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Competition Policy in Banking in the European Union

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by
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To my parents Ulrike and Gerd Laser.

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Summary

In this doctoral thesis, I am assessing competition trends in the banking sector in the European Union. In recent years, market power and market concentration have increased in the European banking markets. I argue that competition policy needs to play a strong role to protect economic prosperity in the European Union. The doctoral thesis contains three chapters covering the main instruments of European competition policy: antitrust, merger control and state aid control.

In the first chapter, I analyze the effects on retail interest rates of the merger between ABN AMRO and Fortis Bank NL in the Dutch banking market. Using a structural model, I simulate decreases in interest rates of up to 30 basis points for the merging banks. Depending on the measure for the change in consumer welfare, the model suggests that the merger caused annual losses of up to 50 euros for customers of the merging banks and between two and seven euros for the average consumer. Accounting for efficiency gains partially offsets the anti-competitive effects for consumers.

In the second chapter, I quantify the potential effects of common ownership on retail interest rates in the Dutch banking market. Using a structural model combining ownership data and survey data on consumers' choice of savings accounts, I simulate interest rates under different assumptions on common ownership. Conditional on a common ownership mechanism, I simulate substantial decreases in interest rates of up to 50 basis points. These results suggest that antitrust authorities should cautiously observe trends in common ownership and assess its potential anti-competitive effects on consumers.

In the third chapter, I investigate the impact of bank bailout during the financial crisis on competition in the European Union. Combining information on individual bank rescues with bank-level measures of market power, I find a substantial decrease of six percentage points in the Lerner index for rescued banks. The estimated effects are heterogeneous and only driven by banks rescued in the first two years of the financial crisis before the European sovereign debt crisis started in 2010. This finding casts a positive light on state aid control in the European Union as beneficiaries of state aid did not abuse public funds to distort competition in their favor. Protecting competition in banking remains a pertinent task in light of possible further public interventions triggered by the ongoing COVID-19 pandemic.

Zusammenfassung

In dieser Doktorarbeit beschäftige ich mich mit Entwicklungen des Wettbewerbs im Bankensektor in der Europäischen Union. In den vergangenen Jahren sind Marktmacht und Marktkonzentration in den europäischen Bankenmärkten angestiegen. Mein Fazit ist, dass die Wettbewerbspolitik eine starke Rolle spielen muss, um den ökonomischen Wohlstand in der Europäischen Union zu sichern. Die Arbeit beinhaltet drei Kapitel, die sich mit den Hauptinstrumenten der Wettbewerbspolitik befassen: Kartellverbot und Missbrauchsverbot für marktbeherrschende Unternehmen, Fusionskontrolle und Beihilfekontrolle.

Im ersten Kapitel analysiere ich die Fusion von ABN AMRO und Fortis Bank NL im niederländischen Bankenmarkt. Ich nutze ein strukturelles Modell, um die Veränderungen im Zinsniveau zu simulieren. Das Zinsniveau der fusionierenden Banken sinkt um bis zu 30 Basispunkte. Daraus errechnet sich ein jährlicher Wohlfahrtsverlust von bis zu 50 Euro für Kunden der fusionierenden Banken und von zwischen zwei und sieben Euro für den durchschnittlichen Konsumenten im Markt. Das Einbeziehen von Effizienzgewinnen durch die Fusion in das Modell neutralisiert die negativen Effekte für Konsumenten nur teilweise.

Im zweiten Kapitel quantifiziere ich die möglichen Effekte von Common Ownership auf das Zinsniveau im niederländischen Bankenmarkt. Dafür benutze ich ein strukturelles Modell unter der Verwendung von Daten über die Eigentümerstruktur der niederländischen Banken und einer repräsentativen Umfrage zu Konsumentenverhalten im Markt für Tagesgeldkonten. Ich simuliere Zinseffekte in Abhängigkeit von verschieden angenommenen Veränderungen in Common Ownership. Das Zinsniveau von Banken verringert

sich um bis zu 50 Basispunkte, vorausgesetzt, dass ein Common Ownership Kanal in das Modell aufgenommen wird. Dieses Resultat unterstreicht, dass Wettbewerbsbehörden die Entwicklungen in Common Ownership verfolgen und kontinuierlich auf mögliche wettbewerbsverzerrende Effekte untersuchen sollten.

Im dritten Kapitel untersuche ich die Wettbewerbseffekte von Bankenrettungen in der Europäischen Union. Aus der Analyse von Daten zu bankspezifischen Rettungsmaßnahmen und Wettbewerbsmaßzahlen auf Bankenebene ergibt sich ein substantieller Rückgang von sechs Prozentpunkten des Lerner-Indexes für gerettete Banken. Die geschätzten Effekte sind heterogen und werden alleinig getrieben von Bankenrettungen in den ersten zwei Jahren der Finanzkrise. Banken, für die eine Rettung seit Beginn der Eurokrise ab 2010 notwendig war, weisen keinen signifikanten Rückgang im Lerner-Index auf. Meine Ergebnisse werfen ein positives Licht auf die Beihilfekontrolle der Europäischen Union, da es nicht so scheint, als hätten gerettete Banken öffentliche Zuwendungen im Rahmen der Bankenrettung für Wettbewerbsreduzierungen missbraucht. Diesen Ergebnissen zum Trotz bleibt der Schutz des Wettbewerbs im europäischen Bankensektor eine wichtige Aufgabe aufgrund von weiteren möglichen Bankenrettungen, die durch die aktuelle COVID-19-Pandemie ausgelöst werden könnten.

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List of Abbreviations

ABS	Asset Backed Securities
BRRD	Bank Recovery and Resolution Directive
CO	Common Ownership
DHS	DNB Household Survey
DNB	Dutch National Bank
EBA	European Banking Authority
EC	European Commission
ECA	European Court of Auditors
ECB	European Central Bank
EFSF	European Financial Stability Facility
ESM	European Stability Mechanism
EU	European Union
GDP	Gross Domestic Product
GHHI	Generalized Herfindahl-Hirschmann Index
GMM	Generalized Method of Moments
HHI	Herfindahl-Hirschmann Index
i.i.d.	independent and identically distributed
I.O.	Industrial Organization
IIA	Independence of Irrelevant Alternatives
IMF	International Monetary Fund
MHHI	Modified Herfindahl-Hirschmann Index
OLS	Ordinary Least Squares
PSM	Propensity Score Matching
RUM	Random Utility Maximization
SCP	Structure-Conduct-Performance
SSM	Single Supervisory Mechanism
TARP	Troubled Assets Relief Program
TFEU	Treaty on the Functioning of the European Union

Introduction

European Commissioner for Competition Margrethe Vestager once described the European Single Market as the compass to navigate the European Union through the clouds of uncertainty in times of socio-economic transitions. We are facing times of major shifts in global markets including increased global competition, market distortions and trade tensions. The European Single Market guarantees that businesses of all member states have a sufficiently large home base to be able to compete globally. According to Vestager, in Europe, global competitiveness must arise from fair competition. And for the European Single Market to function, effective competition rules need to be in place. Only then can the best companies emerge from competition to promote the European Union's socio-economic goals in light of fundamental transitions towards a digital and green economy (Vestager, 2020).

The above mentioned points from Vestager's speech regarding industrial strategy highlight the importance of competition policy. Besides these elements, competition policy has a more tangible mandate: to prevent economic harm to consumers in the European Union. In recent years, market power and market concentration have increased across countries and markets. Explanations for the observed trends include markets having become "winner takes all" in more digitized economies, stronger global competition promoting domestic consolidation, and for the U.S. lenient competition policy (see Monopolkommission (2020), Philippon (2019) and Van Reenen (2018)).

The general trend of rising levels of market power and market concentration has also reached the banking markets in Europe. Maudos and Vives (2019) show that market power in the euro area measured by the Lerner index has been on the rise already since before the financial crisis. Starting at 0.15 in 2000, it climbed to 0.25 to reach a temporary peak

before the crisis erupted. After a small drop during the crisis, the level of market power has been rising ever since, surpassing the threshold of 0.3 in 2014. The authors also show that market concentration in banking has increased in most countries in the European Union between 1997 and 2017. Particular high increases in market concentration can be observed for countries having suffered largely from the last crisis and seen substantial market consolidation in the banking market such as Greece and Spain.

Motta (2004, p. xvii) defines competition policy as "the set of policies and laws which ensure that competition in the marketplace is not restricted in such a way as to reduce economic welfare." For the European Union the mandate for competition policy to protect the European Union's internal market and prevent the distortion of competition is defined in the Treaty on the Functioning of the European Union (TFEU). The toolbox for policy makers includes three major instruments to work towards this goal. Rules on antitrust aim to prevent improper behavior of firms with regard to distorting competition (e.g. cartels or abuse of a dominant position). Merger control intends to pre-empt distortions of competition by requiring mergers and acquisitions to not have anti-competitive effects. State aid control checks that member states do not extend preferential treatment to national firms or industries. The aim is to prevent negative effects on trade between member states and competition in the European Single Market from being negatively affected.[1]

In this doctoral thesis, I focus on analyzing competition trends in the banking sector in the European Union. Banking differs from other markets in several aspects. Beck et al. (2010) point out the high social costs of banks' bankruptcy for two main reasons. Firstly, banks are highly interconnected and the bankruptcy of one bank could have negative spillover effects on others. Secondly, banks' bankruptcy could threaten financial stability and the payment system. During the last financial crisis, the banking sector was at the center of the turmoil. Large amounts of public money were used to rescue banks and in some markets, a wave of consolidation ensued the crisis. Whereas swift and comprehensive intervention by the authorities were needed to prevent a collapse of the financial system, some measures could have had negative effects on competition in the markets.

[1] See https://www.europarl.europa.eu/factsheets/en/sheet/82/competition-policy (last accessed on April 14, 2021).

Similar to Beck et al. (2010), I want to point out that competition is not incompatible with stability or other policy goals in banking. There are several current trends threatening competition calling for competition policy to play a strong role in order to protect economic prosperity in the European Union. Firstly, levels of market power and market concentration are also increasing in banking. Secondly, Vives (2019) expects banking to become more platform based with uncertain effects on competition in the long term. According to Vives (2019), this will dependent on how Big Tech, which are large technology companies such as Amazon, Google and Apple, will enter the market and which will be the dominant players. Thirdly, further market interventions due to the COVID-19 pandemic might become necessary and affect competition through market consolidation or the abuse of rescue money.

The research presented in this doctoral thesis covers all of the abovementioned three main instruments of European competition policy. I start by analyzing a large merger in the Dutch banking market. I proceed by evaluating the relevance of common ownership in antitrust by quantifying the effects of common ownership on consumers in the Dutch banking market. Lastly, I analyze the efficiency of European state aid control with respect to bank bailouts during the last financial crisis.

In Chapter 1, I analyze the merger of ABN AMRO and Fortis Bank NL in the Dutch banking market in 2010. The merger had been cleared before the outbreak of the financial crisis. However, when Fortis Bank came into financial difficulties, the Dutch state nationalized the Dutch branches of the new entity. Subject to state aid, the merger was eventually carried out. I analyze its impact on interest rates in retail banking, a business area in which no merger remedies against anti-competitive effects were imposed on the new entity. I use representative survey data on consumers' choice of savings accounts to calibrate a structural model of demand and supply. In order to identify consumers' reaction to changes in the interest rate, I instrument the endogenous interest rate variable in the demand estimation by product characteristics of alternative products representing general cost shifters. I estimate the effects of the merger on retail interest rates by simulating market outcomes for the demerger counterfactual in the period after

the merger. The model suggests that the merger resulted in interest rate decreases of up to 30 basis points, translating into a loss of annual interest of around 50 euros for customers of the merging banks. I predict anti-competitive effects of the merger in the form of average per capita losses in consumer welfare between two and seven euros per year for each consumer. Accounting for efficiency gains partially offsets the anti-competitive effects of the merger. Despite Fortis Bank NL not having been a large player in the market under consideration, the analysis reveals a not insignificant negative impact of the merger on consumers. My results highlight the importance of applying careful merger control even in times of crisis in order to prevent costly reductions of competition. Stability and competition do not need to be mutually exclusive alternatives in banking.

In Chapter 2, I analyze the potential impact of common ownership on retail interest rates in the Dutch banking market. Common ownership refers to investors owning shares in more than one company in the same industry. In the last years, the volume of equity of publicly traded companies managed by institutional investors such as mutual funds or pension funds has sharply increased. This trend has accelerated the prevalence of common ownership across countries and markets. Common ownership might have anti-competitive effects when managers have incentives to maximize industry profits rather than individual firm profits. The academic literature is divided regarding an existing link between common ownership and retail prices. I demonstrate for the Dutch banking market that common ownership has increased in recent years. In my analysis, I attempt to quantify the potential effects of common ownership on retail interest rates. I combine data on the ownership structure of Dutch banks and data from a representative survey on consumers' choice of savings accounts to calibrate a structural model of demand and supply. I use the model to simulate interest rates under different assumptions on the levels of common ownership. I estimate decreases in interest rates of up to 50 basis points for large banks and predict average losses of interest for consumers ranging between 12 and 33 euros per year. These effects are substantial and suggest that antitrust authorities should cautiously observe the developments on common ownership and continuously assess whether consumer welfare is at risk.

In Chapter 3, I investigate the impact of bank bailout during the financial crisis on competition in the European banking markets. In the course of financial crisis mitigation, member states of the EU extended large amounts in state aid to troubled banks. I use data on individual rescue measures combined with bank-level measures of market power to assess whether beneficiaries of state aid improved their competitive positions vis-à-vis non-rescued banks. In differences-in-differences estimations, I find that bank bailout led to a considerable drop in the Lerner index of six percentage points. Effects are heterogeneous and are among others driven by bank size or the banks' country of origin. Most importantly, the effects are entirely driven by bank rescued in the first two years of the financial crisis. Banks rescued during the European debt crisis starting in 2010 do not suffer from relative drops in market power vis-à-vis non-rescued banks. My results are robust to alterations in the estimation sample suggested by propensity score matching and several placebo tests. The results cast positive light on the implementation of state aid control of the European Commission. It seems that beneficiaries of state aid did not abuse public funds to distort competition in their favor. Despite this finding, protecting competition in the European banking markets remains a pertinent task for policy makers in light of generally rising levels of market power and potentially further public interventions triggered by the current COVID-19 pandemic.

Chapter 1

Bank Mergers in the Financial Crisis - A Competition Policy Perspective[1]

1.1 Introduction

In practice, broader economic policy goals can be at odds with competition policy. Whereas policy makers often put forward the protection of jobs,[2] in banking, the stabilization of financial markets is a major policy goal, especially during the recent financial crisis. Allowing market consolidation through mergers served as a measure to mitigate the adverse effects of the financial crisis in several cases (e.g. JPMorgan Chase and Bear Stearns, or Bank of America and Merrill Lynch in the U.S.; Lloyds and HBOS in the U.K.; and mergers between Landesbanken in Germany).

Such measures, however, were controversial from the perspective of competition policy in the markets. For instance, the Competition and Markets Authority in the U.K. (formerly Office of Fair Trading) objected to the merger of Lloyds and HBOS, voicing concerns about the greater than 30% market share of the new entity and the elimination of HBOS as a challenger to the four larger established banks. Despite these concerns, the U.K. Secretary of State overruled the objection in accordance with the Bank of England,

[1] This chapter is joint work with Michael Hellwig, formerly at ZEW - Leibniz Centre for European Economic Research.

[2] See, e.g., the *EDEKA/Kaiser's Tengelmann* merger in the German supermarket sector in 2015. Although the merger had been prohibited by the German Federal Cartel Office, the German Minister of Economic Affairs issued a ministerial authorization conditionally clearing the merger arguing that job security prevails over the expected restraints on competition.

the Financial Services Authority, and the Treasury, stressing the necessity to maintain financial stability (Vives, 2016). This example illustrates the dilemma policy makers may find themselves in. Whereas mergers might be instrumented to mitigate the effects of financial crises, interventions could result in increases of market power harmful to consumers.

In this paper, we investigate the competition effects of the merger of ABN AMRO and Fortis Bank NL in the Dutch retail banking market. Being one of the largest bank takeovers in recent years, financial stability concerns prompted policy makers to engage in substantial market interventions involving state aid. Originally, Fortis intended to take over the Dutch business of ABN AMRO. However, after facing serious difficulties raising capital after the outbreak of the financial crisis, Fortis needed to be nationalized by the Netherlands, Belgium, and Luxembourg. The Dutch state decided to complete the merger in the already concentrated Dutch market.

The Dutch state's decision to continue the merger after bailing out the banks was justified by expected yearly pre-tax synergies of 1.1 billion euros, integration costs of about 1.2 billion euros, and the aim to earn back the cost of its intervention (European Commission, 2011).[3] The EC's conditional merger approval included divestment remedies worth 1.12 billion euros, which, however, did not affect all business units. The retail business unit, for instance, remained untouched by divestments.

To analyze the merger for potential anti-competitive effects, we focus on the Dutch market for savings accounts – a market which is deemed highly concentrated by both the Dutch central bank (DNB, 2015) and the Dutch competition authority (ACM, 2014) years after the merger. Looking at the anti-competitive effects of the merger during and after the global financial crisis might be even more relevant, given the more pronounced effect of income shocks on consumers during recessions.

[3] The merger was initially motivated by referring to similar figures prior to the crisis. In its offer, the consortium anticipated pre-tax synergies of 1.3 billion euros p.a. and integration costs of 1.54 billion euros for the *Fortis/ABN AMRO* merger. See https://investors.rbs.com/~/media/Files/R/RBS-IR/archived-presentations/archived/consortium-presentation-29-may-07.pdf (last accessed on April 14, 2021).

To single out the competition effects of the merger, we employ estimates from a structural model to simulate product-level interest rates for the two distinct cases of joint and separate ownership of ABN AMRO and Fortis Bank NL for 2010 to 2014 with data from the calibration period 2007 to 2014. We model demand for savings accounts as discrete choice for differentiated goods by identifying the consumers' product choice on the market for savings accounts. We aggregate data and apply a random-coefficients logit estimator following Berry et al. (1995) to estimate consumers' elasticities of demand with respect to interest rates. In order to account for the endogeneity problem between prices and unobserved product characteristics we instrument interest rates by product characteristics of competing products. On the supply side, we model interactions between banks assuming Bertrand Nash competition in a multiproduct oligopoly. Calibrating the model with demand-side interest rate elasticities allows us to simulate bank behavior in the two different scenarios of joint and separate ownership of ABN AMRO and Fortis Bank NL. By making adjustments to the ownership structure, we contrast predicted pricing behavior of the banks in the merger case with the demerger case within years. We simulate interest rates for the actual merger scenario by assuming all products formerly belonging to Fortis Bank NL continued to exist in the market not to underestimate the effects of the merger as ABN AMRO discontinued some of the former products of Fortis Bank NL.[4] Comparing predicted values of both cases instead of comparing predictions for the demerger counterfactual to realized values also allows us to isolate the competition effects induced by a changed ownership structure from changes in the product range.

Our empirical analysis draws on the representative DNB Household Survey (DHS) comprising detailed yearly information on the savings behavior of individuals from more than 2,000 Dutch households. We merge the survey data with product-level information on savings accounts, including interest rates and account restrictions (used for product differentiation) retrieved from price comparison websites specialized on the Dutch market

[4] After the merger, ABN AMRO discontinued three out of four account products of Fortis Bank NL from our sample and continued only one under the brand name of Fortis Bank NL. It seems that customers of the three discontinued account products were migrated to existing products of ABN AMRO. Simulating demerger interest rates only with the change in ownership in the remaining one product of Fortis Bank NL would underestimate the real transfer in market share and downward bias the price effects of the merger.

for financial savings products.[5] Our main data covers the years from 2007 to 2014, enabling us to observe consumer choice conditional on relevant product characteristics and corresponding individual choice sets over time.

We predict that the merger had a significant effect on interest rates of the merging banks, but less so for the remaining banks in the market. We predict interest rates to be around five to six basis points lower for ABN AMRO as a result of the merger. The negative effects are substantially larger for the interest rates of Fortis Bank NL amounting to a decrease in interest rates of 30 basis points (i.e. a reduction in interest rates of 0.3 percentage points). Interest rates do not change substantially for other banks not belonging to the new ABN AMRO entity with changes amounting to less than one basis point. Interestingly, interest rates slightly increase for other small banks as a result of the merger. One explanation could be that Fortis Bank NL used to exert upward pressure on interest rates for large banks (whose interest rates expectedly decrease as a result of the merger), but served as a price leader and exerted downward pressure on interest rates for smaller fringe banks before the merger.

We calculate losses in interest rates to amount to up to 50 euros for customers staying with Fortis Bank NL and to around 10 euros for customers staying with ABN AMRO. The average loss in interest for all customers lies between two and four euros. When calculating the average decrease in consumer surplus resulting from the merger, we obtain decreasing values over time ranging between five and seven euros. We thus find decreasing negative effects of the merger despite decreasing levels of consumer elasticities over time, which would otherwise suggest larger negative effects. This finding might also be due to a lower degree of interest rate dispersion over time and thus the lesser extent to which it is possible to realize higher interest rates when substituting to other products. When accounting for efficiency gains, we find that a 2%-increase in profitability renders the average merger effects for consumers less negative. A 5%-increase in profitability leads to the efficiency gains to be shared with consumers in form of higher interest rates compared to before the merger. We caution, however, against overstating the role of efficiency gains in the

[5] We obtain most data from www.spaarinformatie.nl and also employ information from www.spaarrekeningen.nl and www.spaarrentehulp.nl.

welfare analysis as efficiency gains are unlikely to realize in the short term and uncertain to realize at all. We conclude that the merger has small but significant effects for the average consumer but large effects for customers of the merging banks.

Note that our results do not question the act of saving a bank to prevent financial distress. We argue in our paper that additional social costs from merging banks for the sake of financial stability need to be taken into account and ought to be avoided. Miles et al. (2013) estimate the cumulated and discounted cost of financial crises at 140% of GDP. Estimates in other studies vary between 41% and 180% of GDP.[6] Under these circumstances swift and effective policy responses are needed to prevent financial crisis from wreaking havoc in the entire economy. It surely depends on the context which policy response is the socially optimal solution. If synergies of mergers are low and expected anti-competitive effects are high, maintaining two (potentially nationalized) banks as competitors in a market might be a valid alternative to a merger. If mergers are used as policy responses to avoid financial distress, it is important to implement sufficient remedies to prevent potential anti-competitive effects. Following Beck et al. (2010) we want to point out that there is no reason not to apply thorough competition policy to banks as competition and stability are not incompatible per se.

Our paper aligns with both the empirical banking literature and the applied industrial organization literature using structural models to conduct counterfactual analyses. In this regard, there has been an increasing number of such studies in banking recently. Crawford et al. (2018) build a comprehensive model to analyze interactions between asymmetric information and imperfect competition in the Italian lending markets. Egan et al. (2017) analyze the feedback loop between financial distress and the ability to access (uninsured) deposits in the U.S. Honka et al. (2017) investigate how advertising influences consumer choice in the U.S. retail banking market. Molnar et al. (2013) estimate demand for deposit services in order to test supply models in the Italian retail banking market. Finally, Dick (2008) uses a structural model to estimate demand for deposit services of U.S. commercial banks and measures the effects of U.S. branching deregulation.

[6] Bank for International Settlements (2019) provides an overview of studies related to the cost of financial crises.

Examples for merger simulations are Björnerstedt and Verboven (2016), Ivaldi and Verboven (2005) and Molnar (2008). Björnerstedt and Verboven (2016) conduct a merger simulation and ex-post evaluation in the Swedish market for analgesics to test merger simulation as a prediction tool. Ivaldi and Verboven (2005) analyze a merger in the European truck market and compare the prediction of the merger simulation to other market power tests. Molnar (2008) applies merger simulation to the Finish banking market using aggregated data.

Our study in line with many others follows Berry et al. (1995) and analyzes consumer choice in a discrete choice setting using aggregated data and employing a random-coefficients logit demand model. This way we are able to account for endogenous prices and heterogeneous consumer preferences. Our model can capture flexible patterns of substitution and leads to more realistic estimates of demand-side elasticities. We aim to contribute to the understanding of the banking markets given its importance for national economies.

The paper is structured as follows. In the next section, we provide background information on the merger of ABN AMRO and Fortis Bank NL, and the Dutch banking market. Section 1.3 introduces the model and the steps we undertake for simulation. Section 1.4 describes in detail the compilation of our dataset. Sections 1.5 and 1.6 present the estimation procedure and our results, respectively, whereas Section 1.7 provides a summary and conclusion.

1.2 The Merger of ABN AMRO and Fortis Bank NL

The sale of ABN AMRO was initiated by a publicly disclosed letter of the British hedge fund TCI complaining to ABN AMRO about poor share price returns, urging to "actively pursue the potential break up, spin-off, sale or merger."[7] The letter from February 2007 echoed in the media, reinforcing discussions and negotiations about a sale of ABN AMRO. After a bidding battle between the British bank Barclays and a consortium of Royal Bank

[7] See http://www.telegraph.co.uk/finance/2804714/Letter-from-TCI-to-ABN-Amro.html (last accessed on April 14, 2021).

of Scotland, Fortis, and Banco Santander, the majority of ABN AMRO's shareholders accepted the consortium's offer worth 71.1 billion euros in October 2007, making it one of today's largest bank takeovers.

