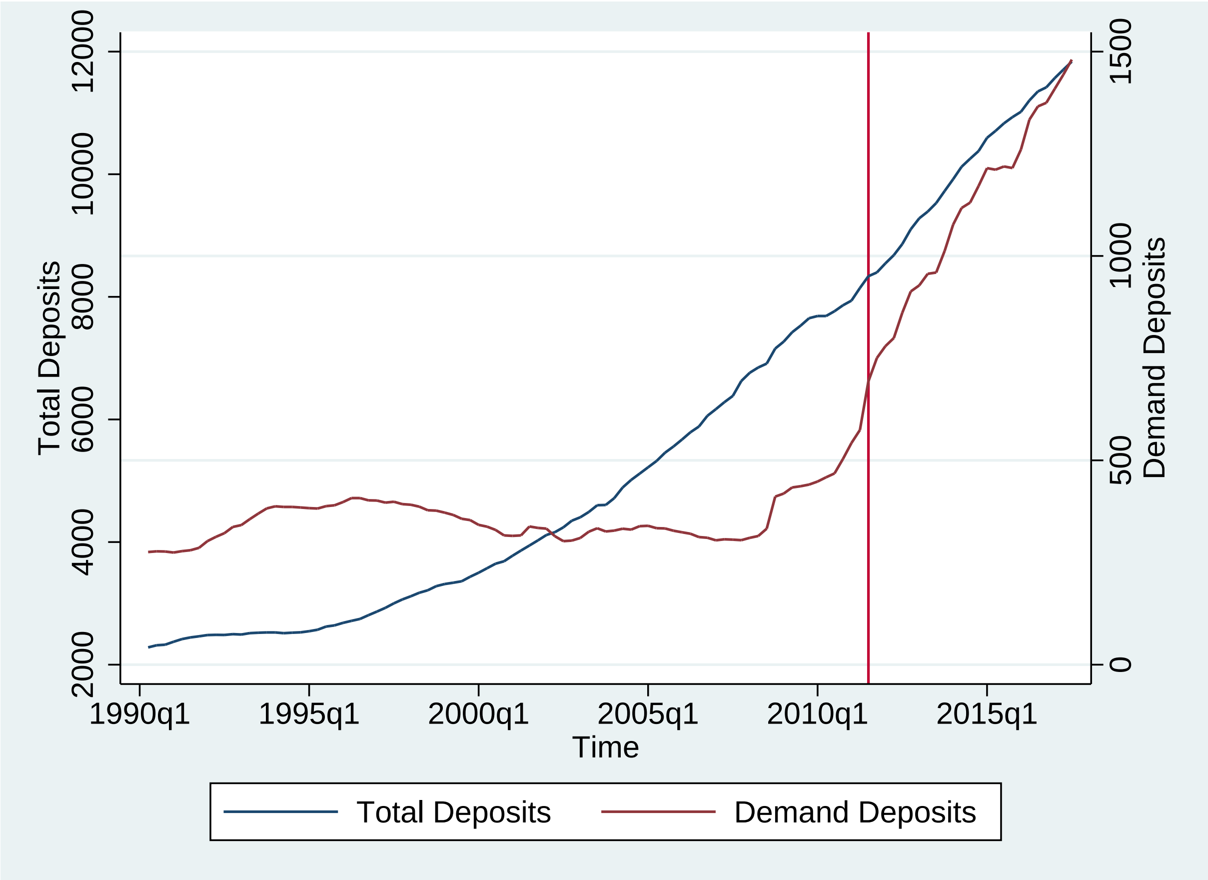


This Figure plots the number of branches per $ billion of deposits for banks with a large (above 14.9% of total assets) share of demand deposits against the amount of branches per $ billion of banks with a low share of demand deposits and the 90% confidence interval. Data is taken from the FDIC call reports and aggregated by the authors.

remaining banks and their 90% confidence intervals. The red line indicates the third quarter of 2011. Both lines are parallel before the reform and just start diverging slowly after the reform has passed and becomes significant some years after. No anticipation effect of the reform is visible and the trends of both subgroups are parallel before the reform was enacted.

As anticipation does not seem to play a role and trends between treatment and control group are parallel before the reform was enacted, we measure the causal effect of the shock to the net interest margin induced by the abandonment of Regulation Q on the branching structure of the affected banks. Another potential explanation for our results could be that banks change their branching network because the demand for demand deposits has declined before the reform took place. To counter these con-

Figure 3.5: Demand Deposits in the Untied States



This Figure shows the total amount in billion dollars of demand and total deposits in the United States from 1959q1 till 2016q3. The red line indicates the abandonment of Regulation Q. Data is taken from the Federal Reserve Bank of St. Louise.

cerns, Figure 3.5 plots the total amount of total deposits and demand deposits in the United States over the last 30 years. It can be seen that the amount of demand deposits does not vary much over time until the reform takes place, while total deposits grow dynamically. Demand deposits start growing dynamically after Regulation Q was abandoned and grow (in relative terms) faster than total deposits. However, an increase in the supply of deposits should lead to an increase of branching and not a decrease and therefore, downward bias our results. This gives us further confidence that the change in the branching network is driven by the reform and not by external demand factors.

The implementation of the different parts of the Dodd-Frank act took different amounts of time. Therefore, there are no important contaminating regulatory events in the third quarter of 2011 that affect banks in the dimension of demand deposits.

Other possible confounding regulatory events are: On 6th of July 2011, the Federal Reserve announced the issuance of new rules on disclosure of credit score requirement. On 14th of June, the FED adopted a final rule regarding a floor for the risk-based capital requirements applicable to the largest, internationally active banking organizations. None of these events should affect the deposits funding or specifically banks with a high share of demand deposits. The only regulatory change associated with demand deposits in the period of interest was the unlimited deposit insurance coverage for non-interest bearing transaction accounts. This change was enacted at the beginning of 2011 and ended at the beginning of 2013. However, the accounts that were eligible for the unlimited deposit insurance coverage must not bare any interest. As we are interested in the change in the interest rate of demand deposit accounts after the abandonment of Regulation Q, this change should not bias our results.

We consider banks that are in the upper quartile of the distribution of demand deposits to total assets as treated. Obviously, every bank might be affected by the abandonment of Regulation Q and they might reshuffle their deposit portfolios and strategies. However, banks, that relied to a large extent on demand deposit funding while Regulation Q was still in place, experience a much larger exogenous increase in their funding cost than banks that only used a small share of demand deposits for funding their activities. Therefore, if a funding shock leads to changes in the branching structure of banks, we would assume that it is particularly strong for banks that relied largely on demand deposits.

As a sensitivity check, we also construct a set of matched banks. Even though the parallel trends assumption is satisfied, the treated banks in our sample might be not comparable to the remaining banks in the sample, i.e. they are substantially smaller. To counter such concerns, we construct a set of matched banks in the following way: For every treated bank in our sample, we look for a bank that is located in the same state and the difference between their log total assets is below one.

A final concern might arise from the fact banks might be different not only in their funding but also in their asset choice. Despite controlling for state-time and bank-specific unobserved characteristics with our fixed effects setting, our results could be driven by the market trend in the corresponding markets rather than the different funding approaches. To counter these concerns, we consider the share of loans granted in the following areas: Commercial and Industrial (C&I), Agricultural, Mortgage and Consumer. We observe that the banks do not differ in these categories to a large extent. Only the share of mortgage loans exceeds the 0.25 cutoff. However, in our matched subsample the differences disappear. This strengthens our confidence that our results are driven by the liability side of the banks and not an unobserved effect affecting their asset holdings.

3 Results

This section describes the results. We start with the results on the bank level, then we turn to the branch level and finally the results of the mortgage credit level are presented.

1. Bank-Level Results

First, we present our baseline results concerning the number of branches. We estimated the model:

$$Branches_{b,t} = \alpha_b + \alpha_{c,t} + \beta \times Dem_{2011Q2,b} \times D_t + \gamma \times X_{b,t} + \epsilon_{b,t} \tag{3.1}$$

$Dem_{2011Q2,b}$ is a dummy that is one if the share of demand deposits in the second quarter of 2011 (one quarter before the reform was enacted) is above 14.9% and D_t is a dummy that is one from the third quarter of 2011 onwards. These banks are most affected by the increase in funding cost after the deregulation and therefore should react more sharply than banks with a lower amount of demand deposits. α_b and $\alpha_{c,t}$ are bank and state-quarter fixed effects and $X_{b,t}$ are additional bank level controls we include. The state-quarter fixed effects should control for changes in the demand for

Table 3.9: Interest Expenses and Net Interest Margin

	(1)	(2)	(3)	(4)
	Interest Expenses		Net interest margin	
Treatment	0.106***	0.100***	-0.0897***	-0.0912***
	(19.93)	(19.53)	(-12.04)	(-12.45)
Bank Size		0.00272***		0.000405
		(11.28)		(1.59)
Profitability		-0.00136		0.000841
		(-0.67)		(0.75)
Liquidity		0.000217		-0.00613***
		(0.44)		(-10.72)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112874	112874	112898	112898
Within R-squared	0.00769	0.0296	0.00359	0.0115

This table reports bank quarter regressions of the interest expenses and the net interest margin on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

banking services the bank faces in their local markets. We present every regression model with and without the additional bank controls.

Before turning to the effect on the branching network, we will analyze the magnitude of the funding shock. Table 3.9 presents the results. We observe that banks, which relied more heavily on demand deposits before the reform took place, experience an increase in their interest expenses by around 0.1pp, which is around half the difference between treated and untreated banks before the reform took place. Further, the net interest margin of the treated banks is depressed with the same magnitude, falling around 0.1 pp.

The baseline result in Table 3.10 column 1 shows that banks relying more on demand deposits in their funding reduce the number of branches per $ billion of deposits when they are allowed to pay interest on these deposits. This result is robust when bank controls (Bank Size, Profitability and Liquidity) are included while the co-

Table 3.10: Branches

	(1)	(2)	(3)	(4)
	Branches per $ bil. of Deposits		Number of Branches	
Treatment	-1.344***	-1.035***	-0.219***	-0.304***
	(-5.68)	(-4.43)	(-4.10)	(-5.39)
Bank Size		-0.143***		0.0388***
		(-7.81)		(7.64)
Profitability		-0.0312		-0.0300***
		(-0.24)		(-5.72)
Liquidity		-0.0317*		-0.00803**
		(-1.80)		(-2.41)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	113009	112874	113033	112898
Within R-squared	0.00147	0.0740	0.000731	0.102

This table reports bank quarter regressions of the number of branches per $ billion of deposits and the number of branches per bank on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

efficient decreases in size. The economic magnitude of the results is between one and one and a third branches per $ billion of deposits. Considering that the total amount of deposits treated banks hold is around $570 billion, this corresponds to a decline in the aggregated amount of branches of around 570 branches. Considering that the treated banks have around 7,000 branches in total, this is a reduction of around 8%.

Furthermore, in the specification of column 3 we look at the number of branches without scaling by the amount of deposits. In the aftermath of the abandonment of Regulation Q, banks with a large share of demand deposits to total assets operate with significantly fewer branches. Controlling for additionally bank controls (column 4) increases the size of the coefficient. As we have over 7000 banks in our sample and treatment as designed in such a way that a quarter of all banks is treated, the aggregated decline in the number of branches is 670 branches. This corresponds to around 0.5% of the total amount of branches in the United States and the average yearly branch growth. Treated banks have around 7,000 branches in total. Therefore, they reduce the size of their branching network by around 10%.

The shock to the net interest margin that we identify is around 0.1 pp per quarter. The aggregate net interest margin has fallen around 0.3 pp annually since the financial crisis. Taking the coefficient we measure, this indicates that the decline in the net interest margin can explain a decline in the aggregate number of branches of around 1600, which is roughly equal to a quarter of the total decrease in the aggregated branching network in the aftermath of the financial crisis.

Banks could concentrate their branches and build bigger but fewer branches, while the financial service provided is unchanged. To rule this out, we consider the number of employees and the number of employees per $ billion of deposits. The results can be found in Table 3.11. We observe that the number of employees is falling drastically. Treated banks reduce their number of FTE (Full-time equivalent) by around 5-7 FTE in the aftermath of the reform. Treated banks have 134,015 FTE in the first quarter before the reform takes place. Therefore, they reduce their total employment by around 12,000 FTE, which corresponds to around 10% of their total employment. Further, banks reduce their number of employees per $ billion of deposits by around 14. Taking into account that the banks, which relied heavily on the amount of demand deposits, have a total amount of deposits corresponding to $570 billion, this corresponds to a reduction in employment of 8,000 FTE, which corresponds to 6% of their total employment.

In addition, banks might reduce bank premises and capital to reduce costs. The results can be found in Table 3.12. We observe that bank premises fall by around 0.05pp, which corresponds to roughly 25% of total bank premises. Furthermore, banks reduce their capital ratio. Banks, that were in the upper quartile of the distribution of demand deposits to total assets, reduce their capital ratio by around 0.3 pp relative to their counterparts. As we use a difference-in-differences methodology, this results cannot be driven by factors like changes in the capital regulations as these effect all banks equally.

