Erasmus School of Economics Rotterdam

The Effect of Capital Requirements on Banks' Syndicated Lending.

Master Thesis for the Degree Master of Science (M.Sc.) in Economics at the Erasmus School of Economics Rotterdam

Supervisor: Narly Dwarkasing
Second Assessor: Sebastian Pfeil
Submitted by: Heinrich von Zitzewitz
Student.Nr.: 578797

Submitted: 03.03.2022

Abstract

Heinrich von Zitzewitz

This paper estimates the impact of capital requirements on syndicated loan volumes. Using a difference-in-difference estimation, I investigate whether banks adjust their syndicated loan volumes after failing a stress test conducted by the European Banking Authority. I find that banks reduce their syndicated loans after underperforming in the stress test. Moreover, the volume of syndicated loans depends on the size of the banks and the individual Common Equity Tier 1 Ratio. However, no robust result could be obtained that would indicate that banks have reduced their lending volume only because of their stress test result. My research findings do however indicate that capital regulations do have a significant impact on the lending behaviour of banks. Finally, the findings suggest that regulatory capital and regulatory capital surcharges reduce syndicated loan volumes for banks with lower Common Equity Tier 1 Ratios.

Contents

1 Introduction

Since the financial crisis in 2008, governments and societies have become more cautious in dealing with banks and the associated regulation of bank capital. Up until 2007, the regulatory set-up concerning the capital of banks has been greatly eased. The financial crisis in 2008 has shown that weak regulation and a lack of adequate supervision of banks provides an environment in which strong incentives for banks occur not to operate in a socially optimal manner.

For banks it is optimal to have as little capital as possible in their accounts, as it allows them to invest more money in the capital market to optimise their profits. This initial situation ensures that in the event of a liquidity shock, banks are not able to repay their loans and thus find themselves in difficulties. To avoid this imbalance, the Basel Committee on Banking Supervision was founded in 1974 to supervise European banks. With the implementation of Basel 1. capital requirements have been introduced and, since the implementation, the capital requirements have been increasingly strengthened. The equity ratio plays a particularly important role in the banking sector since Basel I. The regulation of Basel I and the continuation of Basel II was not particularly successful as can be seen from the crisis in 2008. In 2013, the introduction of Basel III followed. These developments raise the question, why the Basel reforms have not shown the intended positive impacts on the financial system.

Scientific researchers on the Basel reforms observe that bank regulation has a procyclical effect on the economy as a whole. With procyclical behaviour, banks provide more capital in the form of loans in booms and thus further drive the upturn on the economy. Nevertheless, it also describes that in times of recession banks are reducing their allocation of capital and thus ensuring that the economic downturn is further exacerbated. Therefore, the capital requirements resulting from the Basel reforms have a direct procyclical influence on the economy.

There is widespread agreement in the current literature that an increase in capital requirements for banks has an impact on banks' lending. With an increase in capital requirements, not only does lending decrease (Jonathan Wallen, (2017), but banks also increase their risk taken, (Behn et al. (2016)) and expand their lending to customers with lower ratings. This behaviour of the banks ultimately causes a reduction in welfare because fewer loans are granted, and an increase in systemic risk due to the higher risk appetite. All this is triggered by a change in the capital requirements for banks.

This paper aims to investigate and examine how an increase of capital requirements and regulation has an impact on the syndicated loans supply of European banks. For the sample 20 supervised banks are investigated and examined if they change their supply

after they are set higher capital requirements. The banks are chosen according to their total assets displayed in annual balance sheets.

The stress tests, applied since 2003, aim to identify weaknesses in the capital structure. They are intended to ensure that it is recognised when a bank is no longer resilient and becomes a potential threat to financial market stability. Due to the interbank market and the associated contagion effects, individual banks can cause the system to falter. Banks for which the Basel Committee of Banking Supervision has determined that the bank would suffer from a core capital reduction in a crisis scenario and would therefore no longer be stable are prescribed a higher equity ratio, which is intended to help secure payments. This paper examines the effect of such an event on syndicated lending.

Using a difference-in-difference (DID) framework, I attempts to assess the reaction of banks which are likely to find themselves in danger of having to adjust their equity ratio due to their stress test result and how the required adjustment of the capital ratio affects syndicated lending. The results show that banks indeed react to the stress test result and that syndicated loan volume is reduced after the announcement.

Syndicated loans are mainly used by banks for risk sharing, diversification and when individual banks are not able to cover a loan on their own. According to Behn, Haselmann, and Wachtel (2016), banks increase their lending risk when capital requirements increase, to maintain their profitability. As banks use syndicated loans for risk sharing, the question is whether the supply of syndicated loans will be influenced after capital requirements increase. More specifically, I examine the impact of an increase in capital regulations for European supervised banks on the volume of syndicated loans issued. In line with previous literature, I expect that banks facing higher capital requirements will reduce their lending and thus the volume of syndicated loans will also be reduced. With my thesis, I want to provide insights into this lending sector and further investigate the impact of capital requirements on banks' lending behaviour. I will mainly focus on the European banking sector and focus on the largest banks, since an effect on the entire economy can be expected here. The paper will be structured as followed. Information about capital requirements and stress tests will follow in section 2 and 3. Section 4 takes a closer look at syndicated lending and section 5 at the literature. Section 6 and 7 consist of information regarding the data for the approach and the difference-in-difference approach itself. Section 8 displays the results, followed by robustness checks in section 9. Before the conclusion in section 11, in section 10 all results are discussed.

2 Capital Requirements

One of the main tasks of banks is to use capital from savers to invest on the capital market and yield a positive return. The amount of deposited money plus interest may be returned to the depositor and the difference recorded as profit. The smaller the amount of held capital, the more banks are able to make investments on capital markets. As a result, banks try to optimize profit by minimizing the amount of equity held. In a world without any friction, as described in Diamond & Dybvig (1983), banks would aim for an equity rate which converges to zero. The capital market is the only chance for banks to multiply deposits and therefore to make a profit. Thus, banks have a high incentive to reduce their equity ratio as much as possible. In an optimal case banks hold as little equity as possible to have as much money as possible to invest. However, the required equity ratio of banks does not fulfill its purpose to stabilise systemic risks. Conversely, in times of crisis, banks are not able to remain liquid, due to a lack of adequate equity and hence they are costly for governments and taxpayers. Eventually, they become unable to save themselves from bankruptcy and need to be saved by the state with money from a capital rescue fund. Thus, governments started to introduce tighter reforms about the capital requirements of banks. Capital requirements seem to be the most effective tools for ensuring the security and sovereignty of banks.

The banking sector is one of the most heavily regulated sectors in an economy. Companies that are considered credit institutions and thus participate in the financial sector are subject to particularly strict regulatory requirements. In order to make the financial sector safe, various regulatory elements have emerged over the course of time. In addition to the widely known capital regulation, there are barriers to market entry and the associated supervision requirements, liquidity regulations, regulation of lending in the form of limits on large loans and reporting requirements for loans worth millions. Deposit guarantee schemes and traditional consumer protection empower the financial stability. All these measures serve to keep the financial sector stable, but also to strengthen and maintain confidence in the financial sector (Source: Bank of International Settlements).

To monitor all this, the Basel Committee on Banking Supervision was founded in 1974. The Basel Committee issues non-binding recommendations which are then to be converted into national law. The first international agreement was Basel 1 in 1988. Basel 1 was established to regulate capital more accurately. A regulatory capital of 8% was set for the first time. In addition, Tier 1 capital had to be 4% of risk-weighted assets. After refinement with regard to market risks in 1996, Basel 2 was introduced in 2004. The main innovation under Basel 2 was the higher risk sensitivity of the capital requirements. In response to the global financial crisis of 2008, the regulation was reformed again in 2009 to become Basel 3.

The main innovations under Basel 3 were:

- Stricter requirements on the quality of regulatory capital (more emphasis on core capital)
- An increase in equity capital requirements such that Banks from than on finance 4.5% of risk-weighted assets with core capital (CET1) and 6% of risk-weighted assets with core capital (Tier1).
- A Liquidity Coverage Ratio (LCR): ensuring that there are sufficient liquid assets are available to meet deposit withdrawals for more than 30 days
- A Net Stable Funding Ratio (NSFR): ensuring that long-maturity assets with long maturities are stable over a horizon of of 1 year are stably financed
- A Leverage ratio and non-risk-weighted equity ratio: 3% of the non-risk-weighted assets must be financed via core capital
- A Special regulation of systemically important financial institutions (SIFIs): capital surcharge of 1 to 2.5% for (global) SIFIs. (global) SIFIs

The total Tier1 and Common Equity Tier 1 requirement remained at 8%.

It was the first time the Basel Committee on Banking Supervision took economic cyclical phases into account. Hence, the committee implied two buffers to counteract destabilising trends.

Capital Conversation Buffer : The conversation buffer is set at 2%. That means that in the case the core capital drops to under 7%, the bank is not authorised to distribute profit.

Counter cyclical Buffer : In a boom, banks must build up additional equity capital in a boom, which can then be reduced to 0 during a recession (to be set at national level).

According to Basel III the equity capital is composed of *Core Capital* (Tier 1, 4,5%), *Capital Maintenance Buffer* (2,5%), *Additional Core Capital* (Tier 2, 1,5 %), *Supplementary Capital* (2%), *Counter cyclical Buffer* (2,5%), *Surcharge for systemically relevant Banks* (2,5%). Capital requirements have impacts not only on the banking sector in terms of lending but to the whole economy. The impact of capital requirements on both the banking sector and the economy is widely examined in the current literature.

3 Stress Tests

The first stress test was introduced by the International Monetary Fund as part of the Financial Sector Assessment Program (FSAP) in 2003. This stress test primarily examined the effects of various credit and market risks as well as contagion risks in the banking

sector (Elsinger, Lehar, and Summer (2006)).
In 2014, 51 of European banks participated in the ECB's stress test. The 51 participating banks manage 70% of European bank assets with an asset value of 28 trillion euros. The stress test was carried out by the European Banking Authority (EBA). The aim of the test is to examine how banks capital conditions would develop. Banks are subjected to a base scenario and an adverse scenario. The base scenario assumes that economic development remains constant, whereas the adverse scenario assumes a deterioration of the economic situation. The base scenario is determined by the ECB, while the adverse scenario is revised by the European Systemic Risk Board (ESRB) and incorporated for further governmental action. The adverse scenario is comprised the following conditions.

1. A sudden rise in the current low global bond yields, exacerbated by low liquidity in the secondary market.

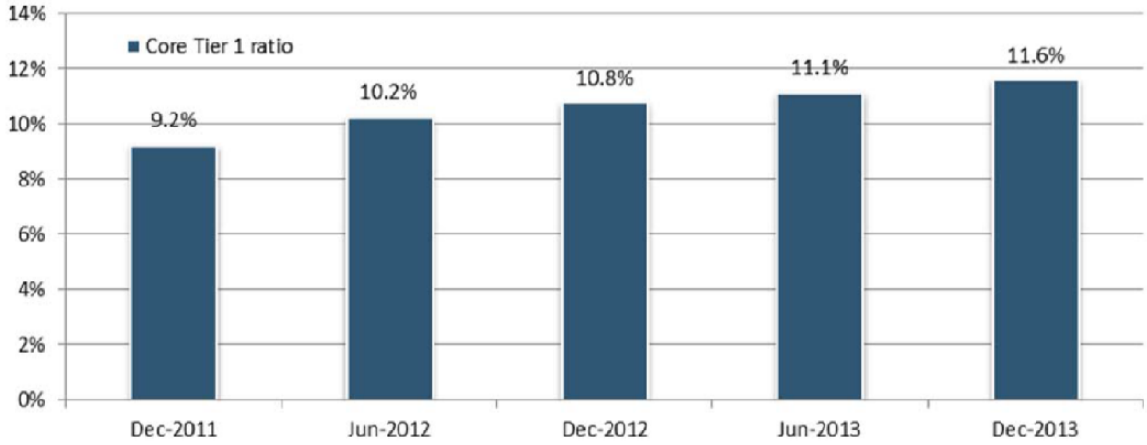
2. Weak earnings prospects for banks against a backdrop of low nominal growth and pending balance sheet adjustments.