The consortium's plan to split the assets of ABN AMRO allowed the Royal Bank of Scotland to obtain the business units Private and Business Clients in Asia, Europe, and North America, whereas Banco Santander received Banco Real and Antonveneta. Fortis obtained the business units Asset Management, Private Banking, and Netherlands, which it intended to merge with its own Dutch arm Fortis Bank NL. All cases were subject to merger control by the European Commission (EC).

Regarding the Dutch assets, the EC conditionally approved the merger of ABN AMRO and Fortis in October 2007. The European Commission (2007) had concerns regarding the Dutch commercial banking market insofar as the combination of the first (ABN AMRO) and fourth largest bank (Fortis Bank NL) would significantly increase the already high concentration level. It requested the sale of several components of the Dutch business unit before the merger could become legal in order to protect corporate customers from reduced competition. The EC, however, did not raise concerns about anti-competitive effects in the similarly concentrated retail banking market on account of the modest market share of Fortis Bank NL (being a distant fourth player in terms of market position after ING, Rabobank, and ABN AMRO).[8]

In the first half of 2008, the consortium sold the individual business units to the consortium members. At the same time, Fortis was preparing the sale of the merger remedy to Deutsche Bank when the global financial crisis of 2008 broke out. Fortis faced liquidity issues in part because of the high acquisition price for ABN AMRO (share of Fortis: 24 billion euros), needing to be eventually rescued in a combined effort of the three governments of the Netherlands, Belgium, and Luxembourg. The Dutch state purchased the Dutch business of Fortis for 16.8 billion euros in October 2008. This move also included the stake in the holding of the consortium comprising the Dutch activities of ABN AMRO.

[8] The EC predicted only a moderate increase of the HHI in retail banking from 3100 to 3300 (European Commission, 2007, recital 137f)

Willing to finalize the intended but frozen merger (European Commission, 2011, recital 42), the Dutch state provided liquidity facilities to implement the separation of the Dutch activities of ABN AMRO from the holding of the consortium, and to cover the costs of the EC divestiture-remedy realized as the sale of several components to Deutsche Bank in April 2010. Although this resulted in the finalization of the initial merger of Fortis Bank NL and ABN AMRO in July 2010, the capital injections of the Dutch state were subject to state aid investigations by the EC. The European Commission (2011) concluded in April 2011 that the recapitalization measures amounting to between 4.2 and 5.45 billion euros (excluding the takeover price[9]) constituted state aid. Yet the EC acknowledged that the need for supporting the banks rather stemmed from undercapitalization than excessive risk taking or unsustainable business models, thereby approving the support package.

The approval, however, was subject to a set of conditions, including (amongst others) a ban on acquisitions and on advertising state ownership, as well as restrictions on price leadership for standardized savings and mortgage products. In other words, ABN AMRO was not allowed to offer price conditions which could not be matched by non-aided competitors. These conditions were set for a duration of three years and would be prolonged to a maximum of five years if the Dutch state continued to hold more than 50% of the ordinary shares after three years. During the state aid investigations, the Dutch state expressed its commitment to a complete exit, aiming to recover its initial investment plus funding costs. Despite a successful IPO in November 2015, the Dutch state still held a 56.3% stake in ABN AMRO in October 2019.[10] The bans therefore only expired in April 2016.[11]

Years after the merger, the Dutch central bank has concluded that high concentration is persistent in the Dutch banking market, calling for less dominance of large banks and the necessity to promote the position of small banks and niche players. It mentions the recent mergers in the market (*ABN AMRO/Fortis Bank NL* and *Rabobank/Friesland*

[9] The purchase price was not considered as representing state aid to the two entities as they did not receive the corresponding money.

[10] See https://www.abnamro.com/en/about-abnamro/our-company/corporate-governance/shareholder-structure/index.html (last accessed on April 14, 2021).

[11] The prolongation did not apply to the price leadership ban which was set for three years only.

Bank) as one source of high concentration (DNB, 2015). Furthermore, the Dutch competition authority finds that the retail banking sector has become less competitive after the financial crisis and identifies the consumers' limited propensity to switch banks (consumer inertia) as another reason for low competitiveness (ACM, 2014).

1.3 Model

In our analysis of merger effects, we focus on the Dutch market for savings accounts. As for other retail banking markets, we choose this market because we can more easily compare products contrary to other banking products. For instance, fixed-term deposits might exhibit different maturities and are thus not easily comparable. Another argument for comparability is that fees do not apply to savings accounts (in the Netherlands). Furthermore, for savings accounts, we can be more confident that consumer choice is driven by a single saving motive, contrary to checking accounts which primarily serve to cater transactional purposes (e.g. payments, reference account to receive salary etc.).

Our analysis is based on a structural model comprising demand and supply as two building blocks. We use estimated demand-side parameters to calibrate the model. Making assumptions on joint bank behavior closes the model. With our model, we are able to simulate different market outcomes regarding changes in the ownership of the banks.

1.3.1 Demand

We model demand using a random-coefficients logit model. Indirect utility of consumer i for savings account product j at time t can be expressed as

$$\begin{aligned} U_{jt}^i &= x_{jt}\beta^i + y_{jt}\gamma + \xi_{jt} + \epsilon_{jt}^i, \\ &= V_{jt}^i + \epsilon_{jt}^i \\ i &= 1, ..., I, j = 1, ..., J, t = 1, ..., T. \end{aligned} \tag{1.3.1}$$

V_{jt}^i reflects the deterministic part of consumer utility including ξ_{jt} accounting for unobserved product characteristics which is the same for all consumers, and ϵ_{jt}^i is a random

term which is independent and identically distributed (i.i.d.) following a type-I extreme-value distribution. In a discrete choice setting, each consumer chooses one product from a set of alternatives. Consistency with random utility maximization (RUM) implies that a consumer chooses the alternative yielding the highest utility. Furthermore, in the random-coefficients model one can differentiate between variables for which the coefficients β^i differ across individuals (i.e. x_{jt}) and variables for which the coefficients γ are constant (i.e. y_{jt}). Note that the corresponding vector of coefficients for x_{jt} carries the superscript i in equation 1.3.1.[12]

The random-coefficients logit model is a generalized form of the standard conditional logit model introduced by McFadden (1973). The probability of individual i choosing alternative j conditional on the vector of random coefficients β^i of individual i is represented by the expression below. For expository purposes we will omit the time index t from here onwards.[13]

$$L_j^i(\beta_i) = \frac{\exp\left(V_j^i(\beta^i)\right)}{\sum_k \exp\left(V_k^i(\beta^i)\right)}. \tag{1.3.2}$$

The vector of individual coefficients β^i is not observable. The (unconditional) random-coefficients logit probability for individual i to choose alternative j is derived as an integral of the standard logit probabilities by integrating out the vector of random parameters β^i and represented by

$$P_j^i = \int \left(\frac{\exp\left(V_j^i(\beta^i)\right)}{\sum_k \exp\left(V_k^i(\beta^i)\right)} \right) f(\beta) d\beta, \tag{1.3.3}$$

where $f(\beta)$ is the mixing distribution of the vector of random coefficients, usually specified to be normal or log-normal.[14]

[12]Note also that the random-coefficients model as presented above can be rewritten to $U_{jt}^i = x_{jt}\beta + y_{jt}\gamma + \xi_{jt} + z_{jt}\mu^i + \epsilon_{jt}^i$, where $z_{jt}\mu^i + \epsilon_{jt}^i = \eta_{jt}^i$ represents the random part of utility. In this error component representation, individual-specific correlation between alternatives is introduced by the random component $z_{jt}\mu^i$. Here, the difference to the standard logit and nested logit is visible as these alternative models do not provide for individual-specific correlation and standard errors are either uncorrelated or correlations exist on the nest levels.

[13]The subsequent paragraphs introducing the mechanics of the random-coefficients logit follow Train (2009).

[14]Note that the random-coefficients logit probabilities collapse to the standard logit probabilities when

The main advantages of the random-coefficients logit model vis-à-vis the conditional logit model or the nested-logit model is that it does not exhibit the independence of irrelevant alternatives (IIA) property at any stage. In the conditional logit model, the ratio of probabilities of two alternatives is independent of the attributes or the existence of all other alternatives yielding rigid substitution patterns. The nested-logit model mitigates this problem as the IIA property does not hold for alternatives in different nests. However, it still holds within each nest and the nesting structure requires further assumptions on potential product groupings. In contrast, in the random-coefficients logit model the ratio of probabilities of alternative j and alternative j' is dependent on all attributes and the existence of other alternatives than j or j'. Equation 1.3.4 for the cross-price elasticity for changes in the interest rate d of alternative j illustrates the flexibility in the substitution patterns:

$$\eta^i_{j'j} = -\frac{d_j}{P^i_{j'}} \int \beta^i_d L^i_j(\beta) L^i_{j'}(\beta) f(\beta) d\beta, \tag{1.3.4}$$

where β^i_d is the individual coefficient on the interest rate d_j. The elasticity differs for each alternative j'. That is, an increase in the interest rate for alternative j will lead to different decreases in the probabilities for each alternative j' unlike in the standard logit model where the probability of choosing alternative j' is canceled out in the formula for the cross-price elasticity. Furthermore, the change in the probability to choose alternative j' depends on the correlation between the conditional likelihoods of choosing alternative j' and j. Alternatives with similar attributes exhibit larger substitutability between each other following price changes. Substitution patterns derived from the random-coefficients logit model can be estimated more flexibly making use of the data at disposal.

We estimate the demand side of the model using the generalized method of moments (GMM) estimator suggested by Berry et al. (1995) using aggregated market shares. We use the user-written Stata code `blp` which relies on simulation (Vincent, 2015). In order to account for potential endogeneity in the price variable in the demand estimation, we

all coefficients are identical across individuals.

follow Berry et al. (1995) and use instruments that are functions of product characteristics of other products of the same bank and competitors and thus more generally cost drivers.

For robustness checks, we estimate a nested-logit version of demand allowing for correlated consumer preferences within product groups. In contrast to the random-coefficients logit model, choice probabilities for products can be represented in a closed form and estimation gives rise to a linear regression. For the estimation of the nested-logit specification we rely on the user-written Stata code `mergersim` (Björnerstedt & Verboven, 2014). Similarly as in the random-coefficients logit model, we use product characteristics of other products to instrument the coefficient for the interest rate. Both approaches account for the choice of an outside good, which is in our application the choice of no savings account product at all and the decision to save in other saving vehicles. Introducing an outside option in the model is important as shifts in the general level of interest rates of the products under consideration may reduce total aggregated demand firms compete for in the given markets.

We use aggregated market shares derived from individual survey responses in the DNB Household Survey data. We use two measures for market shares on the product level. The first measure counts reported product choices by product (binary measure) and the second measure aggregates reported savings for each product (deposit-weighted measure). Survey participants have the possibility to report up to seven accounts they maintain.[15] For the binary market share measure we weigh each product choice by the inverse of the amount of total accounts chosen by the individual. This way, we account for lower deposit amounts per account and control against a downward bias in the market share for the outside option in case individuals distribute their savings across several products. Each individual thus is given a unit weight regardless of whether she maintains more than one account. Concerning the deposit-weighted market shares, we construct an estimate for the potential savings amount of individuals having chosen the outside option as their savings are not reported. We predict savings using tobit regressions on demographics for the entire sample as reported savings are censored. The DNB Household Survey and the aggregation process will be presented in more detail in Section 1.4.

[15] Conditional on having at least one savings account product, survey participants maintain approximately 1.5 savings accounts.

1.3.2 Supply

In a simplified banking model, banks generate profits by lending money to firms below their own borrowing costs. As a common approach to the separate analysis of deposit or loan markets, we allow for separate modeling of pricing decisions in the deposit market (see for example Canhoto (2004) or Pita Barros (1999)). We assume banks to maximize profits in the market for savings accounts with the deposit rates as their choice variables. In our case, the choice variables (i.e. the deposit rates) have negative direct effects on profits. In order not to formulate a degenerated problem, we add $\bar{r_{bt}}$, which is the expected loan rate for bank b at time t. This set-up acknowledges that banks raise deposits to finance lending.[16] Each bank thus has an individual, model-exogenous expectation on its returns on deposits.

Offering savings accounts to consumers involves both variable and fixed operating costs which differ across account products. Variable costs are, for example, additional needs for IT capacity and employees for administration and the provision of customer services. The difference in variable costs across products can result from reduced costs for services as for example for internet managed accounts or from differences in cost efficiencies across banks. We introduce product-specific costs c_{jbt} denoting the per-unit-of-demand costs for account product j of bank b at time t. The maximization problem of bank b at time t offering a subset of products F_{bt} can therefore be written as:

$$\max_{\{d_{jbt}\,\forall\, j\,\in\, F_{bt}\}} \pi_{bt}(\mathbf{d}_t) = \sum_{j\in F_{bt}} (\bar{r_{bt}} - c_{jbt} - d_{jbt}) q_{jbt}(\mathbf{d}_t), \tag{1.3.5}$$

where $q_{jbt}(\mathbf{d_t})$ depicts demand for savings account j and $\mathbf{d_t}$ is a $J \times 1$ vector of deposit rates. We can think of the term $\bar{r_{bt}} - c_{jbt}$ $(= r_{jbt,net})$ as the expected loan rate (net of marginal costs) specific to product j. Setting d_{jbt} allows the bank to set the profit margin or markup, $r_{jbt,net} - d_{jbt}$ for product j. This is analogous to the formulation of the problem when prices enter positively into a firms' profit functions and profit margins are equal to $p_{jt} - mc_{jt}$.

[16] Banks can also use savings accounts as instruments meant to acquire client information, or to cross-sell (Džmuráňová & Teplý, 2016).

Taking into account the optimal pricing decision rules for all banks while assuming Bertrand competition, the Nash equilibrium is defined by the following system of first-order conditions:

$$-q_{jbt}(\mathbf{d}_t) + \sum_{k \in F_{bt}} (\bar{r_{bt}} - c_{kbt} - d_{kbt}) \frac{\partial q_{kbt}(\mathbf{d}_t)}{\partial d_{jbt}} = 0, \qquad j = 1, ...J. \tag{1.3.6}$$

Equation 1.3.6 can be rewritten in vector notation:

$$-\mathbf{q}_t(\mathbf{d}_t) + \{\boldsymbol{\theta}_t \odot \boldsymbol{\Delta}_t(\mathbf{d}_t)\}(\mathbf{r}_{t,net} - \mathbf{d}_t) = 0, \tag{1.3.7}$$

where $\mathbf{q}_t(\mathbf{d}_t)$ is the $J \times 1$ demand vector, $\mathbf{r}_{t,net}$ is the $J \times 1$ expected net loan rate vector and $\boldsymbol{\Delta}_t(\mathbf{d}_t) \equiv \partial \mathbf{q}_t(\mathbf{d}_t)/\partial \mathbf{d}_t'$ is the $J \times J$ Jacobian of first derivatives. $\boldsymbol{\theta}_t$ is the $J \times J$ product-ownership matrix, with $\theta_t(j,k) = 1$ if savings accounts j and k are offered by the same bank and $\theta_t(j,k) = 0$ otherwise. $\odot$ depicts element-by-element multiplication. Equation 1.3.7 will be used for two purposes. The first is to back-out the term $\mathbf{r_{t,net}}$ for each year and the second is to simulate deposit rates resulting from changes in the ownership matrix.

1.3.3 Merger Simulation

The counterfactual scenario for the realized merger is that of separate ownership and the survival of two independent entities in the market. Another interesting scenario would be to model the exit of Fortis Bank NL from the market. In this scenario, the realization of anti-competitive effects should be less mechanical. Furthermore, the way how the exit of Fortis Bank NL was modeled, would decisive with regards to externalities for the remaining banks. An uncontrolled default potentially would have had the largest impact on the market through different channels within a tightly interconnected banking system. Less intrusive to the Dutch banking market should have been the combination of an orderly wind-down of Fortis Bank and retreat from the Dutch market. The modeling of network externalities, however, is beyond the scope of this paper and will be left for

further research avenues. Most likely, the exit of an established market participant would be accompanied with anti-competitive effects for consumers and not necessarily be a good solution from a competition perspective. We proceed with the scenario of separate ownership as counterfactual for the realized merger when simulating interest rates.

We simulate product-level interest rates for each year for both cases of joint and separate ownership of ABN AMRO and Fortis Bank NL. The reason not to simply compare counterfactual demerger interest rates to observed interest rates is that most products of Fortis Bank NL disappeared from the market after the merger. In order to separate price effects resulting from changes in ownership from changes in the product range, we design price simulations in which all products of Fortis Bank NL in the year of the merger continue to exist in both scenarios.

In order to simulate interest rates, we rewrite equation 1.3.7 to obtain equation 1.3.8. Then, we solve for interest rates in both cases, $\mathbf{d}_t^{case}$, $case \in \{\text{merger}, \text{demerger}\}$, in separate simulation exercises following Björnerstedt and Verboven (2014). Thus, simulations are based on bank first-order conditions depending on estimated demand parameters, backed-out expected net loan rates $\mathbf{r}_{t,net}$ and the respective product-ownership matrix $\boldsymbol{\theta}_t^{case}$:

$$\mathbf{d}_t^{case} = \mathbf{r}_{t,net} - \{\boldsymbol{\theta}_t^{case} \odot \boldsymbol{\Delta}_t(\mathbf{d}_t^{case})\}^{-1}\mathbf{q}_t^{case}(\mathbf{d}_t^{case}). \tag{1.3.8}$$

We solve for interest rates using fixed point iterations using a dampening parameter.[17] In each iteration step, the interest rates, predicted market shares and the Jacobian are updated. We proceed with iterations until updates in the interest rates are significantly small.

[17] In the simulation exercises, significantly low dampening parameters of $\lambda \in (0.01, 0.03)$ have proven to support convergence. Using dampening parameters weighs the results of the last two iteration rounds to obtain a new input for the next iteration n: $d_n = \lambda * d_{n-1} + (1-\lambda) * d_{n-2}$. Low dampening parameters put relatively little weight on the recent update of d and therefore prolong the iteration process, but prevent overshooting at the same time.

1.4 Data

We construct the dataset by merging data from two sources. We use data from the DNB Household Survey (DHS),[18] a representative Dutch panel survey, to obtain detailed household information, including information on debt and asset holdings. Most importantly, this comprises individual product choices for savings accounts. We retrieve data from Dutch online comparison platforms for banking products to obtain product-level information on savings accounts products.[19] This includes the interest rate paid on the accounts and several forms of restrictions/conditions[20] applying to the account products. We observe all changes in the interest rate[21] and calculate the annual average. Furthermore, we identify the introduction date for each account product and compute how many years a product has already been on the market.

Around 2,000 households participate in the DHS each year. Whereas all members of the household answer questions on general information, only members of the household older than 16 years are confronted with questions related to income and wealth. After identifying the account product by the entered account name, we match account product information to each observation.[22] Respondents can enter information for up to

[18]The data are collected through the 'CentERpanel' at CentERdata, handled by Tilburg University. The DHS consists of several questionnaires for collecting information about household finances and individual financial decisions. The panel of households used for the survey is designed to constitute a representative sample of the Dutch population. Recruitment for the panel is based on a random national sample drawn from private postal addresses. Upon commitment for participation in the panel, households are included in a database. If a household already in the panel drops out of it, another household from the database with similar characteristics is included in the panel. Despite previous agreement to participate in the panel, response rates are typically around 80% and vary across the different questionnaires. In order to achieve full representativeness, sample weights can be used. Participation in the panel is awarded with a financial compensation (Teppa & Vis, 2012).

[19]We obtain most data from www.spaarinformatie.nl and also employ information from www.spaarrekeningen.nl and www.spaarrentehulp.nl.

[20]These comprise: i) online usage only, ii) minimum amount requirements to open and maintain account, iii) bonus on minimum amount on account within a quarter and base rate on remainder, iv) fixed deposits, v) withdrawal limitations and vi) group eligibility constraints (e.g. account can only be opened by students).

[21]The sample exhibits on average 1.5 changes per savings account in 2007, 1.1 in 2008, 7 (2009), 2.1 (2010), 2.8 (2011), 4.5 (2012), 5 (2013) and 2.9 (2014).

[22]Survey participants have to report both the name of the bank and the product name for each of their accounts. Not all respondents report the exact product name, which requires a hand matching procedure. During hand matching, we rely on a comprehensive list of account products retrieved from 'SpaarInformatie'. Deviations in reporting from actual account names include abbreviations, typos, or alternative naming. During hand matching we compare, on a bank-by-bank basis, the reported answers with all available account products of the respective bank and choose the account closest in terms of name similarity. If a survey participant specifies a bank name but no concrete account name as the

seven savings accounts in the survey. We drop observations for which a match cannot be established.[23]

Table 1.4.1 lists the number of all savings account products in our dataset by bank and year from 2007 to 2014. The first panel lists the amount of products offered by bank. The three large banks (Rabobank, ING and ABN AMRO) offer multiple products including five or more products. The smaller banks seem to specialize and often only offer one product. Roughly speaking, we observe up to 40 products in the market per year. The second panel reports the distribution of restricted account products and products for only online usage. Approximately two thirds of the products each year exhibit at least one of the above mentioned conditions and approximately one third of the total products is for online usage only.

Table 1.4.2 shows the market shares derived from our sample for the years from 2007 to 2014 for the binary measure. In line with the market description of the Dutch competition authority (ACM, 2014), we observe a highly concentrated market. The three large banks account for almost 50% of the market which is substantial observing more than 30% market share for the outside option in most years. Following the three large banks, the market sustains a few mid-sized banks (SNS Bank, Fortis Bank NL, ASN Bank and AEGON) and a larger group of small fringe banks. To cross-check that data retrieved from the DHS survey are representative, we compare it to market shares for deposits retrieved from statistics from the Dutch central bank.[24] We derive those market shares from reported total deposits and scale these through the introduction of a 28.07% share (2014 value in our data) for the outside option. The benchmark market shares as of the second half of 2014 (first period available) are as follows: ING Bank 33%, Rabobank 16.1%, ABN AMRO 13.6 %, and de Volksbank (SNS Bank and subsidiaries) 3.7%. All

respondents have either entered '99' (equivalent to 'I don't know') or reported a generic word for savings account (e.g. rekening), we assign the most often used account of that bank.

[23] We drop observations for which the reported account name corresponds to another bank than actually reported by the survey participant. We drop observations for which no account identification is possible, as given answers are too remote from the actual account names to constitute a reliable match. We also drop observations which could be matched but exhibit inconsistent timing. These are observations for which respondents refer to account products which are not in the market at that time.

[24] See query "Financial data of individual banks" at https://statistiek.dnb.nl/en/downloads/index.aspx (last accessed on April 14, 2021).

Table 1.4.1: Number of products by bank and year

	2007	2008	2009	2010	2011	2012	2013	2014
Rabobank	2	2	3	2	2	2	3	3
ING Bank	6	7	7	8	6	6	7	5
ABN AMRO	4	4	6	6	6	6	6	5
SNS Bank	2	2	2	2	2	2	2	2
Fortis Bank NL	3	4	5	4	1	1	1	1
AEGON	3	3	3	4	4	4	4	2
Argenta	1	1	1	1	1	1	1	1
ASN Bank	2	2	2	2	1	1	1	1
AT Bank	1	2	2	2	2	2	2	2
Credit Europe Bank	-	1	1	1	1	1	1	1
DSB Bank	2	2	2	-	-	-	-	-
Friesland Bank	1	1	1	1	1	1	1	1
GarantiBank	1	1	1	-	1	1	1	-
LeasePlan Bank	-	-	-	-	1	1	1	1
Moneyou	-	-	1	1	1	1	1	1
NIBC Direct	-	1	1	1	1	1	1	1
OHRA	1	2	2	2	2	2	2	2
RegioBank	2	2	1	1	1	2	2	2
Robeco	1	1	1	1	1	1	1	1
Triodos Bank	1	1	1	2	2	2	2	2
Total	33	39	43	41	37	38	40	34
Restricted	23	28	31	31	27	28	30	25
Internet only	11	14	17	17	15	15	16	15

Notes: The upper panel displays the amount of all account products offered by bank and year. The lower panel depicts the total amount of account products, the amount of account products with any kind of restriction, and the amount of account products which are internet managed only in the market by year. Note the existence of brands within larger bank entities. For instance, ABN AMRO continued one account product under the brand name of Fortis Bank NL after the merger in 2010.

other banks have market shares lower than 1%. Whereas the mentioned figures comprise all deposits and not just savings accounts, they serve as a coarse quality check. The data broadly confirms several features of our data. Firstly, the three large banks comprise for most of the market of deposits. Secondly, most of the small banks have relatively low market shares below 1% and lastly, the combined market share of ABN AMRO and all of its subsidiaries is relatively accurately mirrored in the data for total deposits.