Table 3.11: Employees

	(1)	(2)	(3)	(4)
	Number of Employees		Employees per $ bil. of Deposits	
Treatment	-5.270***	-6.816***	-14.42***	-13.31***
	(-4.74)	(-5.75)	(-12.98)	(-12.26)
Bank Size		0.694***		-0.521***
		(7.56)		(-8.58)
Profitability		-0.510***		0.569***
		(-4.32)		(5.10)
Liquidity		-0.129		-0.431***
		(-1.42)		(-4.32)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112898	112898	112898	112898
Within R-squared	0.00107	0.0825	0.00833	0.0601

This table reports bank quarter regressions of the number of employees per bank and the number of employees per $ billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.12: Bank Premises and Equity

	(1)	(2)	(3)	(4)
	Bank premises		Capital Asset Ratio	
Treatment	-0.0582***	-0.0535***	-0.349***	-0.280***
	(-4.56)	(-4.22)	(-6.95)	(-5.92)
Bank Size		-0.00248***		-0.0314***
		(-6.11)		(-10.39)
Profitability		0.0000244		-0.00204
		(0.01)		(-0.19)
Liquidity		-0.00526***		0.00569
		(-8.15)		(1.56)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112898	112898	112898	112898
Within R-squared	0.00152	0.0198	0.00226	0.0854

This table reports bank quarter regressions of the ratio of bank premises to total assets and the capital to assets ratio on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.13: Risk

	(1)	(2)	(3)	(4)
	Nonperforming assets		Risk-weighted Assets	
Treatment	-0.0601*	-0.0669**	-1.028***	-1.079***
	(-1.81)	(-2.03)	(-6.20)	(-6.94)
Bank Size		0.00186**		0.0117**
		(2.44)		(2.44)
Profitability		-0.0125		0.0343***
		(-1.16)		(3.19)
Liquidity		-0.0165***		-0.232***
		(-10.53)		(-17.19)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112898	112898	112898	112898
Within R-squared	0.000168	0.00767	0.00231	0.0568

This table reports bank quarter regressions of nonperforming assets to total assets ratio and share of risk-weighted assets to total assets on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. t statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

So far, our results suggest that the reform, which leads to a funding shock exogenously depressing the net interest margin, leads to a weakening of the capital balance and a reduction in the geographical diversification of banks. In the next step, we want to analyze whether this reduction in branching network reduced banks soundness. Geographical expansion is associated with better diversification opportunities and therefore bank's health should decrease after the branch network is cut (Diamond (1984)). To analyze if banks become riskier after the reform, we perform the same analysis as before using bank soundness measures as dependent variables. Table 3.13 presents the results. Banks reduce the amount of nonperforming assets in their balance sheet by around 0.06 pp (Column 1 and 2).

As a robustness check, we follow Delis and Kouretas (2011) and consider the ratio of risk-weighted assets to total assets. This measure is more universal than the non-performing loans and measures risks in all assets classes not only the loan portfolio.

However, it is also easier for banks to manipulate this measure to save capital. Nevertheless, we observe that after the reform banks reduce the risk weight of their assets by around 1pp (Column 3 and 4). This further indicates that treated banks' assets become safer in the aftermath of the reform.

2. Matched Subsample

Regression analysis only delivers unbiased results if there is no fundamental difference in the treatment and control group prior to treatment after controlling for sufficient covariates. Above, we test the parallel trend assumption and revealed that it holds true. To further strengthen the claim, we look at a sample of similar banks. Imbens and Wooldridge (2009) suggest considering the normalized differences of the variables used in the analysis. Obviously, our treated banks have lower interest expenses and a higher share of demand deposits to total assets. Furthermore, the normalized difference in size is also bigger than the rule of thumb of ± 0.25. To counter possible selection concerns, we match every treated bank with a bank in the same state, the same specialization and similar size (max difference 1 of log assets).[20] The analysis is then repeated using the matched subsample.

Table 3.14 and 3.15 present the result of this exercise. After the matching procedure, we are left with around 36,000 observations compared to the 112,000 before. From the 1887 treated banks, we can find a possible match in around two-thirds of the cases. We end up with a little more than 1200 banks for both our treatment and control group. Column 1 of Table 12 shows the results for the net interest margin. The coefficient of interest (treatment) is highly significant and the coefficient stays significant (Column 2) once we control for additional bank controls. In the next step, we check whether the number of branches per $ billion of deposits decreases (Column 3 and 4). We observe that the results are similar to the coefficients in the baseline model. The magnitude of the effect remains at around one branch per $ billion of deposits.

[20] If more than one match is possible we take the best match in regard of bank size

Table 3.14: Matched Branches and Net Interest Margin

	(1)	(2)	(3)	(4)
	Net interest margin		Branches per $ bil. of Deposits	
Treatment	-0.0813***	-0.0806***	-1.028***	-0.701**
	(-7.56)	(-7.93)	(-3.42)	(-2.41)
Bank Size		0.00105***		-0.114***
		(2.75)		(-8.03)
Profitability		0.0426***		0.0495
		(8.83)		(0.19)
Liquidity		-0.00709***		-0.0633***
		(-7.61)		(-3.12)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	35985	35985	36103	35983
Within R-squared	0.00443	0.0288	0.00177	0.0616

This table reports bank quarter regressions of the net interest margin and the number of branches per $ billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. t statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.15: Matched Risk

	(1)	(2)	(3)	(4)
	Risk-weighted Assets		Nonperforming assets	
Treatment	-1.039***	-0.996***	-0.152***	-0.152***
	(-4.32)	(-4.56)	(-3.17)	(-3.25)
Bank Size		0.0218***		0.000173
		(2.83)		(0.14)
Profitability		0.254***		-0.192***
		(3.38)		(-6.50)
Liquidity		-0.257***		-0.0124***
		(-12.52)		(-5.11)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	35985	35985	35985	35985
Within R-squared	0.00318	0.0710	0.00161	0.0278

This table reports bank quarter regressions of the asset risk measured by the ratio of risk weighted assets to total assets and amount of nonperforming loans to total assets on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Further, asset risk (Table 3.15 Column 1 and 2) and nonperforming loans (Table 3.15 Column 3 and 4) show the same behavior as in the complete sample. Both measures of bank risk decrease by around 1pp and 0.1pp respectively in the aftermath of the reform. This indicates that banks' assets become less risky even through decreasing their geographical diversification.

3. Further Analysis

Our parallel trends test indicates that we measure the causal effect of the abandonment of Regulation Q on the size of banks' branch network. To strengthen this claim further, we perform a placebo test with respect to the reform. Our approach is the following: We move all events back two years, i.e. the new event date is the third quarter of 2009 and the period analyzed is between the second quarter of 2007 and the second quarter of 2011. Table 3.16 presents the results. We observe that the placebo coefficient is insignificant for the specifications with and without controls. In addition, we repeat this exercise for the matched subsample. The prior results are confirmed. For both specification, with and without additional bank controls, the coefficient remains insignificant.

Bertrand et al. (2004) suggest to collapse the data into a pre- and post-reform period to deal with serial correlation. Obviously, serial correlation might be an issue in our setting as the bank branching network is sticky and changes rarely over time. Following their suggestion, we collapse the data into a pre- and a post-reform period and run the same set of regressions as in Table 8. The results can be found in Table 3.17 and confirm our previous findings. In fact, the estimated coefficients are substantially bigger (two branches per bank or 2 branches per $ billion of deposits).

Our analysis including bank and time fixed effects leads to R-squared values above 93%. To exclude potential over-fitting, we run our main regression without fixed effects. The results can be found in Table 3.18 and barely change. The coefficients gain in size (Column 1 & 2). In addition, the results remain robust if the matched

Table 3.16: Placebo Test

	(1)	(2)	(3)	(4)
	Branches per \$ bil. of Deposits		Branches per \$ bil. of Deposits - Matched	
placebo	-0.130	-0.397	0.841	0.640
	(-0.37)	(-1.21)	(1.62)	(1.29)
Bank Size		-0.0649***		-0.0475*
		(-4.83)		(-1.82)
Profitability		-0.617***		-1.147***
		(-3.04)		(-2.78)
Liquidity		-0.0667**		-0.103
		(-2.07)		(-1.64)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112386	112251	35908	35788
Within R-squared	0.00000597	0.0191	0.000369	0.0204

This table reports bank quarter regressions of the number of branches per \$ billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 8 quarters before the reform took place. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.17: Collapsed Data

	(1)	(2)	(3)	(4)
	Number of Branches		Branches per $ bil. of Deposits	
Treatment	-2.074***	-1.277***	-2.053***	-4.002***
	(-10.71)	(-7.49)	(-2.88)	(-5.91)
Bank Size		0.0608***		-0.147***
		(17.50)		(-15.80)
Profitability		-0.161**		-0.723*
		(-2.29)		(-1.81)
Liquidity		-0.0136*		0.0358
		(-1.89)		(1.12)
State-Time Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	13734	13716	13730	13712
Within R-squared	0.0125	0.219	0.00118	0.130

This table reports bank regressions of the number of branches and number of branches per $ billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform took place. Data is collapsed before and after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.18: No Fixed-Effects

	(1)	(2)	(3)	(4)
	Branches per $ bil. of Deposits			
Treatment	-1.825***	-1.327***	-1.373***	-0.872**
	(-7.09)	(-5.46)	(-3.84)	(-2.57)
Regulation Q	-1.882***	-1.531***	-2.070***	-1.742***
	(-11.99)	(-6.69)	(-8.14)	(-4.34)
Treated	8.052***	1.372*	3.297***	2.951***
	(11.01)	(1.88)	(3.08)	(3.11)
Bank Size		-0.0892***		-0.117***
		(-25.32)		(-17.09)
Profitability		0.769		2.462**
		(1.60)		(2.27)
Liquidity		0.00755		-0.0966**
		(0.27)		(-2.58)
Constant	30.87***	139.8***	34.17***	172.1***
	(86.75)	(32.16)	(44.26)	(20.78)
Observations	113122	112987	36118	35998
Adjusted R^2	0.015	0.194	0.005	0.224

This table reports bank quarter regressions of the number of branches per $ billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Regulation Q is a dummy that is one after the second quarter of 2011, Treated is a dummy that is one if the bank was in the upper quartile of the demand deposit to total asset ratio in the second quarter of 2011. Standard errors clustered at the bank level. t statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

subsample is considered (Column 3 & 4).

Our reform might have diverse effects on different kinds of banks. In particular, larger banks might be less affected by the decrease in the net interest margin as they can, on the one hand, compensate with non-interest income and, on the other hand, make a larger use of loans compared to securities and therefore profit more from their branching network. We test this prediction in Table 3.19. Our results suggest that banks, that are in the upper quartile of the size distribution prior to the reform, are unaffected by the increase in interest expenses while the banks that are smaller are largely affected. This indicates that larger banks were less affected by the reform.

Table 3.19: Heterogeneity of the Results

	(1)	(2)	(3)	(4)
	Number of Branches per $ bil. of Deposits			
Treatment	-1.486***	-1.284***	-1.701***	-1.592***
	(-6.03)	(-5.41)	(-4.25)	(-4.11)
Treatment × size_05	1.564***	2.884***		
	(4.26)	(6.48)		
Treatment × agricultural			-0.982**	-0.662
			(-2.04)	(-1.43)
Treatment × commercial			1.334***	1.599***
			(3.21)	(4.01)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Observations	113009	112874	113009	112874
Within R-squared	0.00170	0.0747	0.00258	0.0751

This table reports bank quarter regressions of the number of branches per $billion of deposits on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform took place. Size_05 is a dummy that is one if a bank is in the upper quartile of the size distribution in the second quarter of 2011, agricultural is a dummy that is one if the bank has a agricultural specialization, commercial is a dummy that is one if the bank has a specialization in commercial loans. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

In addition, banks with different specializations might react differently to the decrease in their net interest margin. The FDIC groups banks hierarchically into 9 different categories depending on their asset portfolio. Most of the banks fall into three main categories: Agricultural Specialization (25%), Commercial Lending Specialization (45%) and Other (22%). Banks specialized in mortgage lending account for only 3% of our treated banks. Banks that are specialized in commercial lending might benefit to a larger extent from a large branching network as distance to their clients shortens which facilitates monitoring and information flow. These issues might be less pronounced for banks specialized in agricultural loans, where risks are to a large extent global price changes and the weather, and banks with other specialization, which invest a large share of their assets in the financial market. Our results confirm this view. Banks, which are specialized in commercial lending, do not shrink their branching network. The effect on other banks is both statistically and economically significant. Furthermore, the results indicate that banks specialized in agricultural lending might be affected more strongly by the decrease in the net interest margin.

In our previous analysis, we split the sample based on the fixed cut-off of 14.9% demand deposits to total assets. Now we will relax this assumption and interact the reform dummy with the demand deposit to total asset ratio to proof that our results are not driven by our specific construction of the treatment and control groups. Table 3.20 presents the results. Our previous results are confirmed. Banks that rely more heavily on demand deposits in their funding reduce the amount of branches (column 1 and 2) and the amount of branches per $ billion of deposits significantly.

So far, we can proof that banks reduce their asset risk in the aftermath of the reform. However, as banks reduce their capital at the same time, the overall effect on bank risk remains uncertain. To be able to analyze the overall effect on bank soundness, we employ the Z-score. The Z-score is defined as the sum of the mean capital ratio plus the mean return on assets (ROA) divided by the standard deviation of the ROA. To calculate the standard deviation of the ROA, we collapse the data into a pre and post period in which we calculate the mean of the capital ratio, the

Table 3.20: Branches - Continuous

	(1)	(2)	(3)	(4)
	Number of Branches		Branches per $ bil. of Deposits	
Treatment continuous	-0.0125***	-0.0185***	-0.0655***	-0.0454***
	(-3.93)	(-5.28)	(-3.97)	(-2.75)
Bank Size		0.0389***		-0.143***
		(7.65)		(-7.79)
Profitability		-0.0300***		-0.0313
		(-5.69)		(-0.24)
Liquidity		-0.00832**		-0.0323*
		(-2.49)		(-1.82)
State-Quarter Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	112898	112898	112874	112874
Within R-squared	0.000979	0.102	0.00143	0.0738

This table reports bank quarter regressions of the number of branches per bank and the number of branches per $ billion of deposits on the ratio of demand deposits to total assets interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Table 3.21: Bank Risk - Z-Score

	(1)	(2)	(3)	(4)
		Z-Score		
Treatment	0.0380**	0.0502***	0.0479*	0.0659**
	(2.05)	(2.70)	(1.73)	(2.43)
Bank Size		0.000731***		-0.000103
		(4.13)		(-0.29)
Profitability		0.0166**		0.169***
		(2.46)		(6.30)
Liquidity		0.00369***		0.00418***
		(5.30)		(3.42)
State-Time Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	13600	13600	4434	4434
Within R-squared	0.000587	0.0167	0.00138	0.0562

This table reports bank regressions of the Z-Score on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform took place. Data is collapsed before and after the reform. Standard errors clustered at the bank level. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

mean ROA and the standard deviation of the ROA. As the Z-score is heavily skewed, we take the logarithm of the Z-score as dependent variable. The results are shown in Table 3.21. We observe that the log Z-score is increasing in the aftermath of the reform by between 3.8% and 5.0% (column 1 and 2). Furthermore, the results remain robust if the matched subsample is considered and the magnitude increases to between 4.8% and 6.6% (Column 3 and 4). These results indicate that the overall effect of the reform on bank soundness is positive.