3. Increasing concerns about debt sustainability in the public and non-financial private sector with low nominal growth.

4. Potential strains in a rapidly growing shadow banking sector exacerbated by contagion effects and liquidity risks.

The ECB sets hurdle rates in advance, which banks should not fall below idealy. For the base scenario the common equity tier 1 ratio must not fall below 8%. For the adverse scenario, the limit was 5.5 % Common Equity Tier 1 ratio, which may not be undercut.

Figure 1: Tier1 Ratio Hurdle Rates 2011-2013



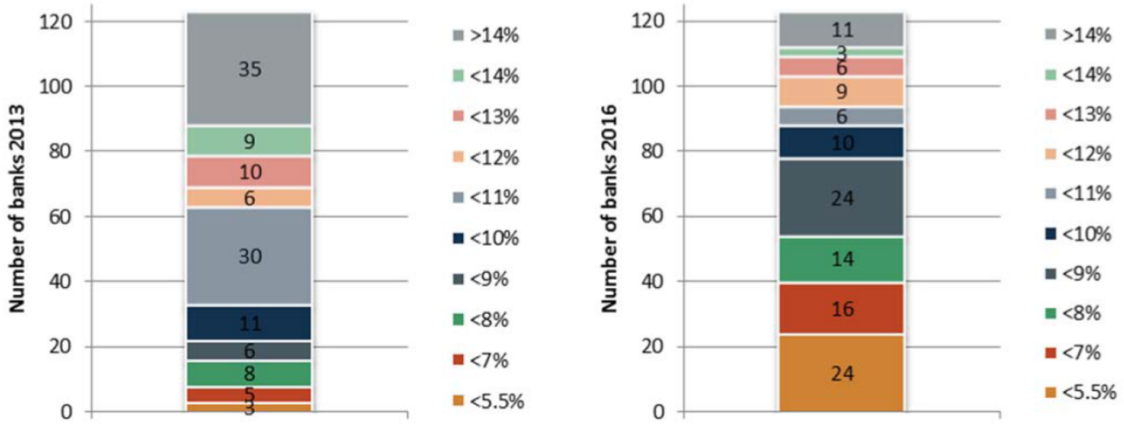
(Source: Basel Committee on Banking Supervision)

The test period was based on a year projection and the result is developed at the end for both scenarios via the balance sheets. Whether a bank passed or failed is not part of

the result, the stress test is less about passing or failing, but rather serves as a guideline for the future behaviour of banks. The ECB takes the stress test as an essential input for the general supervisory review and evaluation process (SREP). The SREP is completed at the end of each financial year and serves as one of the inputs for the supervisory capital requirements for banks. The capital requirements are based on the individual risk profile of a bank and consist of two mandatory requirements and two recommendations. Violations of mandatory requirements result in legal consequences, which are implemented by the ECB. For example, if a bank only complies with its recommendations but not with the mandatory requirements, the supervisors analyse the reasons and circumstances for this and determine specific supervisory measures.

If the capital distribution of a bank deteriorates and the specified capital buffers can no longer be complied with, automatic measures take effect that lead to the limitation of the banks' distributed funds. The results of the stress test are thus included in the SREP and do not represent direct consequences for the banks. Qualitative results are taken into account in the definition of supervisory measures. Quantitative results that affect the CET1 ratio are directly included in the recommendations for the banks. The stress test conducted by the ECB ultimately serves as the basis for the ERSB to take measures and stabilise the financial sector. As banks commit to these measures, they are often forced to adjust their business in the event of a poor performance in the stress test. These adjustments can range from selling assets to improve capital ratios, to adjusting or even increasing their risk appetite/exposure, to adjusting lending to avoid potential default risks. The scenario tested in the 2014 EU-wide stress test resulted in a total capital loss of 261 trillion euros for European banks. These capital losses were mainly due to credit losses.

Figure 2: Number of banks falling below 5,5% CET1 in adverse Scenario



(Source: Basel Committee on Banking Supervision)

In the adverse scenario, the weighted average common equity tier 1 ratio fell from 11.1% at the end of 2013 to 8.5% by the end of 2016. 24 banks fell below the capital threshold

of 5.5% in the adverse scenario. This corresponds to a maximum capital shortfall of 24.6 trillion euros in the adverse scenario and 9.4 trillion euros in the baseline scenario. The main cause of the losses is credit default, closely followed by the increased risk that banks are willing to take in order to remain profitable (Behn, Haselmann, and Wachtel (2016)).

4 Syndicated Loan

4.1 Definition and Development

According to the Federal Reserve Board of America "a syndicated loan is a loan extended by a group of financial institutions (a loan syndicate) to a single borrower"

The syndicated loan is a hybrid instrument that can be a loan under an established credit relationship on the one hand, but also treatable debt instruments on the other. The loan allows credit risks and the amount of the loan to be shared among different banks. One bank usually takes the lead. The so called „lead arranger“can also choose several co-lead arrangers if necessary, so that there is not one responsible arranger, but several. The lead arranger takes over the coordination between the underwriters on the one hand and the borrower on the other. He is responsible for the coordination between the underwriters on the one hand and the borrower on the other hand, especially for setting up the contract, ordering and managing the agreed loan collateral, agreeing the conditions and providing ongoing information about the borrower.

The other participating banks are only liable for their own invested capital and the associated risk. They only have to take into account their syndicate quota, i.e. their share. In the balance sheet of a bank, the syndicated loan appears under loans and advances to customers. Each bank lists its own share of the loan in its own balance sheet.

Finally, a syndicated loan can be divided into a silent and a non-liquid loan. In the case of a silent syndicated loan, the executing bank has shared parts of the loan amount with partner banks without the knowledge of the borrower in order to diversify the risk.

Particularly in the international demand for credit, syndicated loans are playing an increasingly important role, so that in 1997 the share of underwritten international syndicated loans in all international financing, including bonds and equity issues, was more than 30% (Gadanecz (2004b)). The first syndicated loan was made in 1960 in the United Kingdom. Since 1960, the share of syndicated loans has increased by almost 20% annually until 2007 (Dennis and Mullineaux (2000)). In the sample of European banks selected for this paper, the average credit line of all banks for syndicated loans in Europe was 119.65 million in 2010 and 311.03 million in 2019. This increase of 261% illustrates that syndicated loans are still more and more in demand. In 2017, there was a total credit volume of 800 trillion across Europe (Source: ECB). The distribution in the EMEA region in 2017 shows that the majority of loans went to companies (57%) for general corporate purposes, 19% for acquisition financing, 6% for project finance and 18% for other purposes.

In summary, syndicated loans have become an integral part of general lending. Large projects and large companies, because of the size of the line, in particular benefit from the possibility for banks to share their risk.

In addition, the use of syndicated loans appears to be attractive, especially internationally, because banks in the euro area have also expanded their pan-European business, including loans and funding.

As with all loans, the granting of syndicated loans is dependent on external factors. Capital regulation, the economy and a bank's financial position, among other factors.

4.2 Syndicated Loan market

The first syndicated loan was probably issued in England in the 1960s. From London, the syndicated loan market began to develop steadily (Gadanecz (2004a)). According to Gadanecz (2004), the development of the syndicated loan market can be divided into three phases.

Syndication of loans began in early 1960. By 1982, most debt in developing and emerging market countries was originated through syndicated loans. International investors in particular are financed with syndicated loans (Haselmann and Krahnen (2019)). This trend has steadily evolved.

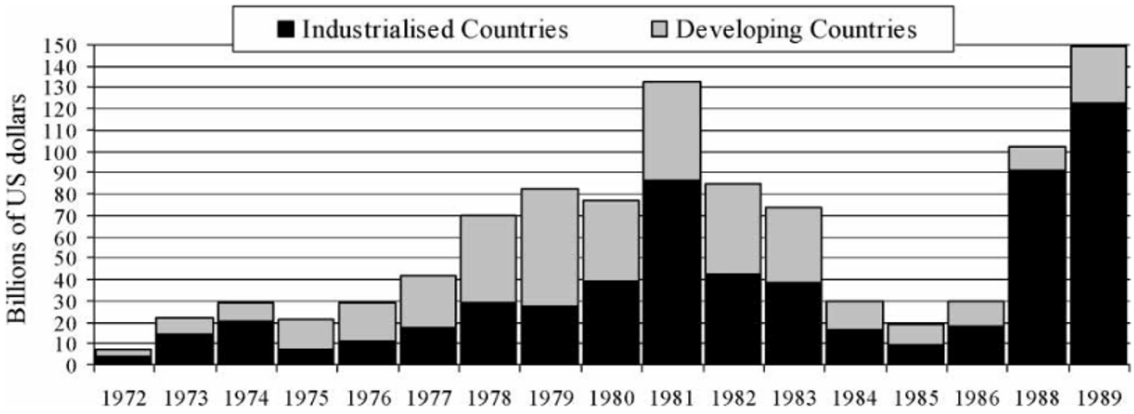
As many emerging market borrowers struggled to make their payments, the market was reconstituted from 1980-1989, so that from then on more was done through bond financing. Starting in 1990, the market flourished again. Syndicated lending has continued to increase since then (Dermine (2015a)). In the first phase, credit was provided mainly to emerging market countries. The fact that costs and risks can be shared, and that this facilitates to borrow significantly larger sums, means that it is also the more economically cautious countries that consider syndicated loans attractive (Haselmann and Krahnen (2019)).

In the second phase, from 1982-1987 (Figure 3), the reputation of syndicated loans was severely damaged as defaults increased. In 1982, Mexico stopped interest payments, which led to an abrupt halt in lending (Gadanecz (2004a)). Other countries followed suit, causing the syndicated loan market to reach its lowest point for the time being in 1987.

Banks subsequently adjusted their lending terms and wrote sophisticated contracts, which made syndicated loans more attractive again from 1990 on wards (Figure 4).

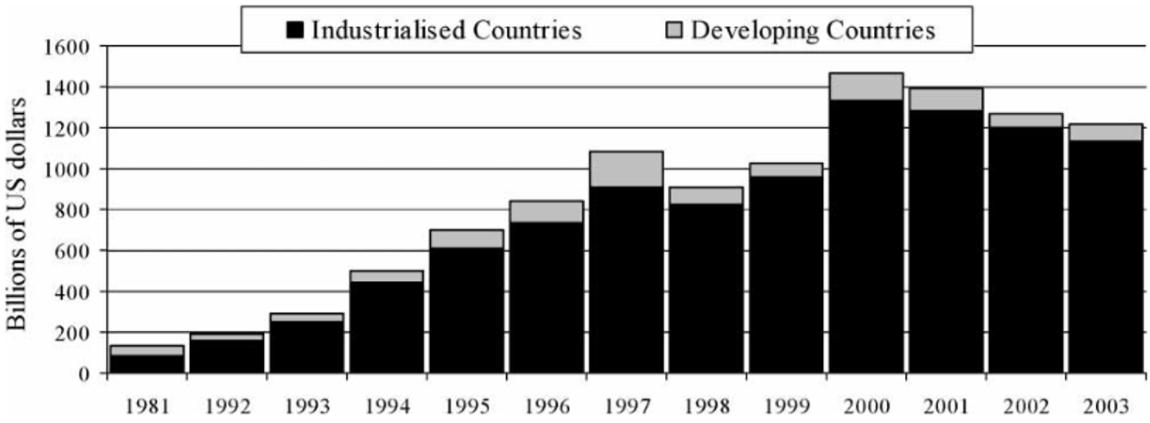
The Bank for International Settlements (BIS) announced in 2010 that the market for syndicated loans in emerging markets was growing strongly again. The permanent increase is not surprising. In 2010, Godlewski, Sanditov, and Burger-Helmchen (2012) examined the relationship between syndicated loan growth and GDP growth in the G7 countries. The authors conclude that the increase in syndicated lending has a positive effect on the overall growth of an economy. Finally, the market has become an integral part of the syndicated loan market. Especially for international money transfers and lending, syndicated loans play a major role and will probably continue to play a decisive role in

Figure 3: Announcements of international syndicated loan credit Facilities 1972-1989 (in US$ Dollar)



(Source: (The Evolution of Syndicated Loan Markets; Altunbaş, Gadanecz, and Kara (2006)))

Figure 4: Announcements of international syndicated loan credit Facilities 1992-2003 (in US$ Dollar)



(Source: (The Evolution of Syndicated Loan Markets; Altunbaş, Gadanecz, and Kara (2006)))

the supply of credit from other countries for emerging and developing countries, but also for domestic credit lending in more uncertain economic times (Haselmann and Krahnen (2019)).