Table 1.4.2: Market shares by bank and year

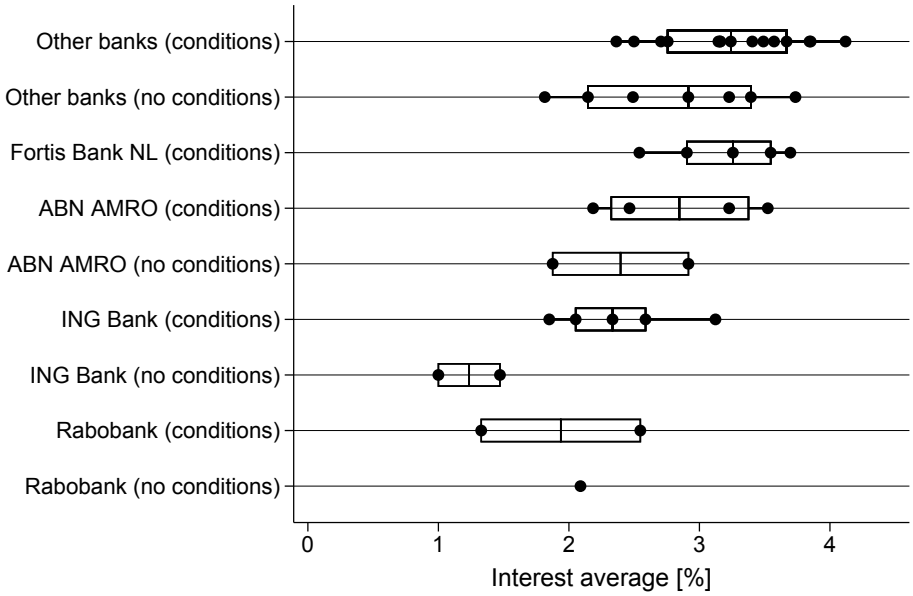
	2007	2008	2009	2010	2011	2012	2013	2014
Rabobank	22.51	22.32	24.03	22.60	23.81	22.71	22.22	27.27
ING Bank	22.10	21.93	21.31	21.25	20.01	20.44	20.47	19.90
ABN AMRO	9.29	8.40	8.99	8.56	10.39	10.77	10.68	10.83
SNS Bank	2.84	2.70	3.30	3.46	3.48	3.35	3.76	4.19
Fortis Bank NL	2.22	2.05	2.50	2.44	0.33	0.25	0.18	0.22
AEGON	2.07	2.19	2.13	2.15	1.74	1.54	1.28	1.07
Argenta	0.11	0.23	0.51	0.37	0.40	0.31	0.36	0.51
ASN Bank	1.67	1.86	2.32	2.66	3.33	3.39	3.68	4.08
AT Bank	0.19	0.49	0.53	0.15	0.24	0.16	0.08	0.16
Credit Europe Bank	-	0.03	0.24	0.23	0.12	0.07	0.08	0.05
DSB Bank	0.63	0.54	1.17	-	-	-	-	-
Friesland Bank	0.22	0.25	0.27	0.24	0.23	0.41	0.36	0.09
GarantiBank	0.09	0.13	0.20	-	0.02	0.02	0.02	-
LeasePlan Bank	-	-	-	-	0.04	0.24	0.28	0.44
Moneyou	-	-	0.12	0.37	0.45	0.46	0.61	0.62
NIBC Direct	-	0.05	0.25	0.48	0.43	0.38	0.63	0.77
OHRA	0.12	0.19	0.44	0.55	0.51	0.30	0.39	0.37
RegioBank	0.26	0.17	0.02	0.02	0.17	0.25	0.23	0.33
Robeco	1.16	1.06	0.84	0.84	0.78	0.52	0.55	0.67
Triodos Bank	0.11	0.11	0.23	0.23	0.38	0.30	0.35	0.35
No savings account	34.42	35.30	30.61	33.40	33.15	34.12	33.78	28.07

Notes: This table displays market shares by bank and year in percent. Market shares are calculated by aggregating observed choices without accounting for deposit amounts (binary method). The last row reports market shares of the outside option calculated by aggregating all incidents in which individuals reported not to maintain any savings account. Note the existence of brands within larger bank entities. For instance, ABN AMRO continued one savings account product under the brand name of Fortis Bank NL after the merger in 2010.

There is considerable variance in the offered interest rates both across and within banks. Figure 1.4.1 illustrates this by comparing the interest rates on accounts in 2009. Accounts are grouped by bank and according to whether account restrictions apply or not. For the majority of banks displayed, restricted accounts offer, on average, higher interest rates than unrestricted accounts. Note that Fortis Bank NL only offered restricted

savings accounts. The group of other banks offers on average the highest interest rates. Presumably, smaller fringe banks have to raise awareness in the market or have to prevail against the perception that savings deposited with big banks are safer by means of higher interest rates. The interest rate spread between and within restricted and unrestricted accounts indicates that banks apply product differentiation. Note further that banks offer several unrestricted accounts at different interest rates, which seems to be implausible at first sight. These were often introduced in different years. Anderson et al. (2014) find that banks use product age for price discrimination. New products with higher deposit rates are used to attract new customers whereas existing customers stick to old products with lower deposit rates.

Figure 1.4.1: Interest rate dispersion by bank (2009)

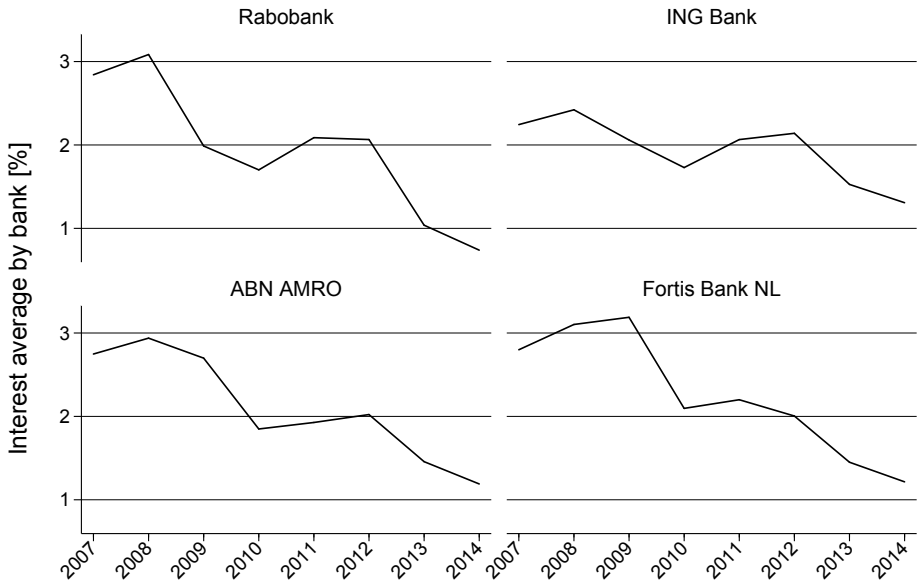


Notes: This figure illustrates interest rates paid on restricted and unrestricted accounts by banks in 2009. Fortis Bank NL only offered restricted account products. Each dot represents one account product.
Source: Price comparison websites and own calculations.

The effects of expansionary monetary policy after the financial crisis in 2008 are depicted in Figure 1.4.2. It displays the average interest rate across savings accounts for the three large banks and Fortis Bank NL from 2007 to 2014. Since 2008, there is a steady decline in the interest rate for all banks with the exception of a short increase starting in 2011. Most products of Fortis Bank NL are withdrawn from the market in 2011 and its

customers transferred to products of ABN AMRO. However, there is one product from our sample which ABN AMRO continued under the brand name of Fortis Bank NL.

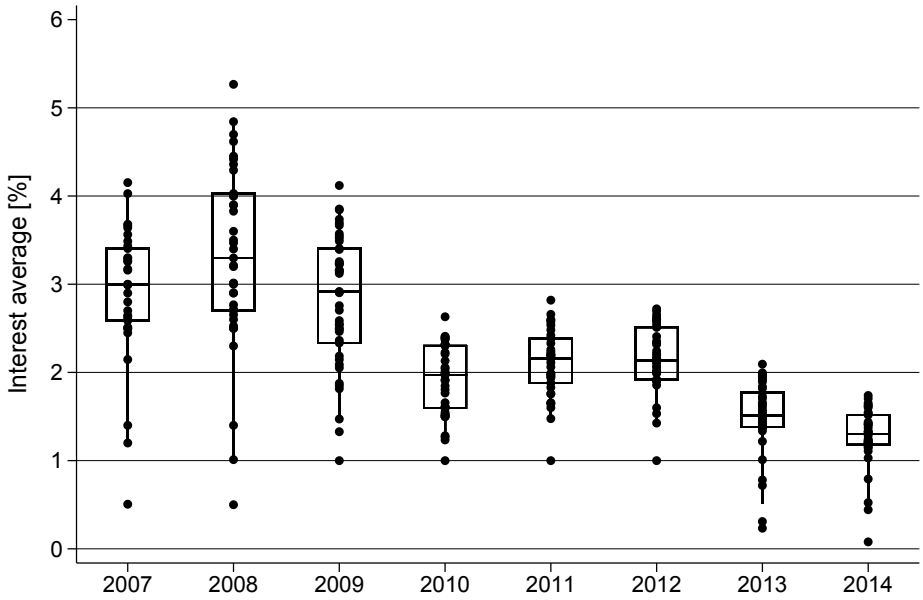
Figure 1.4.2: Development of average interest rates by banks



Notes: This figure illustrates the development of the unweighted average interest rate across account products by bank between 2007 and 2014. ABN AMRO continued one savings account product from our sample under the brand name of Fortis Bank NL after the merger in 2010.
Source: Price comparison websites and own calculations.

The changing macroeconomic and monetary conditions do not only affect the average interest rates but also the dispersion of interest rates offered in the market. In Figure 1.4.3 we demonstrate this trend. The spread between the highest and lowest priced account product and, more generally, the variance in interest rates was substantially reduced between 2007 and 2014.

Figure 1.4.3: Interest rate dispersion by year



Notes: This figure compares interest rates of all available account products between 2007 and 2014. Each product represents one account product.
Source: Price comparison websites and own calculations.

1.5 Estimation

We estimate the following main specification of the demand side of our model using data from 2007 to 2014:

$$\begin{aligned} U^i_{jbt} = \alpha &+ \beta^i interest\ rate_{jbt} + \gamma_1 internet\ only_{jbt} + \gamma_2 minimum\ amount_{jbt} \\ &+ \gamma_3 bonus\ rate_{jbt} + \gamma_4 other_{jbt} + \gamma_5 product\ age_{jbt} \\ &+ bank\,\delta + \eta\, inertia_{jbt} + (inertia_{jbt}\, x\, bank_j)\,\zeta + \epsilon^i_{jbt}, \\ \text{with } i = 1, ..., I, j = 1, ..., J, b = 1, ..., B, t = 1, ..., T. \end{aligned} \tag{1.5.1}$$

where α is a constant. We use bank fixed effects (i.e. the vector *bank*) in order to account for unobserved bank-specific characteristics such as brand reputation, branch networks and marketing expenses, which potentially drive consumer choice. In order to account for state dependence of consumer choice, we employ the variable *inertia*, which we calculate as the fraction of consumers having chosen the same product in period t as in the previous period $t-1$. Additionally, the product-level measure for state dependence

is interacted with a vector of bank dummies scaled to the product level. This way, we provide for heterogeneous effects in state dependence potentially reflecting different business strategies across banks as for instance maintaining a loyal customer stock versus attracting switching customers. Note that prices are posted nationally in the Dutch retail banking market. Thus we consider the geographical scope of the market as national. This concurs with the geographic market definition of the European Commission in its in-depth investigation before the merger (European Commission, 2007).

In the following, we provide an overview of the employed product characteristics. The coefficient for *interest rate* is random and varies across individuals to allow for consumer heterogeneity in the valuation of income and for flexible substitution patterns. The remaining product characteristics enter non-randomly into our model, assuming that the taste for conditions is the same for all customers. The dummy *internet only* indicates whether an account is for online usage only. The variable *minimum amount* indicates whether interest payment is subject to a certain minimum deposit amount. *bonus rate* depicts whether customers are rewarded for not withdrawing savings by offering a bonus on the minimum amount within a quarter and a (lower) base rate on the remainder. *other* subsumes if an account features one or more of the following restrictions: fixed deposit plan, withdrawal limitations, or group eligibility constraints (e.g. only for young customers). The variable *product age* measures the time a product has already been available in the market in years. As mentioned, banks can use the age of a product as a price discrimination tool. Table 1.5.1 provides summary statistics for the control variables.

In order to account for potential endogeneity in the price variable, we follow Berry et al. (1995) and use instruments that are functions of product characteristics of other products of the same bank and of competitors and thus are supposed to proxy cost drivers. Concretely, we employ as instruments for the interest rates the respective sums of the dummy variables for internet only, minimum amount and bonus rate of all other products of the same bank, the sums of the dummy variables minimum amount and bonus rate of all products offered by competitors, and additionally the total amounts of other products offered by the same bank and of products offered by competitors respectively.

As robustness, we estimate a nested-logit model as displayed in equation 1.5.2 (omitting time subscripts for illustrative purposes).

$$\begin{aligned} ln(s_j/s_0) &= \alpha + \beta interest\ rate_j + \gamma x_j + \sigma ln(s_{j|g}) + \xi_j \\ \text{with } j &= 1, ..., J, \end{aligned} \tag{1.5.2}$$

where s_j and $s_{j|g}$ refer to the market shares of product j in the whole market and in the nest respectively. According to the previous notation α is a constant, x_j is a vector of covariates and ξ_j stands for unobserved product characteristics. The nesting parameter σ captures the correlation of consumer preferences for products in the same nest. We separate the products along restricted and unrestricted products. That is, all account products having any of the above mentioned restrictions (e.g. internet only, minimum amount, bonus rate etc.) are in one nest and all unrestricted products are in another nest.

1.6 Results

1.6.1 Demand Estimation

Table 1.6.1 reports our parameter estimates as effects on marginal utilities. We estimate equation 1.5.1 with data from the period from 2007 to 2014. The two reported specifications differ with regard to the measure for market shares (binary versus deposit-weighted). We observe a significant and positive coefficient for the first moment of the interest rate in the main specification using a binary measure for market shares. The estimated standard deviation of the normally distributed coefficient is significantly low that a large share of the probability mass is above zero. Hence, plausibly most consumers prefer higher interest rates. We will use this specification as the baseline model for the simulation exercise. Specification two using deposit-weighted market shares yields a lower estimated effect of interest rates on consumer utility. The second moment is relatively large in relation to the estimated mean effect of the coefficient, which potentially can cause issues of

Table 1.5.1: Summary statistics of product characteristics

	mean	sd	min	max
2007				
Interest average	2.90	0.77	0.51	4.15
Internet	0.33	0.48	0	1
Minimum amount	0.30	0.47	0	1
Bonus rate	0.18	0.39	0	1
Other	0.091	0.29	0	1
Product age	3.64	1.32	0	5
Inertia	0.53	0.26	0	1
2010				
Interest average	1.90	0.40	1	2.63
Internet	0.41	0.50	0	1
Minimum amount	0.32	0.47	0	1
Bonus rate	0.17	0.38	0	1
Other	0.12	0.33	0	1
Product age	5	2.44	1	8
Inertia	0.33	0.23	0	0.70
2014				
Interest average	1.26	0.36	0.079	1.74
Internet	0.44	0.50	0	1
Minimum amount	0.32	0.47	0	1
Bonus rate	0.059	0.24	0	1
Other	0.26	0.45	0	1
Product age	8.09	2.99	1	12
Inertia	0.63	0.23	0	1
Total				
Interest average	2.00	0.84	0.079	4.15
Internet	0.40	0.49	0	1
Minimum amount	0.31	0.47	0	1
Bonus rate	0.14	0.35	0	1
Other	0.16	0.37	0	1
Product age	5.56	2.97	0	12
Inertia	0.48	0.27	0	1

Notes: This table reports summary statistics of variables used in the regression analysis for selected years of the sample. Interest averages are displayed in percent, product age in years, inertia marks the share of a product's customer stock having chosen the product already in the previous period, and all other variables are dummy variables

non-convergence when running the simulation exercises. Besides the coefficients for the interest rate, the estimates are fairly similar across specifications, however they seem to be less precise in the specification using deposit-weighted market shares.

Regarding the control variables, most restrictions enter negatively into the estimated mean utility equation. Product restrictions such as *minimum amount* and *bonus rate* thus have a negative effect on product choice. This seems reasonable, as for example a required minimum amount imposes true costs or obstacles for opening an account. The product feature of online self-administration increases the likelihood for an account to be chosen. Whereas some customers might have difficulties in not being able to rely on counter services at bank branches and, for example, commissioning transfers in online portals, others might well cope with doing so and even appreciate products featuring well developed online platforms potentially especially the young. *Product age* has the expected positive effect on consumer choice, indicating potential lock-in situations for customers. The employed measure for state dependence *inertia* exhibits a significant and positive effect providing a second indication for consumer inertia and sticky product choices. All regressions include bank fixed effects and its interactions with product-level state dependence variables. Bank fixed effects ought to be included to account for unobserved factors, such as service quality, which are potentially correlated with the interest rate and affecting consumer choice.[25]

Table 1.6.2 reports derived own-price elasticities calculated as demand-weighted averages on the bank level. Note that the signs are positive in our application, because an increase in the interest rate usually triggers an increase in demand for savings account products. Three findings are striking: i) the general level of elasticities is relatively low, ii) demand elasticities decline on average over time and iii) larger banks encounter less elastic demand than smaller banks. Concerning low levels of elasticities, the finding broadly aligns with work of Egan et al. (2017) and Molnar et al. (2013) who calculate deposit rate elasticities around 0.5 for insured deposits for the U.S. retail banking market and around one for the Italian market respectively. Especially the later years of our sample

[25] A linear regression of the interest rates on all instruments reveals joint statistical significance of all included instruments.

Table 1.6.1: Demand-side estimates

	(1)	(2)
Mean utility		
Internet only	0.78***	1.22***
	(0.18)	(0.22)
Condition: Minimum amount	-0.38**	-0.31
	(0.18)	(0.22)
Condition: Bonus rate	-0.82***	-0.50
	(0.25)	(0.34)
Condition: Other	-0.32	-0.42
	(0.24)	(0.30)
Product age	0.18***	0.074
	(0.060)	(0.081)
Inertia	1.94**	0.69
	(0.78)	(1.05)
Interest average	0.53***	0.17
	(0.20)	(0.39)
Interest average		
SD	0.29	0.23
	(0.67)	(1.10)
Observations	305	305
Market share calculation	binary	deposit-weighted

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table displays the results of demand-side specifications using the random-efficients logit estimator following Berry et al. (1995) and two different measures of aggregated market shares. Specification in column (1) derives market shares by relating the total number of choices for each product to the total choices observed (binary aggregation). The specification in column (2) derives market shares by relating the total amount of savings observed by account product to total potential savings (deposit-weighted aggregation). In order to estimate the level of total potential savings, we predict savings of individuals having chosen the outside option using demographic variables. The estimations use data for 2007-2014. Reported estimates represent effects on marginal utilities and not on choice probabilities. We instrument the endogenous interest rate using the respective sums of product characteristics of all other products of the same bank and of all products offered by competitors. We also include the total amounts of other products offered by the same bank and of products offered by competitors as instruments to account for average product characteristics of other products. Additionally, all variables used as covariates in the demand estimation are included as instruments. The second panel lists the second moment of the distribution of the covariates specified as random. All estimations include bank fixed effects for all banks and interactions of bank dummies with product-level measures of state dependence which are not reported in the table. The sample size is determined by the total of offered products in the different markets (i.e. years).

are characterized by low elasticities and values are around or below one matching the above mentioned estimates. Decreasing elasticities imply larger anti-competitive merger effects over time all other things equal. One potential reason for declining elasticities are lower levels of deposit rates and lower interest rate differentials between products, and thus resulting lower marginal gains of switching. The three largest banks exhibit rather low elasticities compared to their smaller peers. The range of own-price elasticities reflects different degrees of market power and funding requirements across banks. Larger banks seem to be able to price less aggressively, possibly due to alternative funding sources.

Table 1.6.2: Own-price elasticities averaged by bank

	2007	2008	2009	2010	2011	2012	2013	2014
Rabobank	1.54	1.70	1.20	0.87	1.08	1.08	0.71	0.51
ING Bank	0.81	0.89	0.98	0.96	1.14	1.18	0.84	0.67
ABN AMRO	1.41	1.53	1.26	0.93	0.97	1.10	0.78	0.63
SNS Bank	1.75	1.83	1.72	1.27	1.38	1.57	1.21	0.97
Fortis Bank NL	1.53	1.57	1.70	1.02	1.34	1.19	0.84	0.70
AEGON	2.07	2.51	1.76	1.13	1.37	1.34	0.72	0.79
Argenta	2.60	3.18	2.17	1.47	1.56	1.71	1.25	1.04
ASN Bank	2.40	2.77	2.33	1.44	1.58	1.53	1.08	0.88
AT Bank	2.59	3.30	2.05	0.79	0.95	1.43	0.98	0.83
Credit Europe Bank	-	3.80	2.17	0.93	0.90	0.90	0.86	0.75
DSB Bank	2.25	2.68	2.08	-	-	-	-	-
Friesland Bank	2.21	2.20	1.71	1.11	1.06	1.27	0.88	0.70
GarantiBank	2.37	3.33	2.33	-	1.33	1.45	1.11	-
LeasePlan Bank	-	-	-	-	1.86	1.67	1.22	1.01
Moneyou	-	-	2.78	1.46	1.66	1.75	1.19	0.99
NIBC Direct	-	4.30	2.77	1.47	1.66	1.65	1.16	0.92
OHRA	2.23	2.97	2.57	1.35	1.57	1.40	0.96	0.83
RegioBank	1.81	1.65	2.60	1.53	1.49	1.54	0.92	0.79
Robeco	1.69	1.68	1.25	0.93	1.15	1.11	0.95	0.83
Triodos Bank	1.97	1.94	1.43	0.93	1.02	0.89	0.46	0.25

Notes: This table displays deposit-weighted averages of own-price elasticities by bank using estimation results presented in column (1) of Table 1.6.1. No entry in a given year refers to banks not having realized positive demand within the sample.

As robustness, we estimate a one-level nested-logit model separating accounts into two groups of restricted and unrestricted accounts. Both the interest rate and the market shares in the nests are instrumented with a similar set of instruments as in the baseline model using the random-coefficients logit model.[26] Table 1.6.3 provides the results for

[26]We employ as instruments the respective sums of the dummy variables for minimum amount, bonus

first-stage estimates and Table 1.6.4 yields the results of the estimation of equation 1.5.2 using a two-stage least squares panel regression. The estimated coefficient on interest rates is positive and the sign on the internet-only feature is positive and significant, as well as the estimated coefficient for the product age. Own-price elasticities are estimated much smaller compared to the random-coefficients model as illustrated in Table 1.A.1. This will both have an impact on estimated bank markups and simulation results resulting in more negative merger effects for consumers and larger markups compared to the baseline model.

Table 1.6.3: First-stage estimates (nested logit)

	$\log(p_j)$	$\log(s_{j\|g})$
Condition: Minimum amount	-0.067	-0.25***
(all other products)	(0.058)	(0.1)
Condition: Bonus rate	0.085**	0.25***
(all other products)	(0.042)	(0.074)
Condition: Any	-0.5***	0.14
(all other products)	(0.067)	(0.12)
Condition: Minimum amount	0.048	-0.027
(other products, same bank)	(0.091)	(0.16)
Condition: Bonus rate	0.17	-0.025
(other products, same bank)	(0.12)	(0.2)
Condition: Any	0.023	0.12
(other products, same bank)	(0.12)	(0.21)
# of other products (all)	0.41***	- 0.11
	(0.056)	(0.10)
# of other products (same bank)	-0.11***	-0.23
	(0.11)	(0.2)
Observations	305	305
Prob $> \chi^2$	0.00	0.00

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table displays the results of the first stage of the two-stage least squares panel regression used to estimate the demand coefficients for the nested-logit model. Both the interest rate (results in column 2) and the shares in the nesting group (results in column 3) are instrumented using the displayed instruments.

rate and any condition of all other products of the same bank and of all products offered by competitors, and additionally the total amounts of other products offered by the same bank and of products offered by competitors respectively.