4. Branch-Level Results

In the next step, we analyze whether the reduction in bank risk is associated with expanding into richer or retreating from poorer neighborhoods. Neighborhoods populated by households with a higher income might be safer markets as the poorer customers are riskier as they have more volatile earnings (Gottschalk and Moffitt

Table 3.22: Branch-Level Income

	(1)	(2)	(3)	(4)
	Log Median Income			
Treatment	0.00325**	0.00302**	0.00679***	0.00645***
	(2.11)	(1.96)	(2.82)	(2.66)
Bank Size		0.000000536		0.00000101
		(1.02)		(0.93)
Liquidity		-0.000000593		-0.00000215
		(-0.61)		(-1.18)
Profitability		0.00000616***		0.0000157
		(18.40)		(0.95)
State-Year Fixed Effect	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	35595	35551	11660	11621
Within R-squared	0.000351	0.00576	0.00192	0.00451

This table reports regressions on the bank's average zip code level median income over all branches on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 if the quarter is after the second quarter of 2011. Standard errors clustered at the bank level. t statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

(1994)). As the summary of deposits data supplies us with information for every branch a bank has, and even more importantly its location, we are able to aggregate the zip-code level income of all branches up to a bank level measure. To achieve that, we match the branch data to the corresponding zip code level median family income obtained from the US 2010 census. As zip code level income is only available at the census frequency (every five years), the income of a given zip code stays constant in our sample period. Therefore, our measure only changes if the bank opens a new or closes an existing branch. The findings of this exercise can be found in Table 3.22.

In the first instance, we run our standard model from the previous section with new the dependent variable average log median income. Column 1 presents the result. It states that banks change their branching network in the way that branches are located in richer areas after the reform. The results hold true if bank controls are included. The magnitude of the effect is 0.3pp increase in median family income. To rule out selection bias in our result, we employ the same analysis with our matched data set. The results can be found in column 3 and 4. Previous results still hold but the magnitude of the coefficients increases to around 0.6% in both cases. These results indicate that banks close branches in neighborhoods with a lower income or open branches in areas with a higher income, potentially harming access to finance for poorer households.

5. Loan-Level Results

Banks might reduce credit provision in neighborhoods that are less prosperous. To test this, we analyze data from the Home Mortgage Disclosure Act (HMDA). The HMDA provides data on all mortgage loan applications from households in a given area, the area's median income, the applicant's income and a link to the FDIC identifier of the bank that reported the application. We collapse this data on the bank-year level to obtain the mean HUD (Department of Housing and Urban Development) income and mean income of the applicants. Furthermore, we observe which loans were accepted and which were used for refinancing. The results are presented in Table 3.23.

Column (1) reports the change in median income after the reform for all applications. In line with our previous results, we observe that banks that had a high share of demand deposits before the reform took place receive applications from borrowers that live in 0.6% richer areas. Further, we observe that there is no significant improvement in the applicant's income (Column 2). In addition, we exclude loans that were made for refinancing purposes. These loans might just be rolled over by the same bank and therefore downward bias our results. However, we observe that the results remain unchanged. Median family income of the area where the loan was provided increases for treated banks while the individual applicant's income remains unchanged. Finally, we consider only loans that were granted. The observed coefficients stay robust even though we consider only loans that are granted.

These results indicate that banks try to mitigate poorer neighborhoods after the

Table 3.23: HUD-Median Income and Applicant's Income of Loan Applicants

	(1) area_income_all	(2) income_all	(3) area_income_noref	(4) income_noref	(5) area_income_acc	(6) income_acc
Treatment	0.00678***	0.00856	0.00705***	0.00998	0.00641**	0.00635
	(2.91)	(1.01)	(2.81)	(0.96)	(2.58)	(0.55)
Bank Size	0.00000141***	0.000000719	0.00000142***	0.000000647	0.00000142***	0.000000945
	(2.75)	(0.40)	(2.66)	(0.36)	(2.68)	(0.54)
Liquidity	-0.00000111	-0.00000187	-0.00000105	-0.000000987	-0.00000103	0.00000285
	(-0.92)	(-0.36)	(-0.83)	(-0.16)	(-0.80)	(0.43)
Profitability	-0.0000224**	0.0000609*	-0.0000168	0.0000833*	-0.0000136	0.0000935**
	(-2.03)	(1.68)	(-1.36)	(1.92)	(-1.10)	(2.01)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9127	9134	9125	9133	9119	9128
Within R-squared	0.00877	0.00107	0.00709	0.000992	0.00611	0.000953

This table reports regressions on the income of the ares where loan applicants live on a dummy that is 1 if the share of demand deposits to total assets prior to the abandonment of Regulation Q was in the upper quartile of the distribution interacted with the time dummy that is 1 after the reform. Standard errors clustered at the bank and county level for the first two columns. *t* statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

reform as their newly issued loans are given to customers in richer neighborhoods than before. However, they do not achieve a significantly better client portfolio (at least in the sense of household income) as the applicants remain unchanged. This behavior might be favorable for banks as houses in richer neighborhoods could be better suited as collateral.

4 Conclusion

The branching network is at the core of transmission of funds and the absorption of shocks of the financial system. However, the low interest rate environment shrinks banks' profits by a reduction in the net interest margin and causes a massive consolidation in the banking market. In this study, we analyze the effects of an exogenous decrease in the net interest margin, caused by the abandonment of Regulation Q, on the banking sector, the bank branching structure, and the mortgage market. This gives us a natural experiment to study the effect the low interest rate environment has on the banking market. Using data on all depository banking institutions in the United States, we show that banks, that relied more on financing through demand deposits before the abandonment of Regulation Q, reduced the size of their branching networks in response to the funding shock caused by the reform. Overall, the abandonment of Regulation Q led to around 700 additional branch closures, which corresponds to the average yearly branch growth in the United States and 10% of the affected banks branching network. Taking our results, the decline in the net interest margin in the United States since the end of the financial crisis can account for the entire decline in the number of branches in the United States. Further, treated banks are able to reduce nonperforming loans, risk-weighted assets, and capital ratios. It appears that banks' assets have become safer even though they are less diversified. The increase in the banks' Z-Score indicates that banks have become overall safer as well.

Banks achieve this by a reduction of financial service offered in less prosperous areas. Banks create branches in areas that are populated by 0.6pp richer households in the aftermath of the reform. Further, the area income of their loan applicants as well as granted loans increases by around 0.6pp. Hence, the positive effect on banks stability is achieved by reducing the availability of financial services and in particular mortgage credit to poorer households. On the other hand, companies benefit from the reform as they are granted the opportunity to store their cash and earn interest on it. As the repeal of Regulation Q cleared a market friction, the reduction in bank branches might be the return to a more efficient equilibrium.

Our results have implications on the effect of the low interest rate environment on the bank branching network. However, the welfare implications of the effect are uncertain. If interest rates would remain low for long, banks have to take cost-saving measures to remain profitable. Once interest rates normalize, this might lead to a banking system that is too small to finance the economy. This might be especially harmful to small and medium-sized companies as these depend to a larger extent on local bank credit. On the other hand, there is evidence (Berger et al. (1997)) that there are too many bank branches and that reducing their number might be efficient, strengthening bank profits and increasing the resilience of the financial system.

These results contribute to the emerging literature about the importance of the bank branching network. We are able to demonstrate that banks branch network is sensitive to regulation and funding conditions and that this has real effects for the financial inclusion of households. Further research is needed to clarify the effect of the bank branching network on income, employment and credit access of households.

Chapter 4

The Corporate Equity Puzzle

[1]

1 Introduction

A strong reliance on debt can negatively affect firms' resilience in times of crisis. Following the financial crisis, companies in Europe suffered from severe debt overhang, which depressed corporate investment and slowed down growth in Europe for several years (Geanakoplos (2014); Lo and Rogoff (2014); Reinhart and Rogoff (2015); Kollmann et al. (2016)). In addition, as investments in intangibles become an ever more important part in firms' investment mix (Falato et al. (2013); Dell'Ariccia et al. (2017); Thum-Thysen et al. (2017); EIB (2017)), a heavy reliance on debt finance risks to hamper future investment activities as the lack of collateral associated with these types of assets makes debt finance less suitable.[2] Notwithstanding, firms in Europe rely primarily on debt if they need external financing for their investments.[3] Results from the 2016 European Investment Bank's Investment Survey suggest that debt finance (specifically bank loans) accounts for the vast majority of firms' external finance.[4]

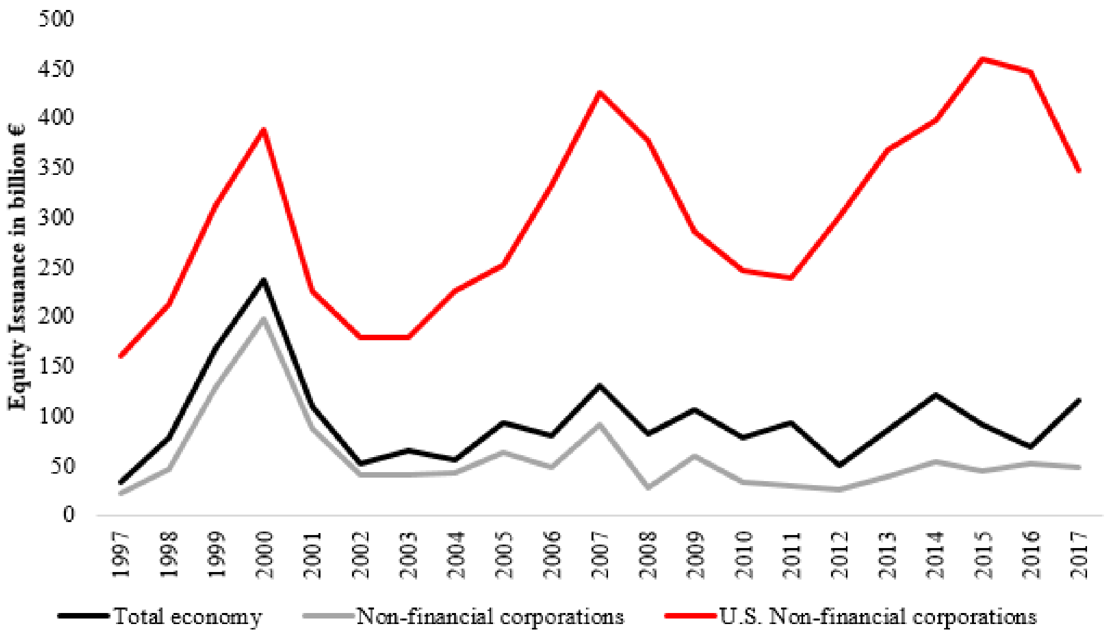
[1] This chapter is joint work with Phillip-Bastian Brutscher.

[2] Dell'Ariccia et al. (2017) suggest that the ratio of tangible relative to intangible assets has risen from roughly 40% to over 100% between the 1970's ind the 2000's.

[3] Results by Fan et al. (2012) indicate that firms in Europe use debt securities and bank loans to a greater extent than their American counterparts.

[4] This does not imply that firms finance their investment entirely using debt. Results from the survey suggest that firms finance around two thirds of their total investment using internal finance, i.e. retained earnings and other free cash-flow. However, debt accounts for 99% of the external finance used by companies in the survey

Figure 4.1: Equity Issuances



This figure presents the listed shares' equity issuance of European companies between 1990 and 2017. The black line is all equity issuances of listed shares in the economy. The grey line takes into account only equity issuances from non-financial companies. Data for Europe is from the ECB and for the United States from the FED. Data for 2017Q4 is missing.

Only a negligible share of external finance comes in the form of external equity. In addition, IPOs are still far below their pre-crisis levels and have been stagnating over the recent years, despite massive increases in stock prices, which should encourage firms to issue new stocks (Taggart (1977); Marsh (1982); Hovakimian et al. (2001); Baker and Wurgler (2002)). [5] Following the market timing hypothesis, rising stock prises should have led to an increase in external equity funding, which cannot be seen in the data.

There are two potential reasons why firms might neglect equity financing. First, there could be a shortage in the supply of this kind of finance, i.e. firms do not use more equity because investors do not buy their shares. This could be due to underdeveloped equity markets or high non-financial costs of equity. Second, firms might simply not be interested in equity financing. To understand why firms in most

[5]Figure 4.1 displays the evolution of issuance of listed stocks over the last two decades. While there has been a rise in equity issuances for financial companies, equity issuances of non-financial companies remain below its pre-crisis level and substantial below both the levels of the early 2000's and the level of the United States.

of Europe continue to rely so much on debt and so little on external equity for their investment activities, we conducted an online choice experiment. By offering firms pairs of hypothetical financing options, we were able to study their preferences over different types of financing.