5 Literature Review

There is widespread agreement in the current literature that an increase in capital requirements for banks has an impact on banks' lending. With an increase in capital requirements, not only does lending decrease (Wallen (2017)) , but banks also increase their risk taken (Behn, Haselmann, and Wachtel (2016)) and expand their lending to customers with lower ratings. This behaviour of the banks ultimately causes a reduction in

welfare because fewer loans are granted, and an increase in systemic risk due to the higher risk appetite. All this is triggered by a change in the capital requirements for banks.

5.1 Capital Requirements and Economy

Since capital regulation is considered as an economic shock, there is a broad consensus in the literature that capital regulation has an impact on a country's economy. Junge and Kugler (2013) examined the long-term consequences for the society in the Swiss. They concentrated on social cost and benefits outgoing from the increment of capital requirements. The result illustrates two sides. On the one hand, capital regulation weakens GDP growth, on the other hand, financial regulation strengthens the financial sector and thus reduces systemic risk. Using loan-level data, Fraisse, Lé, and Thesmar (2020) examined the impact of an increase in regulations on corporate borrowing, investment and employment. The authors concluded that a 1% increase of regulation leads to a decline in all three. In current literature economic growth is mostly used as a parameter to quantify the impact of capital requirements, set by the ECB.
However, Martynova (2015) stressed that there is a little evidence of a direct effect. The authors investigated that there is no significant evidence that higher bank capital regulation influences economic growth and following, the society. Quantifying general influences on the economy as a whole is difficult. Behn, Haselmann, and Wachtel (2016) investigated that banks increase their risk as regulation increases. This increases financial risk and weakens the economy. According to Dermine (2015b), capital requirements decrease the probability of bank runs and Akram (2014) examines that any macroprudential measures lead to an increase in specifically house prices and credit. By increasing the banks' resilience to economic shocks, the regulations have had an initial success (Garcia (2016)). However, it is also widely known that the increase leads to hesitant lending and reinforces cyclical behaviour of banks (Jokipii and Milne (2008)). The literature in this segment agrees that capital regulation is a helpful tool to counter systemic risks, but there are further areas of research that need to provide more transparency on the economic impact of increased capital regulation.

The economic impact of increased capital regulation is difficult to quantify. The different sectors affected by capital regulations are difficult to generalise and can therefore only be considered individually. When participating in a syndicated loan, many factors play a role for banks. Capital ratio, liquidity and risk diversification are the main reasons for banks to participate in syndicated lending. All of the above aspects are influenced by capital regulations. The changing influence of capital regulations on syndicated lending has been researched in the literature for some time.

5.2 Syndicated Lending

The first time syndicated loans were used was in the 1960s when the "Eurodollar" was created (Ballantyne (1996)) Since then, syndicated loans have been recognised credit options that were first studied in detail in America and later in Europe. The study of the factors driving syndicated loans has become a branch of the literature. Since then, various influences on syndicated lending have been studied in order to explain the behaviour of banks and to be able to transparently explain the effects on the economy as a whole.
Kim (2019) examines the impact of political uncertainty on the contractual uncertainty of syndicated loans. The author finds that political uncertainty in a country leads to an increment in financial costs and thus increased prices for syndicated loans. Using a quasi-natural experiment, Kim (2019) finds that political activity has an impact on syndicated loans. Karavitis and Kazakis (2020) examine how multinational companies need to adjust their borrowing to the political situation in subsidiaries in other countries. The authors of this paper find that the political situation has an impact on the prices of the syndicated loans they request. Karavitis and Kazakis (2020) studied American companies with subsidiaries in 69 countries. The political input on the banking sector and on the granting and demand for syndicated loans also includes central bank targeting in the form of interest rates. The lowering of negative interest rates by the European Central Bank (ECB) generally has a major impact on lending (Demiralp, Eisenschmidt, and Vlassopoulos (2017)).
Banks tend to lend more when interest rates are low (Demiralp, Eisenschmidt, and Vlassopoulos (2017). Heider, Saidi, and Schepens (2019) use for their study the impact of negative interest rates on European banks' syndicated lending in the period 2013-2015. The authors find that the introduction of negative interest rates has an impact on syndicated lending, following in a reduction in syndicated lending. Schepens et al. (2018) described in their article that the introduction of negative interest rates, especially for high-deposit banks, leads to less syndicated lending. The literature on Negative Interest on Excess Reserves (NIRP) shows a direct link between syndicated lending and negative interest rates. (Heider, Saidi, and Schepens (2019), Schepens et al. (2018), Demiralp, Eisenschmidt, and Vlassopoulos (2017)). Besides politics and interest rates, many other factors influence banks' syndicated lending behaviour. Apart from bank structure (Godlewski, Sanditov, and Burger-Helmchen (2012)), sovereign debt exposure (Popov and Van Horen (2013)), the reputation of participants (Kalyaeva (2018)) and even ethical behaviour (Kim, Surroca, and Tribó (2014)). The literature also examines the influence of regions, in where banks operate, on banks' lending behaviour. Godlewski, Sanditov, and Burger-Helmchen (2012) found out that specific developing countries demand syndicated loans from industrial regions such as the US or Europe. The authors described in their paper that US EU banks pool their risks with local banks.
Kim, Surroca, and Tribó (2014) investigate the extent to which syndicated lending was restricted or maintained after the Lehman bankruptcy and find that US banks significantly

reduced their lending to other countries after the shock. The current literature displays that local shocks are transmitted to other regions through the syndicated loan sector. In their paper De Haas and Van Horen (2012) emphasise that region plays an important role in banks supply for syndicated loans.

5.3 Capital Regulation on Syndicated Loans

With their paper "Is Bank Regulation Costly for Firms? Evidence from syndicated Loans" Lambertini and Mukherjee (2016) examine the impact of capital requirements on lending spreads charged by banks. Using a diff-in-diff method, the authors find that as demands increase, prise for wages increase. To quantify capital regulations more precisely, Lambertini and Mukherjee (2016) looked at how banks adjust their syndicated lending after failing a stress test conducted by the supervisor. As a result, the authors concluded that higher requirements lead to an increase in the cost of syndicated loans. To examine this fact in more detail, Lambertini and Mukherjee (2021) contributed to the topic in another paper, examining stress tests and their impact on lending spreads. They come to a coherent conclusion, namely that stress tests lead to a general inflation of lending spreads. The impact of capital regulation on participation and/or lending is not yet fully understood in the current literature. The occurrence of an influence on the granting of loans and syndicated loans is widely agreed.

Chu, Zhang, and Zhao (2019) examine how capital ratios affect the incentives for banks to participate in and or issue syndicated loans. After successfully eliminating the (mostly unobservable) demand-side factors, Chu, Zhang, and Zhao (2019) figured that increased capital ratios lead to increased participation and lending propensity of banks. With an within-loan estimation the authors found that a 1% increase in capital ratio leads to a 0.5% more contribution to a loan. As regulations increase, capital ratios generally increase as well, so that the consensus in the literature is that the granting of syndicated loans is influenced by the effect of the regulations. Consistent with this result, Simons et al. (1993) and Eichengreen and Mody (2000) found that banks with higher liquidity tend to participate more in syndicated loans. Additionally, the findings of “Determinants of syndicated lending in European banks and the impact of the financial crisis” (2014) are in line with these results. The authors put syndicated loans in relation to all loans extended and use this variable for a Heckman’s two-step estimation. “Determinants of syndicated lending in European banks and the impact of the financial crisis” (2014) concentrate on the supply after the crises of 2008. In line with previous results, the authors find, among other insights, that banks with high regulatory capital increasingly rely on syndicated lending.

6 Data & Methodology

6.1 Difference in Difference

The Difference-in-Difference method has recently gained a lot of popularity. The method is a reliable non-experimental evaluation method that is used especially for panel data and repeated cross-sectional data. The DID approach is therefore used especially when follow-up estimates are examined. In addition, the method simplifies the analysis of the causal inference of an intervention when time-invariant unobserved heterogeneity prevails (Angrist and Pischke 2008). As these two aspects affect the analysis of causal effects, the DID method is an alternative (Angrist and Pischke 2008). The DID method is often used because it provides unbiased results that take into account both time-invariant and unobserved heterogeneity.

The following four elements are specific to a DID estimate:

1. The presence of a treatment group and a control group.
2. The presence of parallel paths in the trends before observation.
3. A clear distinction at the start of the treatment.
4. The assumption that the treatment group would show a similar trend to the control group without treatment.

The treatment effect is therefore determined when panel data are available and a treatment has been administered (Villa 2016)

6.2 Sample Data

The data for the difference-in-difference regression come from Thompson Reuters Dealscan, from the Wharton Research Data Service (WRDS). The data period is from year 2010 to 2019, starting with the first recovery after the financial crisis of 2008 and ending just before the start of the corona pandemic in March 2020. By 2010, the supply of syndicated loans had plummeted due to the financial crisis. After 2010, the supply rose again until the European debt crisis struck. Since the treatment, considered in this paper, is defined as the event announcement in 2016 of the stress test results by the ECB, the period before and after the treatment were chosen to be somewhat equal for research purposes.

Data regarding the stress test and capital regulations are taken from the website of the European Central Bank, as well as the website of the European Banking Authority and the Basel Committee of Banking Supervision (BIS). For the analysis of syndicated lending, the size of the syndicated loans is considered rather than the loans themselves. From Thompson Reuters Dealscan I got daily information on the loan size and when it was guaranteed. Only loans that have been issued in Europe and hence, have a European country as a country of syndication are taken into account (*Source: ECB*). Western

Europe is the market of syndication. Since the European area is considered for the analysis of an effect, it is also imperative to limit the market of syndication. The data was additionally filtered so that only syndication has been chosen as the distribution method of the loans.

Table 1: Sample for 10 Banks of Data Collection

Bankname	LeadAr	DealAm (Mio €)	Date	Area of Syndication	Country of Syndication	TotalAssets (Mio €)
Barclays	Commerzbank, ABN Amro...	538	22.01.2010	Western Europe	United Kingdom	1.498.645
ABN AMRO Bank NV	BNP Paribas, ABN Amro...	650	09.02.2010	Western Europe	Netherlands	379.599
Banco Bilbao Vizcaya Argentaria SA [BBVA]	Banco Bilbao, Deutsche Bank...	230	11.02.2010	Western Europe	Spain	552.738
BNP Paribas SA	Credit Agricole Corporate & Investment Bank SA	580	08.01.2010	Western Europe	Germany	1.998.158
BPCE SA	Credit Agricole Corporate & Investment Bank SA	133	14.01.2010	Western Europe	Italy	1.048.441
Commerzbank AG	Commerzbank AG, Deutsche Bank AG, Portigon AG	580	08.01.2010	Western Europe	Germany	754.299
Credit Agricole Corporate & Investment Bank SA	Credit Agricole Corporate & Investment Bank SA	3.200	04.01.2010	Western Europe	France	6.713
HSBC Banking Group	BNP Paribas SA, HSBC Bank Plc, SG Corporate & Investment Banking	269	30.03.2011	Western Europe	France	2.555.579
Intesa Sanpaolo SpA	Banca d'Intermediazione Mobiliare IMI SpA	750	07.02.2010	Western Europe	Italy	658.757
Rabobank	Cooperative Centrale Raiffeisen-Boerenleenbank BA	82	05.02.2010	Western Erurope	Netherlands	625.536

(Source: Own representation based on Dealscan data)

The data set included 20 banks, all of which are considered by the ECB in its capital regulations. According to the ECB, these are only banks with a total asset amount of more than €30 million. In total, the ECB supervises 115 banks in the euro area. The 20 examined banks differ in size. The size of the banks is determined by the total assets and ranges from the smallest bank (383.5 million) to the largest (2,715 trillion).
The 20 selected banks issued 54,604 syndicated loans during the period 2010-2019. The stress test result for all European banks was published in 2016. The treatment event is therefore the publication of the results of the individual banks.