Table 1.6.4: Demand-side estimates (nested-logit)

	(1)
Interest average	0.084
	(0.070)
Nesting parameter (σ)	0.69***
	(0.11)
Internet only	0.43***
	(0.11)
Condition: Minimum amount	0.036
	(0.11)
Condition: Bonus rate	-0.14
	(0.14)
Condition: Other	-0.011
	(0.13)
Product age	0.048**
	(0.021)
Inertia	0.35
	(0.31)
Observations	305
Market Shares	binary

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table displays the results of demand-side specifications using the nested-logit estimator grouping the products into restricted and unrestricted accounts. We employ as instruments the respective sums of the dummy variables for minimum amount, bonus rate and any condition of all other products of the same bank and of all products offered by competitors, and additionally the total amounts of other products offered by the same bank and of products offered by competitors respectively. Additionally, all variables used as covariates in the demand estimation are included as instruments. We instrument both interest rate and the market shares in the nests. We derive market shares by relating the total number of choices for each product to the total choices observed (binary method). The estimations use data for 2007-2014. Reported coefficient estimates represent effects on marginal utilities and not on choice probabilities. All estimations include bank fixed effects for all banks and interactions of bank dummies with product-level measures of state dependence which are not reported in the table. The sample size is determined by the number of products in the different markets (i.e. years).

1.6.2 Merger Simulation

Before applying the simulation procedure introduced in Section 1.3.3, we comment on the backed-out expected net loan rates r_{net}^{2009} and markups in Table 1.6.5. Expected net loan rates represent profitability measures net of marginal costs other than deposit rates. Markups are calculated as the difference between expected net loan rates and deposit rates and thus can be seen as a profitability measure of a given product. Whereas market conditions seem to slightly deteriorate after 2012 as the mean for expected net loan rates declines by almost one percentage point by 2014, the markup stays rather constant around 1.9 percentage points. Note that deposit rates represent substantial funding costs for banks and that the negative effect of profitability through decreasing loan rates can be compensated for by lower deposit rates. There is substantial variation in both the expected net loan rate and the markup across products. A higher markup suggests that banks can realize higher returns on each euro deposited with them.

Table 1.6.5: Summary statistics of expected net loan rates and markups

	mean	sd	min	p10	p50	p90	max
2010							
Expected net loan rate	3.82	0.33	2.97	3.36	3.89	4.18	4.44
Markup	1.92	0.25	1.54	1.66	1.85	2.30	2.37
2011							
Expected net loan rate	3.99	0.34	3.04	3.46	4.03	4.40	4.52
Markup	1.89	0.24	1.52	1.60	1.82	2.26	2.36
2012							
Expected net loan rate	4.05	0.35	3.03	3.43	4.13	4.44	4.67
Markup	1.90	0.23	1.59	1.61	1.86	2.25	2.35
2013							
Expected net loan rate	3.41	0.35	2.34	2.89	3.44	3.80	4.07
Markup	1.92	0.24	1.59	1.64	1.91	2.23	2.60
2014							
Expected net loan rate	3.27	0.31	2.47	2.97	3.25	3.59	3.87
Markup	2.01	0.29	1.66	1.72	1.97	2.46	2.89

Notes: This table reports summary statistics of unweighted backed-out deposit-weighted expected net loan rates and respective markups by year in percent. Expected net loan rates represent profitability measures net of marginal costs other than deposit rates. Markups are calculated as the difference between expected net loan rates and deposit rates and thus can be seen as a profitability measure of a given product. In formal notation that is $markup_{jbt} = r_{\bar{b}t} - c_{jbt} - d_{jbt}$.

Table 1.6.6 presents weighted merger effects on interest rates. We subtract simulated

interest rates in the demerger counterfactual from simulated interest rates in the actual case of the merger. A negative value therefore refers to negative effects of the merger on interest rates. The largest negative effects are realized for Fortis Bank NL ranging around a reduction of 30 basis points or 0.3 percentage points in interest respectively. This is substantial given mean interest rates of 1.26% and a standard deviation of 0.36% in 2014. ABN AMRO features the largest negative effects among the three large banks comprising most of the market. However, decreases in the interest rate are substantially lower compared to Fortis Bank NL being around six basis points. Similar negative effects are found for Moneyou being a subsidiary of ABN AMRO. The effects for Rabobank and ING Bank are insignificantly small but negative. Interestingly, many small banks exhibit small positive effects. This might seem puzzling at first. Potentially before the merger, Fortis Bank NL used to exert upward pressure on interest rates for large banks, but served as a price leader for smaller fringe banks thus reducing interest rates (see Figure 1.4.1). This way, the merger of ABN AMRO and Fortis Bank NL could have caused smaller banks to price slightly more beneficially for consumers. A general conclusion is that price changes except for those of the merging banks can be considered negligible. Figure 1.A.1 illustrates the merger effects for the three largest banks and Fortis Bank NL. The simulated interest rates for the merger case (dashed line) are very similar to the observed interest rates in all cases (solid line).

Table 1.6.7 reports changes in realized demand in both scenarios. All banks belonging to the newly merged entity experience decreases in demand. Fortis Bank NL is affected most substantially. Demand decreases by almost 20 percent in the merger case compared to the case of the demerger, whereas the aggregated demand for ABN AMRO decreases by between two and three percent. Note that these figures comprise demand shifts solely due to price changes as the simulations deliberately continue all products of Fortis Bank NL in both scenarios and do not account for demand consolidation of former products of Fortis Bank NL into products of ABN AMRO. The competitors of the merging banks benefit in terms of larger market shares. It seems that smaller banks increase market shares more than Rabobank and ING Bank potentially because they attract much of the

Table 1.6.6: Weighted merger effects on interest rates (in basis points)

	2010	2011	2012	2013	2014
Rabobank	-0.27	-0.54	-0.31	-0.19	-0.30
ING Bank	-0.19	-0.23	-0.20	-0.15	-0.086
ABN AMRO	-6.36	-8.87	-5.55	-4.83	-5.02
SNS Bank	0.26	0.40	0.22	0.17	0.21
Fortis Bank NL	-24.4	-28.0	-29.9	-29.8	-31.6
AEGON	0.49	0.79	0.54	0.53	0.53
Argenta	0.45	0.72	0.48	0.41	0.48
ASN Bank	0.23	0.32	0.23	0.19	0.23
AT Bank	0.61	1.00	0.53	0.47	0.55
Credit Europe Bank	0.56	1.03	0.65	0.49	0.57
Friesland Bank	0.52	0.93	0.55	0.48	0.59
GarantiBank	-	0.82	0.53	0.44	-
LeasePlan Bank	-	0.66	0.49	0.42	0.49
Moneyou	-6.15	-8.39	-5.40	-4.69	-4.85
NIBC Direct	0.44	0.69	0.49	0.42	0.50
OHRA	0.46	0.71	0.53	0.46	0.54
RegioBank	0.22	0.37	0.24	0.24	0.27
Robeco	-0.25	-0.50	-0.28	-0.23	-0.38
Triodos Bank	0.56	0.95	0.65	0.62	0.79

Notes: This table displays weighted merger effects on interest rates by bank. We subtract simulated interest rates in the demerger counterfactual from simulated interest rates in the actual case of the merger. Negative values refer to decreases in interest rates resulting from the merger. Merger effects are aggregated on the bank level using simulated market shares in the merger scenario as weights. Changes are measured in basis points (i.e. one hundredth of one percentage point).

Table 1.6.7: Merger effects on demand (percentage change)

	2010	2011	2012	2013	2014
Rabobank	0.66	0.98	0.70	0.63	0.57
ING Bank	0.70	1.15	0.76	0.67	0.71
ABN AMRO	-2.88	-3.80	-2.33	-2.07	-2.06
SNS Bank	1.02	1.58	1.09	0.92	0.94
Fortis Bank NL	-14.5	-16.5	-18.2	-18.4	-19.0
AEGON	1.09	1.74	1.17	1.01	1.07
Argenta	1.17	1.83	1.27	1.07	1.11
ASN Bank	1.03	1.60	1.08	0.91	0.93
AT Bank	1.10	1.75	1.23	1.05	1.09
Credit Europe Bank	1.11	1.74	1.16	1.04	1.09
Friesland Bank	1.13	1.76	1.20	1.04	1.08
GarantiBank	-	1.80	1.24	1.07	-
LeasePlan Bank	-	1.89	1.26	1.07	1.11
Moneyou	-3.01	-3.98	-2.47	-2.14	-2.11
NIBC Direct	1.17	1.84	1.26	1.06	1.09
OHRA	1.15	1.82	1.22	1.04	1.09
RegioBank	1.04	1.59	1.08	0.90	0.93
Robeco	0.66	0.99	0.70	0.63	0.57
Triodos Bank	1.11	1.75	1.16	1.00	1.05

Notes: This table displays changes in demand by bank. We aggregate simulated demand on the bank level in the demerger counterfactual and subtract it from aggregated simulated demand in the actual case of the merger. Changes are reported as percentage changes.

market shares lost by Fortis Bank NL, which might have been a closer competitor to small banks before the merger.

Efficiency gains are often brought forward by the merging parties to convince regulators of broader economic gains of mergers. Whether bank mergers eventually lead to efficiency gains is rather contested in the academic literature. For instance, Coccorese and Ferri (2020) find that bank mergers only realize such gains under special circumstances analyzing mergers among Italian banks. In order to account for the mitigating impact of efficiency gains on anti-competitive effects of the merger, we allow for increases in profitability by 2% and 5% respectively for 2013 onwards.[27] Doing so accounts for a transition period of around two and a half years in which the banks can internally pro-

[27] We introduce efficiency gains by multiplying the backed-out expected net loan rates by (1+x%) for products of the merging banks, where x is the increase in efficiency assumed. We have to resort to enlarging the backed-out expected net loan rates as measures of profitability as these are retrievable from the model in contrast to marginal costs.

cess the merger and no efficiency gains are to be expected. The increase in profitability by 5% would have a substantial effect on the relative ranking between banks. It would allow ABN AMRO to reach Rabobank and ING Bank, its main competitors, in terms of profitability (being the least profitable large bank otherwise) and shift Fortis Bank into the group of the most profitable banks among all smaller banks. Table 1.A.2 shows the impact on merger effects on interest rates when accounting for efficiency gains. Whereas a 5%-increase in profitability seems to be sufficient to turn the merger effects positive for ABN AMRO, the impact is still negative for the interest rates of Fortis Bank NL. A 2%-increase in profitability (results not shown here) does not mitigate negative merger effects for ABN AMRO. Curiously, a more cost efficient entity of the merging banks leads the two main large competitors of ABN AMRO to price more consumer friendly compared to the no-efficiency-gains scenario but reaches the opposite for the smaller banks. In any case, price changes by the non-merging banks are rather insignificant.

Next, we will interpret the simulation results based on the nested-logit demand estimations. Table 1.A.3 provides summary statistics for backed-out net loan rates and markups. The expected net loan rates are between five and six percentage points and around two percentage points higher than in the estimations using the random-coefficients demand specification. Similarly, there is a two percentage point differential in the resulting average markups being around four percent in the nested-logit case. Simulation exercises reveal slightly larger negative effects of the merger on interest rates for ABN AMRO and Fortis Bank NL as shown in Table 1.A.4 compared to the baseline model. Similar to the random-coefficient model, anti-competitive effects are insignificantly small for banks not directly involved in the merger.

1.6.3 Welfare Effects on Consumers

In order to assess what the merger could have cost consumers, we provide a back-of-the-envelope calculation, multiplying average savings per account product with the resulting changes in the interest rates from the merger. This measure quantifies welfare effects on consumers who do not switch products in reaction to changing interest rates. Table

1.6.8 shows that the largest effects are borne by consumers banking with Fortis Bank NL. The economic effects for those customers are substantial amounting to more than 50 euros per capita in 2014. Lost interest for customers of ABN AMRO is more moderate ranging around 10 euros across years. Customers of Moneyou, an ABN AMRO branch, are affected with lost interest above 10 euros. Customers of the two remaining large banks besides ABN AMRO incur relatively small losses below one euro. Most of the other small banks pay slightly more interest to their customers due to small increases in interest rates resulting from the merger. The average effects across all banks are negative in all years and range between losses of two and five euros. There is no clear time trend in the merger effects. It is important to note that the merger effects cannot easily be compared over time as market conditions are subject to change. This, for example, includes changes of the general level of interest rates and entry and exit of competitors. When accounting for efficiency gains, the effects become less harmful for consumers. For instance, a 2%-increase in profitability render the average effects less negative and a 5%-increase in profitability switches the sign of the impact on savings and produces gains in retrieved interest by consumers.

For the nested-logit model, we calculate the effects of the merger on consumers through the expected change in consumer surplus thus allowing for a change in consumer choice resulting from the merger. As in Train (2009), we use the following formula to calculate the change of consumer surplus in monetary values:

$$\Delta E[CS_t] = \frac{1}{\beta}\left[ln\sum_{j=1}^{J}\left(exp(V_{jt}^{merger})\right) - ln\sum_{j=1}^{J}\left(exp(V_{jt}^{demerger})\right)\right]. \tag{1.6.1}$$

Figure 1.6.1 displays the change in the estimated average consumer surplus. Whereas the results of this exercise and those of the previous calculations are not directly comparable, the effects are slightly larger in the framework of the nested-logit estimates. In the nested-logit specification the average effect is decreasing in absolute numbers over time. This might be due to a lower degree of interest rate dispersion over time and thus

Table 1.6.8: Change in interest (in euros)

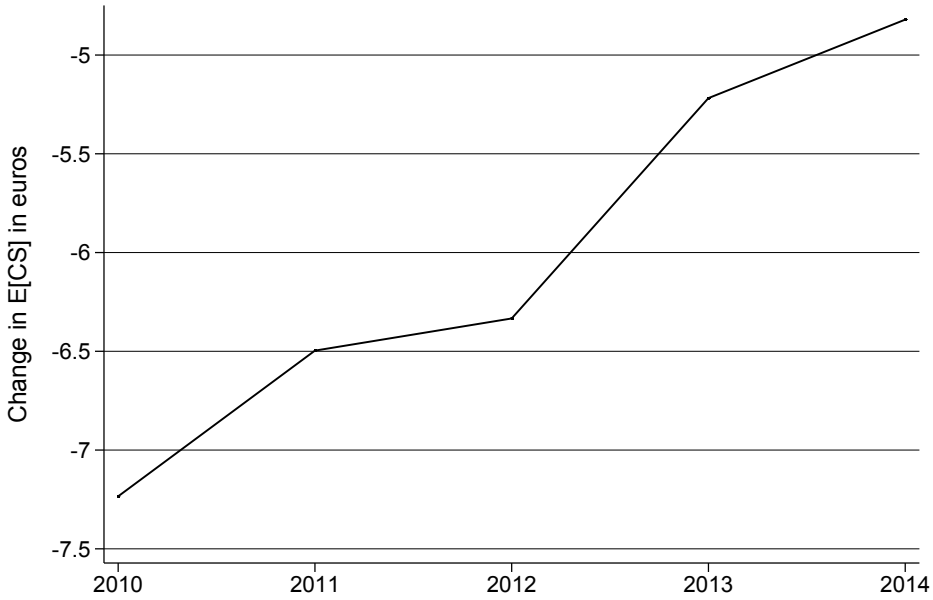
	2010	2011	2012	2013	2014
Rabobank	-0.47	-1.02	-0.58	-0.36	-0.55
ING Bank	-0.40	-0.47	-0.35	-0.30	-0.17
ABN AMRO	-12.2	-15.7	-9.47	-7.21	-6.70
SNS Bank	0.59	0.93	0.44	0.36	0.51
Fortis Bank NL	-36.6	-45.1	-49.0	-46.3	-52.1
AEGON	1.17	1.93	1.42	1.32	1.40
Argenta	1.42	1.70	1.05	1.01	0.97
ASN Bank	0.54	0.76	0.56	0.41	0.44
AT Bank	1.97	2.54	0.80	0.96	0.96
Credit Europe Bank	1.32	2.29	2.10	1.36	2.39
Friesland Bank	0.36	0.52	0.80	0.22	0.0059
GarantiBank	-	0.61	0.058	0.010	-
LeasePlan Bank	-	2.44	1.73	1.52	1.81
Moneyou	-17.1	-23.6	-12.6	-12.0	-11.1
NIBC Direct	1.21	1.70	1.36	0.93	1.08
OHRA	1.10	1.62	1.23	0.81	0.81
RegioBank	0.0072	0.55	0.28	0.31	0.34
Robeco	-0.61	-1.12	-0.67	-0.49	-0.86
Triodos Bank	0.99	1.74	1.37	1.47	1.35
Total	-3.17	-4.85	-3.30	-2.62	-2.54

Notes: This table displays average bank-level consumer welfare effects derived by multiplication of the merger-induced interest rate difference with the average savings amount on the product level. We calculate bank-level effects using simulated market shares in the merger scenario as weights. The last row displays the average effect on all consumers. Effects are displayed in euros.

the lesser extent to which it is possible to realize higher interest rates when substituting to other products.

In conclusion, merger effects are on average small but not negligible. The bank-level analysis has shown that particularly customers of the merging banks are adversely affected by the merger, incurring yearly losses in foregone interest rates of up to 50 euros. Whereas these figures stem from a simplified approach neglecting the possibility for consumers to switch accounts, relatively low estimated elasticity levels and consumers' limited propensity to switch banks in the Dutch market might render such estimates realistic. In our welfare analysis, we have accounted for modest efficiency gains and its mitigating impact on anti-competitive effects of the merger. We want to stress, however, that efficiency gains are unlikely to realize instantly after the merger and therefore unlikely

Figure 1.6.1: Change in consumer surplus



Notes: This figure illustrates the estimated average effects of the merger on consumer surplus. The estimates are based on demand estimations of the nested-logit model and calculations in equation 1.6.1.

to dampen anti-competitive effects for consumers in the short term. Furthermore, it is uncertain whether cost efficiencies are realized at all and if so, whether they are passed on to consumers.

1.7 Conclusions

In this paper, we investigated the competition effects of the merger of ABN AMRO and Fortis Bank NL in the Dutch market for savings accounts. We employed structural industrial organization methodology to single out the merger effects. Using aggregated data derived from a representative survey, we obtained model predictions for the merger effects by simulating product-level interest rates for the two distinct cases of joint and separate ownership of the banks.

Our analysis suggests substantial effects on interest rates in the market, which are to a large extent confined to the merging banks. The merged entity of ABN AMRO and Fortis Bank NL offers interest rates which are up to 30 basis points lower as a result of the merger. We calculate per-capita losses in interest rates amounting to up to 50 euros

for consumers of the previously independent Fortis Bank NL. The average per capita loss in consumer welfare across the market ranges between two and seven euros depending on year and method of calculation. When accounting for efficiency gains, anti-competitive effects on consumers can partially be offset.

Whereas our results appear small compared to the merger deal volume, they still point towards the need to heed the additional social costs caused by reduced competition when merging banks for the sake of financial stability. Furthermore, the focus on the market for savings accounts might not represent the full extent of anti-competitive effects of this merger as evidence by Dijkstra and Schinkel (2019) on the mortgage market suggests. We do not contest bank mergers conducted during financial crises to be effective policy responses to prevent financial distress. We rather caution against not applying careful merger control and disregarding costly reductions in competition in times of crisis. Stability and competition do not need to be mutually exclusive alternatives in banking. We leave paths for future work that could focus on the long-term effects of the merger, which could be contrasted with realized synergies (ABN AMRO reports that the merger was completed in 2012) and the model to include channels for network externalities to allow for the exit of market participants.

1.A Appendix

Table 1.A.1: Own-price elasticities averaged by bank (nested-logit)

	2007	2008	2009	2010	2011	2012	2013	2014
Rabobank	0.61	0.67	0.46	0.37	0.44	0.44	0.23	0.16
ING Bank	0.58	0.62	0.53	0.45	0.53	0.55	0.39	0.34
ABN AMRO	0.71	0.76	0.71	0.49	0.50	0.53	0.38	0.31
SNS Bank	0.89	0.93	0.80	0.58	0.63	0.69	0.53	0.44
Fortis Bank NL	0.74	0.83	0.85	0.56	0.59	0.53	0.39	0.32
AEGON	0.84	0.97	0.70	0.45	0.49	0.44	0.24	0.25
Argenta	0.98	1.14	0.86	0.61	0.66	0.70	0.53	0.45
ASN Bank	0.88	0.97	0.82	0.58	0.66	0.65	0.47	0.39
AT Bank	0.98	1.14	0.81	0.37	0.45	0.65	0.43	0.37
Credit Europe Bank	-	1.30	0.86	0.43	0.43	0.43	0.39	0.35
DSB Bank	0.82	0.95	0.84	-	-	-	-	-
Friesland Bank	0.87	0.88	0.72	0.49	0.49	0.56	0.40	0.33
GarantiBank	0.92	1.19	0.91	-	0.59	0.63	0.49	-
LeasePlan Bank	-	-	-	-	0.76	0.69	0.52	0.44
Moneyou	-	-	1.03	0.61	0.69	0.71	0.50	0.42
NIBC Direct	-	1.41	1.02	0.61	0.68	0.68	0.50	0.40
OHRA	0.88	1.16	1.02	0.61	0.67	0.61	0.44	0.38
RegioBank	0.66	0.66	0.99	0.64	0.64	0.67	0.46	0.38
Robeco	0.72	0.72	0.57	0.43	0.52	0.51	0.43	0.38
Triodos Bank	0.80	0.80	0.63	0.51	0.52	0.46	0.27	0.17

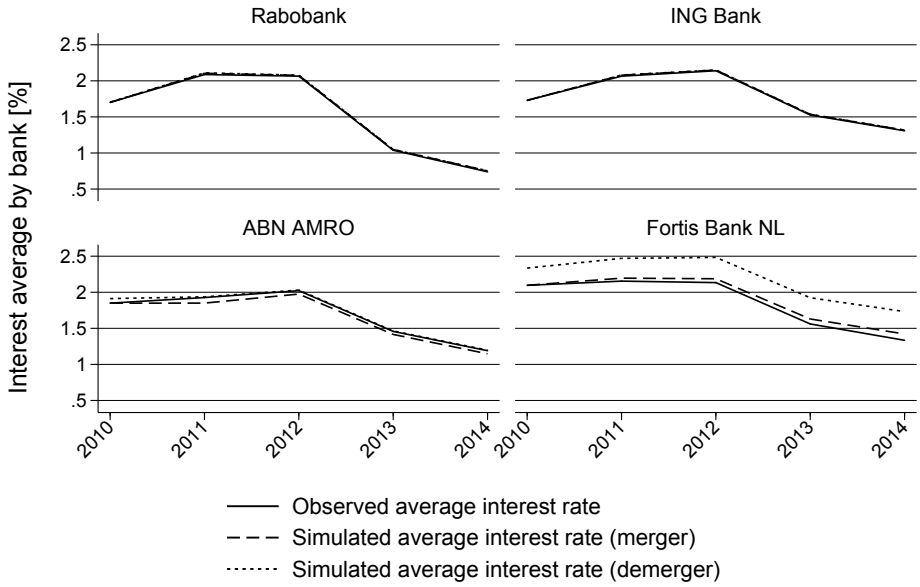
Notes: This table displays deposit-weighted averages of own-price elasticities by bank using estimation results presented in Table 1.6.4. No entry in a given year refers to banks not having realized positive demand within the sample.

Table 1.A.2: Weighted merger effects on interest rates including efficiency gains (in basis points)

Efficiency gains	2013 no	2013 yes	2014 no	2014 yes
Rabobank	-0.19	0.18	-0.30	0.24
ING Bank	-0.15	0.14	-0.086	0.076
ABN AMRO	-4.83	12.7	-5.02	12.1
SNS Bank	0.17	-0.14	0.21	-0.15
Fortis Bank NL	-29.8	-12.1	-31.6	-14.1
AEGON	0.53	-0.47	0.53	-0.39
Argenta	0.41	-0.36	0.48	-0.35
ASN Bank	0.19	-0.16	0.23	-0.17
AT Bank	0.47	-0.41	0.55	-0.40
Credit Europe Bank	0.49	-0.44	0.57	-0.43
Friesland Bank	0.48	-0.42	0.59	-0.44
GarantiBank	0.44	-0.39	-	-
LeasePlan Bank	0.42	-0.37	0.49	-0.36
Moneyou	-4.69	-9.42	-4.85	-9.65
NIBC Direct	0.42	-0.36	0.50	-0.37
OHRA	0.46	-0.41	0.54	-0.40
RegioBank	0.24	-0.21	0.27	-0.20
Robeco	-0.23	0.21	-0.38	0.30
Triodos Bank	0.62	-0.55	0.79	-0.60

Notes: This table displays weighted merger effects on interest rates by bank and compares results when accounting for a 5%-increase in profitability to baseline results for 2013 and 2014. We subtract simulated interest rates in the demerger counterfactual from simulated interest rates in the actual case of the merger. Negative values refer to decreases in interest rates resulting from the merger. Merger effects are aggregated on the bank level using simulated market shares in the merger scenario as weights. Changes are measured in basis points (i.e. one hundredth of one percentage point).

Figure 1.A.1: Simulated and observed interest rates



Notes: This figure illustrates the simulated merger effects and displays the unweighted averages of observed interest rates and of simulated interest rates for the merger and the demerger scenario.
Source: Price comparison websites and own calculations.