Our results suggest that firms have an aversion towards external equity finance vis-a-vis debt. When faced with the choice between a debt offer and an equity offer, firms pick the debt offer in 80% of cases. Our results suggest that firms would be willing to pay 880bp more for a debt offer compared to an equity offer with comparable characteristics (assuming a debt offer with the desired amount; maturity; uncollateralized and a fixed interest rate and an equity participation including voting rights). The net premium on debt, which corrects for the influence of corporate control rights, taxes and growth expectations, is around 250bp.[6] While our paper cannot provide a definitive explanation of why firms dislike equity, our data suggest that the dominance of the banking system in most European economies may have led to a crowding-out effect in the corporate finance market. We observe that firms that have used bank loans in the past, have no issues in achieving external finance, and those located in regions with stronger property rights, i.e. firms that seem to be better suited to use bank debt, exhibit a larger debt premium. While the willingness to pay higher costs of capital may seem irrational in the first instance, this behavior could be justified to the extent that their relationship with their main bank might provide benefits, i.e. emergency credit lines or prolonging credit in the case of temporary earning shortfalls. Furthermore, we observe that firms with greater growth perspectives, measured by higher expected net income growth and lower company age, are willing to pay less for debt compared to their less innovative counterparts.

Our paper adds to the literature in several ways. First of all, it adds to the literature on capital structure choice. Numerous studies (i.e. Titman and Wessels (1988); Rajan

[6]Our results can be interpreted as a complement to the Mehra and Prescott (1985) equity premium puzzle. While they observe that equity returns are too high to be explained by a standard asset-pricing model, we observe that companies are unwilling to issue equity as long as equity is not substantially cheaper than debt.

and Zingales (1995); Frank and Goyal (2009)) have addressed the question of which type of firms tend to rely more on debt (vs equity); looking at the correlation between firms' leverage ratios and their level of uniqueness (usually measured as R&D exposure), size, asset tangibility, profitability etc. [7] However, they take the supply of external finance as given, which is not the case, since the availability of equity finance in particular is likely to vary over time, across countries, sectors and firms types. Our study overcomes this obstacle by presenting firms with exogenous financing offers (both debt and equity). This allows us to see which types of firms prefer debt over equity.

Secondly, while the existing literature had to be largely qualitative in its prediction on firms' preference structures, our choice experiment allows us to quantify these preferences and put a 'willingness to pay' label on the debt vs equity trade-off. This is particularly interesting, insofar as it allows us to examine the question of whether firms opt for the cheapest financing source or whether – in line with the pecking order theory – they inhibit a strong hierarchy in their choice of financing (Leary and Roberts (2005); Lemmon et al. (2008); Lemmon and Zender (2010); DeAngelo and Roll (2015)).

Finally, our results add to the discussion on the skewness of equity returns. Bessembinder (2017) suggests that stock returns skewness is so large that the median stock delivers a lower return than a one-month treasury bill, and that only a very small fraction of stocks is responsible for all wealth creation. Our findings complement this, to the extent that we are able to quantify the firms' willingness to pay for an equity participation and confirm that firms are unwilling to accept large costs of equity, which could explain the large amount of firms that deliver returns below the one-month treasury rate. Furthermore, this is in line with the results of Fama and French (2004), who suggest that companies that newly list on the stock market have lower survival rates and skewed returns.

The remainder of the paper is organized as follows: Section 2 lays out the experi-

[7] Their work has been expanded by the effect of firms' history (Welch (2004); Leary and Roberts (2005); Kayhan and Titman (2007)) and adjustment behaviour (Flannery and Rangan (2006); Faulkender et al. (2012)).

mental design and the data. Section 3 describes our calculations of the debt premium. Section 4 presents the empirical results. The relationship between the financial structure and the debt premium is analysed in Section 5. Section 6 checks for heterogeneity in the debt premium and performs several robustness checks, while we conclude in Section 7.

2 Data and Descriptive Statistics

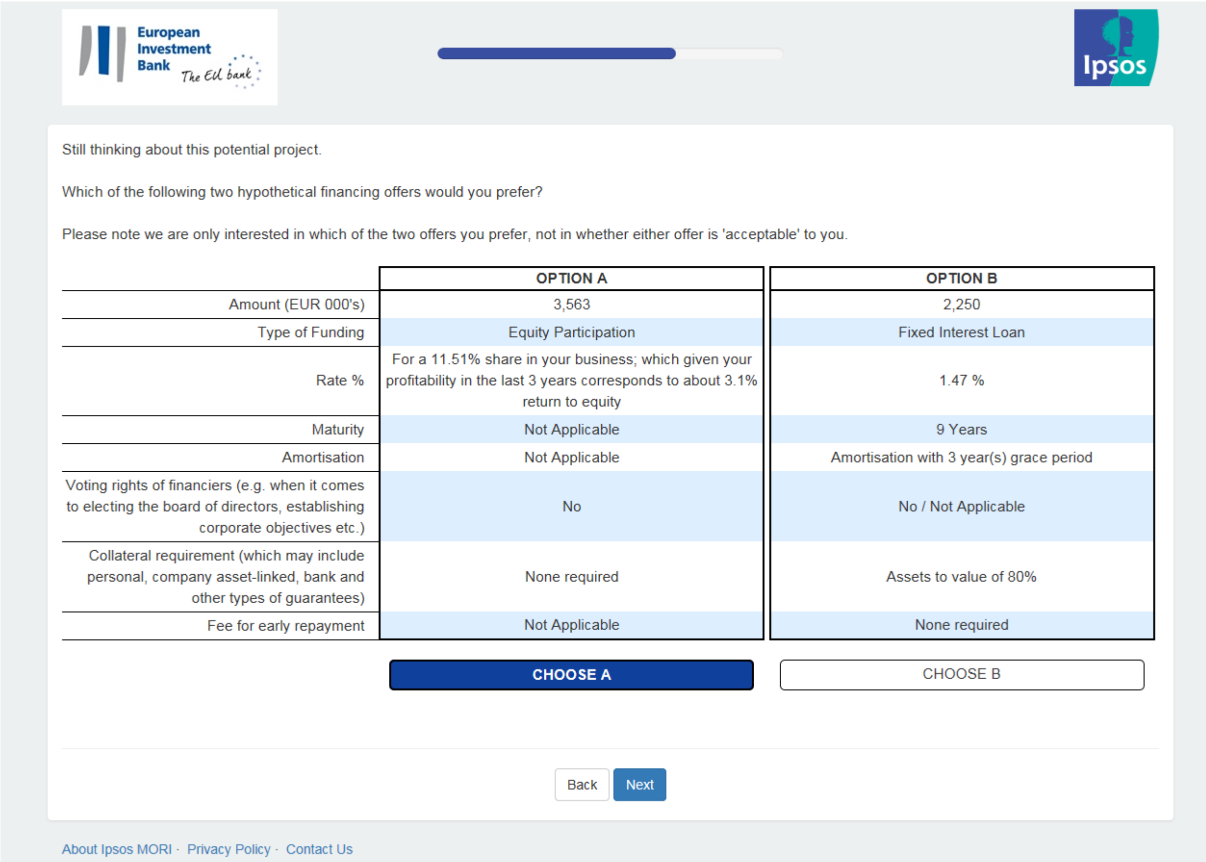
Prior studies analysing firm's capital structure choice lack the ability to account for a firms' financing options (Titman and Wessels (1988); Rajan and Zingales (1995); Hovakimian et al. (2001)). To close this gap, we carried out a randomized choice experiment in which firms were explicitly presented with a series of financing alternatives. In the first step, firms were asked several questions about their planned investment project, i.e. the type of investment they would like to undertake, the size of project, the share of external finance desired, the ideal maturity and in which currency they would like to receive this finance.[8] In addition, firms were asked about their net income in the last three years and their growth expectations going forward. This information was necessary to calculate reasonable equity participations. The value of the company cannot be observed as the survey is answered by the companies anonymous and the vast majority is not listed on the stock market.

In the second step, they were presented with two different hypothetical financing offers and asked which option they preferred (Offer A or Offer B). Figure 4.2 presents the design of the choice experiment. This exercise was repeated for eight pairs of financing offers. The financing offers could be either a loan offer or an equity participation with different characteristics. All possible values were drawn randomly around the demanded financing characteristics.[9] Firms were not incentivized in the

[8] Firms had to classify their investment project as one or several of the following: (1) land, business buildings and infrastructure, (2) machinery and equipment, (3) research and development , (4) software, data and website activities, (5) training of employees, (6) organisation and business process improvements or (7) none of these

[9] The domain of possible characteristics varies across firms and we are interested in how firms value

Figure 4.2: Experimental Design


Still thinking about this potential project.

Which of the following two hypothetical financing offers would you prefer?

Please note we are only interested in which of the two offers you prefer, not in whether either offer is 'acceptable' to you.

	OPTION A	OPTION B
Amount (EUR 000's)	3,563	2,250
Type of Funding	Equity Participation	Fixed Interest Loan
Rate %	For a 11.51% share in your business; which given your profitability in the last 3 years corresponds to about 3.1% return to equity	1.47 %
Maturity	Not Applicable	9 Years
Amortisation	Not Applicable	Amortisation with 3 year(s) grace period
Voting rights of financiers (e.g. when it comes to electing the board of directors, establishing corporate objectives etc.)	No	No / Not Applicable
Collateral requirement (which may include personal, company asset-linked, bank and other types of guarantees)	None required	Assets to value of 80%
Fee for early repayment	Not Applicable	None required

CHOOSE A CHOOSE B

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This figure presents the design of the choice experiment. Offers' characteristics are randomly drawn. In this example, the hypothetical company wants to finance 7.5 million euros, has a net income of 2 million euros and the ideal maturity is 7 years.

experiment, i.e. they did not receive any money or transfer to participate in the experiment. Therefore, we have to rely on the assumption that firms answer the questions truthfully.

Loan offers differed in their amount, the interest type (floating or fixed), the interest rate, the maturity, the amortization period, the collateral requirement and whether or not fees for early repayment were included. Equity participations had different financing amounts, different demanded shares in the company (the implied cost of equity was stated as well) and different voting right structures (voting rights or no voting rights).[10] Table 4.1 lists all variables included in the choice experiment, their

certain loan characteristics over a realistic domain. Firms, which desire a loan of 50 million euros, might not consider financing offers with an amount of 500 million euros, as they are too large if their desired amount of external finance is just 50 million euros. However, around the realistic domain of 50 million euros a higher loan amount might be favourable for firms.

[10]Some characteristics were not applicable for either loan or equity offers, i.e. loan offers do not specify voting rights and equity participations have no maturity. To estimate all coefficients properly,

distribution and the constraints that were applied. The amount offered was equally distributed over 30%, 47.5%, 60%, 82.5%, 100% of the desired amount (stated by firms at the beginning). The maturity and grace period of the debt options were equally distributed over 50%, 75%, 100%, 125%, and 150% desired maturity and 0%, 20%, 40%, 60%, and 100% of the offered maturity, respectively. Collateral requirements were distributed equally over 0, 20%, 40%, 60%, 80%, 120%, and 160% of assets to loan value. The financing offers had three different types (floating interest rate loan, fixed interest rate loan and equity participation). Therefore, we can compare equity participations with floating and fixed interest rate loans. The risk of the company as well as the project are unobservable. Therefore, the interest rates were equally distributed around the corresponding mean market interest rate of the country of residence taken from the ECB bank lending survey for the specific loan size.[11]

we employ the following approach: voting rights is set to no for loan offers. Collateral, fees and amortization are set to zero, interest type to floating, and maturity to 1.5 times the desired for equity offers.

[11] The lowest possible rates was set at the yield on German bunds (for the given maturity) for fixed interest rates and the 3m-benchmark rate from the country of reference for floating interest rates. The highest possible interest rate is equally distributed around two times the Midpoint of market interest rates for a given country, maturity and loan amount (from ECB bank lending survey) minus the lower market end measured by the Yield on German bunds of desired maturity for fixed interest rates and the 3m-benchmark rate plus two times the market mid-point for floating interest rates for the given country and desired loan amount.

Table 4.1: Support of Financing Offer Characteristics used in the Experiment

	Levels	Unit	Constraints
1 Amount	30%, 47.5%, 60%, 82.5%, 100% of desired amount	Local currency or EUR	none
2 Maturity	50%, 75%, 100%, 125%, 150% of desired maturity	Years	Not applicable for Equity Options
3 Grace periods	0%, 20%, 40%, 60%, 100% of desired maturity	Years	Not applicable for Equity Options
4.i Fixed interest rate	1: Yield on German bunds of desired maturity 3: Midpoint of market interest rates for a given country (from ECB bank lending survey) 2,4,5: distributed with equal distances around level 3	percent	5 of one not with 1 or 2 of the other option 4 of one not with 1 of the other option
4.ii Variable interest rate	1: 3m-benchmark rate 2: 3m-br + 50% of bp for desired amount 3: 3m-br + 100% of bp for desired amount 4: 3m-br + 150% of bp for desired amount 5: 3m-br + 200% of bp for desired amount	percent	5 of one not with 1 or 2 of the other option 4 of one not with 1 of the other option
4. iii Cost of equity	Equally distributed around 2.5 times the Midpoint of market interest rates for a given country (from ECB bank lending survey) minus 1.5 times the lower market end measured by the Yield on German bunds of desired maturity	percent	Only applicable for firms that pass the Equity criteria specified below

Table 4.1: Support of Financing Offer Characteristics used in the Experiment

	Levels	Unit	Constraints
4. iv Equity participation	Equals the cost of equity times the external finance amount divided by the company's net income	percent	Only applicable for firms that pass the Equity criteria specified in section 3
5 Collateral	0, 20%, 40%, 60%, 80%, 120%, 160% of assets to loan value	percent	No collateral required for Equity Options
6 Voting	1: No Voting Rights 2: Voting Rights	/	Only applicable for equity options
7 Type of interest rate	1: Fixed 2: Floating 3. Equity Participation	/	For Equity: Loan is not greater than 10 times Net Income For Equity: Upper Equity is not greater than 50 %
8 Fee for early repayment	1: No fee 2: Linked to NPV of remaining interest payment on loan	/	Not applicable for Equity Options

This table provides the design of financing offers, the levels of the characteristics, and units and constraints of the variables used in the choice experiment.