The total number of syndicated loans can be divided into four groups:

Table 2: Table of Syndicated Loans Pre- and Post Treatment Event

	Post		
Treat	0	1	Total
0	11846	16006	27852
1	11608	15160	26768
Total	23454	31166	54620

(Source: STATA)

The total number of syndicated loans can be divided into four groups.

1. Syndicated loans issued *before* the treatment event by banks that performed well in the adverse stress test scenario, i.e. could show a CET1 ratio of around 15% after the stress test. Out of 54604 loans, these are 11846.

2. Syndicated loans issued *after* the treatment event by the same banks as the first group. Out of 54604 loans, these are 16006.

3. Syndicated loans issued *before* the treatment event by banks that performed poorly in the adverse stress test scenario, i.e. have a CET1 ratio of <10% after the stress test and have to fear surcharges. Out of 54604 loans, these are 11608.

4. Syndicated loans issued *after* the treatment event by banks that performed poorly in the adverse stress test scenario. These loans were issued after the treatment point, i.e. in 2016 when the stress test announcement was made.
   Out of 54604 loans, these are 15160.

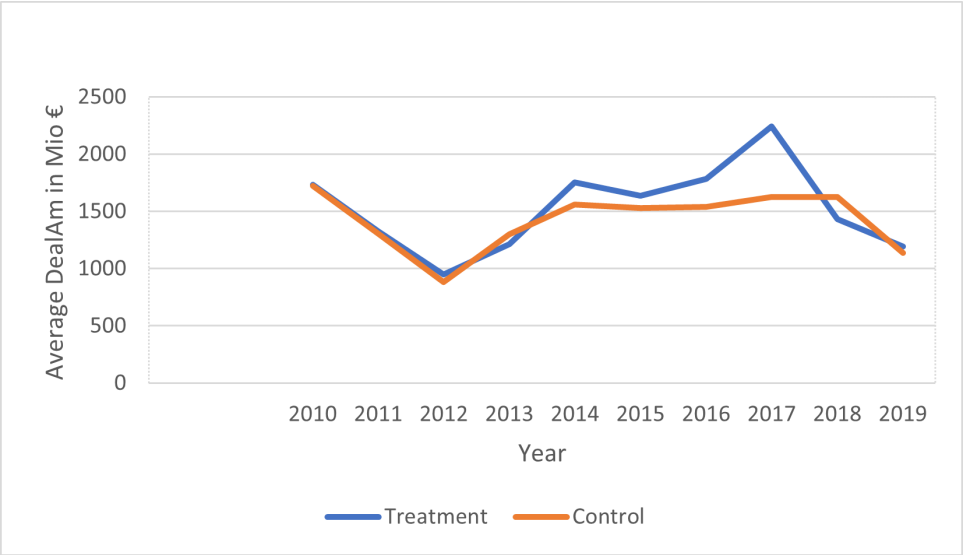
In addition to deal amount, total assets, deal date, market of country and syndication, the data set also contains the lead arrangers of the respective deals. In most cases, there are multiple Lead Arrangers, which is why I decided not to assign a Lead Arranger to each bank and loan, but to focus entirely on the largest of the syndicated loans and the change in this size over the period 2010-2019. Hence, the independent variable is the deal amount before and after treatment. Finally, two control variables were included. With GDP growth and inflation growth in relation to the previous year (t-1), macroeconomic effects are taken into account that certainly have an influence on the granting of loans and the reaction to changes in capital regulations for banks.

6.3 Parallel Trend Assumption

A basic assumptions the use of a DID regression model is the Parallel Trends Assumption. This assumption is used to examine whether the treatment and control groups can be compared with each other. For a significant result, the emitted deal amount of both groups should indicate in the same direction. The trend examined in this paper is the volume of syndicated loans issued in the period 2010-2019. A treatment effect can only be examined sufficiently if both groups have previously issued a comparable volume of syndicated loans. Parallel Trends Assumption ensures that the treatment and control groups can be compared with each other. It examines whether the outcome before the treatment event is the same. The following chart shows the average volumes of syndicated loans originated from 2010-2019. First, it is of interest whether the average deal amount up to the 2016 treatment event shows a similar trend for both groups.

In fact, the graph displays a reduction in volumes between 2010 and 2012 for both the treatment- and control group. From 2012 to 2016, both groups show a moderate increase. The trend of the treatment group and the control group up to the treatment event are parallel and hence comparable. The parallel trend assumption is therefore fulfilled.

Figure 6: Treatment- and Control Group Average Deal Amount



(Source: Own representation based on Dealscan data)

7 Difference-in-Difference

The DID methodology is widely used in the current literature. For a better understanding of the approach used, some characteristics are discussed in the following subsections. The explanation serves for a better understanding and helps solve potential inconsistencies.

7.1 Treatment event

In 2014, the European Banking Authority (EBA) conducted a stress test for European banks. The stress test started in 2014 and ended 2016. The result was published 2016 and thus serves as a treatment event. With the publication of the results, it can be assumed that banks show reactions to the public results from that day on. Hence, the day of publication is defined as a treatment event.

7.2 Treatment Effect

To prove that the publication of the results led to a change in banks' behaviour, a closer look at the literature has been taken. Nguyen et al. (2020) studied the impact of the Fed's stress test on banks in the United States of America. They found that the result had a negative effect on the balance sheets of the participating banks. The result affects both the creation of liquidity and assets. Banks participating in the stress test automatically reduce their liquidity to perform better in the stress test. In most cased, a reduction in liquidity reduces lending. The negative effects of the stress test persist for several quarters in the near future (Nguyen et al. (2020)). The authors conclude that banks that participated in stress tests reduced their lending.
This is the same result for Acharya, Berger, and Roman (2018), who also conclude that stress-tested banks reduce their lending. In addition, they found that tested banks manage

their risks more carefully than untested banks. One can assume that banks that are less well capitalised manage their risks more carefully. In their paper, the authors formulate a thesis, the Risk Management Hypothesis which indicates that Stress-tested banks manage their risks more carefully and prudently due to one or more of these channels (Mechanical, Reduced Moral Hazard, and/or Increased Charter Value). They reduce their supplies of credit - particularly to riskier borrowers to decrease their credit risk exposure (Acharya, Berger, and Roman (2018))
In his paper, Georgescu et al. (2017) investigated whether the results of stress tests led to changes in banks' behaviour and concluded that banks that performed worse tend to commit price discrimination. In particular, weaker banks have increased credit default swap and equity prices.

7.3 Treatment Group

The announcement of a stress test leads to negative return in 2 out of 4 cases in Europe. Passing banks or banks who perform well experience significantly positive abnormal returns of 59 basis points (Ahnert et al. (2018)). CET1 has the strongest impact on bank profitability and is the main capital ratio (Santos (2018)). According to this information, the stress test announcement indeed has an impact on banks behaviour and even their lending strategies.

Favara et al. 2021, examined the impact of lower CET1 ratio and concluded that below 8% CET1 ratio bigger banks are more in danger to get charged with surcharge according to their CET1 ratio. Banks who are potentially suffering from surcharges mitigate their credit supply. Since CET1 ratio has the strongest impact on capital ratio, it can be concluded that the lower the CET1 ratio, the higher the potential surcharges. This on the other hand leads to adjustments and the volume of credit granted. The results of a stress-test conducted by the Basel committee of banking supervision gives information about banks status and whether banks need to take action regarding potential surcharges or not. The lower the stress test result the more likely the surcharge and hence, the lower the credit supply to companies (Favara et al. 2021)
The average CET1 ratio for all Global systemically important banks (GSIBs) across Europe is 15% (Source: Statista.com). From a CET1 ratio of 4.5%, the BIS determines measures to reduce the potential risk posed by banks characterized by weak capital ratios and therefore pose a threat to the financial stability of an economy. If banks have less than 4.5%, stabilisation measures are inevitably required. Banks that slip below 10% in the basis scenario of the stress test run the risk of slipping into the consideration of BIS.

Assuming that lower CET1 ratios lead to higher measures and surcharges, banks that slip below the 10% Tier 1 ratio in the basis scenario have incentives to adjust their lending and risk. Adjusting risk can have many channels. Banks can change their lending behaviour to mitigate their risk. Using a syndicated loan is a common tool to share risk and thus mitigate it for the individual participating bank. The group of banks that

slipped below 10% in the basis scenario of the 2014 stress test conducted by the Basel Committee of Banking Supervision are therefore suitable as a treatment group, as these banks are expected to change their lending behaviour in order to increase their capital ratio again without being burdened with surcharges (Favara et al. 2021).

For the experimental set-up, 10 banks were selected that were at 15% ± 2% even after the basis stress test scenario. These 10 banks serve as a control group, as no change in lending or risk adjustment is expected from them. With a CET1 ratio of 15% ± 2%, the banks are not in danger of being burdened with surcharges because they are also prepared for economic downward trends.

The treatment group is therefore the group of European banks that have a CET1 ratio below 10% under the basis scenario. Of this group, 10 banks were again selected. These 10 banks are expected to adjust their lending sooner or later based on the outcome, because otherwise they will be exposed to measures such as surcharges to ensure the financial stability of the banks.

8 Economic Model Results

8.1 Estimating a Treatment Effect

In this chapter, the differences-in-differences approach is explained in more detail. Using a DID approach I examined whether banks that have a poor or even insufficient result in the 2014 stress test adjust their syndicated loan allocation or not. Through this method, my intention is to investigate whether banks with a insufficient result increase or decrease their lending. Ultimately, it is possible that the result and the resulting changes in the capital structure of the respective bank will not lead to any change in syndicated lending. The focus in this context is on the deal volume of selected banks and banks total assets as an indicator for size-dependent decisions. It is assumed that banks that are the "too big to fail", i.e. large banks, react differently than smaller systemically more irrelevant banks.

To find out whether there is an effect of publishing the stress test results, the following equation has been estimated:

$$DealAmount_{ij} = \beta_0 + \beta 1 * Treat_j + \beta 2 * Post_i + \beta 1 * Treat_j * Post_i + \epsilon_{ij} \qquad (1)$$

The dependent variable is the volume of syndicated loans issued by banks between 2010-2019. In this context, *Treat*Post* is a variable indicating whether there was an effect of the treatment for the treatment group. The interaction term *Treat*Post* consist of the multiplication of two other coefficients, *Treat* and *Post*. *Treat* is a binary variable indicating whether the bank is in the treatment group or not. If the bank is in the

treatment group, the value is 1, if not, 0 and belongs to the control group. The second binary variable is *Post* which indicates whether the respective bank was considered at the time after the treatment or before. A bank that belongs to the treatment group and is examined after the treatment has the value *1* for both variables. This method attempts to find out whether the announcement of the results has any effect on the dependent variable *DealAmount* on syndicated loans. The treatment effect shows whether there is a causal relationship between the event and the adjustment of the loans. Taking both variables together, we obtain a coefficient *Treat*Post* which indicates whether there is an effect and if so, whether it is significant or not. *Treat*Post* is the interaction term needed to obtain a causal effect. The interaction term also indicates how the dependent variable changed after the treatment.The equation also contains fixed effects. Bank fixed effects compensate for inconsistencies for individual banks that would distort the equation and time fixed effects do the same for inconsistencies that would distort over time.
The period includes daily deal amounts for the 20 selected banks. In order to analyse and use such a large and individual data set of 54604 observations, fixed effects were implemented for banks. Bank fixed effects ensure that individual activities and externalities in the area of lending are removed and thus do not lead to a distortion of the results. When using a period of 10 years, it is also necessary to install fixed effects for the time. With the time fixed effects, time distortions are absorbed and the result is more accurate.