Table 1.A.3: Summary statistics of expected net loan rates and markups (nested-logit)

	mean	sd	min	p10	p50	p90	max
2010							
Expected net loan rate (nested-logit)	6.03	0.55	4.76	5.28	6.07	6.74	7.08
Markup	4.13	0.39	3.72	3.74	4.06	4.76	4.76
2011							
Expected net loan rate (nested-logit)	6.13	0.53	4.76	5.43	6.17	6.81	7.13
Markup	4.03	0.34	3.72	3.73	3.95	4.63	5.02
2012							
Expected net loan rate (nested-logit)	6.19	0.54	4.73	5.33	6.17	6.89	7.20
Markup	4.03	0.34	3.72	3.73	3.99	4.65	4.93
2013							
Expected net loan rate (nested-logit)	5.53	0.58	3.96	4.64	5.54	6.21	6.65
Markup	4.04	0.34	3.69	3.72	3.96	4.66	4.87
2014							
Expected net loan rate (nested-logit)	5.31	0.50	4.21	4.56	5.40	5.91	6.21
Markup	4.05	0.34	3.51	3.72	4.01	4.59	4.96

Notes: This table reports summary statistics of unweighted backed-out deposit-weighted expected net loan rates and respective markups by year in percent. Expected net loan rates represent profitability measures net of marginal costs other than deposit rates. Markups are calculated as the difference between expected net loan rates and deposit rates and thus can be seen as a profitability measure of a given product. In formal notation that is $markup_{jbt} = \bar{r_{bt}} - c_{jbt} - d_{jbt}$.

Table 1.A.4: Weighted merger effects on interest rates (in basis points) - nested-logit

	2010	2011	2012	2013	2014
Rabobank	-0.70	-0.85	-0.71	-0.71	-0.74
ING Bank	0.054	0.057	0.072	0.059	0.10
ABN AMRO	-10.9	-8.63	-6.64	-7.41	-7.59
SNS Bank	0.057	0.075	0.073	0.069	0.076
Fortis Bank NL	-42.7	-40.5	-39.1	-45.6	-45.6
AEGON	-0.055	-0.012	-0.024	-0.028	-0.064
Argenta	-0.028	-0.0074	-0.011	-0.018	-0.034
ASN Bank	0.057	0.075	0.073	0.069	0.076
AT Bank	-0.00025	0.00052	0.0011	0.0023	-0.0039
Credit Europe Bank	0.0040	0.0088	0.0082	0.0059	0.0034
Friesland Bank	-0.028	-0.015	-0.046	-0.041	-0.014
GarantiBank	-	0.0010	0.00098	0.00074	-
LeasePlan Bank	-	0.0041	-0.0026	-0.0013	-0.0075
Moneyou	-32.1	-34.4	-33.0	-29.8	-31.0
NIBC Direct	-0.032	0.0010	-0.0051	-0.041	-0.041
OHRA	-0.010	0.013	0.0098	-0.0019	-0.0092
RegioBank	0.057	0.075	0.073	0.069	0.076
Robeco	0.028	-0.023	-0.026	0.016	0.048
Triodos Bank	-0.014	-0.0082	-0.015	-0.033	-0.033

Notes: This table displays weighted merger effects on interest rates by bank. We subtract simulated interest rates in the demerger counterfactual from simulated interest rates in the actual case of the merger. Negative values refer to decreases in interest rates resulting from the merger. Merger effects are aggregated on the bank level using simulated market shares in the merger scenario as weights. Changes are measured in basis points (i.e. one hundredth of one percentage point).

Chapter 2

Common Ownership in the Dutch Banking Market

2.1 Introduction

Institutional investors (e.g. mutual funds, hedge funds, insurance companies and pension funds) increasingly own larger fractions of publicly-traded stock in the U.S. and Europe (see Azar et al. (2018) for the U.S. and Seldeslachts et al. (2017) for Germany). Backus et al. (2018) report combined holdings of 10.2 trillion dollars by the two largest asset managers Blackrock and Vanguard as of September 2017. For comparison, the total market capitalization of the S&P 500 at the end of 2017 was 23.9 trillion dollars. Decreasing costs for retail investors to invest in index funds and thereby diversifying their portfolio have contributed to an increase in the volume of funds managed by large institutional investors.

Common ownership (CO) refers to investors owning shares in more than one company in the same industry. Recently, the academic community has been discussing extensively the potential anti-competitive effects of common ownership. The potential link is that investors with stakes in several companies in the industry have incentives to maximize industry profits rather than individual firm profits. As a result, they might influence managers to price less competitively and thus more harmfully to consumers.

The academic community is divided about the effects of rising common ownership on competitive outcomes and implications for regulatory responses. For instance, the authors

in Azar et al. (2018) and Azar et al. (2019) find negative effects of common ownership on retail prices in the U.S. airline and the U.S. banking industry respectively. Furthermore, they calculate that levels of market concentration, when taking into account common ownership, would substantially exceed the threshold above which antitrust concerns arise according to the merger guidelines of the antitrust authorities in the U.S. (Azar et al., 2018). As a consequence, they propose to take into account common ownership when assessing concentration levels in markets and to scrutinize prospective mergers between institutional investors from a competition perspective to mitigate anti-competitive effects. Elhauge (2016) suggests interventions from antitrust authorities when common ownership can be shown to have anti-competitive effects.

On the contrary, other researchers are more skeptical about policy implications derived from the existing body of literature. For instance, O'Brien and Waehrer (2016) caution against drawing any premature conclusions. Their main arguments are that existing research either lacks scope for causal inference or is not robust in the sense that findings cannot be replicated. Further, the applied assumptions on how financial cash flow rights by investors translate into control rights over companies and make managers deviate from firm-level profit maximization are neither theoretically founded nor empirically observed they claim. Ginsburg and Klovers (2018) complement existing concerns from a legal perspective. Section 2.2 provides an overview of the corresponding literature.

Obviously such scholarly dissent does not diminish the relevance of the topic, especially in light of such substantial shifts in ownership in the recent decade. The trend of increasing common ownership links to the topical debate about increasing market concentration and market power and its macroeconomic implications (see Van Reenen (2018), De Loecker et al. (2020) and Philippon (2019)) and potentially serves as an explanation for documented decreases in competition across countries and markets.

In this paper, I want to contribute to the current debate about common ownership and its potential anti-competitive effects. I use ownership data for Dutch banks and pricing data for savings accounts in the Dutch retail banking market (see Section 2.3). I demonstrate increasing common ownership for the banking market in the Netherlands,

both induced by increasing private investment through large investment funds and substantial involvement in the market by the Dutch state due to bailout policies to counter the adverse effects of the financial crisis.

I run simulations based on a structural model to demonstrate how pricing decisions of banks change when a common ownership mechanism enters the model. The theoretical framework is provided in Section 2.4. My structural approach relies on estimating demand elasticities with product-level data for savings accounts for 2014 using data from the calibration period from 2007 to 2014 (see Section 2.5). I back out marginal cost equivalents and predict product-level retail prices for different levels of common ownership.

I present simulation results in Section 2.6. Conditional on a common ownership channel entering the model, I provide a set of results making different assumptions about the levels of common ownership. I choose interest rates in 2014 as a baseline to compare simulated counterfactual interest rates to. I use three different scenarios varying in the magnitudes of common ownership assumed. In the first scenario, I allow observed levels of common ownership in 2014 to enter the structural model and find mostly negative effects for the interest rates. Some banks decrease interest rates by up to almost 30 basis points. In the second scenario, I assume larger observed levels of common ownership in 2017 to govern price setting behavior in 2014. This causes decreases in interest rates of up to 40 basis points compared to realized levels of interest rates in 2014. In the last scenario, I manipulate the ownership structure to reflect hypothetical, albeit not unrealistic levels of common ownership when extrapolating the trend of increasing common ownership in the Dutch banking market. The negative effects on interest rates are large with some large banks pricing up to 50 basis points lower compared to observed interest rates in 2014. These changes are substantial given average interest rates of 1.26% and a standard deviation of 0.36% in the market in 2014. Related changes in annual interest payments to consumers are heterogeneous across banks and scenarios and vary between small increases and reductions in interest of more than 100 euros. The average effect for consumers is an annual decrease in interest payments between 12 and 33 euros depending on the scenario.

My analysis shows that common ownership can have large detrimental effects on retail prices. The results are based on a structural model assuming a direct link between portfolios of investors in the same industry and individual pricing decisions at the company level. Following the theory such common ownership links tie firms together with regards to pricing decisions with similar effects as collusion between firms or outright mergers. The stipulated interdependence can be large even in light of small investment shares. Whether financial cash flow rights by investors translate into decisive control rights on the corporate level remains an empirical question and more research is needed. My work contributes to the current discussions of increasing market power by quantifying the potential effects of common ownership on pricing behavior.

2.2 Literature

The notion that ownership structures might influence firm pricing behavior has received vivid attention long before the current debate about common ownership. Few would contest that mergers within industries might influence competition. How about firms acquiring shares in rival firms? Such a situation of so called cross-ownership can be considered as a joint venture. O'Brien and Waehrer (2016) illustrate the theory of joint ventures as follows. If firm 1 acquires a certain share in firm 2, there are two channels how competition could be lowered in the market. Firstly, firm 1 has less incentives to behave aggressively on the market as it will harm itself through its investment position in firm 2. Secondly, firm 1 has an interest in firm 2 to attenuate the level of competition and depending on the corporate governance structure might promote such behavior within decision processes of firm 2. What would theory predict about the effects of common ownership? Consider appendix 2.A.1 for a graphical illustration of different ownership structures and its effects on competition.

The theoretical I.O. literature has looked into such issues as early as Bresnahan and Salop (1986) and Reynolds and Snapp (1986). Bresnahan and Salop (1986), for instance, suggested a modified Herfindahl-Hirschmann Index (MHHI) to measure concentration

taking into account the effects of joint ventures and thus incorporating firms' financial interests in its rivals. O'Brien and Salop (2000) generalize the MHHI to take into account common ownership.

More and more empirical approaches have been conducted lately. Azar et al. (2019) use another generalized form of the Herfindahl-Hirschmann Index (GHHI) taking into account both cross-ownership and common ownership. Doing so, they establish negative correlations between deposit rates and concentration measures accounting for common ownership and cross-ownership in the U.S. banking industry. Similarly, Azar et al. (2018) investigate the effects of rising common ownership on ticket prices in the U.S. airline industry. They find that market concentration is substantially larger once common ownership is accounted for compared to using conventional measures, and also larger compared to what regulators deem to be harmful for competition in product markets. The authors find that increased concentration can explain substantial increases in ticket prices.

Establishing causal links between common ownership and prices using concentration measures is controversial. Among others, Gramlich and Grundl (2017) point out the main issues with concentration measures based on the Herfindahl-Hirschmann Index (HHI). First, these measures are endogenous as they rely on market shares which depend on quantities. Second, concentration measures only vary at the market level and therefore lose a substantial amount of variation as profit weight measures vary on the firm level. Backus et al. (2018) emphasize the theoretical limitations of the existing modifications of the HHI which only hold under Cournot competition with homogeneous products. They call for using structurally founded measures such as profit weights and not resort to measures related to the structure-conduct-performance paradigm which have seen a demise in modern I.O. literature.

Backus et al. (2019) offer a helpful literature overview of the recent academic activity on the topic of common ownership. Among the papers reviewed are the papers from José Azar and coauthors mentioned above. These papers attracted replies among others by Kennedy et al. (2017), Dennis et al. (2019) and Gramlich and Grundl (2017), all of whom cannot replicate that common ownership results in anti-competitive effects in the

respective markets. They criticize the empirical set-up using concentration measures based on the HHI in price regressions. They claim that the HHI and all measures derived from it are endogenous and regression results become spurious. Kennedy et al. (2017) argue in favor of using profit weights derived from ownership structures to measure common ownership. Using this methodology, they cannot find positive effects of common ownership on ticket prices in the U.S. airline industry in contrast to Azar et al. (2018). Among the proponents of using profit weights as theory-founded measures for common ownership are also Gramlich and Grundl (2017) and Backus et al. (2018) with preliminary findings for the U.S. banking market and the U.S. cereal industry respectively.

Whereas empirical evidence on the existence of anti-competitive effects is scarce, different channels are debated how these could come into play. Azar et al. (2018) offer several possible links. On the one hand, they reckon that diversified investors do not actually need to intervene actively and push managers to slack on product market competition. It is sufficient to be passive and not to urge managers to act in a more competitive way. Thought differently, if diversified investors crowd out activist investors who would otherwise urge managers more to out-compete rival firms, product market competition can be relaxed. On the other hand, Azar et al. (2018) suggest an active role in corporate governance through several channels. Investors can address managers directly either in public forums or in private meetings (voice channel), can adjust managers' incentives through, for instance, flat payment schemes (incentives channel) or either threaten to use or outright use their voting rights (vote channel) to urge managers to implement a product market strategy in their favor. Antón et al. (2018) find that manager compensation is more sensitive to firm performance if common ownership is lower. On the contrary, O'Brien and Waehrer (2016) point out fiduciary duties that firm managers have to oblige to and which legally forbid them to pursue any goals beyond the own firm's interests.

2.3 Data and Trends

Data on quantities at the product level originate from survey data from the DNB Household Survey (DHS) which provides detailed household information, including information on debt and asset holdings. Most importantly, this comprises individual product choices for savings accounts. DHS is a representative survey with around 2,000 households participate in DHS each year. More information on the survey is provided in Teppa and Vis (2012). I use such data from 2007 to 2014 for the demand-side estimations. I retrieve data on interest rates from online comparison websites, mostly Spaarinformatie and I obtain ownership data at the bank-level from the Bureau van Dijk Orbis (Orbis) database. I possess data on ownership for the years from 2011 to 2017 and focus on 2014 in the simulation exercises as the most recent year of overlap of all data sources.

Most banks selected in the survey are represented either directly or indirectly in the ownership data. In some cases, the parent company is listed in the data (e.g. the retail bank Centraal Beheer belongs to Achmea). After data cleaning,[1] I obtain time series for ownership data from 2011 to 2017. Table 2.3.1 lists the banks which were selected by the DHS survey participants and provides information about the availability in the ownership data and the parent company's name if applicable. I assume no common ownership for banks for which I do not observe any entries in the Orbis database. Note that the banks missing in the ownership data are rather small players with usually less than 1% market share such as Argenta or AT Bank.

Tables 2.3.2 and 2.3.3 describe how the ownership structure developed in the Dutch banking market in the time period from 2011 to 2017 through the common ownership lens. Table 2.3.2 displays the number of common owners by bank. I define common owners as investors which are invested in at least two banks in the Dutch banking market in any given year.[2] The amount of common owners remains relatively low in the beginning. Starting from 2015, however, the amount sharply increases for ABN AMRO and ING

[1] In some instances, Orbis does not provide the exact ownership shares but a lower threshold (e.g. <3%). In that case I assume exact ownership of the lower threshold.

[2] Seldeslachts et al. (2017) call those investors to have "blockholdings". Their definition is that an investor with blockholdings has investments in at least four companies from the same industry.

Table 2.3.1: Banks in the Netherlands

Banks chosen in the survey	Listed in Orbis	Ownership links
ABN AMRO	ABN AMRO Group N.V.	
AEGON	AEGON Bank NV	
ASN Bank	ASN Bank	owned by SNS Bank
AT Bank		
Argenta		
Centraal Beheer	Achmea Bank NV	owned by Achmea Bank
Credit Europe Bank		
DSB Bank		not in data (bankrupt in 2009)
Fortis Bank NL		not in data (merged with ABN AMRO)
Friesland Bank		owned by Rabobank
GarantiBank	GarantiBank International NV	
ING Bank	ING Groep NV	
LeasePlan Bank	Leaseplan Corporation N.V.	
Moneyou		owned by ABN AMRO
NIBC Direct		
Nationale-Nederlanden	Nationale-Nederlanden Bank NV	
OHRA	Delta Lloyd Bank NV	owned by Delta Lloyd
Rabobank	Cooperatieve Rabobank U.A.	
RegioBank		owned by SNS Bank
Robeco		owned by Rabobank
SNS Bank	De Volksbank N.V.	parent company's name
Triodos Bank	Triodos Bank NV	

Notes: This table shows all banks which were chosen by participants of the representative DHS survey in column 1. Column 2 mentions all banks for which information on the shareholder structure is available in Orbis and therefore which banks potentially exhibit common ownership. Column 3 provides information about subsidiary structures.

Bank. A similar structural break can be observed regarding the magnitude of shares jointly held by common owners as reported in Table 2.3.3. The banks ABN AMRO, ASN Bank and SNS Bank have the Dutch state as one large common owner. Starting with the nationalization of SNS Bank in 2013, common ownership links the three banks. Table 2.3.3 reveals interesting dynamics regarding common ownership of ABN AMRO and ING Bank. ABN AMRO's common ownership starts to decrease from 2015 onwards which coincides with divestment of shares to private investors by the Dutch state. Common ownership in ING Bank, however, increases substantially starting in 2015. The reason is that ING Bank is the only bank with a largely diversified ownership structure before 2015 and increases in common ownership come about when ABN AMRO is slowly re-privatized.

Table 2.3.3 also presents some odd results. For instance, the shares of Rabobank commonly held amounts to 100% in 2011 and 100% for SNS Bank in 2011 and 2012 already before its nationalization. The reason is that in both cases the respective holding company

Table 2.3.2: Number of common owners

	2011	2012	2013	2014	2015	2016	2017
ABN AMRO	0	0	1	1	11	20	31
AEGON	0	0	0	0	0	0	0
ASN Bank	.	.	1	1	1	.	.
Centraal Beheer	0	0	0	0	0	0	0
GarantiBank	0	.	0	0	0	0	0
ING Bank	2	1	0	1	10	20	30
LeasePlan Bank	.	.	.	.	.	.	0
Nationale-Nederlanden	.	.	0	1	1	1	1
OHRA	.	.	0	0	0	1	1
Rabobank	1	0	0	0	0	0	0
SNS Bank	1	1	1	1	1	1	1
Triodos Bank	0	0	0	0	0	0	0

Notes: This table presents the number of common owners by bank and year. Common owners are defined as investors which are invested in at least two banks in the Dutch banking market in any given year. Dots represent missing data.

Table 2.3.3: Shares jointly held by common owners

	2011	2012	2013	2014	2015	2016	2017
ABN AMRO	0	0	97.8	100	100	78.3	74.8
AEGON	0	0	0	0	0	0	0
ASN Bank	.	.	100	100	100	.	.
Centraal Beheer	0	0	0	0	0	0	0
GarantiBank	0	.	0	0	0	0	0
ING Bank	.47	.31	0	.73	8.74	19.2	20.1
LeasePlan Bank	.	.	.	.	.	.	0
Nationale-Nederlanden	.	.	0	100	100	100	100
OHRA	.	.	0	0	0	100	100
Rabobank	100	0	0	0	0	0	0
SNS Bank	100	100	100	100	100	100	100
Triodos Bank	0	0	0	0	0	0	0

Notes: This table presents the total of shares in percent commonly held by common owners by bank and year. Common owners are defined as investors which are invested in at least two banks in the Dutch banking market in any given year.

which is the exclusive owner holds small shares in ING Bank and therefore is labeled as a common owner. In order to present a more accurate picture of economic cross-interests, I present tables applying a more restrictive definition of common ownership. Tables 2.3.4 and 2.3.5 present the number of common owners and shares commonly owned if common ownership requires investors to have a minimum of 1% of total shares in at least two banks at any time. I follow Seldeslachts et al. (2017) and exclude shareholders with a very small minority share who can arguably not have a large impact on strategic decisions at the bank level. The tables reveal a much lower prevalence of common ownership in both the number of common owners and jointly owned shares. The dynamics in common ownership, however, seem to be driven at large by ABN AMRO and ING Bank.

Table 2.3.4: Number of common owners (1% threshold)

	2011	2012	2013	2014	2015	2016	2017
ABN AMRO	0	0	1	1	2	2	4
AEGON	0	0	0	0	0	0	0
ASN Bank	.	.	1	1	1	.	.
Centraal Beheer	0	0	0	0	0	0	0
GarantiBank	0	.	0	0	0	0	0
ING Bank	0	0	0	0	1	1	3
LeasePlan Bank	.	.	.	.	.	.	0
Nationale-Nederlanden	.	.	0	0	0	0	1
OHRA	.	.	0	0	0	0	1
Rabobank	0	0	0	0	0	0	0
SNS Bank	0	0	1	1	1	1	1
Triodos Bank	0	0	0	0	0	0	0

Notes: This table presents the number of common owners by bank and year. Common owners are defined as investors which are invested with a minimum of 1% in at least two banks in the Dutch banking market in any given year. Dots represent missing data.

Table 2.3.6 lists the respective five largest owners of Dutch banks in 2017. While most banks are exclusively held by a holding company, the ownership structures of ABN AMRO and ING Bank are diversified with institutional investors such as Blackrock, Vanguard and State Street owning small but some of the largest stakes in ING Bank.

Table 2.3.5: Shares jointly held by common owners (1% threshold)

	2011	2012	2013	2014	2015	2016	2017
ABN AMRO	0	0	97.8	100	99.6	71.9	61.1
AEGON	0	0	0	0	0	0	0
ASN Bank	.	.	100	100	100	.	.
Centraal Beheer	0	0	0	0	0	0	0
GarantiBank	0	.	0	0	0	0	0
ING Bank	0	0	0	0	1.84	1.7	5.41
LeasePlan Bank	.	.	.	.	.	.	0
Nationale-Nederlanden	.	.	0	0	0	0	100
OHRA	.	.	0	0	0	0	100
Rabobank	0	0	0	0	0	0	0
SNS Bank	0	0	100	100	100	100	100
Triodos Bank	0	0	0	0	0	0	0

Notes: This table presents the total of shares in percent commonly held by common owners by bank and year. Common owners are defined as investors which are invested with a minimum of 1% in at least two banks in the Dutch banking market in any given year.

Table 2.3.6: Largest owners (2017)

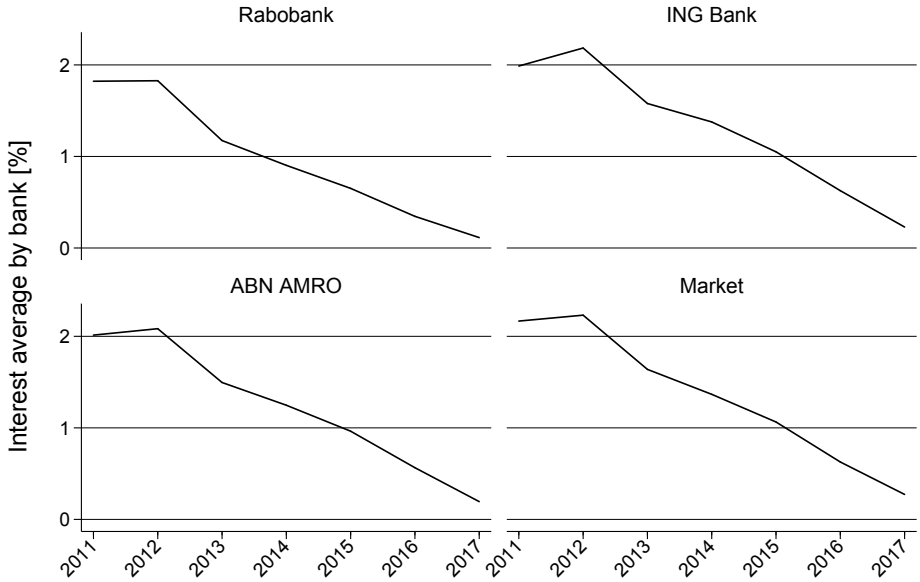
Bank	Name of owner	Share
ABN AMRO	Staat der Nederlanden	56.26
ABN AMRO	Capital Group Co Inc	4.31
ABN AMRO	Capital Research and Management Co	3.01
ABN AMRO	Capital Group International	3.01
ABN AMRO	Parvus Asset Management Europe Limited	2.87
AEGON	Aegon NV	100
Centraal Beheer	Achmea BV	100
Rabobank	Cooperatieve Rabobank U.A.	100
SNS Bank	Staat der Nederlanden	100
OHRA	NN Group NV	100
GarantiBank	GarantiBank International NV	100
ING Bank	Blackrock Inc	4.76
ING Bank	Artisan Partners Asset Management Inc	2.91
ING Bank	Vanguard Group Inc	2.52
ING Bank	Sas Rue La Boetie	1.7
ING Bank	State Street Corp	1.57
LeasePlan Bank	LP Group B.V.	100
Nationale-Nederlanden	NN Group NV	100
Triodos Bank	Triodos Bank NV	100

Notes: This table lists the largest owners by bank. Column 3 denotes the share in percent.

Interest rates were subject to changing monetary policy conditions and experienced a steady decline in the period under observation. Figure 2.3.1 displays the trajectories of average interest rates of savings accounts on the bank level for selected banks and the

average for the Dutch market.

Figure 2.3.1: Development of average interest rates by banks and the market



Notes: This figure illustrates the development of the unweighted average interest rate across savings account products by selected banks between 2011 and 2017. The fourth panel depicts the average for the Dutch market for savings accounts products. *Source:* Price comparison websites and own calculations.