As we lack information about the market value of the companies, we had to use their reported net income to calculate reasonable equity participations. We did this as follows: first, we drew a cost of equity from a uniform distribution. In a second step, we combined this with firms' past net income and the amount of external finance to calculate an equity participation as

$$Equity\ Participation = \frac{Cost\ of\ Equity \times Financing\ Amount}{Net\ Income} \tag{4.1}$$

Standard asset pricing models predict that corporate equity should yield a higher yield than corporate debt due to the higher risk equity investors face. To avoid making unrealistically cheap equity offers, the cost of equity was equally distributed around 2.5 times the midpoint of the loan offers. This ensured two things: First, that the cost of equity was always substantially far away from the zero lower bound. Second, that a broader spread of possible cost of equity options was possible. This allows us to study the trade-off between debt and equity offers with similar as well as substantially different interest rates and costs of equity.[12]

To be eligible to receive an equity offer, a company needed to satisfy two criteria. First, the amount of external finance had to be smaller than ten times the net income. Second, the largest possible equity stake in the company had to be smaller than 50%.[13] This assured that no equity offer was made that would result in the majority of the company being sold. Furthermore, these conditions were necessary as negative net income would lead to equity values of zero in our analysis. If firms violated one of these criteria, they only received loan offers. 65% of all firms were eligible to receive equity offers. In our analysis, we excluded firms that were unable to receive equity

[12] A potential concern of this strategy is that the higher average cost of equity dominates our results. Therefore, we check if the higher cost of equity is driving our results by looking specifically at equity offers that yielded a lower cost of equity than the yield of the alternative financing offer as a robustness check.

[13] The maximal cost of equity were 3.5 times the midpoint of the market interest rate minus 2.5 times the yield on the German bunds of desired maturity.

offers.[14]

The choice experiment was carried out[15] on the back of the second wave of the EIB Group Survey on Investment and Investment Finance (EIBIS). EIBIS is a survey that collects qualitative and quantitative information on firms' investment activities across all 28 EU Member States. Survey participants were drawn from the BVD ORBIS database and included both large companies (above 250 employees) as well as SMEs (5-250 employees). An important feature of the survey is that the vast majority of firms are private, i.e. not listed on the stock market. The total number of firms surveyed was 12,338, and interviews took place between April and August 2017 over the phone.

This paper is based on an additional online module of EIBIS. Firms that reported during the telephone interview that they had an investment project that they would like to carry out were sent a link to an online platform. On this platform firms would see the initial questions to the experiment as well as the choice experiment itself.

The final sample of companies that participated in the online experiment consisted of 973 firms out of which 865 completed the experiment and the rest completed only parts of it. Table 4.2 summarizes the distribution of firms over different countries, sectors and size classes. The countries with the largest number of firms in the experiment are Finland, Italy and Spain with 75, 72 and 65 companies, respectively. The countries with the smallest number of firms are Cyprus, Luxembourg, Ireland and United Kingdom with 4, 10, 11 and 14 firms, respectively. The companies in the sample belong to four different sectors: Manufacturing (NACE sector C), Construction (NACE sector F), Services (NACE sector G or I) or Infrastructure (NACE sector D, E, H or J). Manufacturing firms account for the largest share of firms with around 34%, while firms from the construction sector represent only 17% of all firms. Firms from the service and infrastructure sector account for 22% and 27%, respectively. Around 80% of all companies are SMEs (less than 250 employees), whereas the remaining companies are large companies (more than 250 employees).

[14]Robustness checks at a later stage demonstrate that this exclusion does not alter the results.

[15]The design of the choice experiment is similar to the design of Brutscher et al. (2017). However, in this experiment, firms might be presented with equity and debt offers.

Table 4.2: Distribution of Companies

	Manufacturing	Construction	Services	Infrastructure	SME	Large	Total
Austria	50.0	25.0	12.5	12.5	62.5	37.5	16
Belgium	31.7	19.5	22.0	26.8	87.8	12.2	41
Bulgaria	40.4	21.2	23.1	15.4	76.9	23.1	52
Croatia	33.3	10.5	22.8	33.3	89.5	10.5	57
Cyprus	25.0	25.0	25.0	25.0	100.0	0.0	4
Czech Republic	42.1	13.2	18.4	26.3	78.9	21.1	38
Denmark	26.5	20.6	26.5	26.5	82.4	17.6	34
Estonia	46.4	21.4	14.3	17.9	92.9	7.1	28
Finland	22.7	17.3	25.3	34.7	78.7	21.3	75
France	38.1	21.4	21.4	19.0	78.6	21.4	42
Germany	37.5	12.5	0.0	50.0	62.5	37.5	16
Greece	44.8	20.7	20.7	13.8	82.8	17.2	29
Hungary	27.5	27.5	25.5	19.6	80.4	19.6	51
Ireland	27.3	27.3	27.3	18.2	100.0	0.0	11
Italy	34.7	20.8	19.4	25.0	72.2	27.8	72
Latvia	35.1	8.1	8.1	48.6	86.5	13.5	37
Lithuania	26.7	16.7	26.7	30.0	70.0	30.0	30
Luxembourg	10.0	20.0	40.0	30.0	100.0	0.0	10
Malta	24.0	8.0	64.0	4.0	96.0	4.0	25
Netherlands	31.6	5.3	21.1	42.1	78.9	21.1	38
Poland	38.6	18.2	13.6	29.5	81.8	18.2	44
Portugal	27.8	11.1	25.0	36.1	69.4	30.6	36
Romania	25.9	14.8	25.9	33.3	77.8	22.2	27
Slovakia	40.7	7.4	37.0	14.8	92.6	7.4	27
Slovenia	40.6	12.5	21.9	25.0	84.4	15.6	32
Spain	49.2	10.8	18.5	21.5	70.8	29.2	65
Sweden	22.7	22.7	31.8	22.7	90.9	9.1	22
United Kingdom	28.6	21.4	21.4	28.6	64.3	35.7	14
Total	34.2	16.5	22.7	26.5	80.3	19.7	973

This table shows the distribution of firms by sector for each country (in % of all firms and in terms of size classes (in % of the country's total). 1% corresponds to 9.73 firms.

Table 4.3 provides an overview of the investment projects that firms are contemplating to put into place (that is, their type, size, desire external finance amount, currency and maturity). Overall, firms demanded external finance with an average amount of 9 million euros. However, only a few companies drive this result by demanding very large amounts. The median financing amount is 500 thousand euros, which is around 8% of the median annual sales. The desired financing amounts differ remarkably between different countries. The median firm in Ireland desires external finance amounting to 150 thousand euros while Danish firms request a median financing amount of 1.8 million euros. The 10th percentile of loan size is 50 thousand euros and the 90th percentile is around 10.0 million euros.[16] The desired maturities of potential loans differ to a lesser extent than the desired amounts. The median maturity is five years and does not vary over different sectors. We observe that 45% of all firms intend to invest in real estate, 64% of all firms aim to invest in machinery and equipment, 12% of firms consider investing in research and development, 22% of firms have a potential investment project in the area of digital activities, 15% plan training their employees and 19% of all firms intend to invest in measures to improve business processes.[17]

3 Derivation of the Debt Premium

The results of the choice experiment reveal firms' preferences over the two presented financing offers. As we repeat the choice experiment eight times for every firm, we get eight choices per company. Making use of these, we analyse the trade-off between different financing offers and under which conditions firms switch from one to the other. In the following, we will lay out our empirical framework and how the estimated coefficients can be transformed into the firms' willingness to pay for debt and

[16] In the whole sample, there are 14 firms with desired financing above 100 million euro and around 7 firms with desired financing below 1.000 euro.

[17] Firms could state multiple investment purposes and therefore percentages do not sum up to 100%.

Table 4.3: Summary Statistics

	Desired Amount (in k EUR)		Desired Maturity (in years)		Type of Investment Project						
	Mean	Median	Mean	Median	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Austria	8,458	1,000	9.31	6	62.5	68.8	6.3	25.0	12.5	25.0	0.0
Belgium	15,487	500	7.24	5	48.8	56.1	12.2	19.5	14.6	31.7	0.0
Bulgaria	3,610	409	6.3	5	55.8	59.6	0.0	15.4	15.4	13.5	1.9
Croatia	17,881	270	5.14	5	36.8	68.4	10.5	17.5	12.3	17.5	1.8
Cyprus	10,213	7,900	11.25	10	50.0	75.0	25.0	50.0	50.0	25.0	25.0
Czech Republic	1,597	370	6.71	5	52.6	68.4	15.8	28.9	18.4	15.8	0.0
Denmark	11,755	1,882	10.32	7.5	47.1	52.9	5.9	29.4	14.7	14.7	5.9
Estonia	3,727	360	6.01	5	53.6	78.6	7.1	21.4	14.3	17.9	0.0
Finland	8,814	600	8.48	7	38.7	52.0	21.3	18.7	6.7	18.7	1.3
France	2,484	800	5.94	5	42.9	59.5	16.7	23.8	11.9	19.0	0.0
Germany	11,149	4,000	13.94	12.5	31.3	75.0	0.0	37.5	0.0	31.3	0.0
Greece	1,608	500	6.97	5	31.0	72.4	10.3	17.2	17.2	13.8	0.0
Hungary	1,770	242	7.56	5	52.9	72.5	5.9	25.5	25.5	11.8	0.0
Ireland	552	150	7.45	5	45.5	36.4	27.3	18.2	9.1	18.2	0.0
Italy	6,400	900	7.35	5	33.3	63.9	19.4	33.3	18.1	31.9	2.8
Latvia	4,847	270	8.73	10	51.4	62.2	0.0	8.1	2.7	8.1	5.4
Lithuania	13,370	375	7.55	5	40.0	50.0	6.7	13.3	10.0	13.3	3.3
Luxembourg	1,098	525	9.75	10	70.0	40.0	0.0	20.0	0.0	20.0	0.0
Malta	2,364	500	8.84	10	64.0	56.0	4.0	0.0	0.0	0.0	12.0
Netherlands	5,784	1,500	10.34	7.5	31.6	57.9	10.5	34.2	5.3	18.4	7.9
Poland	2,904	586	6.19	5	45.5	77.3	29.5	29.5	29.5	29.5	2.3
Portugal	2,431	500	8.44	6	38.9	63.9	22.2	30.6	27.8	27.8	0.0
Romania	1,409	449	7.41	5	59.3	59.3	11.1	22.2	29.6	22.2	0.0
Slovakia	2,407	280	6.89	7	63.0	59.3	11.1	25.9	22.2	18.5	0.0
Slovenia	1,930	490	7.07	5	56.3	71.9	12.5	9.4	18.8	18.8	0.0
Spain	47,902	800	7.25	5	29.2	76.9	13.8	15.4	7.7	10.8	4.6
Sweden	2,116	419	7.82	6	36.4	72.7	9.1	18.2	36.4	31.8	0.0
United Kingdom	28,955	860	8.71	5	57.1	35.7	14.3	21.4	7.1	0.0	0.0
Manufacturing	4,911	740	7.37	5	36.6	77.2	21.6	20.1	14.1	19.8	1.5
Construction	7,562	300	6.76	5	45.3	64.6	6.2	19.9	23.0	19.9	1.9
Services	3,129	323	7.07	5	57.0	47.5	8.6	23.1	11.8	21.3	2.7
Infrastructure	20,938	888	8.92	5	44.6	58.9	7.4	24.0	14.0	14.7	2.7
SME	6,496	350	7.38	5	44.8	62.7	11.4	21.0	15.5	18.8	2.6
Large	20,173	3482	8.57	7	44.8	66.7	16.1	25.0	13.0	18.8	0.5
Total	9,195	500	7.61	5	44.8	63.5	12.3	21.8	15.0	18.8	2.2

This table provides the descriptive statistics over the desired amount, maturity and type of investment project (1: Land, business buildings and infrastructure, 2: Machinery and equipment, 3: Research and Development, 4: Software, data and website activities, 5: Training of employees, 6: Organisation and business process improvements, 7: None of these).

equity. The setting is similar to a binary choice model that varies over alternatives.[18] Assuming that firms have monotone preferences, the firms' utility functions are quasi-concave. Let $k = 1, ..., K$ be an index for the different financing offer characteristics x and $\epsilon_{it}(j)$ is an unobserved part of utility for firm i choosing offer j. The utility $u_{it}(j)$ of firm i choosing financing offer $j \in A, B$ at the t^{th} round of the choice experiment is given by:[19]

$$u_{it}(j) = \sum_{k=1}^{K} \beta_k x_{kit}(j) + \epsilon_{it}(j) \tag{4.2}$$

This assumes that companies treat different financing offer characteristics as substitutes. As utility is unobservable, the utility function cannot be estimated directly. However, we observe the choice the firm makes. Under the assumption of rationality, firms should choose the financing offer that yields the higher utility for them. Therefore, the decision between the offers A and B, y_{it}, and the utility derived from its characteristics, $u_{it(j)}$, are linked in the following way:

$$y_{it} = \begin{cases} 1 \; if \; u_{it}(A) > u_{it}(B) \\ 0 \; if \; u_{it}(A) < u_{it}(B) \end{cases} \tag{4.3}$$

y_{it} is a dummy that is one if the firm chooses offer A. Under the assumption that unobserved part of utility, $\epsilon_{it}(j)$, is type-I-extreme-value distributed, the probability of the firm choosing offer A is given by the logit model:

[18] For a more detailed discussion of choice models see Train (1993).