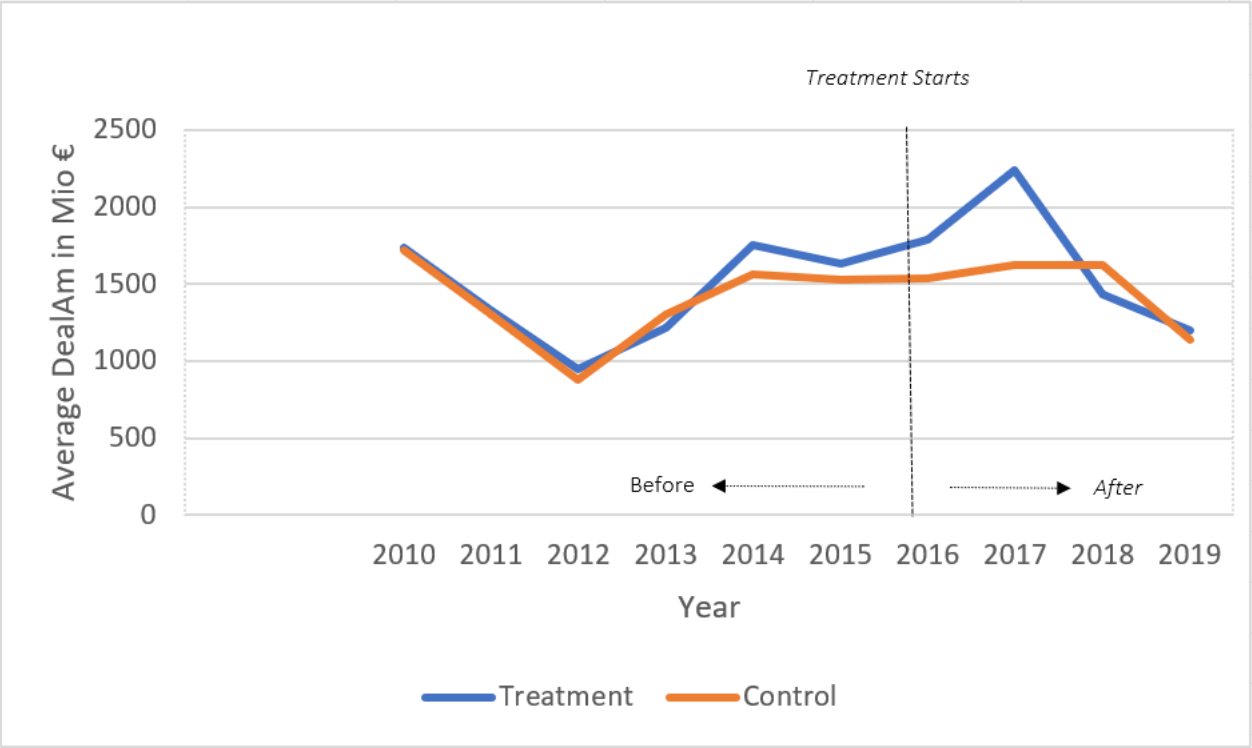
8.2 Parallel Trend analysis

The results of the difference-in-difference regression are displayed below. Before examining the difference-in-difference regression, we take a look at the parallel trend assumption and examine whether there is an effect displayed on the graph.

Figure 7 shows that there was indeed an effect in 2016. While the graph of the control group continues to show a slight positive slope until 2018, the volume of syndicated loans granted in the treatment group rises sharply after 2016. The increase is only temporary. After about 1 year, the average volume of the treatment group decreases again until it finally shows a similar trend to the control group in 2018. In the following, I will discuss in more detail whether this effect is related to the treatment event and if there is a direct causal relationship between the increase in 2016 and the announcement of the stress test results. However, the graph gives a first insight for the upcoming regression results.

The graph for the average loan volume has shown an effect for the treatment group. To further investigate this effect, the results of the difference-in-difference regression are evaluated below.

Figure 7: Average Deal Amount 2010-2019 for Treatment- and Control Group



(Source: Own representation based on Dealscan data)

8.3 Difference-in-Difference Estimation

The graph has shown that the loan volume increases only for the treatment group after 2016. Hence, we expect a significant treatment effect.
The estimation results are displayed in figure 8.

The before rows contain information about the average outcome for the control group and the treatment group before the treatment event. Diff(T-C) shows the individual differences for each group. The results are produced together with the standard deviation, the T-statistic and the P-value. The P-value for the mean outcome, the treatment, is significant. However, since there was no treatment yet and thus no effect can be expected, this value is not of interest so far.

The same properties apply to the rows after the treatment. The average values after the treatment are similar to those before the treatment. Diff-in-Diff indicates whether there was a significant effect of the treatment. Diff-in-Diff is significant at a significance level of 10%. It can be concluded that the treatment group was affected by the treatment and reduced their volume of syndicated loans by €115,104 million after the event.

8.3.1 Results

The results of the difference-in-difference estimation are displayed below. The method was used to examine whether there is an influence of the stress test resulting in an adaption of the volumes for syndicated loans.

Figure 8: Difference in Difference Treatment Effect without Fixed-Effects

Number of observations in the DIFF-IN-DIFF: 54608

	Before	After	
Control:	11846	16001	27847
Treated:	11608	15153	26761
	23454	31154	

Outcome var.	DealA	S.	Err.	t	P>t
Before					
Control		1531.140			
Treated		1682.182			
Diff (T-C)	151.042		50.128	3.010	0.003***
After					
Control		1488.812			
Treated		1524.690			
Diff (T-C)	35.878		43.508	0.820	0.410
Diff-in-Diff	-115.164		66.376	1.740	0.083*

R-square: 0.00
* Means and Standard Errors are estimated by linear regression
**Inference: *** p<0.01; ** p<0.05; * p<0.1

Figure 9: Difference in Difference Treatment Effect Results

Linear regression

DealA	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
treat	151.042	50.128	3.01	.003	52.79	249.294	***
post	-42.329	46.523	-0.91	.363	-133.514	48.857	
int_tp	-115.164	66.376	-1.74	.083	-245.262	14.934	*
Constant	1531.14	35.266	43.42	0	1462.019	1600.261	***

Mean dependent var	1549.054	SD dependent var	3838.859
R-squared	0.000	Number of obs	54608
F-test	6.258	Prob > F	0.000
Akaike crit. (AIC)	1056311.063	Bayesian crit. (BIC)	1056346.695

*** p<.01, ** p<.05, * p<.1

The three binary variables *Treat*, *Post* and ***Int_TP*** should show whether there is a treatment effect or not. The variance is divided into the variance that arises from independent variables and those that cannot be explained by the independent variables (Residuals). The sum of the models variance and the residual leads to the total variance. The table shows that there is a high variance in the results, both in the model and in the residual. Since there are four independent variables, three degrees of freedom are created. The degrees of freedom correspond to the number of predictions minus one.

R-squared is the proportion of variance in the dependent variable that can be predicted from the independent variables. The R-Square value is 0.0003 (Figure 9) and is therefore small. However, since the value is not 0, the conclusion is that there is an influence of the independent variables on the dependent variable.

The mean squares are the sum of the squares divided by the degrees of freedom. The mean squares of the residuals are used to compute the F-ratio to test the significant of the results. The result of the F-value is 6.26. The P-value associated with this F-value is 0.0003. Since the P-value is 0.0003 and the regression was performed with a 95% confidence interval, the independent variables have a significant influence on the dependent variable, *DealA*. In the following, the individual variables and the results associated are discussed in more detail.

The variable *Treat* indicates how the banks' deal amount changed when they are treated in the treatment group. These banks are in danger of receiving a surcharge if their CET1 ratio is evolving below 10%. The coefficient is 151.0421. When banks belong to the treatment group, they increased their syndicated loans volume by the coefficient 151.0421. The result shows a P-value of 0.003, which is significant at the 95% confidence interval. The standard deviation for this coefficient is comparatively high at 50.128. However, this result is consistent with the results of the graphs. The regression confirmed that banks that belong to the treatment group and thus had a lower CET1 ratio significantly increased their syndicated loan volume. First and foremost, this result indicates that banks in the treatment group, i.e. with a lower CET1 ratio, are more likely to increase their syndicated loan volumes than to reduce them. However, there is no indication whether this increase in lending volume is related to the treatment or occurs independently of it.

Post explains how the volume of syndicated loans changes after the treatment event. Here, loans of all 20 banks were taken into account that were issued after the announcement of the 2016 stress test results. The regression results display that the *DealA* decreased by the coefficient -41.329 after the announcement. Banks are issuing a lower volume of syndicated loans after publication. With a standard deviation of 46.52 and a P-value of 0.363, the result is not significant. The standard deviation is larger than the coefficient itself and the P-value is clearly above the significance level of 95%.

The variable *Int_TP* states whether a treatment effect can be detected or not. The interaction term has a coefficient of -115.164 and describes that banks that were assessed after the treatment event and have a CET1 ratio of <10% reduce their volume of syndicated loans by the coefficient -115.164. The P-value is 0.083 and hence, the result is significant at a 10% significant level. This indicated banks behaviour after the treatment and gives us first insights that there might be an effect on banks lending behaviour by the announcement of the stress test results. However, the result of the treatment effect contradicts the result of the graphs. A significant negative treatment effect indicates a reduction in banks' syndicated loan volumes after the treatment event. The graph shows that the average volume increases. The results show that banks are reacting to the announcement of the stress test results. The interaction term is negative and significant and can therefore be used for explanatory approaches. Banks that performed poorly in the stress test and therefore have to expect surcharges reduce their syndicated loan volume.

The constant variable *Cons* represents the intercept showing the change in the de-

pendent variable when all other variables are 0. The results of the regression display that there is no significant treatment effect for banks that have a CET1 ratio below 10%. It illustrates that banks did not adjust the volume of their syndicated loans after the treatment event.

Eventually, the coefficient for the treated banks as well as the graph display a generally increase of syndicated loan volume for under-capitalised banks which have a CET1 ratio below 10%. However, while the effect for treated banks is significant at a 10% significant level, it is not possible to clearly determine whether the effect is dependent on the treatment or not. The result of the regression displayed that the coefficient for the treatment effect is negative and significant. Hence,it can be concluded that under performing banks in the European stress test took action by reducing the volume of syndicated loans.

8.4 Including Fixed Effects

To determine the treatment effect more precisely, the variables *Treat* and *Post* were omitted in a second equation and replaced by bank and time fixed effects. To estimate the treatment effect the following equation was estimated:

$$DealAmount_{ij} = \beta_0 + \beta 1 * Treat_j * Post_i + b_j + t_i + \epsilon_{ij} \tag{2}$$

Figure 10: Difference-in-Difference Estimation with Fixed Effects

Linear regression

DealA	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
int_tp	-154.557	66.521	-2.32	0.020	-284.938	-24.176	**
Constant	1573.663	122.634	12.83	0.000	1333.3	1814.027	***

Mean dependent var	1548.812	SD dependent var	3838.589
R-squared	0.016	Number of obs	54617
F-test	29.804	Prob > F	0.000
Akaike crit. (AIC)	1055690.228	Bayesian crit. (BIC)	1055957.471

*** p<.01, ** p<.05, * p<.1

When bank and time fixed effects are added to the equation, the interception term is still negative and significant. Bank and time fixed effects reinforce the result. The fixed effects eliminate further inconsistencies in the equation. The result shows that the volume of syndicated loans was reduced by €154 million after the treatment effect for Treated banks. The result is significant with a P-value of 0.20 at a significance level of 5%. It strengthens the results we obtained before. The second equation shows that there is an effect on the volume of syndicated Credits.