2.4 Structural Measure of Common Ownership

I derive profit weights to measure common ownership following Backus et al. (2018). To see how profit weights are derived, consider the following profit maximization set-up for a firm in a general context. Shareholder s has the cash flow right β_{fs} in firm f. The profit of shareholder s is given by the sum of her cash flow rights in all companies g, i.e. $\pi_s = \sum_{\forall g} \beta_{gs}\pi_g$. The objective function O of firm f thus can be considered as the maximization of its shareholders' profit functions weighted by respective control weights γ_{fs}. The control weights denote the importance of shareholder s in firm $f's$ profit considerations or from a corporate decision making point of view, by how much

shareholder s is capable of influencing the firm's strategic choice in her favor.

$$
\begin{aligned}
O_f(\mathbf{p_f}, \mathbf{p_{-f}}) &= \sum_s \gamma_{fs}\pi_s(\mathbf{p_f}, \mathbf{p_{-f}}) = \sum_s \gamma_{fs}\left(\sum_{\forall g} \beta_{gs}\pi_g(\mathbf{p_f}, \mathbf{p_{-f}})\right) \\
&= \sum_s \gamma_{fs}\beta_{fs}\pi_f + \sum_s \gamma_{fs} \sum_{\forall f \neq q} \beta_{gs}\pi_g \\
&= \alpha\pi_f + \sum_{g \neq f} \underbrace{\frac{\sum \gamma_{fs}\beta_{gs}}{\sum \gamma_{fs}\beta_{fs}}}_{\kappa_{fg}} \pi_g = \pi_f + \sum_{g \neq f} \kappa_{fg}\pi_g,
\end{aligned}
\tag{2.4.1}
$$

where $\mathbf{p_f}$ and $\mathbf{p_{-f}}$ denote vectors of own prices as firm $f's$ strategic choice variables and prices of the other firms respectively. In the last line of the equation, I follow Backus et al. (2018) and normalize the own weights κ_{ff} to 1. Doing so provides for interpreting κ_{fg} as relative profit weights, i.e. how much firm f considers firm $g's$ profits relative to its own. The objects κ_{fg} are crucial for understanding how common ownership is measured and for how it enters the structural model for the simulation exercises. All κ_{fg} taken together form the coordination or profit weight matrix κ. Section 2.A.2 in the appendix illustrates how the profit weights are calculated. Note the subtle distinction between the cash flow rights β and the control weights γ. While β is relatively straightforward to measure by the invested amounts in each firm, assumptions on corporate government and corporate decision making govern the magnitude of γ. Note that I follow the common assumption in the literature that $\beta_{fg} = \gamma_{fg}$ which corresponds to proportional treatment of shareholders relative to the shares owned ("one share one vote"-rule or proportionate control).

I derive the empirical κ_t for $t \in [2011, 2017]$ using ownership data. Tables 2.4.1 and 2.4.2 present the coordination matrix for 2014 and 2017 respectively. The off-diagonal elements are of particular interest as these will govern the changes of pricing behavior of banks once the common ownership channel is active. In Table 2.4.1 the large entries between ABN AMRO and SNS Bank are striking. Both banks have the Dutch state as the (almost) exclusive common owner.[3] Integrating the common ownership channel into

[3] The share of the Dutch state in ABN AMRO in 2014 is 97.78%. The almost exclusive ownership of both banks by one owner results in a quasi-merger in the model. A similar result would have realized if more than one investor with common ownership in both banks was present (see Section 2.A.2).

the model would therefore predict the two banks to almost act as one entity. Comparing profit weights three years later in Table 2.4.2 reveals positive non-diagonal elements also for ING Bank and OHRA. Especially, the interaction between ING Bank and ABN AMRO is relevant in economic terms. Given a weight of around one quarter ING Bank places on profits of ABN AMRO, one can expect substantial shifts in the pricing behavior of at least ING Bank. Dependencies regarding common ownership between these two banks have risen as ABN AMRO constantly has been diversifying ownership away from the Dutch state and investors have become more active in ABN AMRO who already had been invested in ING Bank.

Table 2.4.1: Profit weights (2014)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rabobank (1)	1	0	0	0	0	0	0	0	0	0
ING Bank (2)	0	1	0	0	0	0	0	0	0	0
ABN AMRO (3)	0	0	1	1.02	0	0	0	0	0	0
SNS Bank (4)	0	0	.978	1	0	0	0	0	0	0
Triodos Bank (5)	0	0	0	0	1	0	0	0	0	0
LeasePlan Bank (6)	0	0	0	0	0	1	0	0	0	0
OHRA (7)	0	0	0	0	0	0	1	0	0	0
GarantiBank (8)	0	0	0	0	0	0	0	1	0	0
Centraal Beheer (9)	0	0	0	0	0	0	0	0	1	0
AEGON (10)	0	0	0	0	0	0	0	0	0	1

Notes: This table reports profit weights following the methodology of Backus et al. (2018). The labeling of the columns follows the order of the rows but bank names are omitted in the column headers for illustrative reasons. Hence, column (1) refers to Rabobank and the entry in (1,2) of the matrix refers to the profit weight Rabobank places on ING Bank's profits.

One controversial notion is that the applied methodology potentially leads to large profit shares despite relatively small investment shares under certain circumstances. Whereas this is not an inconsistency in the methodology, it does not seem straightforward that very small investors have a decisive impact on corporate decisions. In order to mitigate an overstated effect of small investors, I provide the profit weight matrix for 2017 after omitting all investors with less than 1% in any bank in Table 2.4.3. In this altered version, the large weight OHRA has on ING Bank's profit disappears completely, while other effects are reduced in magnitude.

Table 2.4.2: Profit weights (2017)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rabobank (1)	1	0	0	0	0	0	0	0	0	0
ING Bank (2)	0	1	0.26	0	0	0	0.74	0	0	0
ABN AMRO (3)	0	0.0050	1	1.74	0	0	0.0043	0	0	0
SNS Bank (4)	0	0	0.56	1	0	0	0	0	0	0
Triodos Bank (5)	0	0	0	0	1	0	0	0	0	0
LeasePlan Bank (6)	0	0	0	0	0	1	0	0	0	0
OHRA (7)	0	0.0046	0.0014	0	0	0	1	0	0	0
GarantiBank (8)	0	0	0	0	0	0	0	1	0	0
Centraal Beheer (9)	0	0	0	0	0	0	0	0	1	0
AEGON (10)	0	0	0	0	0	0	0	0	0	1

Notes: This table reports profit weights following the methodology of Backus et al. (2018). The labeling of the columns follows the order of the rows but bank names are omitted in the column headers for illustrative reasons. Hence, column (1) refers to Rabobank and the entry in (1,2) of the matrix refers to the profit weight Rabobank places on ING Bank's profits.

Table 2.4.3: Profit weights (2017) - 1% threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rabobank (1)	1	0	0	0	0	0	0	0	0	0
ING Bank (2)	0	1	0.15	0	0	0	0	0	0	0
ABN AMRO (3)	0	0.0026	1	1.75	0	0	0	0	0	0
SNS Bank (4)	0	0	0.56	1	0	0	0	0	0	0
Triodos Bank (5)	0	0	0	0	1	0	0	0	0	0
LeasePlan Bank (6)	0	0	0	0	0	1	0	0	0	0
OHRA (7)	0	0	0	0	0	0	1	0	0	0
GarantiBank (8)	0	0	0	0	0	0	0	1	0	0
Centraal Beheer (9)	0	0	0	0	0	0	0	0	1	0
AEGON (10)	0	0	0	0	0	0	0	0	0	1

Notes: This table reports profit weights following the methodology of Backus et al. (2018) and omitting investors with less than 1% market share. The labeling of the columns follows the order of the rows but bank names are omitted in the column headers for illustrative reasons. Hence, column (1) refers to Rabobank and the entry in (1,2) of the matrix refers to the profit weight Rabobank places on ING Bank's profits.

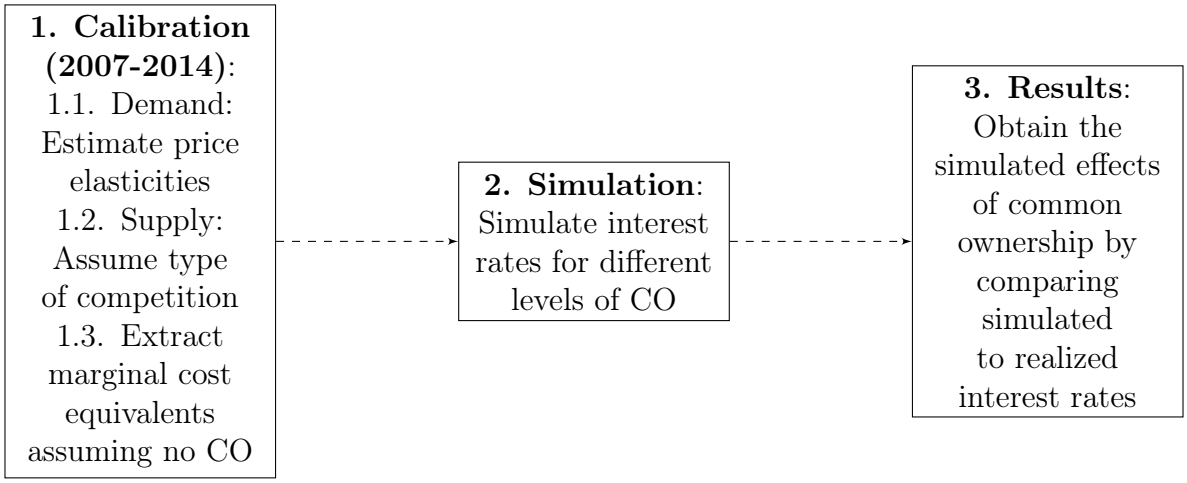
Lastly, entries in the profit weight matrix above 1 warrant further explanation. Note that entries of 1 denote joint ownership in coordination matrices. Values above 1 thus seem difficult to reconcile with the common understanding of firm interactions. The literature has coined the term tunneling to explain similar findings bearing the notion that funds would be transferred from one company to another. This seems to be unlikely between independent banks in a competitive banking market and the implications of common ownership might be overstated.

2.5 Structural Model

The structural model I use for obtaining the simulation results includes three steps (graphically illustrated in Figure 2.5.1) and is adopted from Chapter 1.[4] Step 1 involves the calibration of the model. That is, I use demand-side estimations to derive consumer demand elasticities with respect to the interest rate. On the supply side, I make assumptions on the type of competition allowing me to back-out the expected net loan rates (which can be considered as the marginal cost equivalents in the context of using interest rates and not prices). When retrieving the expected net loan rates, I assume no common ownership to affect pricing in the market. Note that the first step is data driven and the retrieved variables can be considered as empirical market descriptions. With these essentials I turn to the simulation part of the model depicted in step 2. When simulating interest rates, I change the levels of common ownership in the model to predict different equilibria. In the third step, I analyze the effects of common ownership on prices by comparing the simulated interest rates in different scenarios with realized levels of interest in 2014. In the remainder of this section, I will specify the modeling of demand and supply.

[4] In this section, I summarize the main points of the shared methodology with Chapter 1 and highlight the changes to include a common ownership channel in the structural model. In the interest of conciseness, I do not duplicate the results of the model calibration (demand estimation and backing out of marginal cost equivalents) but provide cross-references to tables presented in Chapter 1.

Figure 2.5.1: Components of the structural model



Demand:

I estimate the following random-coefficients logit specification for the demand side of the model using data from the calibration period 2007 to 2014:

$$\begin{aligned} U^i_{jbt} &= \alpha + \beta^i \textit{interest rate}_{jbt} + \gamma_1 \textit{internet only}_{jbt} + \gamma_2 \textit{minimum amount}_{jbt} \\ &+ \gamma_3 \textit{bonus rate}_{jbt} + \gamma_4 \textit{other}_{jbt} + \gamma_5 \textit{product age}_{jbt} \\ &+ \textit{bank}\,\delta + \eta\, \textit{inertia}_{jbt} + (\textit{inertia}_{jbt}\, x\, \textit{bank}_j)\,\zeta + \epsilon^i_{jbt}, \\ \text{with } i &= 1, ..., I, j = 1, ..., J, b = 1, ..., B, t = 1, ..., T. \end{aligned} \tag{2.5.1}$$

This specification recognizes the RUM principle that consumer i chooses product j of bank b (at time t) yielding the highest utility in expectation. I estimate the model using the generalized method of moments (GMM) estimator suggested by Berry et al. (1995) and using aggregated market shares. The random-coefficients logit model allows for heterogeneity in consumer preferences and more realistic substitution patterns across alternatives. The variable *interest rate* enters the model with a random coefficient. In order to mimic consumer choice, I employ product characteristics as covariates in the utility equation: *internet only* indicating whether an account is for online usage only, *minimum amount* indicating whether interest payment is subject to a certain minimum

deposit amount, *bonus rate* depicting whether customers are rewarded for not withdrawing savings by offering a bonus on the minimum amount within a quarter and a (lower) base rate on the remainder, *other* subsuming whether an account features one or more of the following: fixed deposit plan, withdrawal limitations, or group eligibility constraints (e.g. only for youth), and *product age* measuring the time a product has already been available in the market in years. Banks can use the age of a product as a price discrimination tool.

Further *bank* is a vector of bank fixed effects accounting for features all products from the same bank share. This could be thought of as bank reputation or physical infrastructure including bank branches or automated teller machines which customers of a bank can use. I employ the variable *inertia* measuring the fraction of consumers having chosen the same product in period t as in period $t-1$ to account for state dependency and I interact the variable of state dependency with bank fixed effects to control for different business strategies across banks. Lastly, α is a constant and ϵ^i_{jbt} is an i.i.d. error term. In order to account for endogeneity, I instrument the interest rate with functions of other products' characteristics serving as cost shifters. The results of the demand estimation using the same sample as in Chapter 1[5] can be found in Section 1.6.1.[6]

Supply:

On the supply side of the model I incorporate a common ownership channel similar to Backus et al. (2018). In order to model bank pricing behavior, I consider the following multiproduct profit maximization problem in the assumed context of Bertrand competition. Bank b sets the deposit rates d_j for all its savings account products j in its product set F_b. In this case the choice variables are interest rates for deposits. Within the process of credit transformation, banks raise deposits to lend to firms and to potentially realize a positive margin. In the model I allow for separate modeling of pricing decisions in

[5] Data used for demand estimation stems from the DHS survey and price comparison websites. I match observed individual product choice with product-level information. For the estimation procedure I aggregate data on the market level (see Table 1.4.2 for corresponding market shares). A more thorough description of the data can be found in Section 1.4. Note that Nationale Nederlanden is not part of the sample used for estimation and simulation as I encountered convergence issues. However, omitting Nationale Nederlanden should not alter the results given its relatively small market shares.

[6] Summary statistics of the employed variables are displayed in Table 1.5.1, estimated coefficients in Table 1.6.1 and derived own-price elasticities in Table 1.6.2.

the deposit market and assume banks to adjust their deposit rates subject to bank-level exogenous expected loan rates $\bar{r_b}$. Each bank thus has individual, model-exogenous expectations on its returns on deposits. Furthermore, raising deposits creates marginal costs varying on the product level c_j. Different marginal costs across products can be explained by product differentiation. For instance, the marginal costs for internet-only accounts can be expected to be lower than for accounts allowing customers to use branch services. Besides the profit raised from its own products, each bank values the profits generated by other banks to the extent governed by the common ownership channel. The following equation formalizes the profit maximization problem for bank $b \in 1, 2, ...B$ with a subset of products F_b (time subscripts are omitted):

$$\max_{\{d_j \, \forall \, j \, \in \, F_b\}} \pi_b(\mathbf{d}) = \underbrace{\sum_{j \in F_b} (\bar{r_b} - c_j - d_j) q_j(\mathbf{d})}_{\text{conventional component}} + \underbrace{\sum_{g \neq b}^{B} \kappa_{bg} \sum_{k \in F_g} (\bar{r_g} - c_k - d_k) q_k(\mathbf{d})}_{\text{common ownership component}}, \tag{2.5.2}$$

where $q_j(\mathbf{d})$ depicts demand for savings account j and $\mathbf{d}$ is a $J \times 1$ vector of deposit rates with J being the total number of all products in the market. The first part of the sum represents the conventional component of profit maximization. Bank b maximizes the profits from its own products in the market. The second part reflects the common ownership component in profit maximization according to which the profit generated by products of all other banks g enter bank $b's$ profits according to weights κ_{bg}. Note that the second part of the profit maximization captures the driving forces of changes in the ownership structure on pricing behavior of banks and determines the deviations from pricing behavior in traditional models.

Taking into account the optimal pricing decision rules for all banks while assuming Bertrand competition, the Nash equilibrium is defined by the following system of first-

order conditions spelling out implicitly the optimal pricing rules for each product j:

$$-q_j(\mathbf{d}) + \sum_{l \in F_b} (\bar{r_b} - c_l - d_l) \frac{\partial q_l(\mathbf{d})}{\partial d_j} + \sum_{g \neq b}^{B} \kappa_{bg} \sum_{k \in F_g} (\bar{r_g} - c_k - d_k) \frac{\partial q_k(\mathbf{d})}{\partial d_j} = 0, \qquad j = 1, ...J. \tag{2.5.3}$$

One can think of the term $\bar{r_b} - c_j$ $(= r_{j,net})$ as the expected loan rate (net of marginal costs) specific to product j. Setting d_j allows the bank to set the profit margin, $r_{j,net} - d_j$ for product j. This is analogous to the formulation of the problem when prices enter positively into the firms' profit functions and profit margins are equal to $p_j - mc_j$. Equation 2.5.3 can be rewritten in vector notation:

$$-\mathbf{q}(\mathbf{d}) + \{\boldsymbol{\Gamma}(\boldsymbol{\kappa}) \odot \boldsymbol{\Delta}(\mathbf{d})\}(\mathbf{r_{net}} - \mathbf{d}) = 0, \tag{2.5.4}$$

where $\mathbf{q}(\mathbf{d})$ is the $J \times 1$ demand vector, $\mathbf{r_{net}}$ is the $J \times 1$ expected net loan rate vector and $\boldsymbol{\Delta}(\mathbf{d}) \equiv \partial \mathbf{q}(\mathbf{d}) / \partial \mathbf{d}'$ is the $J \times J$ Jacobian of first derivatives. $\boldsymbol{\Gamma}$ is the profit weight matrix transformed to the $J \times J$ product space, with $\Gamma(j,k) = 1$ if savings accounts j and k are offered by the same bank b and $\Gamma(j,k) = \kappa_{bg}$ if products j and k are offered by banks b and g respectively. $\odot$ depicts element-by-element multiplication.

Consider equation 2.5.4 rewritten as presented below. I use equation 2.5.5 to back out the term $\mathbf{r_{net}}$ under the assumption of no common ownership.[7]

$$\mathbf{d} = \mathbf{r}_{net} - \{\hat{\boldsymbol{\Gamma}}(\boldsymbol{\kappa}) \odot \boldsymbol{\Delta}(\mathbf{d})\}^{-1} \mathbf{q}(\mathbf{d}). \tag{2.5.5}$$

Having backed out the vector of expected net loan rates $\mathbf{r_{net}}$, one can test for the price effects of different values $\hat{\boldsymbol{\Gamma}}$ of the coordination matrix. I concretely show this in equation 2.5.6. Plugging in the backed-out empirical term $\mathbf{r}_{2014,net}$ and some specification of the coordination matrix $\hat{\boldsymbol{\Gamma}}^{CO}_{2014}$ enabling the common ownership channel allows for an iterated solving for interest rates under common ownership $(\mathbf{d}^{CO}_{2014})$.

$$\mathbf{d}^{CO}_{2014} = \mathbf{r}_{2014,net} - \{\hat{\boldsymbol{\Gamma}}^{CO}_{2014} \odot \boldsymbol{\Delta}(\mathbf{d}^{CO}_{2014})\}^{-1} \mathbf{q}^{CO}_{2014}(\mathbf{d}^{CO}_{2014}). \tag{2.5.6}$$

[7] Backed-out expected net loan rates and markups are displayed in Table 1.6.5.

I solve for interest rates using fixed point iterations using a dampening parameter. In each iteration step, the interest rates, predicted market shares and the Jacobian are updated. I proceed with iterations until updates in the interest rates are significantly small.

2.6 Simulations

In the following, I provide counterfactual simulation results of interest rates in 2014 for three scenarios of common ownership. Taking 2014 as the baseline year for the comparison of observed interest rates and simulated interest rates is an artifact of data availability given it is the most recent year for which I possess data both on ownership and on consumer choice. Results should therefore not be interpreted as actual effects in 2014 but as general potential effects given different magnitudes of common ownership. In all cases I estimate the effects of common ownership by comparing simulated interest rates to actual interest rates from 2014. Table 2.6.1 shows the results of the simulations.

In the first scenario, I use the profit weight matrix suggested by the actual ownership structure observed in 2014 (see Table 2.4.1). As common ownership is mostly driven by the Dutch government owning shares in ABN AMRO and SNS Bank resulting from bank bailouts during the financial crisis, I call this scenario the *public-common-ownership scenario*. Column (1) of Table 2.6.1 shows that the imposed ownership structure in the first scenario has the largest negative effects on interest rates of ABN AMRO and SNS BANK and its subsidiaries (Fortis Bank NL and Moneyou belonging to the former and ASN Bank and RegioBank belonging to the latter). This is not surprising given that the changes in the profit weights are tantamount to a merger of the two entities. Effects for the mentioned banks range approximately between 20 and 30 basis points, which is substantial given average interest rates of 1.26% and a standard deviation of 0.36% in 2014. Other banks exhibit much smaller effects or even positive effects of the common ownership channel. Interestingly, in all scenarios considered, small banks not associated with any of the three large banks slightly increase interest rates following the introduction of common ownership. Potentially, the market is two-tiered with small banks competing

Table 2.6.1: Weighted effects of common ownership on interest rates (in basis points)

	(1)	(2)	(3)	(4)
Rabobank	-1.14	-1.82	-1.61	-3.63
ING Bank	-0.31	-7.58	-4.22	-31.6
ABN AMRO	-20.8	-38.8	-38.6	-50.0
SNS Bank	-27.0	-14.0	-14.1	-13.3
Fortis Bank NL	-20.7	-38.5	-38.3	-49.7
AEGON	2.32	3.34	2.98	5.92
Argenta	2.04	2.91	2.60	5.18
ASN Bank	-27.3	-14.1	-14.2	-13.3
AT Bank	2.38	3.43	3.06	6.11
Credit Europe Bank	2.53	3.66	3.27	6.54
Friesland Bank	2.60	3.77	3.37	6.73
LeasePlan Bank	2.10	3.00	2.68	5.34
Moneyou	-19.8	-36.8	-36.6	-47.7
NIBC Direct	2.16	3.08	2.76	5.48
OHRA	2.35	3.05	3.02	5.06
RegioBank	-28.1	-14.4	-14.5	-13.3
Robeco	-1.56	-2.42	-2.16	-4.72
Triodos Bank	3.88	5.75	5.15	10.3
CO	2014 levels	2017 levels	2017 levels	hypothetical levels
1% threshold	no	no	yes	no

Notes: This table displays weighted effects of common ownership on interest rates by bank. I subtract observed interest rates in 2014 from simulated interest rates allowing for different levels of common ownership. Negative values refer to decreases in interest rates resulting from common ownership. Column (1) shows the effects of the *public-common-ownership scenario*, columns (2) and (3) the effects of the *private-common-ownership scenario* and column (4) the effects of the *hypothetical-private-common-ownership scenario*. Effects are aggregated on the bank level using observed market shares as weights. Changes are measured in basis points (i.e. one hundredth of one percentage point).

more fiercely against each other for the demand set free from increases in interest rates by the large banks.

In the second scenario, I simulate the effects of changing ownership structures applying the profit weight matrix from 2017 to the simulation of interest rates in 2014. The difference between 2014 and 2017 lies in the Dutch government having divested shares in ABN AMRO to private investors and therefore established common ownership links between the two large banks ABN AMRO and ING Bank (see Table 2.4.2). I label this scenario the *private-common-ownership scenario*. Columns (2) and (3) of Table 2.6.1 display the results of this scenario. The difference between the two sets of results is that the results summarized in column (3) follow a 1% threshold when calculating profit weights. Compared to the previous scenario, common ownership affects more banks. Besides ABN AMRO and SNS Bank, also ING Bank and OHRA have positive off-diagonal entries in the profit weights matrix. ABN AMRO features the largest negative effects resulting from common ownership amounting to almost 40 basis points. ING Bank decreases interest rates by almost eight basis points but by approximately only four basis points when investors with low investments are excluded. Results between columns (2) and (3) are fairly similar except for ING Bank. The reason is that ING Bank has a relatively dispersed ownership structure with many small investors while other banks' ownership structure is more concentrated on one or just a few owners.