[19] Linearity of the utility function is not a necessary assumption. The utility function can be interpreted as a first Oder Taylor approximation from a more complex non-linear utility function.

$$P(y_{it} = 1|x_{it}) = \frac{exp(\sum_{k=1}^{K} \beta_k x_{it}(A))}{exp(\sum_{k=1}^{K} \beta_k x_{it}(A)) + exp(\sum_{k=1}^{K} \beta_k x_{it}(B)} \tag{4.4}$$

$$\Leftrightarrow P(y_{it} = 1|x_{it}) = \frac{exp(\sum_{k=1}^{K} \beta_k \Delta x_{it})}{1 + exp(\sum_{k=1}^{K} \beta_k \Delta x_{it}} \tag{4.5}$$

Therefore, the coefficients β'_k,which determine to what extent loan characteristics affect utility, can be estimated using a logit model with the decision between the two financing offers as the dependent variable and the differences between the financing offers characteristics as regressors. In addition, we can calculate the elasticity of substitution between different loan characteristics. Taking the total derivate of the utility function and using the elasticity of substitution between two characteristics given by $\eta_{lm} = -\frac{\beta_l}{\beta_m}$, we obtain the following expression:

$$0 = \beta_l dx_l + \beta_m dx_m \tag{4.6}$$

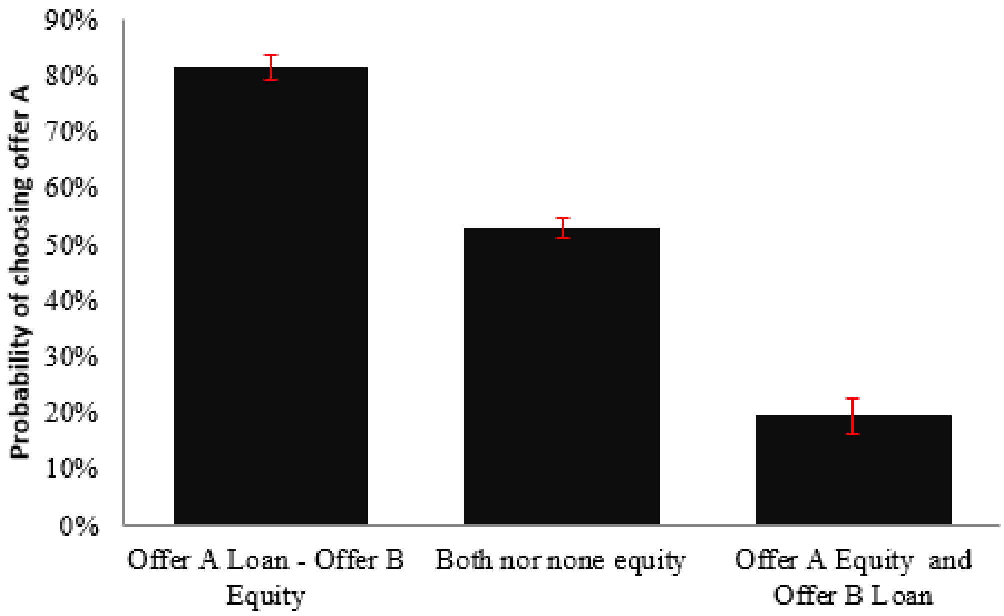
$$dx_m = \eta_{lm} dx_l \tag{4.7}$$

If x_m is the interest rate and x_l the equity dummy, then dx_m is the amount of interest rate a firm would be willing to pay more for a financing offer that is a loan instead of an external equity offer holding everything else constant.

4 Estimation and Baseline Results

Before turning to the estimation, it is insightful to look at the probability of firms preferring equity. Figure 4.3 shows the share of firms choosing an equity offer over a debt offer when faced with the choice between the two. It shows that firms choose loan offers more frequently. In 80% of all decisions, offer A is chosen if offer A is a loan offer and offer B is an equity participation. If both offers are either a loan or an equity offer, the chance is around 50% that either offer A or B is chosen. This gives

Figure 4.3: Debt Equity Choice



This figure shows firms' choice between different external finance offers. The black bars represent the share of firms that have chosen option A conditional on either option A being an loan offer while option B is an Equity offer (first bar), both offers being either equity or loan offers (second bar) or option A being an equity offer while option B is a loan offer.

us a first intuition that firms seem to dislike equity participations if they have the opportunity to get a loan.

In the next step, we want to quantify firms' willingness to pay for debt over equity. To do so, we regress firms' choice between two financing offers on the difference in its characteristics. More specifically, we regress y, which is a dummy that is one if the firm chooses offer A and zero otherwise, on the difference between financing offer A's and financing offer B's characteristics using a logit model. As the support of some variables differ remarkably for different firms, we normalize the variables around adequate midpoints.[20] The regression model is

[20]The financing characteristics are defined as follows: the amount takes a value 100 if the firm is offered precisely the desired amount and X if X% of the desired amount was offered. Correspondingly, maturity is defined as a percentage of the requested maturity and equals 100 if the offer equals the desired maturity. Grace period (amortization) is converted in a percentage of the desired maturity, taking the value 100 for a loan with bullet repayment, i.e. repayment of the full loan amount at the end of loan period. Collateral requirement are used non-transformed in the following estimations, i.e. as a percentage of the value of the loan, where 100 corresponds to a fully collateralized loan. The interest rate and the cost of equity are the rate offered based on the equal distribution around the market midpoint of the resident country. The cost of equity and the interest rate are not normalized to 100 if the interest rate or cost of equity are equal to the market midpoint because we want to express the willingness to pay more for different financing offer in percentage points of interest in the later stage.

$$logit(y_{it}) = \delta \times \Delta Equity_{it} + \gamma \times \Delta r_{it} + \Delta X'_{it}\beta + \epsilon_{it}(j) \tag{4.8}$$

The coefficients of interest are δ and γ, which measures the effect of the financing offer being an equity offer and the cost of financing. The baseline results can be found in Table 4.4. They show that coefficients are in line with the hypothesis. Firms value financing offers with larger amounts, lower cost of equity or interest rates on loans, longer maturities and lower collateral requirements. In addition, they dislike floating interest rates. Fees for early repayment and the amortization period have no significant effect on the choice of firms. The coefficients of interest in this specification are equity participation and voting rights. Both are negative, i.e. firms dislike equity; and in particular if equity comes with investor voting rights. In the second specification, we test whether there is extra utility if the maturity or the amount of the financing offer is at or above the desired. The maturity coefficient becomes insignificant in this specification, which indicates that firms value maturities up to the desired maturity, but not beyond. The coefficients on the amount offered, on the other hand, remains significant, indicating that higher amounts are beneficial over the complete support of the variable. In the third specification, we replace our maturity variables with a dummy variable taking a value of one if the offered maturity is at or above the desired maturity and zero otherwise. The results are not harmed by this. Finally, in model (4) we drop voting rights to see the average effect of a financing offer being an equity participation. The equity participation coefficient increases substantially. Firms choose equity over debt in every specification, and this effect is remarkably strong. Furthermore, preferred equity (without voting rights) is favoured to common equity (with voting rights), which indicates that firms value corporate control rights.

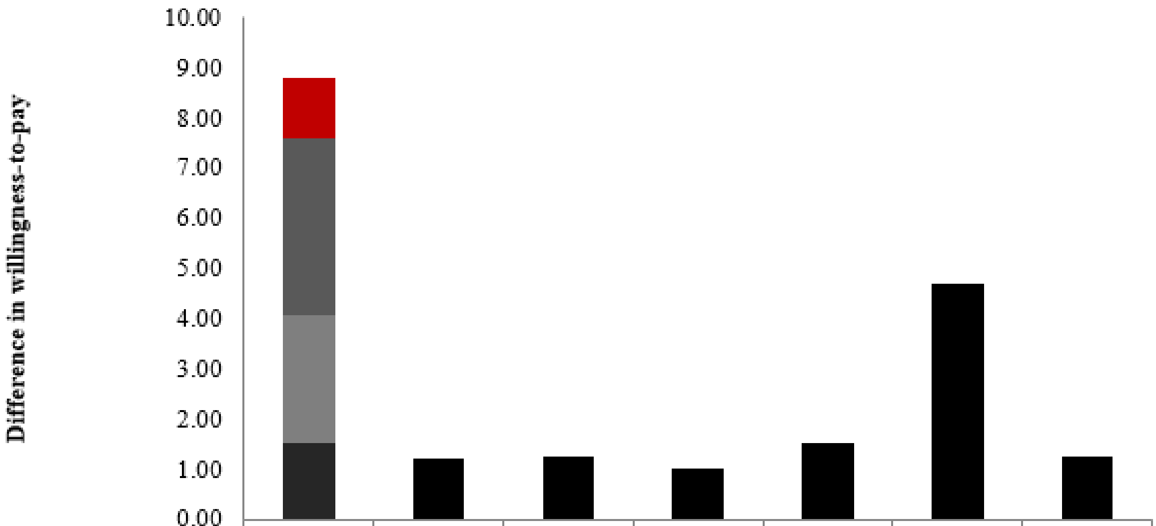
Figure 4.4 plots firms' willingness to pay for different financing characteristics. We observe that firms are indifferent between a loan (with desired maturity, no collateral requirement, no fees, same amount as the equity offer) with an 880bp higher interest

Table 4.4: Baseline

	(1) Baseline	(2) Above Maturity and Amount	(3) Above Maturity	(4) No voting
Equity Participation	-0.989***	-0.930***	-0.978***	-1.119***
	(0.130)	(0.131)	(0.127)	(0.116)
Interest or Return Rate	-0.160***	-0.162***	-0.162***	-0.160***
	(0.0113)	(0.0114)	(0.0114)	(0.0113)
Amount	0.00963***	0.0105***	0.00969***	0.00980***
	(0.000897)	(0.00129)	(0.000898)	(0.000898)
Maturity	0.00196***	-0.00207		
	(0.000711)	(0.00149)		
Amortization	0.000191	0.000373	0.000323	0.000240
	(0.000649)	(0.000654)	(0.000651)	(0.000650)
Interest type	-0.192***	-0.212***	-0.201***	-0.195***
	(0.0598)	(0.0610)	(0.0600)	(0.0599)
Voting Rights	-0.252***	-0.253***	-0.243***	
	(0.0886)	(0.0901)	(0.0887)	
Collateral	-0.00764***	-0.00758***	-0.00758***	-0.00751***
	(0.000610)	(0.000612)	(0.000611)	(0.000610)
Fee	-0.0160	-0.0563	-0.0349	-0.0328
	(0.0735)	(0.0748)	(0.0736)	(0.0735)
Above desired maturity		0.335***	0.202***	0.208***
		(0.110)	(0.0525)	(0.0524)
Desired amount		-0.0724		
		(0.0774)		
Observations	4,710	4,710	4,710	4,710
LR Chi2̂	854.9	858.6	857.5	852.1

This table provides the results of logit regressions over firm preferences between the financing offers A and B on different financing offer characteristics. Column (1) presents the baseline specification, column (2) tests for asymmetries at the desired amount and maturity, column (3) presents the results for asymmetries for the desired maturity only and column (4) presents the results without voting rights. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

Figure 4.4: Decomposition - Debt Equity Choice



	Fixed Interest Loan vs. Preferred Equity	20% higher Amount	Interest type - fixed vs. floating	1pp less Interest or Return Rate	No Voting Rights vs. Voting Rights	No Collateral vs. 100% Collateral	Above vs. below desired maturity
Willingness to pay	1.21	1.20	1.24	1.00	1.50	4.68	1.25
Growth Expectations	3.50						
Taxes	2.57						
Voting Rights	1.50						

This figure compares firms' willingness-to-pay in terms of interest rate percentage points over the different characteristics of the hypothetical financing offers everything else held equal..

rate than the cost of equity of an offer including voting rights. To put this into perspective: The willingness to pay for a loan instead of equity is around seven times as large as the willingness to pay for a 20% larger loan size, the difference between fixed and floating interest loan offers, the difference between financing offers with or without the desired maturity or above. Moreover, it is six times the difference between equity offers with or without voting rights and twice as large as the difference in willingness to pay between a fully collateralised and an uncollateralised loan; suggesting that firms prefer a fully collateralised loan to an equity participation.

In the next step, we decompose the willingness to pay and analyse whether corporate control rights, taxes and growth expectations can account for firms' aversion towards equity. From our estimation, we know that some part of the willingness to pay is driven by the aversion of firms to grant corporate control to investors. However, this explains a small share of 150bp only. Furthermore, debt could be preferred because of its tax shield. Corporations can deduct interest payments from their corporate taxes and this gives debt a funding advantage over equity. However, corporate taxes would have to be astronomically high in order to rationalize our results. Considering cost of equity equal to the midpoint of the lending market (3%) for an equity participation without voting rights, firms would be indifferent if the alternative is a loan offer with an interest rate of 11%. The corporate tax rate would need to be more than 60% to rationalize the result. This is substantially higher than a median tax rate for a European country (below 30%). Considering a corporate tax rate of 25%, 260bp can be explained by corporate taxes. Finally, another possible explanation is that firms consider equity unappealing because they have high growth expectations. In our choice experiment, the equity participation demanded is independent of the growth perspective and perception of the company as they were not taken into account to calculate the equity participations. Taking a simple rule of thumb and given average expected net income growth rates of 3.5%, a substantial part of the equity premium (120bp) remain unexplained after excluding taxes and corporate control rights.[21] Using a comparison of the net present value of the cost of the different financing offers, the premium increases to 250bp. (For a detailed description of this calculation see Annex C). The growth expectations necessary to rationalize the net premium (controlled for taxes and voting rights) is around 4.7% annually, which is substantially larger than average self-reported net income growth or nominal GDP growth.