8.5 Estimating the Effect on the Volume of Syndicated Loans

To determine an effect on the volume of syndicated loans issued by banks, a regression was set up taking into account banks' total assets, the amount of lead arrangers and two binary variable focusing and controlling on the impact of strongly capitalised banks and weakly capitalised banks.

The following regression was estimated:

$$DealA_{ij} = \beta_0 + \beta 1 Treat * Post + \beta 2 * TotalAinMrd_{ij} + \beta 3 * LeadArBinary + \beta 4 * TotalABinary + b_j + t_i + \epsilon_{ij} \quad (3)$$

DealAinMio is the volume in millions of euros issued in syndicated loans. The loan is composed of the individual shares of the participating banks. Each deal consists of at least four participating banks. For each deal there is at least one lead arranger. However, in most of the cases there are several lead arrangers. Hence, the risk of being the lead arranger is shared too. *TotalAainMrd* is the total equity of the bank and determines the size of the banks in trillion Euro. It is composed of all liquid and illiquid assets. Assets are also classified in the balance sheet as current assets and long-term assets. These sub-types added together give the total assets used for the regression. *Treat*Post* is the intercept between the two binary variables, *Treat* and *Post*. The intercept is equal to 1, if a bank belongs to the treatment group and fell below the threshold of 10% CET1 ratio for the stress test result and is equal to 0, if not. *LeadABinary* is the second binary variable in the regression. The variable is equal to 1, if more than 4 banks are subscribed as lead arrangers and 0, if less. The variable occurs in the regression to check if the amount of lead arrangers for syndicated loans plays an important role in the volume of the loan itself. Macroeconomic independent variables, such as *GDPGrowth* and *Inflation* were used to account for external influences on banks' decision. Since the macroeconomic variables are absorbed by fixed effects, they are negligible. b denotes bank fixed effects to control any variations in the data regarding loan supply and avoid any further inconsistencies. t are time fixed effects to control for time-invariant biases and is the error term. The final sample includes 54604 loans issued by 20 European banks in the period from 2010 to 2019.

8.5.1 Results

Based on the assumption that banks with more equity and a higher CET1 ratio have less fear of surcharges (Favara, Ivanov, and Rezende (2021)), it is expected from the regression results that larger banks will see less incentive to issue syndicated loans to mitigate their risk-taking.

The results of the regression are shown in Figure 11.

Figure 11: Regression Results

Linear regression

DealAinMio	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
int_tp	-142.806	65.844	-2.17	.03	-271.861	-13.751	**
TotalAinMrd	-.203	.111	-1.83	.068	-.421	.015	*
LeadABinary	1376.832	36.95	37.26	0	1304.409	1449.255	***
TotalAbinary	-208.517	168.242	-1.24	.215	-538.272	121.237	
Constant	524.13	133.588	3.92	0	262.296	785.964	***

Mean dependent var	1548.812	SD dependent var	3838.589
R-squared	0.040	Number of obs	54617
F-test	71.419	Prob > F	0.000
Akaike crit. (AIC)	1054314.050	Bayesian crit. (BIC)	1054608.017

*** $p<.01$, ** $p<.05$, * $p<.1$

The results show that there is a significant decrease in syndicated loan volume with increasing bank size. The dependent variable *TotalAinMrd* has a value of -0.203 and is significant with a P-value of 0.068 at a significance level at a confidence interval of 90%. As the size of the banks increases, the volume of syndicated loans issued decreases. The result suggests that banks with a higher CET1 ratio have less incentive to syndicate their loans. A potential explanation for this behaviour is that the syndication of loans is mainly used to mitigate risk. This finding is consistent with the literature around Behn, Haselmann, and Wachtel (2016), who conclude that banks with lower capital ratios tend to increase their risk. By implication, this means that banks with high capital ratios are less inclined to reduce their risk. Since syndicated loans are a recognised means of reducing risk, it can be assumed that banks with lower CET1 ratios are on the one hand more likely to resort to syndicated loans, but on the other hand reducing syndicated lending in order to mitigate risk. With the syndication of loans, weaker capitalised banks can continue to issue loans without having to significantly increase their risk level. In addition, banks that have lower CET1 ratios have a higher risk of receiving surcharges. Surcharges are also imposed based on the risk banks display (Favara, Ivanov, and Rezende (2021)). The result can therefore be interpreted in that sense that banks with lower capital ratios have to fear surcharges and are therefore more likely to reduce lending and issuing syndicated loans.

The interaction term *Int_TP* is negative and significant with a P-value of 0.03 and a coefficient value of -142.806. The interaction term describes a treatment effect that is similar to the treatment effect of the previous regression and thus confirms our assumption that banks that were not in the treatment group and are generally larger, i.e. have more total assets, have less total volume of their syndicated loans. In more detail, the result illustrates that banks that were in the treatment group and were examined after the

treatment event reduce their deal volume by 142,806 million euros.

This confirms the expectation that banks that performed worse will reduce their volume of syndicated loans for a better equity ratio to avoid the risk of being penalised by the BIS. The binary variable *LeadArBinary* provides information on whether syndicated loans originated by more than four banks have more volume than loans originated by only a few institutions. In fact, the result describes that syndicated loans are larger if they are issued by more than four banks. The coefficient shows that syndicated loans issued by more than four banks are 1,376 billion euros larger. The result is significant. For the hypothesis stressing the syndicated loan volume is influenced by the stress test results, this coefficient has little significance. *TotalABinary* indicates that above average sized banks issue smaller syndicated loans than banks with total assets below average. However, the coefficient is not significant with a P-value of 0.215 and therefore no statement about a dependency can be made. The binary variables are considered as control variables.

8.5.2 Economical Significants

The coefficient *Int_TP* is negative. From an economic point of view, this can be explained. As already known from the literature, banks in difficult situations reduce their lending in order to lower costs and risks and to increase their equity ratios. As syndicated loan spreads become expensive (Lambertini and Mukherjee (2016)), the volume of loans issued by banks decreases in line with demand. Theoretically, it seems economically significant that the volume will be reduced after the announcement. Due to the bad result, banks are forced to take measures. The coefficient for the Interaction term shows that the reduction of the volume is €142,806 million. For the treatment group, calculations showed that banks issued an average of €1526 trillion in syndicated loans between 2010 and 2019. For the control group, it was €1422 trillion. 142,806 correspond to a change of approx. 10% and it is therefore debatable whether the result can be considered economically significant.

Due to the fact that syndicated loans are on average 10 times larger than the changes that took place after the announcement, it can be concluded that the result is statistically but not necessarily economically significant. Banks that reduce their loans reduce them to an extent that could lead to an economic effect. A 10% reduction in loan volumes represents a fundamental change in loans allocation and therefore leads to economic changes. The sample used for the calculations includes 20 banks displaying a statistically significant result. If the sample is extended to all European banks, it represents a significant impact on the real economy. A total reduction of approx. 10% in syndicated loan volume has a significant economic impact on the economy. Hence, the coefficient Int_TP must be considered economically significant. The variable *TotalAinBillion* is to be interpreted differently from the treatment effect. The statistically significant value -0.203 indicates that banks reduce their volume of syndicated loans the larger they are. Since the value is very small, it does not have the necessary significance and therefore it cannot be said

that an influence on the real economy can be read directly. Consequently, this coefficient is not economically significant.

9 Robustness Check

In this section some robustness checks are conducted to examine if the results are valid.

9.1 Change the Definition of Treatment to 7%

In order to confirm the result of the diff-in-diff effect more closely and to see whether it is robust, the definition of the treatment was changed. Previously, exceeding the 10% mark of the CET1 ratio in the baseline scenario was considered a treatment effect for the respective banks. These banks have to fear surcharges on their capital if they further deteriorate their CET1 ratio. Banks that were below 10% were assigned to the treatment group and banks that were above 10% to the control group. To further measure the robustness of the result, the definition was changed so that the treatment is now defined to include banks that slipped below 7% CET1 ratio in the adverse scenario. Banks with a CET1 ratio above 7% form the control group. In total, 7 banks are in the treatment group and 13 in the control group.

The newly defined treatment group further amplifies the effect of the surcharges, as they have a CET1 ratio that is 3 percentage points lower. The result can be seen in Figure 12.

Figure 12: Banks below 7% CET1 Ratio

Number of observations in the DIFF-IN-DIFF: 54434

	Before	After	
Control:	11846	16006	27852
Treated:	11515	15067	26582
	23361	31073	

Outcome var.	DealA	S.	Err.	t	P>t
Before					
Control		1531.140			
Treated		1690.820			
Diff (T-C)	159.680		50.300	3.170	0.002***
After					
Control		1488.369			
Treated		1527.363			
Diff (T-C)	38.994		43.629	0.890	0.371
Diff-in-Diff	-120.685		66.586	1.810	0.070*

R-square: 0.00
* Means and Standard Errors are estimated by linear regression
**Inference: *** p<0.01; ** p<0.05; * p<0.1

The table shows that the robustness check estimated a weakly significant value for

the treatment effect. The *diff-in-diff* coefficient is significant at the 10% significance level with a P-value of 0.07.

Banks that slipped below the 7% CET1 ratio due to the stress test result reduce the volume of their loans by €120,685 million. The result indicates that banks that performed worse tend to reduce their volume of syndicated loans. This result complements the previous findings. Banks with weaker performance issue smaller syndicated loans.

9.2 Change the Definition of Treatment to 12%

The check whether the change in the treatment group leads to a change in the treatment effect showed that banks issue smaller syndicated loans if they performed below 7% in the adverse scenario.

The next check is to examine how it looks in the opposite direction. For this purpose, the treatment group was changed once again. This time, banks with a CET1 ratio of more than 12% in the stress test are included in the control group and banks with a CET1 ratio of less than 12% in the treatment group. The banks that performed particularly well and are therefore are well capitalised should see no reason to reduce their volume of syndicated loans according to the assumptions made. These banks do not have to fear being prosecuted by surcharged. No change, i.e. treatment effect, is expected from the new treatment group.

The result is shown in Figure 13.

Figure 13: Banks above 12% CET1 Ratio

Number of observations in the DIFF-IN-DIFF: 54620

	Before	After	
Control:	11846	16006	27852
Treated:	11608	15160	26768
	23454	31166	

Outcome var.	DealA~o	S. Err.	t	P>t
Before				
Control		1531.140		
Treated		1682.182		
Diff (T-C)	151.042	50.124	3.010	0.003***
After				
Control		1488.369		
Treated		1524.013		
Diff (T-C)	35.644	43.496	0.820	0.413
Diff-in-Diff	-115.398	66.365	1.740	0.082*

R-square: 0.00
* Means and Standard Errors are estimated by linear regression
**Inference: *** p<0.01; ** p<0.05; * p<0.1

It shows that even for better capitalised banks an effect can be seen that hardly differs from the previous effect. The *Diff-in-Diff* coefficient is significant at a 10% significance level and differs only very slightly from the value of the original treatment group. The effect indicates that banks in the treatment group reduce their volume of syndicated loans

by €115.398 million after the treatment event. Compared to a reduction of 115.164, also at a 10% significance level, this result does not reinforce the actual result.

The robustness check illustrates that no clear statement can be made as to whether the reduction in syndicated loan volumes is due to the treatment effect. It contradicts the hypothesis that lower stress test results leads to volume adjustment for syndicated loans. However, it supports the thesis that banks with a low CET1 ratio issue smaller syndicated loans.

9.2.1 Changing the Treatment Intro

To examine whether the result changes when the time of the treatment is changed, the event at which the stress test results were published was changed to the year 2014. By changing the treatment event, a new artificial effect is created. This makes it possible to check whether the result actually depends on the real treatment result or not. This approach should bring further robustness to the results obtained. The following figure shows the treatment effect when the treatment did not take place in 2016 but in 2014.