In the third scenario, I extrapolate the observed trend of increasing private common ownership initiated before 2017. Besides ABN AMRO and ING Bank I assume common owners also to own shares in SNS Bank in this scenario. This way, the common ownership link between banks with a substantial share in the market rises and larger effects of common ownership can be expected. I describe this scenario as the *hypothetical-private-common-ownership scenario*.

The third scenario warrants further explanation. In this setting, I manipulate the ownership structure of 2017 such that it reflects hypothetical larger, albeit not unrealistic levels of common ownership. Doing so, I attempt to extrapolate the trends observed on the Dutch banking market. Until 2017, common ownership excluding the Dutch state as

a common owner almost exclusively featured ING Bank and ABN AMRO. The shares of Rabobank, a cooperative bank are not publicly traded. I therefore tripled the shares owned by common owners for both ING Bank and ABN AMRO and reduced the shares of the Dutch state and retail investors respectively. For ABN AMRO, this would mean a continuation of the divestment of shares held by the public to private investors. Further, I conduct a similar divestment of public shares in SNS Bank, which until today is exclusively state-owned. Concretely, I allow the largest 10 common owners to have a 5% stake respectively in SNS Bank and leave the Dutch state with 50%.

Table 2.6.2: Hypothetical profit weights

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rabobank (1)	1	0	0	0	0	0	0	0	0	0
ING Bank (2)	0	1	0.56	0.76	0	0	0.53	0	0	0
ABN AMRO (3)	0	0.21	1	1.67	0	0	0.060	0	0	0
SNS Bank (4)	0	0.071	0.42	1	0	0	0	0	0	0
Triodos Bank (5)	0	0	0	0	1	0	0	0	0	0
LeasePlan Bank (6)	0	0	0	0	0	1	0	0	0	0
OHRA (7)	0	0.014	0.0042	0	0	0	1	0	0	0
GarantiBank (8)	0	0	0	0	0	0	0	1	0	0
Centraal Beheer (9)	0	0	0	0	0	0	0	0	1	0
AEGON (10)	0	0	0	0	0	0	0	0	0	1

Notes: This table reports profit weights following the methodology of Backus et al. (2018). Profit weights are manipulated in the following way: starting from 2017 I multiply the shares held by all common owners for ING Bank and ABN AMRO times 3. For SNS Bank I newly introduce the ten largest common owners from 2017 with a respective share of 5%. I respectively adjust the holdings of the Dutch state in ABN AMRO and SNS Bank by the increase in private owners. The labeling of the columns follows the order of the rows but bank names are omitted in the column headers for illustrative reasons. Hence, column (1) refers to Rabobank and the entry in (1,2) of the matrix refers to the profit weight Rabobank places on ING Bank's profits.

Table 2.6.2 presents the profit weights of the third scenario. Compared to profit weights in 2017, the three affected banks are more interconnected with profit weights between 7% and more than 1. The levels of common ownership in this hypothetical example are such that all three affected banks would have up to 60% of their shares held by institutional investors which are common owners, whereas the other banks remain practically unaffected by common ownership. Such resulting levels of common ownership do not necessarily exceed levels currently observed in other markets. For instance, Ben-David et al. (2016) report that common owners account for 70% to 80% of shareholdings

of publicly traded firms in the U.S.

Table 2.6.3: Largest common owners - manipulated

Bank	Name of owner	Manipulated share	Actual share (2017)
ING Bank	Vanguard Group Inc	7.56	2.52
ING Bank	Sas Rue La Boetie	5.1	1.7
ING Bank	State Street Corp	4.71	1.57
ING Bank	Norway	4.5	1.5
ING Bank	Janus Henderson Group Plc	4.17	1.39
ABN AMRO	Staat der Nederlanden	19.26	56.26
ABN AMRO	Capital Group Co Inc	12.93	4.31
ABN AMRO	Norway	7.05	2.35
ABN AMRO	Fidelity International Limited	4.38	1.46
ABN AMRO	Janus Henderson Group Plc	4.17	1.39
SNS Bank	Staat der Nederlanden	50	100
SNS Bank	Societe Generale SA	5	0
SNS Bank	Fidelity International Limited	5	0
SNS Bank	State Street Corp	5	0
SNS Bank	Sas Rue La Boetie	5	0

Notes: This table lists the largest common owners by bank after increasing the shares owned by common owners from observed levels of 2017 for ABN AMRO and ING Bank. For SNS Bank, levels of private common owner investors are introduced on the expense of holdings of the Dutch government. Column 3 reports the result of the manipulated shares and column 4 provides the actual shares of 2017 for reference.

Column (4) of Table 2.6.1 presents the results of simulations of the *hypothetical-private-common-ownership scenario*. Effects are substantial with interest rate decreases larger than the standard deviation of interest rates for 2014 for ABN AMRO and its subsidiaries. Also ING, another large bank, decreases interest rates by more than 30 basis points. Further SNS Bank and its subsidiaries decrease interest rates significantly. The decrease in interest rates by two of the large banks is partially compensated for by an increase in interest rates by smaller banks as already observed in the other scenarios.

Welfare effects calculated as annual losses in interest payments conditional on staying with a bank are displayed in Table 2.6.4. Effects are heterogeneous across banks and scenarios. In the least intrusive scenario displayed in column (1), average losses in interest amount to around 12 euros with customers of SNS Bank and Fortis Bank NL being most affected incurring losses above 50 euros. The negative effects on interest are slightly larger when I assume the common ownership structure of 2017 to be in place already in 2014 (see columns (2) and (3)). The highest detrimental effects on consumers are produced when I assume hypothetical but already elsewhere observed levels of common ownership

Table 2.6.4: Change in interest (in euros)

	(1)	(2)	(3)	(4)
Rabobank	-2.09	-3.32	-2.95	-6.64
ING Bank	-0.57	-14.0	-7.77	-58.2
ABN AMRO	-27.8	-51.8	-51.6	-66.8
SNS Bank	-65.7	-34.2	-34.3	-32.4
Fortis Bank NL	-74.1	-137.9	-137.4	-178.1
AEGON	6.28	9.02	8.06	16.0
Argenta	4.10	5.84	5.22	10.4
ASN Bank	-51.3	-26.5	-26.7	-24.9
AT Bank	4.17	6.00	5.36	10.7
Credit Europe Bank	10.6	15.3	13.6	27.2
Friesland Bank	0.026	0.038	0.034	0.067
LeasePlan Bank	7.72	11.0	9.85	19.6
Moneyou	-45.5	-84.4	-83.8	-109.3
NIBC Direct	4.66	6.66	5.95	11.8
OHRA	3.55	4.60	4.56	7.64
RegioBank	-35.9	-18.4	-18.5	-17.0
Robeco	-3.56	-5.53	-4.92	-10.8
Triodos Bank	6.61	9.80	8.77	17.5
Total	-12.4	-17.3	-15.5	-32.9

Notes: This table displays average bank-level consumer welfare effects derived by multiplication of the interest rate difference induced by the common ownership channel (as displayed in aggregated terms in Table 2.6.1) with the average savings amount on the product level. I calculate bank-level effects using observed market shares as weights. The last row displays the average effect on all consumers. Column (1) shows the effects of the *public-common-ownership scenario*, columns (2) and (3) the effects of the *private-common-ownership scenario* applying a 1% threshold when calculating profit weights in column (3), and column (4) the effects of the *hypothetical-private-common-ownership scenario*. Effects are displayed in euros.

(column (4)). The average effect exceeds 30 euros. Customers of ABN AMRO and ING Bank incur losses of more than 50 euros. Even for Rabobank, a not insignificant loss in interest of around six euros can be observed. Some of the smaller subsidiaries of the large banks pay on average less than 100 euros in interest to their customers.[8] Other smaller banks increase their interest payments to their customers. These positive effects, however, cannot compensate for larger losses of customers at larger banks and average market effects are negative.

Before concluding, I want to discuss several aspects of the simulation framework which ought to be taken into account when drawing policy conclusions from structural analyses like this one. My analysis rests on the assumption that the ownership structure of companies has an influence on strategic price interactions between firms. The theory used is well founded in the I.O. literature. However, whether financial cash flow rights eventually shape corporate control rights is an empirical question, the answer to which remains highly disputed in the academic debate. The growing literature focusing on common ownership promises to shed more light on the existence of potential causal links. My work therefore should be seen under the perspective of attempting to quantify potential effects for consumers conditional on a common ownership mechanism in place.

In my analysis, some of the dynamics are driven by the involvement of the Dutch state as a result of bank bailouts. Some might argue that detrimental effects for consumers are unlikely to arise as a public investor would internalize any negative externalities not following a mere profit maximizing motive. Often, however, it is not obvious to what extent the state enters corporate decision making after such a bailout. Following anecdotal evidence, governments taking over banks in the last financial crisis were primarily concerned to prevent excessive risk taking by the banks. It is not clear whether the state's influence on corporate decisions would include areas such as retail pricing. If government officials had such influence it might also result in the increase of prices. Prices in controlled entities could have been increased to boost bank profits and present voters a balanced

[8] Losses in interest are much larger for Fortis Bank NL than for the other products of ABN AMRO. The reason is that the average amount of deposits is more than double in the last remaining product of Fortis Bank NL in my sample compared to most products of ABN AMRO.

result of unpopular involvements in banks.

Another point of discussion concerns large profit shares (some of them exceeding unity) often arising from relatively small shares of investment. Whereas all models exhibit certain levels of abstraction, this seems dissatisfactory. To make inference from simulation exercises more credible, future research will have to identify under which conditions investors can exert influence on corporate policy. This might include analyzing what role corporate structures play in forming corporate decisions. Lastly, I assume no common ownership mechanism when backing out the marginal cost equivalents for 2014. This could potentially overstate the effects of common ownership in the simulations if there already had been effects on realized interest rates in 2014. I argue, however, that common ownership was not very prevalent in the Dutch banking market yet in 2014 with the Dutch state being the sole common owner. Potential effects might have started to realize later when common ownership increased, fueled by the divestment of public shares in ABN AMRO (see Table 2.3.2).

2.7 Conclusions

In this paper, I investigated the effects of common ownership on retail prices in the Dutch market for savings accounts. My analysis is based on a structural approach simulating changes in interest rates taking into account a common ownership mechanism. I compare observed interest rates assuming no common ownership with interest rates simulated under different assumptions on the levels of common ownership. Depending on the scenarios for common ownership assumed, the model suggests decreases in interest rates of up to 50 basis points for some large banks. These changes are substantial given average interest rates of 1.26% and a standard deviation of 0.36% in the market in 2014. Average decreases in interest paid out to consumers range between 12 and 33 euros depending on the magnitude of common ownership.

My paper contributes to the growing literature on common ownership and its potential anti-competitive effects. I focus on quantifying such effects conditional on common

ownership influencing firm pricing behavior and not on providing empirical evidence for a causal link. Future research is needed to establish an understanding of how financial cash flow rights by investors might entail control rights over companies and shape corporate decisions including pricing decisions. This might generate new information regarding how to accurately feed common ownership into structural models. The simulated effects on retail interest rates are substantial and to the detriment of consumers. In light of unprecedented growth of funds managed by large institutional investors and increasing market power across countries and industries, antitrust authorities should follow the developments surrounding the rise of common ownership very closely and continuously assess whether consumer welfare is at risk.

2.A Appendix

2.A.1 Illustration of Different Ownership Structures

The following Figures 2.A.1, 2.A.2 and 2.A.3 illustrate different ownership structures. Figure 2.A.1 depicts the change in ownership structure after a merger. Firm 1 fully takes over firm 2. Downward pressure on competition might arise from the new entity pricing less aggressively.

Figure 2.A.1: Illustration of a merger

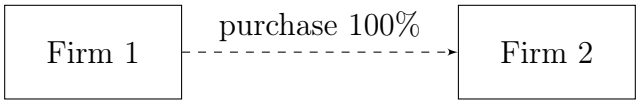


Figure 2.A.2 illustrates the case of cross-ownership. Firm 1 purchases a share of its direct competitor, firm 2. Competition might be restrained because of firm 1's lower incentives to price aggressively as this would harm the profits from its investment in firm 2. Moreover, firm 1 could use its influence on firm 2's strategic decisions to lower competition through the corporate decision mechanism.

Figure 2.A.2: Illustration of cross-ownership

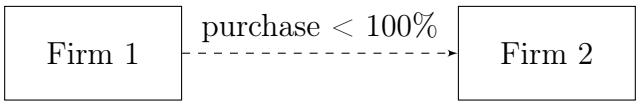


Figure 2.A.3 depicts the case of common ownership. A third party investor purchases minority shares in both firm 1 and firm 2. It is in the third party investor's interest to lower competition between the two firms and realize larger joint profits. Competition might be reduced if the investor can influence the two firms' strategic decisions.

2.A.2 Changes in the Coordination Matrix

In the following, I illustrate how changes in the ownership structure translate into changes in the coordination matrix. I will provide comparative statics to provide intuition how

Figure 2.A.3: Illustration of common-ownership

weights are changed in the bank's profit maximization problem and how the relative preference for a rivaling bank's profits change. I will use notation and wording in the context of banking in order to allow for consistency with the rest of the paper.

Let us denote C as the SxB ownership matrix with entry c_{sb} denoting the cash flow rights of investor (shareholder) s in bank b where $s = 1, 2, ...S$ and $b = 1, 2, ...B$ refer to all involved investors and banks. Matrix κ collects the profit weights that can be employed in a Bertrand oligopoly price competition setting. κ is a BxB matrix with κ_{ij} representing the weight which bank i places on the profits of bank j. The diagonal elements are normalized to one so that off-diagonal elements can be interpreted as the relative value firms place on rival firms' profits. That is, a value of $\kappa_{ij} = 0.5$ tells us that bank i values a euro change in bank $j's$ profits half as much as their own profits. This has implications on the price setting behavior of the banks. Whereas banks cannot influence prices and resulting demand in the products of rival banks directly, they will take into account the effects of price changes of their own products on other banks' prices and demand and ultimately rivals' profits. The extent to which this is happening is reflected in the coordination matrix.

Below I show a benchmark ownership matrix C and coordination matrix κ. Each element of κ can be calculated according to $\kappa_{ij} = (C_i' \cdot C_j) / (C_i' \cdot C_i)$. In the example below investor 1 owns 25% of shares in bank 1 and 25% of the shares of bank 1 and 25% of the shares of bank 2. I will refer to investors owning shares in more than one bank as *diversified investors*. Investor 2 owning 25% of bank 2 only is an *undiversified investor*. Investor 3 (yet) owns no shares in any of the two banks. I assume that the remaining shares are owned by retail investors who own significantly small amounts so they will not be considered in joint profit maximization.[9]

[9] Gramlich and Grundl (2017) refer to these kind of investors as atomistic.

Benchmark:

$$C = \begin{pmatrix} 0.25 & 0.25 \\ 0 & 0.25 \\ 0 & 0 \end{pmatrix} \qquad \kappa = \begin{pmatrix} 1 & 1 \\ 0.5 & 1 \end{pmatrix}$$

The resulting coordination matrix κ shows non-zero off-diagonal elements. However, κ_{12} is larger than κ_{21} meaning that bank 2's profit are relatively more important in bank 1's profits than vice versa. This is because investor 2 only has shares in bank 2 and does not benefit from increases in bank 1's profits.

Increase in ownership of diversified owner:

$$C = \begin{pmatrix} 0.50 & 0.25 \\ 0 & 0.25 \\ 0 & 0 \end{pmatrix} \qquad \kappa = \begin{pmatrix} 1 & 0.5 \\ 1 & 1 \end{pmatrix}$$

Here, I have increased the share in bank 1 of the diversified owner. The result is that compared to the previous situation, the relative weight of bank 2 in bank 1's profits decreases (i.e. κ_{12} decreases) and the relative weight of bank 1 in bank 2's profits increases (i.e. κ_{21} increases). The reason is that the diversified investor becomes more interested in the effects of profit changes in bank 1 induced by actions of bank 2 as she owns relatively more in bank 1 than previously.

Increase in ownership of undiversified owner:

$$C = \begin{pmatrix} 0.25 & 0.25 \\ 0 & 0.50 \\ 0 & 0 \end{pmatrix} \qquad \kappa = \begin{pmatrix} 1 & 1 \\ 0.2 & 1 \end{pmatrix}$$

Compared to the benchmark situation, the undiversified investor increases her share in

bank 2 to 50%. This leads to a relative decrease in the weight bank 2 places on bank 1's profits. The reason is that with increased ownership in bank 2 the undiversified investor is relatively more interested in maximizing bank 2's profit instead of minding the effects bank 2's pricing decisions have on bank 1's profits.

Introduction of a new diversified investor:

$$C = \begin{pmatrix} 0.25 & 0.25 \\ 0 & 0.25 \\ 0.25 & 0.25 \end{pmatrix} \qquad \kappa = \begin{pmatrix} 1 & 1 \\ 0.667 & 1 \end{pmatrix}$$

Here, I look at the effects of the introduction of a new diversified investor who is a duplication of investor 1 compared to the benchmark situation. The results are similar to the simultaneous increase of all shares by the existing diversified investor (not presented here). Compared to the benchmark situation the relative weight of bank 1's profits in bank 2's profit maximization increases. The reason is that with the introduction of another diversified investor the preference for maximizing industry profits rather than specific bank's profits increases (i.e. κ_{21} increases).

Tunneling:

$$C = \begin{pmatrix} 0.75 & 0.25 \\ 0 & 0.25 \\ 0 & 0 \end{pmatrix} \qquad \kappa = \begin{pmatrix} 1 & 0.333 \\ 1.5 & 1 \end{pmatrix}$$

Increasing the share of investor 1 in bank 1 leads to the awkward result that the bottom left entry is larger than 1 in the coordination matrix. The mechanics are that investor 1 has a large interest in the performance of firm 1 and thus would like to transfer the profits from firm 2 to firm 1. This situation has been coined as tunneling (of funds across firms). The result, however, is difficult to interpret as coordinative behavior would be stronger than in the monopoly case with off-diagonal entries larger than 1.

Summing up, increasing common ownership in the market (either by introduction of a new diversified investor or by the simultaneous increase of shares of already present diversified investors) increases profit weights in off-diagonal entries of the coordination matrix and hence increases incentives for maximizing industry profits rather than firm profits.

Chapter 3

State Aid and Competition in the European Banking Markets

3.1 Introduction

The 2008 global financial crisis and the following European sovereign debt crisis saw an unprecedented wave of bank failures in Europe. Large amounts of public money were used to rescue banks and avert the collapse of the financial systems. In 2015, the European Commission (EC) published an assessment of state aid measures for European banks during the financial crisis and its aftermath. The EC, responsible for state aid control in the European Union (EU), had granted individual aid to a total of 112 banks between 2007 and 2014. Aid provided as cash expenditure by either recapitalization or loans amounted to 671 billion euros (5.4% of the EU's GDP in 2008) and 1,288 billion euros respectively as contingent exposures such as liquidity or asset guarantees (10.3% of the EU's GDP in 2008). Many more cases involved aid under governmental schemes, however with much smaller aid levels (European Commission, 2015).

Given these large-scale public interventions aimed at safeguarding financial stability and reducing negative externalities for the real economy, the EC issued remedial action to mitigate potential anti-competitive effects. Besides restrictions on the duration of the rescue measures, the EC requested rescue aid to be conditional on structural and behavioral remedies such as forced divestment of business units, advertising bans for received aid or price leadership bans. Yet, it is not clear how effective such remedies

were in preventing undue distortions of competition to arise from rescue measures. For instance, Vives (2016) refers to a potential trade-off between stability and competition inherent to bank rescues. He cautions against not applying thorough competition policy to banks. In a similar vein, Beck et al. (2010) point out that competition and stability are not incompatible per se in banking. There are several potential channels how bank bailout measures could distort competition. Berger and Roman (2015) mention that aided banks might derive competitive advantages from being perceived safer in a distressed banking environment (*safety channel*) or face lower costs vis-à-vis their competitors (*cost-advantage channel*). The opposite might also hold true. Bank rescues could leave affected banks in a worsened competitive situation due to a deterioration of their reputation (*stigma channel*) or higher costs (*cost-disadvantage channel*). Which of the hypothesized channels prevails is an empirical question.

The recent literature on bank bailout is vast and dwells on its effects on various economic outcomes such as GDP growth (e.g. Barucci et al. (2019)), bank performance (e.g. Gerhardt and Vennet (2017)) and bank risk-taking (e.g. Gropp et al. (2011)). Surprisingly and despite its relevance for policy and regulation, much less focus has been drawn to the effects of bank bailout on competition in the banking sector. There are various studies about the competition effects of market interventions in the U.S. banking sector. Berger and Roman (2015), for instance, study the effect of the U.S. government funded Troubled Assets Relief Program (TARP) on competition and find that aided banks exhibit increased marked power after the intervention. Similarly, Koetter and Noth (2016) investigate TARP with regard to distortions of competition, focusing on the indirect effect of bailout through bailout expectations. The authors find statistically significant anti-competitive effects, which, however, are economically small and only lasted for the short period when TARP was in place. In a panel study across different countries, Calderon and Schaeck (2016) find that government interventions during banking crises account for less market power. Montes (2014) develops a structural model to investigate the effects of comprehensive consolidation among the Spanish savings banks following the financial crisis. In a counterfactual analysis he simulates pre-crisis mortgage rates under a post-

consolidation market structure. Simulated mortgage rates only experience a mild increase suggesting little harm for consumers arising from the reduction of independent banks in the market.

To the best of my knowledge, there are no academic contributions analyzing the competitive effects of bank bailouts in the European banking sector. I want to provide insights into how bailout affected market power of rescued banks vis-à-vis their competitors. A priori, results cannot be expected to be similar to the previously mentioned studies investigating the effects of TARP in the U.S. According to Berger and Roman (2015), approval to the investigated TARP measures hinged on the viability of the applicant with healthier banks being more likely to receive capital. The bailout measures under consideration in this paper constitute outright rescue measures without which most banks probably would have needed to file for insolvency.

The relevant policy question is whether competition authorities and the member states succeeded in preventing rescued banks to derive an undue advantage from receiving aid by increasing market power vis-à-vis their non-rescued competitors. Competition policy in banking during financial crises has to find a critical balance between allowing public interventions to safeguard financial stability and preventing distortions of competition. Balance also ought to be achieved between negative competition effects from bank exit and aided banks not abusing government support. The European Court of Auditors (ECA) has recently published its evaluation of state aid committed to banks in the financial crisis. Among others, it recommends the EC to evaluate its state aid rules and improve its performance measures (European Court of Auditors, 2020). In this light, my analysis shall contribute to ex-post evaluation of state aid with respect to the assessment if beneficiaries of aid received an undue advantage over competitors.

In order to investigate the effects of bank bailout on competition I construct a dataset containing large banks taking part in the stress test exercise of the European Banking Authority (EBA) in 2011. I collect data on individual aid measures to banks in the EU requiring clearance from the EC, drawing on press releases from DG Competition, the EC's competition unit. I merge information on aid with data on bank-level market power

measured by the Lerner index. My sample consists of 87 banks from 20 EU countries and includes annual observations from 2000 to 2018. In order to identify the effects of aid on competition, I employ a differences-in-differences strategy to compare the development of market power between aided and non-aided banks. Separating the effects on market power resulting from receiving aid and bank distress leading to bailout is challenging as both arguably have an effect on market power and are deterministically linked. I argue that banks in my sample are comparable as they were all deemed systemically relevant due to size and relevance within the national banking markets. However, the results concerning market power should not be attributed to the rescue measures alone, but also to corresponding financial distress.

My findings suggest that market power decreased for aided banks vis-à-vis their non-aided competitors. The effect is substantial corresponding to a reduction of around six percentage points in the Lerner index which is around two fifths of its standard deviation in the sample. This result, however, seems to be driven by bank rescues which took place right after the start of the financial crisis in 2008 and 2009. Banks rescued in a second wave starting in 2010 and coinciding with the start of the European sovereign debt crisis do not exhibit a drop in market power relative to their non-aided peers. Further analyses reveal that rather small-to-medium banks and the largest banks significantly lost market power when rescued. I apply a battery of robustness checks such as placebo tests in time and cross-sectional dimensions. In order to improve comparability of banks I apply propensity score matching as a robustness check confirming the validity of the results. While the heterogeneity across treatment periods is striking, it is not entirely clear what it stems from. Larger disruptions in bank profitability for banks falling into distress in the financial crisis and not in the sovereign debt crisis and different sets of remedial actions across these groups might play a role.

Given my results European competition policy appears to have been effective during and after the last financial crisis. Bailed out banks do not appear to have unduly capitalized on rescue money in terms of market power. The inherent motivation of policy makers to bail out banks certainly is to protect financial stability during crisis times.

However, aspects from competition policy are highly relevant as well in order to establish the least-cost policy response. My results carry important implications for future policy responses with regards to an active element of competition policy. My results concur with other recent studies, for example by Maudos and Vives (2019), showing increasing levels of market power in the European banking market with potentially negative effects for consumers. In light of the ongoing COVID-19 pandemic which might also threaten the stability of banks and banking markets as a whole, it remains a pertinent task for policy makers to assess potential rescue measures against anti-competitive effects.