5 The Corporate Equity Puzzle and Financial Structure

Our results suggest that firms would rather pay more for a debt contract, and therefore make lower profits, than using external equity to finance their investment activities. While we are unable to provide an exclusive explanation for this effect, we find

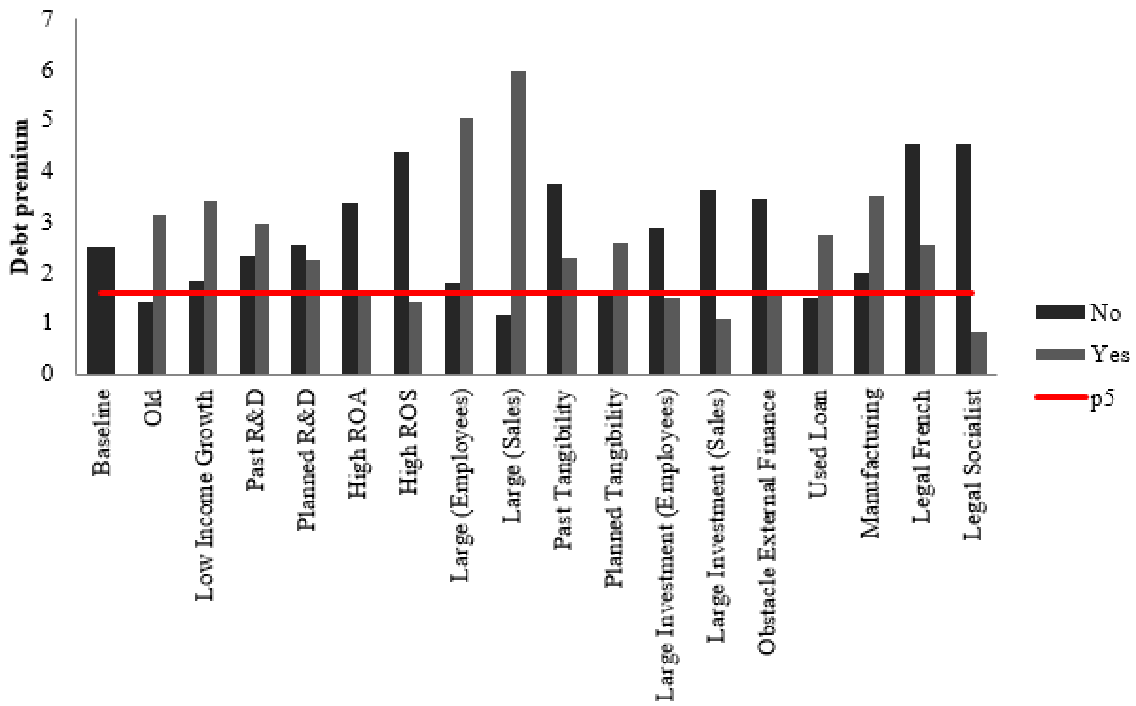
[21] Taking a simple additive rule of thumb with $premium = taxes + control\ \ rights + growth\ expectations + \epsilon$

evidence that the financial structure of the European economy is associated with the large premium.

Many of the European economies are bank-based. The largest share of external finance is intermediated through banks rather than financial markets and venture capital markets are substantially smaller in Europe compared to the US or Israel (Kraemer-Eis et al. (2017)). This difference in the financial structure might promote firms that are bankable, i.e. firm that have a business model, which qualifies them for bank loans. As bankable firms benefit from looser financing conditions, this could lead to a competitive advantage and a crowding-out of firms that would need large amounts of equity financing to emerge and operate, i.e. start-ups that have a need for large amounts of venture capital. Therefore, for firms that are more suited for debt finance, issuing equity might not be desirable even at low rates as these firms might have a strong relationship to their main bank, which provides additional economic benefits through emergency credit lines as well as the prolongation of credit in times of crisis. (Lummer and McConnell (1989); Petersen and Rajan (1994); Uchida et al. (2012)).

To test whether the premium is larger for bankable firms, we employ four tests. First, we analyse whether firms that report access to finance as an obstacle towards their investment plans have a lower equity premium. As most external financing in Europe is provided by banks, firms that have obstacles finding adequate external finance might be firms that do not have an existing banking relationship or that are less suited for bank financing in general and would appreciate external equity financing. Second, we test whether firms, which relied on bank loan finance in their last financial year, express a lower debt premium. EIB (2016) suggests that firms like to stick to the type of finance that they have used in the past, which is bank loans in the vast majority of cases. A stable relationship to their main bank could provide economic value to the company and make bank loans the preferred type of external finance. Third, we test whether the effect is driven by manufacturing firms that make up the largest share of the firms in our sample. In comparison to the US, manufactur-

Figure 4.5: Debt Premium over Different Company Characteristics



This figure illustrates the debt premium in terms of interest rate percentage points over different firm characteristics. Bars larger than the red line are significant at the 5

ing plays a large role for the European economy and manufacturing companies have many pledgeable assets on their balance sheet, which makes them excellent clients for banks. If these firms particularly like to use debt financing because they benefit from the stable relationship with a bank, this could be the main driver behind our results. Last, we analyse whether the legal system has an effect on the debt premium. La Porta et al. (1997) and La Porta et al. (1998) suggest that the access to external finance is linked to the legal environment the firm operates in. Many European countries have a French or socialist legal origin and this might lead to different values for the bank-client relationship and therefore, different preferences of the use over external financing types.[22]

The results can be found in Table 4.5. Firms that are stating that access to external finance is an obstacle are more likely to accept equity offers and the debt premium for these firms lowers to 150bp. This indicates that firms, which have trouble getting

[22]The premium firms are willing to pay are plotted for all subgroups in Figure 4.5.

a loan (i.e. are less bankable), are more likely to accept equity. Firms, which relied on bank credit in the past period, are more likely to choose a loan in the choice experiment and their debt premium increases to 270bp. This indicates that firms achieve value from relationship banking. In addition, we want to analyse whether firms from different sectors choose differently between equity and debt offers. Therefore, we create a dummy that is one if the firm is in one of the manufacturing sectors and zero otherwise. We observe that firms from the manufacturing sector are less likely to accept equity offers and their debt premium increases to 350bp. To test whether certain legal codes affect the capital structure choice and drive our premium, we split our sample in the following groups: (1) countries with French legal origin, (2) countries with socialist legal origin and (3) countries with either German, Scandinavian or English legal origin. The results are presented in column (4). We observe that firms from countries with French legal origin are more likely to accept equity offers. To an even larger extend, this is true for countries with former socialist legislation. This is in line with the predictions that different legal codes lead to different patterns in firms' external financing behaviour as the legal systems differ in their protection of property rights, their insolvency procedures and their disclosures laws. The premium for debt financing is equal to the baseline in the French legal system (250bp), substantially lower in the former socialist countries (80bp) and substantially higher in the rest of Europe (450bp). All the results suggest that the financial structure in Europe, as well as the self-selection of companies and relationship financing, influence the acceptance of debt in an economy.

6 Heterogeneity and Robustness Checks

Some companies have stronger incentives to rely on debt financing than others. In this section, we want to test if the debt premium varies over characteristics that influence the capital structure. In addition, we address issues regarding the robustness of our results. The premium could be limited to firms with decent growth prospects. To

Table 4.5: Equity Premium and Financial Structure

	(1) Obstacle External Finance	(2) Used Loan	(3) Sector	(4) Legal Origin
Equity Participation	-1.188***	-0.801***	-0.864***	-1.454***
	(0.145)	(0.147)	(0.135)	(0.180)
Amount	0.00978***	0.00955***	0.00967***	0.00965***
	(0.000902)	(0.000962)	(0.000898)	(0.000901)
Amortization	0.000375	0.000401	0.000321	0.000328
	(0.000653)	(0.000701)	(0.000651)	(0.000652)
Interest type	-0.200***	-0.225***	-0.200***	-0.209***
	(0.0602)	(0.0648)	(0.0600)	(0.0601)
Interest rate or cost of equity	-0.163***	-0.173***	-0.162***	-0.167***
	(0.0114)	(0.0124)	(0.0114)	(0.0114)
Voting Rights	-0.245***	-0.291***	-0.241***	-0.241***
	(0.0889)	(0.0958)	(0.0888)	(0.0890)
Collateral	-0.00760***	-0.00800***	-0.00755***	-0.00760***
	(0.000613)	(0.000662)	(0.000611)	(0.000612)
Fee	-0.0310	-0.0494	-0.0328	-0.0348
	(0.0738)	(0.0792)	(0.0736)	(0.0737)
Above desired maturity	0.203***	0.226***	0.204***	0.205***
	(0.0526)	(0.0565)	(0.0525)	(0.0526)
Equity Participation # Obstacle Ext. Finance	0.408***			
	(0.130)			
Equity Participation # Used Loan		-0.287**		
		(0.142)		
Equity Participation # Sector			-0.334**	
			(0.139)	
Equity Participation # Legal Origin French				0.443**
				(0.184)
Equity Participation # Legal Origin Socialist				0.822***
				(0.176)
Observations	4,686	4,116	4,710	4,710
Combination	-0.780***	-1.088***	-1.199***	
P-value	3.22e-08	0	0	
chi2	855.4	762.0	856.8	863.9
Combination French				-1.011***
Combination Socialist				-0.632***
P-value French				0
P-value Socialist				1E-3

This table provides the results of logit regressions over firm preferences between the financing offer A and B on different financing offer characteristics. Column (1) presents the results firms that state access to finance as an obstacle to their investment, column (2) analysis firms that have used bank credit to finance their investment in the previous year, column (3) analysis if being a manufacturing firm changes the results and column (4) controls for different legal origins. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

counter these concerns, we test whether firms with higher future growth prospects are less likely to accept equity participations. Moreover, the experimental design could bias our results. To address these issues, we employ several robustness checks regarding the design of the choice experiment.

1. Heterogeneity

Results by Rajan and Zingales (1995) suggest that firms with lower profitability, larger size and more tangible assets have higher leverage ratios. These characteristics could influence firms' aversion towards equity. Therefore, we create dummies that split the sample by profitability, size and asset tangibility. We define profitability as net income over fixed assets and sales, respectively, and construct a dummy that is one if profitability is above the median, and zero otherwise. Table 4.6 columns (1) and (2) present the results. The net debt premium for less profitable firms increases to 340bp and 440bp, respectively. Size is measured as the number of employees or the value of sales. We create a dummy that is one if the firm has more than 250 employees or more than 25 million euros in sales. Both correspond roughly to the largest quartile of the size distribution, and in the case of employees, it follows the definition of EIBIS (EIB (2017)). The net debt premium for large companies lies between 500bp and 600bp, which is substantially larger than the premium of SMEs. Firms with a higher share of tangible assets should be more likely to finance their investment using debt as tangible assets can be used to collateralize debt. From the survey data, we do not directly see the share of tangible assets in total assets. However, we can analyse whether firms that plan to invest in tangible assets are less likely to choose equity participations. The results can be found in Table 4.7 columns (1) and (2). We observe that firms with past or planned investment projects in land and real estate or machinery and equipment are equally likely to pick the equity options. Nevertheless, firms are willing to pay a positive net premium for all subgroups.

In addition, we test whether firms are more likely to accept equity options if their

Table 4.6: Profitability and Size

	(1) ROA	(2) ROS	(3) Size Employees	(4) Size Sales
Equity Participation	-1.237***	-1.387***	-0.831***	-0.708***
	(0.158)	(0.159)	(0.132)	(0.132)
Amount	0.00994***	0.00975***	0.00977***	0.00970***
	(0.000925)	(0.000901)	(0.000903)	(0.000902)
Amortization	0.000285	0.000334	0.000359	0.000348
	(0.000670)	(0.000652)	(0.000655)	(0.000653)
Interest type	-0.212***	-0.204***	-0.199***	-0.204***
	(0.0614)	(0.0600)	(0.0603)	(0.0601)
Interest or Return Rate	-0.172***	-0.163***	-0.163***	-0.167***
	(0.0118)	(0.0113)	(0.0114)	(0.0114)
Voting Rights	-0.231**	-0.251***	-0.240***	-0.249***
	(0.0914)	(0.0891)	(0.0895)	(0.0893)
Collateral	-0.00758***	-0.00755***	-0.00749***	-0.00761***
	(0.000629)	(0.000612)	(0.000614)	(0.000614)
Fee	-0.0242	-0.0395	-0.0193	-0.0286
	(0.0756)	(0.0737)	(0.0741)	(0.0738)
Above desired maturity	0.219*** (0.0539)	0.207*** (0.0526)	0.200*** (0.0528)	0.203*** (0.0527)
Equity Participation # ROA	0.419*** (0.139)			
Equity Participation # ROS		0.639*** (0.140)		
Equity Participation # Size Employees			-0.704*** (0.175)	
Equity Participation # Size Sales				-1.075*** (0.174)
Observations	4,520	4,710	4,662	4,710
Combination	-0.818***	-0.748***	-1.535***	-1.784***
P-value	5.25e-09	3.14e-08	0	0
LR Chi2̂	844.7	857.5	847.8	856.9

This Table provides the results of logit regressions over firm preferences between the financing offers A and B on different financing offer characteristics. Column (1) presents the results for highly profitable firms defined as firms with an above median return over assets, column (2) uses profitability measured by return over sales, column (3) presents the results for asymmetries for the size of the company measured by the amount of employees and column (4) presents the firm size measured by sales. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