Figure 14: Change of the Treatment Event

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS
Number of observations in the DIFF-IN-DIFF: 54608

	Before	After	
Control:	8405	19442	27847
Treated:	7576	19185	26761
	15981	38627	

Outcome var.	DealA	S.	Err.	t	P>t
Before					
Control		1392.881			
Treated		1309.289			
Diff (T-C)	-83.592		60.775	-1.380	0.169
After					
Control		1556.075			
Treated		1705.042			
Diff (T-C)	148.967		39.040	3.820	0.000***
Diff-in-Diff	232.559		72.234	3.220	0.001***

R-square: 0.00
* Means and Standard Errors are estimated by linear regression
**Inference: *** p<0.01; ** p<0.05; * p<0.1

The result shows that a significant and positive treatment effect was estimated again. Unlike the first estimate, the result is now positive and significant. Hence, it indicates that banks are increasing their loan volume. This is in contrast to the previous result and strengthens the previous estimate that the treatment effect has an influence on the volume. However, the result shows once again that there are significant changes, but that these changes cannot be regarded as robust.

9.3 Effect of CET1 Ratio on Syndicated Loan Volume

In order to find out whether the treatment effect is due to the fact that generally poorly capitalised banks perform worse in the stress test and therefore reduce their loan volume, a further regression was set up. The robustness checks so far indicate that the treatment effect is not robust enough to say whether the stress test result gives banks with weaker capitalisation an incentive to reduce the volume of their syndicated loans.

For this reason, a further check was conducted to investigate whether a lower CET1 ratio leads to smaller syndicated loans.

$$DealAinMio_{ij} = \beta_0 + \beta 1 * TotalAssets_{ij} + \beta 2 * TotalAbinary + \beta 3 * LeadA + \beta 4 * CET1 + b_j + \epsilon_{ij} \tag{4}$$

DealAinMio still indicates the size of the syndicated loan granted. *TotalA* determines the size of the banks by adding all on and off balance sheet assets. *LeadABinary* is a binary variable that takes the value 1 if more than 4 banks participate in a syndicated loan and 0 if less. *CET1* is the CET1 ratio that banks have in the adverse scenario. The equity ratio is the main point of interest in this regression. *TotalABinary* is a second binary variable which has the value of 1 if banks a above the average bank size and 0, if below. The binary variable is used ones more to check if the size of banks has a significant impact on the loans granted. As a control, bank fixed effects were implemented. Time fixed effects were omitted this time, as it is only a period in which we want to see whether banks with a lower CET1 ratio issue smaller loans.

Figure 15: Regression for Robustness Check

Linear regression

DealAinMio	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
TotalAinMrd	-.318	.104	-3.06	.002	-.522	-.114	***
TotalAbinary	-228.208	222.643	-1.02	.305	-664.59	208.175	
LeadABinary	1405.502	37.451	37.53	0	1332.098	1478.907	***
CET1	-177.081	58.173	-3.04	.002	-291.1	-63.063	***
Constant	1898.34	447.299	4.24	0	1021.631	2775.05	***

Mean dependent var	1533.524	SD dependent var	3825.186
R-squared	0.037	Number of obs	51996
F-test	98.909	Prob > F	0.000
Akaike crit. (AIC)	1003524.700	Bayesian crit. (BIC)	1003710.738

*** p<.01, ** p<.05, * p<.1

The coefficients *TotalAinMrd* and *LeadABinary* are similiar to the regression, conducted in the first place. Both are significant and hence, influence the dependent variable. The regression shows that the effect remains significant even with further control

variables. However, the result of the regression shows that banks with a lower CET1 ratio reduce the volume of syndicated loans they issue by €177.081 million. The result is significant at a 1% significance level and supports the hypothesis that banks with a lower CET1 ratio issue syndicated loans that are smaller in volume than banks with a higher CET1 ratio. The robustness checks have shown that despite significant treatment effects, the result is not robust enough to make a reliable statement.

10 Discussion

10.1 Theory vs Empiric

It is common in the existing literature that increased capital regulations have an impact on lending. Syndicated loans are also affected by requirements. According to Lambertini and Mukherjee 2016, capital increases for banks are costly for firms as banks increase their loan spreads. This finding is consistent with previous literature. Aiyar, Calomiris, and Wieladek 2012 concludes that capital requirements and monetary policy reduce the supply of lending. Since these two papers serve as the basis for the regression, the following section compares the empirical evidence with new findings.

The findings of the regression show that banks facing potentially increasing capital regulations issue less volume of syndicated loans. This finding is consistent with Lambertini and Mukherjee 2016. by increasing spreads, the economic models know that demand decreases and so do the number and volume. What remains to be discussed is whether demand falls because of less supply or rising prices. The authors do not explain this. The results of this paper imply that both factors play a role. Both the rising spread price for syndicated loans and the reduced loan volume in connection with the stress test lead to the fact that: 1. Companies demand less and 2. Banks are forced to hold back more equity. Individually and together, these effects lead to a decline in the loan volume.

The results differ for the effect on the aggregate of all banks. The authors find that all banks considered show a reaction to the stress test result. The results from this paper do not suggest that banks participating in a stress test adjust their loans. Moreover, the Lambertini and Mukherjee 2016 use significantly more control variables and are able to make more precise statements. Furthermore, the authors use firm fixed effects to absorb lending to different firms. In this paper, I have not used firm fixed effects, since only the volume of syndicated loans is considered and not the prices, which would affect the firms.

10.2 Results

First of all, it was examined whether the treatment and control groups could be compared with each other. The parallel trend assumption showed that both groups had a comparable approach to syndicated loans up to the 2016 treatment event. Both the treatment

and the control group show a slight positive trend for the volume of syndicated loans granted compared to 2010. After the 2016 treatment event, the syndicated loan volume of the control group remains relatively constant before decreasing again in 2018. For the treatment group, on the other hand, the volume increases for 2 years after the treatment effect, before it decreases again in 2018.
In contrast to this result is the result of the first regression. The first regression was set up to find out whether there is a treatment effect for the treatment group. In fact, the estimation showed that banks that belonged to the treatment group also reduced their volume of syndicated loans after the treatment event. This significant result illustrates that banks that have under performed reduce syndicated loan volume.

In a further estimation, I examined what else the reduction in loan volume might depend on. With the addition of further dependent variables, the second regression considered the size of the banks as well as the number of lead arrangers. The result shows that more strongly capitalised banks issue smaller syndicated loans than banks whose size is below the average total asset amount of the sample of 20 banks. Since bank and time fixed effects were implemented, macroeconomic and time-invariant effects can be excluded.
In order to further substantiate the results, four robustness checks were performed, which showed that banks with a lower CET1 ratio have a higher treatment effect. It could not be determined whether banks with a high CET1 ratio had a low or no treatment effect. This result leads to the assumption that further control variables are necessary to obtain an exact treatment effect. In order to investigate whether the result also depends on the CET1 ratio and thus distorts the treatment result, a third regression was set up to investigate how a low CET1 ratio affects the lending volume. The result shows that banks with a lower CET1 ratio issue more loans than banks with a high CET1 ratio.

This result gives an indication of what the treatment effect is based on.

10.3 Interpretation

At a superficial glance, the interpretation of the results leads to two different directions. If we look at the parallel trend assumption up to 2019, we can see that the treatment effect has led to an increase in syndicated loan volumes. The slight upward trend can be explained, among other things, by the recovery of the economy after the European debt crisis of 2012. However, the regression shows that the treatment effect is significantly negative. Banks from the treatment group therefore reduce their loan volume. Among other things, this may be related to the fact that banks that have carried out a stress test and performed poorly demand higher spreads for their loans. This lowers demand and consequently the volume of loans issued. According to Aiyar, Calomiris, and Wieladek 2012, banks even reduce any kind of loans when capital increases are expected. Looking at the reasons listed, one can further discuss which additional effect played a role.

Banks that are better capitalised also show a reduction in syndicated loan volume as total assets increase. This means that the larger a bank, the smaller the volume of syndicated loans it issues. This could be related to the fact that syndicated loans are mainly used for risk and capital sharing. More precisely, banks that cannot bear the risk or size of the credit line themselves primarily use syndication of their loans. Conversely, this means that large banks have less incentive to syndicate their loans.
In addition, there is a moral hazard problem associated with syndicated loans (Godlewski, Sanditov, and Burger-Helmchen 2012) and large banks can afford to forego this problem. The moral hazard problem ultimately increases the monetary cost of syndicated lending. Finally, the third regression in the robustness check showed that banks with a lower equity ratio and therefore a lower CET1 ratio issue smaller loans than banks that are well capitalised. One reason for this is the size of the banks. In the sample used, poorly capitalised banks are also more likely to be smaller banks. Smaller banks make smaller loans and so this could be another explanation for the effect.

The results as a whole can be interpreted in such a way that banks that have performed poorly in a stress test show a reaction. This reaction is that the volume of loans that banks have issued in the period after the announcement has been reduced. This reduction is due, among other things, to rising spreads (Lambertini and Mukherjee 2021), the general decline in lending (Aiyar, Calomiris, and Wieladek 2012 and the fact that banks have to fear rising capital requirements and surcharges (Favara, Ivanov, and Rezende 2021).

10.4 Limitations

10.5 Coefficients

The regression used attempted to explore an effect on syndicated lending. However, the selected variables *ToalAinMrd*, *LeadArBinary* and *TotalABinary* can only explain the impact on the lending sector to a limited extent. They serve to get an insight into how the syndicated lending situation changes and on which dependent variables the result depends. For an even more precise analysis, many more variables should be integrated into the regression. For example, it matters in which market system the effects are examined. More specifically, the bank-based system in Europe should be compared with the market-based system in America to see if the results can be applied to other economies.
Another point for discussion is the sole consideration of the CET1 ratio as an equity capital coefficient. The equity capital of a bank consists only partly of CET1 core capital. For a more accurate statement on the effects of a capital increase, further research should also examine other parts of the equity and investigate the effects of changes.

10.5.1 Risk Parameters

Another component to investigate could be the calculation approach for internal risks of banks. Behn, Haselmann, and Wachtel 2016 finds that banks that use the internal risk-based approach to calculate risk reduce their lending more than banks that use the standard approach. A coefficient that calculates approaches or the risk that banks take does not play a role in the estimate. As a risk parameter increases, the result of the regression becomes more meaningful. Should further research be done on this topic, one could install the loss-given-default or the non-performing loan ratios as coefficients to find out what influence these variables have on the treatment effect and on the reduction of the syndicated loan volume.

According to Behn, Haselmann, and Wachtel 2016, banks increase their credit risk as a reaction to remain profitable when they fear that the bis will impose higher capital requirements on them. This leads to increased systemic risk and is ultimately counter-productive in terms of capital regulation. In this paper, we have seen that loan volumes are being reduced. The aspect of risk is ignored. The question of whether the result is therefore less meaningful can be answered with *No*. A decrease in volume is equivalent to a decrease in risk, since banks have less money in circulation. According to Behn, Haselmann, and Wachtel 2016 results, the regression results from this paper and those of the authors do not coincide. According to the authors' theory, credit volumes should remain the same. In this case, banks would issue the same volume of credit, but increase the risk at the same time. Since syndicated loans are a risk-sharing tool, it is difficult to make a concrete statement about this. However, it might be that banks reduce their volume of syndicated loans and at the same time increase the granting of riskier normal loans. For in debt information, the regressions need to be extended to include risk parameters.

10.5.2 Sample

The stress test examined 115 banks and checked how resistant they are to shocks. The selected sample contains 20 banks, 10 of which belong to the treatment group and 10 to the control group.

20 banks represent a small part of the total size and can therefore only be used as an indicator for all other banks to a limited extent. Although 54604 loans were considered, it remains to be discussed whether the sample size of banks is sufficient to make a valid statement about the entire banking sector in Europe. Due to the increasing homogenisation of the banking sector and the fact that Europe is overbanked, it is becoming increasingly challenging to subdivide banks. The division into low and high CET1 ratios is a first approach. The stress test result provides a good framework for looking at European banks.

However, there remain few significant differences between banks. Capital ratios and total assets are fixed parameters that can still be used to measure the performance of banks. In order to make a well-founded statement about the entire banking sector in

Europe, all banks must be examined and classified in the best case. An enlargement of the sample leads to a more precise result. For further research, it is therefore recommended to significantly increase the sample size.