Table 4.7: Tangibility and Investment Size

	(1) Tangibility (Planned)	(2) Tangibility (Past)	(3) Investment Size (Asset)	(4) Investment Size (Sales)
Equity Participation	-1.242***	-0.794***	-1.124***	-1.217***
	(0.209)	(0.226)	(0.145)	(0.141)
Amount	0.00967***	0.00968***	0.00993***	0.00970***
	(0.000898)	(0.000898)	(0.000925)	(0.000899)
Amortization	0.000311	0.000332	0.000283	0.000310
	(0.000651)	(0.000651)	(0.000670)	(0.000652)
Interest type	-0.200***	-0.201***	-0.211***	-0.201***
	(0.0600)	(0.0600)	(0.0614)	(0.0600)
Interest rate or cost of	-0.162***	-0.162***	-0.171***	-0.162***
equity	(0.0114)	(0.0114)	(0.0118)	(0.0114)
Voting Rights	-0.241***	-0.242***	-0.228**	-0.249***
	(0.0887)	(0.0887)	(0.0913)	(0.0890)
Collateral	-0.00757***	-0.00758***	-0.00760***	-0.00756***
	(0.000611)	(0.000611)	(0.000630)	(0.000612)
Fee	-0.0326	-0.0342	-0.0254	-0.0379
	(0.0736)	(0.0736)	(0.0756)	(0.0737)
Above desired	0.202***	0.202***	0.218***	0.204***
maturity	(0.0525)	(0.0525)	(0.0539)	(0.0525)
Equity Participation #	0.310			
Tangibility	(0.192)			
Equity Participation #		-0.203		
Tangibility		(0.208)		
Equity Participation #			0.324**	
Asset			(0.133)	
Equity Participation #				0.547***
Sales				(0.129)
Observations	4,710	4,710	4,520	4,710
Combination	-0.932***	-0.997***	-0.801***	-0.670***
P-value	0	0	7.61e-08	3.63e-06
chi2	857.3	858.2	843.2	856.4

This Table provides the results of logit regressions over firm preferences between the financing offers A and B on different financing offer characteristics. Column (1) presents the results controlling for whether investment purpose is tangible using planned investment, column (2) presents the results controlling for whether investment purpose is tangible using past investment, column (3) analyses whether the investment size plays a role, measured by investment over total fixed assets and column (4) presents the results for firms that invest a large share with respect to their sales. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

investment project is especially large. Issuing new outside equity might come at substantial administrative cost, especially for private companies and therefore they might only be willing to accept equity if the investment they are planning to undertake is substantial in size, which could drive the debt premium. To test this hypothesis, we create a dummy that is one if the ratio of planned investment to total fixed assets or sales is in the upper quartile of the distribution. The results can be found in columns (3) and (4). Companies, whose investment projects are large relative to their firm size, are more likely to accept equity offers. The coefficient becomes significantly smaller for firms in the top quartile of the investment to firm size distribution, and the debt premium falls to 150 and 110bp, respectively.

2. Robustness Checks

Even though our estimated debt premium is substantially higher than possible growth expectations, firms with very high growth expectations could drive the debt premium. We want to analyse if firm characteristics associated with future growth expectations drive our debt puzzle. We use firm age and self-reported growth expectations as proxies for higher growth expectations in the short run and firm's R&D dependence as proxies for higher growth expectations in the long run. To test whether these variables affect the debt premium, we interact the equity coefficient with a dummy. We split the firms in the following way: (1) firms that are older than 20 year, (2) firms that report an expected growth in net income below 2.5%, (3) firms that planned to invest or (4) firms that did invest in the last financial year into R&D. The results can be found in Table 4.8. While we expected young and growing firms to consider equity less attractive due to the design of the choice experiment (i.e. the equity participations are constructed using past net income), we observe that old firms and firms with low expected net income growth are less likely to accept equity. Old firms (310bp) and firms with low growth expectations (340bp) are willing to pay a significantly higher net debt premium (premium abstracted from control rights, taxes and growth expectations). Furthermore, we test if the debt premium is different for more firms with higher long-term growth prospects (measured by planned or past investment in R&D). The results can be found in columns (3) and (4). We observe that firm uniqueness measured by R&D investment is unrelated with the choice between equity and debt in both cases. Therefore, firms investing in unique assets do not drive the debt premium.

We acknowledge that the experimental design could influence the results. To mimic realistic financing offers, firms were offered equity participations that had costs of equity substantially higher than the interest rate on debt in the majority of cases. Baker and Wurgler (2002) suggest that firms choose the security that is the cheapest for them, i.e. firms issue equity when their stock price is particularly high. Following this argument, firms could reject equity offers because the difference between the cost of equity and the interest rate dominates all other factors and this could drive the net debt premium. To test this prediction we employ two measures: (1) we test whether firms are more likely to choose equity if they received a cheap equity offer relative to the midpoint, and (2) we analyse whether companies reduce the aversion towards equity if the cost of equity is smaller than the cost of the corresponding financing offer. The results can be found in Table 4.9. First, we observe that firms do not react if equity is cheap with respect to our midpoint. Having controlled for the difference between the cost of equity and the interest rate, equity offers that are cheaper than twice the midpoint of the market interest rate are as likely to be accepted as other equity offers. However, we observe that for equity offers with costs of equity below the interest rate of the corresponding financing offer, the debt premium shrinks. These results indicate that the price of equity might be an important reason for firms to consider debt for their external financing mix only.

Moreover, the choice experiment imposed several restrictions on the type of finance that was presented to firms. In other words, firms that had low net income compared to the amount they wanted to finance were not presented with equity offers. To check if the selection of firms affects our results, we estimate our baseline

Table 4.8: Growth Perspectives

	(1) Age	(2) Growth	(3) Uniqueness (Planned)	(4) Uniqueness (Past)
Equity Participation	-0.744***	-0.841***	-0.933***	-0.986***
	(0.150)	(0.139)	(0.134)	(0.129)
Amount	0.00971***	0.0101***	0.00970***	0.00969***
	(0.000899)	(0.000919)	(0.000898)	(0.000898)
Amortization	0.000339	3.93e-05	0.000319	0.000322
	(0.000651)	(0.000663)	(0.000651)	(0.000651)
Interest type	-0.202***	-0.215***	-0.201***	-0.201***
	(0.0600)	(0.0612)	(0.0600)	(0.0600)
Interest rate or cost of equity	-0.162***	-0.165***	-0.162***	-0.162***
	(0.0114)	(0.0116)	(0.0114)	(0.0114)
Voting Rights	-0.243***	-0.256***	-0.242***	-0.244***
	(0.0888)	(0.0906)	(0.0887)	(0.0887)
Collateral	-0.00758***	-0.00777***	-0.00757***	-0.00758***
	(0.000612)	(0.000624)	(0.000611)	(0.000611)
Fee	-0.0349	-0.0590	-0.0343	-0.0356
	(0.0736)	(0.0751)	(0.0736)	(0.0736)
Above desired maturity	0.205***	0.186***	0.202***	0.202***
	(0.0525)	(0.0535)	(0.0525)	(0.0525)
Equity Participation # Age	-0.372***			
	(0.131)			
Equity Participation # Growth		-0.340**		
		(0.137)		
Equity Participation # Uniqueness			-0.139	
			(0.138)	
Equity Participation # Uniqueness				0.0648
				(0.190)
Observations	4,710	4,557	4,710	4,710
Combination	-1.116***	-1.181***	-1.071***	-0.921***
P-value	0	0	0	1.09e-05
LR Chi2̂	858.6	845.3	858.1	857.5

This table provides the results of logit regressions over firm preferences between the financing offers A and B on different financing offer characteristics. Column (1) presents the results for young firms defined as firms below 20 years of existence, column (2) uses firms growth opportunities as self-reported expected net income growth, column (3) presents the results for asymmetric firms that are unique measured by planned investment in R&D and column (4) presents the uniqueness measured by past investment in R&D. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

model including all firms that were unable to receive an equity offer. The results are presented in Table 4.9 column (3). We observe that the results barely change. Some firms completed the choice experiment in parts only, i.e. terminated before the eighth round of the experiment. As a robustness check, we present the results of our baseline regression for firms that completed the choice experiment only (see column (4)). We observe that the results are in line with our previous results.

7 Conclusion

In this study, we analyse the trade-off between equity and debt financing for investment projects of European firms using an experimental approach. It allows us to abstract from market conditions and analyse firms' reported preferences without their interference. This grants us with the opportunity to uncover which kind of finance is desired by firms.

Our results suggest that firms generally prefer debt financing. Firms are willing to pay a substantial premium of 250bp for debt financing, which can neither be explained by growth expectations, nor by corporate control rights, taxes or the cost of equity. This effect is particularly strong for firms that are particularly suited to receive debt financing and have small investment projects. This results suggest that the adaptation of firms towards a bank-based financial system could be an important driver of the aversion towards equity.

To increase the amount of equity financing, the financial structure of the European economy would need to adapt. Financial markets could be strengthened through the capital markets union, i.e. a common capital market for the European Union. This would increase the market size as well as diversification possibilities, and simplify access to finance, especially for SMEs, which show the largest appetite for external equity financing. Moreover, we observe that the cost of equity is an important driver of the aversion towards equity. Abandoning the preferred tax treatment of debt might incentivise companies to rely on equity financing to a greater extent.

Table 4.9: Experimental Design

	(1) Low expected return on Equity	(2) Return rate on equity lower than alternative offer	(3) All firms	(4) Only firms that finished the experiment
Equity Participation	-0.964***	-1.081***	-0.798***	-0.990***
	(0.137)	(0.129)	(0.108)	(0.130)
Amount	0.00969***	0.00938***	0.00983***	0.00968***
	(0.000898)	(0.000898)	(0.000710)	(0.000923)
Amortization	0.000312	0.000398	-0.000551	0.000240
	(0.000652)	(0.000647)	(0.000486)	(0.000675)
Interest type	-0.202***	-0.164***	-0.217***	-0.193***
	(0.0602)	(0.0600)	(0.0448)	(0.0620)
Interest rate or cost of	-0.163***	-0.139***	-0.192***	-0.164***
equity	(0.0119)	(0.0119)	(0.00926)	(0.0118)
Voting Rights	-0.243***	-0.286***	-0.248***	-0.248***
	(0.0887)	(0.0923)	(0.0893)	(0.0898)
Collateral	-0.00758***	-0.00742***	-0.00786***	-0.00738***
	(0.000612)	(0.000607)	(0.000440)	(0.000630)
Fee	-0.0343	-0.0270	-0.0556	-0.0241
	(0.0736)	(0.0732)	(0.0553)	(0.0762)
Above desired	0.202***	0.193***	0.238***	0.214***
maturity	(0.0525)	(0.0521)	(0.0391)	(0.0543)
Equity Participation #	-0.0305			
Low expected return	(0.113)			
Equity Participation #		0.530***		
Return rate lower		(0.102)		
Observations	4,710	4,710	7,237	4,496
chi2	857.4	899.1	1213	835.8

This table provides the results of logit regressions over firm preferences between the financing offers A and B on different financing offer characteristics. Column (1) presents the results adding a dummy that is 1 if the equity offer was cheaper than twice the mean lending rate, column (2) adds a dummy that is 1 if the equity offer has costs of equity lower than the loan offer, column (3) presents the results only considering firms that were eligible for equity participations, and column (4) presents the results for firms that finished the experiment only. Standard Errors are given between parentheses. *, **, *** denote significance at the 10%, 5% and 1% level, respectively.

Our findings open room for a debate on why firms dislike equity. As our sample is mainly SMEs, the lending relationship might be driving our results. A stable banking relationship creates economic value for the companies and might compensate companies for the potential higher costs of capital. Our results should guide policymakers in that it might be hard to attract additional equity investments through changes in regulation if companies dislike equity in the first place.

1 NPV Calculation

Equity participations and loans have different cost profiles. While the costs of a loan a firm has to bear are fixed ex ante, the cost for an equity participation depend on uncertain (and in expectations growing) future net income. In addition, firms can deduct the interest paid on a loan from their corporate taxes. This makes the comparison between the cost of equity and the cost of debt non-trivial. Therefore, we will derive how the net present value of the future cost of an equity and a loan offer relate ex ante. First, we will consider a loan with an infinite maturity and a fixed interest rate i. Let I be the Investment amount, r being the discount rate, τ being the corporate tax rate, and t being a time index. ϵ is a non-monetary benefit a company has if it uses debt financing, which can be either positive or negative. The NPV of the costs of this loan is given by

$$NPV_{loan} = \sum_{t=1}^{\infty} \frac{(i * (1-\tau) - \epsilon) \times I}{(1+r)^t} \tag{9}$$

The cost of equity have a different cost profile. While the interest rate of the loan is fixed ex-ante, the cost of equity depends on the uncertain future net income of the company. The NPV of the costs of an equity participation is given by the discounted sum of demanded share e of future net income NI_t. Let c be the implied cost of equity and g the growth rate of net income. In the experiment, the cost of equity were set to $e = \frac{c * I}{NI_0}$. Assuming further a constant expected growth rate, we can simplify the NPV of the costs of the equity option.

$$NPV_{equity} = \sum_{t=1}^{\infty} E\left[\frac{e * NI_t}{(1+r)^t}\right] \tag{10}$$

$$\Leftrightarrow NPV_{equity} = \sum_{t=1}^{\infty} \frac{c * I * (1+g)^t}{(1+r)^t} \tag{11}$$

Taking equations (7) and (9), we can compare the expected cost between the loan and the equity option. Under the assumption of rationality, the firm should take the offer with lower expected costs. Therefore, we can solve for the difference between i and c that can be rationalized by growth expectations. The results is

$$i = \frac{r + rg}{(r - g} \times c + \tau \times i + \epsilon \tag{12}$$

For conservative choices of r and g $(r = 0.1; g = 0.04)$, the difference between the cost of equity and the interest rate on the fixed interest rate should not be larger than 1.8 times the fixed interest rate plus the tax shield and the non-monetary utility ϵ. Taking our midpoint of 3%, a corporate tax rate of 25%, and a non-monetary benefit of zero this would result in an interest rate of 8.25%. Therefore, firms should not express a willingness to pay for debt that is larger than around 5pp.

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