10.6 Bank-based vs Market-based

The paper can only refer to the German or the European market. In Europe, there is a strong bank-based system that allows depositors to finance their investments through indirect funding. Companies first turn to a bank for financing. Therefore, in a bank-based system, the effects of an increase in capital requirements directly affect companies and thus affect the entire macroeconomic sphere. Due to the dependence of all market participants on banks, the effect of capital increases is amplified. There are relatively many banks in the EU. The European Union is a particularly strong bank-based economic union, which triggers the effect of increasing capital regulations for banks.

Since the US has a very strong market-based system, the results of the estimation can mainly be applied to the European market. Especially in the US, companies primarily finance themselves with internal funds and via the capital market, for example through the stock exchange and cooperative bonds. American companies do not take the diversions via the capital market. This change in distribution also changes the effect of an increase in capital requirements for banks on the entire economy. Only some of the market participants finance themselves through banks. In this case, compared to the European Union, only smaller companies and households finance themselves through banks and are therefore less affected by the reduction of credit through banks. The impact of the capital increase on the entire economic area is therefore smaller. For this reason, the results and statements are rather applicable only to bank-based market systems and have less significance for market-based systems.

11 Conclusion

Over a period of 10 years from 2010-2019, 20 banks were examined to see how they would react to the outcome of the stress test that BIS conducted in 2014. The response was measured by dividing the banks into a treatment and a control group and then examining the volume of syndicated loans in each group. A total of 54,604 syndicated loans and their volume were examined.
By examining the total volume and not the pure amount of issued syndicated loans I stressed more on the generally impact on macro-economical development

The approach of looking at loan volumes rather than the number of loans was intended to provide a general statement on the consequences for the economy as a whole. It was important to note that syndicated loans are large loans that are mainly issued to small and medium enterprises (SME). It is therefore not possible to make a statement for

households. Syndicated lending occupies a large position in the lending business of banks and therefore serves as an indicator of the economic situation of banks. I expect the results to provide a statement on the impact of capital regulations on lending and thus on the macroeconomic status quo. Using a difference-in-difference analysis, it could be shown that there is a significant effect of the stress test result on the volume of syndicated loans extended. In addition, larger banks tend to issue smaller syndicated loans. Banks that performed worse than average in the stress test and had a CET1 ratio below 10% reduced the volume of their syndicated loans in the post-treatment period. However, robustness checks have shown that the result leaves 2 questions unanswered. Was it the treatment alone that led to this significant effect? Do banks with less CET1 have less incentive to issue large syndicated loans? The second question could be at least partially answered with a regression. And so we know that banks with a low CET1 ratio issue smaller loans. Thus, it can be concluded that banks which realize through the stress test result that they have under performed have to fear increasing capital requirements and consequently their volume of syndicated loans is reduced. Whether this effect is due to the stress test result alone cannot be clearly proven.
In this paper, I try to provide further information on the impact of capital regulation on banks' lending behavior, as it is undisputed in today's literature that banks reduce lending when capital requirements are higher. Because the credit market has become so large, it is important to dis-aggregate the lending sector and look more closely individual products, such as a syndicated loan. With this paper, I contribute to the literature for examining the impact of capital regulations on the syndicated lending sector. To the best of my knowledge, I am largely alone in taking the approach of looking at the volume rather than the number of loans.

However, from a macro-economic perspective and for macro-prudential measures, looking at the money supply is important because it indicates the impact of measures. With this paper, I tried to provide further information for potential upcoming measures. The results display that the reduction of credit volumes could lead to a decrease in loans granted to poorly capitalized banks. The effect of an increase in the capital requirement mainly affects lending, since banks particularly use this sector to raise money. These loans, especially in the case of smaller banks, go to smaller SMEs, which rely heavily on these loans due to the bank-oriented market in Europe. If banks perform worse and reduce their lending volume accordingly, this is likely to affect smaller SMEs in particular, which have little capacity to switch to other institutions. In addition, the social impact is greater, as small SMEs are less inclined to have large capital buffers. The result of the difference-in-difference regression provides only a small insight into the impact of capital regulations on syndicated lending. It should be noted, however, that the result follows previous literature and adds to the general body of knowledge on capital regulations. Further research is needed to derive macroprudential measures based on this result. However, the estimate supports previous literature in a fact that capital regulations do not always

have an impact on reducing procyclical systemic risks. With this result, I have tried to contribute to the analysis on capital regulation. Before supervising institutions take macro-prudential measures, it is important to interpret the information of all previous contributions and to conduct further research.

A Bibliography

Acharya, Viral V., Allen N. Berger, and Raluca A. Roman. 2018. "Lending implications of U.S. bank stress tests: Costs or benefits?" *Journal of Financial Intermediation* 34:58–90.

Ahnert, Lukas, Pascal Vogt, Volker Vonhoff, and Florian Weigert. 2018. "The impact of regulatory stress testing on bank's equity and CDS performance."

Aiyar, Shekhar, Charles W Calomiris, and Tomasz Wieladek. 2012. "Does Macro-pru leak? Evidence from a uk policy experiment," http://www.nber.org/papers/w17822.

Akram, Q Farooq. 2014. "Macro effects of capital requirements and macroprudential policy." *Economic Modelling* 42:77–93.

Angrist, Joshua D, and Jörn-Steffen Pischke. 2008. "Parallel worlds: fixed effects, differences-in-differences, and panel data." In *Mostly harmless econometrics,* 221–248. Princeton University Press.

Ballantyne, William. 1996. "Syndicated Loans." *Arab Law Quarterly* (Leiden, Niederlande) 11 (4): 372–382.

Behn, Markus, Rainer Haselmann, and Paul Wachtel. 2016. "Procyclical Capital Regulation and Lending." *Journal of Finance* 71 (2): 919–956.

Chu, Yongqiang, Donghang Zhang, and Yijia Eddie Zhao. 2019. "Bank capital and lending: Evidence from syndicated loans." *Journal of Financial and Quantitative Analysis* 54 (2): 667–694.

De Haas, Ralph, and Neeltje Van Horen. 2012. "International shock transmission after the Lehman Brothers collapse: Evidence from syndicated lending." *American Economic Review* 102 (3): 231–37.

Demiralp, Selva, Jens Eisenschmidt, and Thomas Vlassopoulos. 2017. *Negative interest rates, excess liquidity and bank business models: Banks' reaction to unconventional monetary policy in the euro area.* Technical report. Working Paper.

Dennis, Steven A, and Donald J Mullineaux. 2000. "Syndicated loans." *Journal of financial intermediation* 9 (4): 404–426.

Dermine, Jean. 2015a. "Basel III leverage ratio requirement and the probability of bank runs." *Journal of Banking and Finance* 53 (2015): 266–277.

———. 2015b. "Basel III leverage ratio requirement and the probability of bank runs." *Journal of Banking & Finance* 53:266–277.

Eichengreen, Barry, and Ashoka Mody. 2000. "Lending booms, reserves and the sustainability of short-term debt: inferences from the pricing of syndicated bank loans." *Journal of Development Economics* 63 (1): 5–44.

Elsinger, Helmut, Alfred Lehar, and Martin Summer. 2006. "Risk assessment for banking systems." *Management science* 52 (9): 1301–1314.

Favara, Giovanni, Ivan Ivanov, and Marcelo Rezende. 2021. "GSIB surcharges and bank lending: Evidence from US corporate loan data." *Journal of Financial Economics.*

Fraisse, Henri, Mathias Lé, and David Thesmar. 2020. "The real effects of bank capital requirements." *Management Science* 66 (1): 5–23.

Gadanecz, Blaise. 2004a. "Struktur, Entwicklung und Bedeutung des Marktes für Konsortialkredite." *BIZ Quartalsbericht, Dezember,* 85–101.

———. 2004b. "The syndicated loan market: structure, development and implications." *BIS Quarterly Review, December.*

Garcia, Pablo. 2016. "The Macroeconomic Consequences of Bank Capital Requirements," 1–22.

Georgescu, Oana Maria, Marco Gross, Daniel Kapp, and Christoffer Kok. 2017. "Do stress tests matter? Evidence from the 2014 and 2016 stress tests."

Godlewski, Christophe J, Bulat Sanditov, and Thierry Burger-Helmchen. 2012. "Bank lending networks, experience, reputation, and borrowing costs: empirical evidence from the French syndicated lending market." *Journal of Business Finance & Accounting* 39 (1-2): 113–140.

Haselmann, Prof Rainer, and Prof Jan Krahnen. 2019. "Evaluierung gesamt- und finanzwirtschaftlicher Effekte der Reformen europäischer Finanzmarktregulierung im deutschen Finanzsektor seit der Finanzkrise."

Heider, Florian, Farzad Saidi, and Glenn Schepens. 2019. "Life below Zero: Bank Lending under Negative Policy Rates." *The Review of Financial Studies* 32, no. 10 (February): 3728–3761. ISSN: 0893-9454.

Jokipii, Terhi, and Alistair Milne. 2008. "The cyclical behaviour of European bank capital buffers." *Journal of banking & finance* 32 (8): 1440–1451.

"Determinants of syndicated lending in European banks and the impact of the financial crisis." 2014. *Journal of International Financial Markets, Institutions and Money* 32:473–490.

Junge, Georg, and Peter Kugler. 2013. "Quantifying the impact of higher capital requirements on the Swiss economy." *Swiss Journal of Economics and Statistics* 149 (3): 313–356.

Kalyaeva, Daria. 2018. "Participants' Reputation in the Syndicated Lending Market." *Swiss Finance Institute Research Paper,* nos. 18-77.

Karavitis, Panagiotis, and Pantelis Kazakis. 2020. "Political Sentiment and Syndicated Loan Borrowing Costs of Multinational Enterprises." *Available at SSRN 3747125.*

Kim, Moshe, Jordi Surroca, and Josep A Tribó. 2014. "Impact of ethical behavior on syndicated loan rates." *Journal of Banking & Finance* 38:122–144.

Kim, Olivia S. 2019. "Does political uncertainty increase external financing costs? Measuring the electoral premium in syndicated lending." *Journal of Financial and Quantitative Analysis* 54 (5): 2141–2178.

Lambertini, Luisa, and Abhik Mukherjee. 2016. "Is bank capital regulation costly for firms?-evidence from syndicated loans." *The École Polytechnique Fédérale de Lausanne Working Paper.*

———. 2021. "Stress tests and loan pricing—Evidence from syndicated loans." *Finance Research Letters,* 102349.

Martynova, Natalya. 2015. "Effect of bank capital requirements on economic growth: a survey."

Nguyen, Thach Vu Hong, Shamim Ahmed, Thanaset Chevapatrakul, and Enrico Onali. 2020. "Do stress tests affect bank liquidity creation?" *Journal of Corporate Finance* 64:101622.

Popov, Alexander A, and Neeltje Van Horen. 2013. "The impact of sovereign debt exposure on bank lending: Evidence from the European debt crisis."

Santos, Filipe Ferreira dos. 2018. "The performance of Portuguese banks under Basel III: how have the new capital requirements impacted the profitability of Portuguese banks?" PhD diss.

Schepens, Glenn, et al. 2018. "Bank lending under negative policy rates." *Research Bulletin* 43.

Simons, Katerina, et al. 1993. "Why do banks syndicate loans?" *New England Economic Review,* no. Jan, 45–52.

The Evolution of Syndicated Loan Markets; Altunbaş, Yener, Blaise Gadanecz, and Alper Kara. 2006. "The Evolution of Syndicated Loan Markets." *The Service Industries Journal* 26 (September): 689–707.

Villa, Juan M. 2016. "diff: Simplifying the estimation of difference-in-differences treatment effects." *The Stata Journal* 16 (1): 52–71.

Wallen, Jonathan. 2017. "The Effect of Bank Capital Requirements on Bank Loan Rates."

Erklärung

Bonn, Januar 28, 2020 .....

Heinrich von Zitzewitz