The paper is structured as follows. Section 3.2 gives an overview of bank rescues in the European Union and the corresponding legal procedure. Section 3.3 discusses the data sources and Section 3.4 introduces the empirical models. Section 3.5 presents the results of the estimations and Section 3.6 provides a set of robustness checks. In Section 3.7, I test for the potential sources of heterogeneity in treatment and Section 3.8 concludes.

3.2 Institutional Background

The EC reacted to the financial crisis by lowering the bars for the application of state aid rules to the financial sector documented in a series of communications. The intent was to provide a unified and swift approach to counter financial distress on the markets. Broadly speaking, EC policy during the financial crisis initially was guided by enabling swift emergency interventions (see First Banking Communication from October 13, 2008[1]), also catering to the heterogeneity of aid necessities by providing a diverse toolkit for bank rescues.

There are four major types of aid types which were applied. Laprévote et al. (2017) distinguish between non-structural aid, direct liquidity support via loans or indirect liquidity support via guarantees on bank lending and structural aid, recapitalizations and impaired asset measures. Rules for recapitalizations were clarified in the Recapitalization

[1] Press release concerning the communication available at http://europa.eu/rapid/press-release_IP-08-1495_en.htm?locale=en (last accessed on April 14, 2021).

Communication[2] or for asset relief schemes in the Impaired Assets Communication[3]. With the Restructuring Communication[4] the EC provided guidance on restructuring plans ensuring that the aided bank would have an economic prospect (viability), stake-holders to participate in rescue efforts (burden-sharing)[5] and anti-competitive effects to be contained. Latest with the issuance of the new Banking Communication[6] in August 2013, when markets had already relatively calmed down, more focus was shifted towards the obligation to present viable restructuring plans contingent on which aid measures were approved. In this context the EC admitted that incentives to stick to orderly restructuring would be low without such enforceable restructuring plans.

In order to prevent that public funds would be used to finance an aggressive business strategy to the detriment of competitors, aid was made conditional on remedies. Laprévote et al. (2017) separate remedies in two categories: structural and behavioral. Structural remedies refer to measures which impact on the size and scope of a bank's business activities such as the required reduction of capacities, the divestment of subsidiaries, branches or portfolios or acquisition bans of competitors. Behavioral remedies restrict the way of doing business with examples ranging from price leadership bans, moratoriums on dividend payments, limitations on management remuneration or limitations on the size of balance sheet, and bans on share buy-backs from private creditors under public engagement in the institution to prevent cross-financing from public to private investors.

Approaches to counter distress in the financial markets differed across the member states of the European Union. Countries were heterogeneously affected by the financial crisis. Also, the causes for the banks' distress varied from substantial exposure to subprime mortgage markets (e.g. in Germany), domestic real estate lending (e.g. Ireland or Spain) or exposure to an ailing sovereign (e.g. Greece). Consequently, the rescue of the banks,

[2] Press release concerning the communication available at https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:010:0002:0010:EN:PDF (last accessed on April 14, 2021).

[3] Press release concerning the communication available at http://europa.eu/rapid/press-release_IP-09-322_en.htm?locale=en (last accessed on April 14, 2021).

[4] Press release concerning the communication available at http://europa.eu/rapid/press-release_IP-09-1180_en.htm?locale=en (last accessed on April 14, 2021).

[5] This usually did not mean bail-in but rather significant remuneration for public recapitalization or loan measures or fair prices for the divestment of business units.

[6] Press release concerning the communication available at http://europa.eu/rapid/press-release_IP-13-672_en.htm (last accessed on April 14, 2021).

the subsequent market consolidations and the remedies assigned to recipients of state aid had distinct handwritings. For instance, in Spain many mergers were conducted to consolidate and stabilize the domestic banking market which was fragmented due to the relative importance of locally operating savings banks (cajas).[7] The surviving banks in Greece often did not have to commit to substantial down-sizing in return for receiving state aid. Bank distress was considered a result of substantial exposure to an ailing sovereign and not caused by risky activities per se and therefore potentially deemed less punishable and less conducive to promote moral hazard.

Remedies imposed to contain potential anti-competitive effects of state aid were diverse as well. The most prominently featured remedies were down-sizing obligations, acquisition bans and advertising bans. In some cases, however, other solutions were designed. For instance, in Ireland so-called market opening measures were used to promote competition after discriminatory government intervention. These measures forced recipients of state aid to allow competitors access to cash networks and to inform their own customer base about product information of their market rivals. Against this background, it seems worthwhile to investigate the effects of state aid on bank competition and analyze the state interventions for potential heterogeneous effects.

3.3 Data and Methodology

3.3.1 Sample

My sample contains all banks taking part in the 2011 stress test exercise of the European Banking Authority and which thus were deemed systematically important institutions.[8] Narrowing down the sample to systemically important banks improves comparability across banks. Table 3.3.1 displays the included banks in the sample.

[7] Montes (2014) reports that out of initially 45 Spanish savings banks, 38 were involved in consolidation processes after which only 18 independent savings banks remained in the Spanish market.

[8] In total, my sample contains 87 out of the total of 89 EU banks stress tested in 2011. The German bank WestLB and the Spanish savings bank Caja Espana de Inversiones, Salamanca y Soria are not included due to missing data in the Bankscope dataset. More information on the EBA stress testing exercise can be accessed under https://eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2011 (last accessed on April 14, 2021).

In order to identify the effects of state aid on market power, I create a treatment and a control group. I define those banks as treated banks which have received individual state aid requiring separate clearing by the European Commission. Participation in a national aid scheme alone does not suffice to enter the treatment category. Compared to aid from national schemes, individual aid measures were more substantial aid measures which usually were contingent on restructuring plans including measures to contain potential distortions of competition. One issue that could confound the assignment into groups is that the potential benefits of state aid might have been transferred from aided banks to otherwise non-aided banks in bank purchases. This could have happened in two ways, either by the merger of several aided banks into a new entity (e.g. Spanish cajas) or the purchase of an aided bank by a non-aided bank. I keep track of such potential indirect transfers of benefits and test for it in a separate analysis.

3.3.2 Dependent Variable

I use bank balance sheet data from the Bureau van Dijk Bankscope and BankFocus databases.[9] In order to identify the effects on competition in the EU banking markets, I use unconsolidated balance sheets when possible. For some banks in the dataset only consolidated data are available. I use these data to avoid sample attrition. For measuring market power, I use the Lerner index. The benefit of the Lerner index is that it is a bank-level index not requiring market delineation such as concentration measures like the Herfindahl-Hirschman Index (HHI). Further, following the New Empirical I.O. approach, the Lerner index as a direct measure of market power is preferred over indirect measures such as the HHI suggested by the structure-conduct-performance (SCP) paradigm. The reason is that market structure alone does not allow for clear inference on competition in markets (e.g. a highly concentrated market might as well be highly competitive due to,

[9] Bureau van Dijk discontinued the Bankscope database in the end of 2016 and now is providing bank balance sheet data through BankFocus. Both databases have an overlapping coverage before Bankscope was taken offline. In order to maximize the data coverage of my sample I use both data relying on Bankscope until 2014 and switching to BankFocus starting with year 2015.

Table 3.3.1: Included banks

Country	Banks
Austria (3)	Erste Bank, Raiffeisen Bank, Oesterreichische Volksbank AG
Belgium (2)	Dexia (later Belfius), KBC Bank
Cyprus (2)	Marfin Popular Bank, Bank of Cyprus
Denmark (4)	Danske Bank, Jyske Bank, Sydbank, Nykredit
Finland (1)	OP-Pohjola Group
France (4)	BNP Paribas, Credit Agricole, BPCE, Societe Generale
Germany (11)	Deutsche Bank, Commerzbank, Landesbank Baden-Württemberg, DZ BANK, Bayerische Landesbank, Norddeutsche Landesbank, Hypo Real Estate, HSH Nordbank, Landesbank Berlin AG, DekaBank, WGZ Bank
Greece (6)	EFG Eurobank Ergasias, National Bank of Greece, Alpha Bank, Piraeus Bank, Agricultural Bank of Greece, TT Hellenic Postbank
Hungary (1)	OTP Bank
Ireland (3)	Allied Irish Banks, Bank of Ireland, Irish Life and Permanent
Italy (5)	Intesa Sanpaolo, Unicredit, Banca Monte dei Paschi di Siena, Banco Popolare, Ubi Banca
Luxembourg (1)	Banque et Caisse d'Epargne de l'Etat
Malta (1)	Bank of Valletta
Netherlands (4)	ING, Rabobank, ABN Amro, SNS
Poland (1)	Powszechna Kasa Oszczędności Bank Polski
Portugal (4)	Caixa Geral de Depósitos, Banco Comercial Português, Espírito Santo Financial, Banco BPI
Slovenia (2)	Nova Ljubljanska Banka, Nova Kreditna Banka Maribor
Spain (24)	Banco Santander, BBVA, Bankia, and several mostly savings banks (see footnote)
Sweden (4)	Nordea Bank, Skandinaviska Enskilda Banken (SEB) Svenska Handelsbanken, Swedbank
United Kingdom (4)	Royal Bank of Scotland, HSBC, Barclays, Lloyds

Notes: This table gives an overview of included banks in the sample. The number in brackets behind the country name indicates the total of banks from the respective countries. Listed are all banks from EU countries which took part in the stress test exercise of the EBA in 2011. WestLB is excluded as no data is available on Bankscope. The Spanish banks which are omitted from the table for illustrative purposes are Caja de Ahorros y Pensiones de Barcelona, Effibank, Banco Popular Español, Banco de Sabadell, Caixa d'Estalvis de Catalunya, Tarragona i Manresa, Caixa de ahorros de Galicia, Vigo, Ourense e Pontevedra, Banco Mare Nostrum, Bankinter, Caja España de Inversiones, Caja de Ahorros y Monte de Piedad, Banca Civica, Caja de Ahorros y m.p. de Zaragoza, Aragon y Rioja, Monte de Piedad y Caja de Ahorros de Ronda, Cadiz, Almeria, Malaga, Antequera y Jaen, Banco Pastor, BBK Bank, Caixa d'Estalvis Unio de Caixes de Manlleu, Sabadell i Terrassa, Caja de Ahorros y m.p. de Gipuzkoa y San Sebastian, Banco Grupo Caja3, Banca March, Caja de Ahorros de Vitoria y Alava, Caja de Ahorros y m.p. de Ontinyent, Colonya - Caixa d'Estalvis de Pollensa, Caja de Ahorros del Mediterraneo.

for example, low entrance barriers). The Lerner index for bank i in time t is defined as follows:

$$Lerner_{it} = \frac{p_{it} - mc_{it}}{p_{it}}, \tag{3.3.1}$$

where p is the price of the bank's output good and mc is its related marginal costs. In fact, the Lerner index measures the mark-up relative to the price. I assume that the price p of a bank's average output good can be proxied by the ratio of all interest and non-interest income to total assets as the average price of a bank's asset. For the calculation of marginal costs mc, I estimate the translog cost function presented below following Coccorese (2014) or Koetter et al. (2012). Note that the Lerner index inversely measures the degree of competition (i.e. larger values reflect less competition).

$$\begin{aligned} ln\,TC_{it} =& \alpha_i + \sum_{j=1}^{3} \beta_j ln\,w_{jit} + \gamma_1 ln\,TA_{it} + \left(\frac{\gamma_2}{2}\right)(ln\,TA_{it})^2 \\ &+ \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \delta_{jk} ln\,w_{jit} ln\,w_{kit} \\ &+ \sum_{j=1}^{3} \xi_j ln\,w_{jit}\,ln\,TA_{it} + \sum_{j=1}^{2} \eta_j trend^j \\ &+ \sum_{j=1}^{3} \zeta_j ln\,w_{jit} trend + \nu ln\,TA_{it} trend + \varepsilon_{it}, \end{aligned} \tag{3.3.2}$$

where TC represents total costs being the sum of total interest expenses, personnel expenses and operating expenses. The cost inputs w_1, w_2 and w_3 take account of the price of borrowed funds, the price of labor and the price of fixed capital respectively. w_1 is proxied by the ratio of total interest expenses to total deposits and money market borrowing (total borrowing). w_2 is proxied by total personnel expenses divided by total assets. Lastly, w_3 is proxied by the ratio of total operating expenses net of personnel expenses to total assets.[10] α_i are bank fixed effects and TA represents total assets. $trend$ captures time

[10]Many papers use other operating expenses divided by fixed assets to proxy the input price of fixed

effects through a time trend and ε is an error term. All variables used for the calculation of the Lerner index are taken from the Bankscope and BankFocus datasets. Imposing homogeneity of degree 1 and dividing TC, w_1 and w_2 by w_3 as in Coccorese (2014) or Koetter et al. (2012) results in the following condensed translog cost function:

$$\begin{aligned} ln\left(\frac{TC_{it}}{w_{3it}}\right) =& \alpha_i + \beta_1 ln\left(\frac{w_{1it}}{w_{3it}}\right) + \beta_2 ln\left(\frac{w_{2it}}{w_{3it}}\right) + \gamma_1 ln\, TA_{it} + \frac{\gamma_2}{2}\left(ln\, TA_{it}\right)^2 \\ &+ \frac{\delta_{11}}{2}\left(ln\left(\frac{w_{1it}}{w_{3it}}\right)\right)^2 + \frac{\delta_{22}}{2}\left(ln\left(\frac{w_{2it}}{w_{3it}}\right)\right)^2 + \frac{\delta_{12}}{2}\left(ln\left(\frac{w_{1it}}{w_{3it}}\right) ln\left(\frac{w_{2it}}{w_{3it}}\right)\right) + \\ &+ \xi_1 ln\left(\frac{w_{1it}}{w_{3it}}\right) ln\, TA_{it} + \xi_2\, ln\left(\frac{w_{2it}}{w_{3it}}\right) lnTA_{it} + \eta_1 trend + \eta_2 trend^2 \\ &+ \zeta_1 ln\left(\frac{w_{1it}}{w_{3it}}\right) trend + \zeta_2 ln\left(\frac{w_{2it}}{w_{3it}}\right) trend + \nu ln\, TA_{it} trend + \varepsilon_{it}. \end{aligned} \tag{3.3.3}$$

Table 3.A.1 presents the results of the estimation of equation 3.3.3 using a fixed effects panel estimator. Finally, marginal costs are calculated using the regression results from Table 3.A.1 according to the following equation:

$$mc_{it} = \frac{TC_{it}}{TA_{it}}\left[\gamma_1 + \gamma_2 ln\, TA_{it} + \xi_1 ln\left(\frac{w_{1it}}{w_{3it}}\right) + \xi_2 ln\left(\frac{w_{2it}}{w_{3it}}\right) + \nu trend\right]. \tag{3.3.4}$$

Table 3.3.2 displays country-level averages for the price, the marginal costs and the Lerner index for the banks in the sample. The table reveals substantial differences across national banking markets in the EU. Germany, Italy and France are among the countries with relatively low levels of market power. Countries with a relatively large Lerner index are

capital. However, inconsistent data labeling prevents me from doing so. Concretely, the variable other operating expenses seems to capture different positions in the balance sheet across data sets leading to a discrete jump in the time series of the ratio of fixed capital cost in 2015 when I change the data source. In my approach to use total operating expenses net of personnel expenses to total assets (i.e. other operating expenses and other administrative expenses) as a proxy for fixed capital cost, I follow Demirguc-Kunt and Martínez Pería (2010) providing the methodology for the calculations of the Lerner index of the World Bank.

Sweden and the U.K. For most countries, the Lerner index varies between 0.1 and 0.25 displaying substantial market power for banks in Europe.[11] My results align with Maudos and Vives (2019) in terms of the general levels of market power and ordering into low and high ranking countries. Figure 3.3.1 illustrates the ranking of the average Lerner index by country. Similar to Weill (2013), the average Lerner index is larger for transition countries in Central Europe such as Hungary or Poland compared to Western European countries.

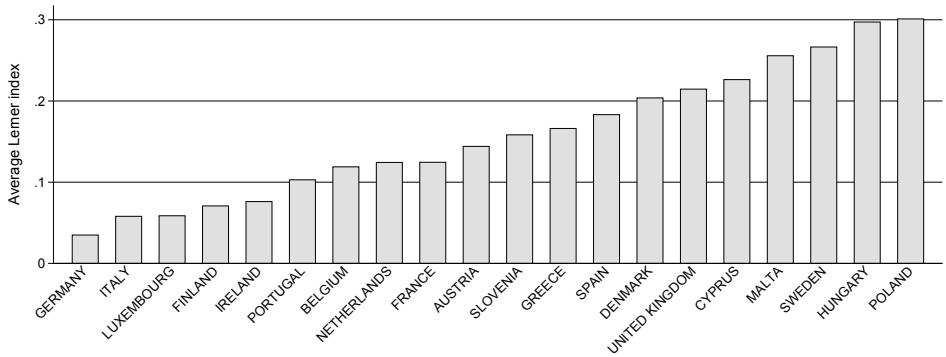
[11]Note that a value of say 0.2 suggests that the average price exceeds marginal costs by more than 20%.

Table 3.3.2: Price, marginal costs and Lerner index

	Avg. price			Avg. marginal costs			Avg. Lerner index		
	2000-2007	2008-2018	2000-2018	2000-2007	2008-2018	2000-2018	2000-2007	2008-2018	2000-2018
Austria	0.053	0.044	0.046	0.046	0.037	0.039	0.11	0.16	0.14
Belgium	0.046	0.047	0.046	0.042	0.042	0.042	0.10	0.13	0.12
Cyprus	0.067	0.055	0.060	0.056	0.041	0.046	0.17	0.26	0.23
Denmark	0.047	0.030	0.037	0.041	0.022	0.030	0.13	0.26	0.20
Finland	0.091	0.058	0.064	0.085	0.055	0.060	0.064	0.072	0.071
France	0.033	0.028	0.029	0.033	0.025	0.027	0.18	0.10	0.12
Germany	0.048	0.036	0.041	0.047	0.035	0.040	0.026	0.042	0.035
Greece	0.068	0.048	0.058	0.055	0.040	0.048	0.19	0.14	0.17
Hungary	0.11	0.11	0.11		0.057	0.057		0.30	0.30
Ireland	0.047	0.030	0.036	0.042	0.029	0.035	0.12	0.049	0.076
Italy	0.048	0.031	0.038	0.042	0.031	0.035	0.11	0.021	0.058
Luxembourg	0.074	0.037	0.052	0.077	0.033	0.052	-0.049	0.14	0.059
Malta	0.059	0.038	0.047	0.048	0.027	0.036	0.18	0.31	0.26
Netherlands	0.046	0.040	0.042	0.046	0.035	0.038	0.083	0.14	0.12
Poland	0.11	0.066	0.083	0.086	0.042	0.060	0.20	0.37	0.30
Portugal	0.071	0.057	0.063	0.063	0.053	0.058	0.11	0.096	0.10
Slovenia	0.080	0.053	0.064	0.070	0.044	0.055	0.12	0.18	0.16
Spain	0.050	0.037	0.043	0.042	0.031	0.035	0.18	0.18	0.18
Sweden	0.059	0.032	0.044	0.039	0.022	0.029	0.18	0.33	0.27
United Kingdom	0.052	0.025	0.036	0.039	0.020	0.028	0.26	0.18	0.21
Total	0.055	0.039	0.045	0.047	0.033	0.038	0.14	0.15	0.15
Observations	551	784	1335	528	766	1294	528	766	1294

Notes: This table sums up the average price, the average marginal costs and the average estimated Lerner index by country for the pre-crisis period (2000-2007), the period including the crisis and after (2008-2018) and the entire period (2000-2018). Empty cells refer to missing data.

Figure 3.3.1: Average Lerner index by country (2000-2018)



Notes: This figure displays the average Lerner index by country for the selected set of large banks listed in the 2011 EBA stress test exercise. The time period is from 2000 to 2018.
Source: BvD Bankscope, BvD BankFocus and own calculations.

Table 3.3.3 shows the descriptive statistics for the main variables used throughout the analysis.

Table 3.3.3: Summary statistics

	mean	sd	min	max	count
Total assets	229,878	349,616	160	2,246,381	1,294
Total equity	14,049	19,344	-7,991	104,117	1,294
Total loans	114,380	164,444	106	1,113,372	1,293
Total borrowing	136,725	189,162	147	1,167,854	1,294
Fixed assets	1,118	2,114	.4	19,458	1,273
Interest income	6,448	9,179	9	108,030	1,294
Non-interest income	1,811	3,303	-911	23,955	1,294
Interest expenses	4,292	7,200	.65	101,786	1,294
Personnel expenses	1,304	2,022	.14	14,515	1,294
Operating expenses	1,321	2,243	2	16,918	1,294
Total cost	6,917	9,976	9	105,633	1,294
Price of borrowed funds (w1)	.034	.029	.00046	.29	1,294
Price of labor (w2)	.0071	.0037	6.3e-06	.022	1,294
Price of capital (w3)	.0067	.0055	.00033	.088	1,294
Price of bank output	.045	.019	.0078	.17	1,294
Marginal costs	.038	.018	.0031	.2	1,294
Lerner	.15	.14	-.86	.83	1,294
Treated	.42	.49	0	1	1,294

Notes: This table displays summary statistics of variables used in the estimation of the translog cost function in equation 3.3.3 and the model in equation 3.4.1. The variables w1, w2 and w3, price of bank output, marginal costs and the Lerner index are ratios and Treated is a dummy variable indicating whether a bank received state aid. All other variables are in million euros.

3.4 Model and Estimation

In order to analyze the effects of bank rescues on market power, I employ a differences-in-differences strategy using the following panel model:

$$Lerner_{it} = \alpha_i + \beta Rescue_{it} + \gamma X_{it} + \lambda_t + \varepsilon_{it}, \tag{3.4.1}$$

in which $Lerner_{it}$ denotes the Lerner index for bank i at time t, α_i is a bank-specific fixed effect and X_{it} is a vector of controls. I employ time fixed effects, λ_t, and ε_{it} denotes an error term with standard errors clustered at the country level. The coefficient of interest is β capturing the effect of the dummy variable $Rescue_{it}$, being 1 for the year of the bank rescue of bank i and all subsequent years, and 0 otherwise.[12] I will refer to the model displayed in equation 3.4.1 as the baseline model. Employing both bank and time fixed effects allows for interpreting β as the effect of the bank rescue on the Lerner index. The econometric set-up acknowledges overlapping treatments in which initial treatment periods are distributed over time and has been similarly applied by Calderon and Schaeck (2016). The treatment effects, however, might be confounded as banks rescued later serve as control banks for earlier treated banks. In order to control for such confounds, I insert bank specific time trends as an additional check against heterogeneous time trends following Angrist and Pischke (2008).[13]

Identification of the model presented above is based on the common trends assumption. Both the treatment group (i.e. rescued banks) and the control group need to be comparable in trend in non-observable characteristics potentially influencing market power. The sample of large and systemically important bank represents a homogenous group of banks. This should reduce possible confounding heterogeneity in the sample with re-

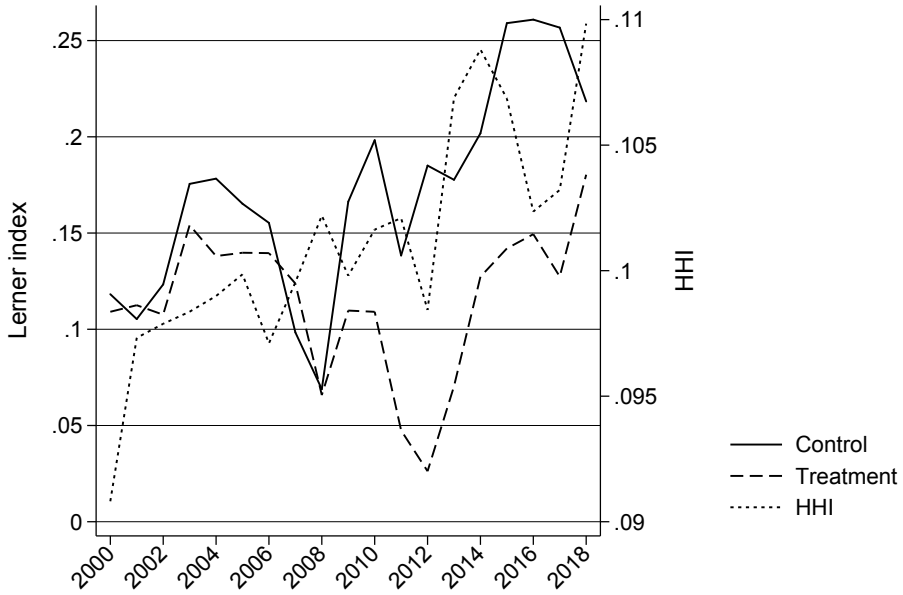
[12] I also categorize banks as being rescued emerging from state assisted consolidation as for instance in the case of some mergers of Spanish savings banks or banks which change their name after the bank's rescue (e.g. Dexia becomes Belfius in Belgium).

[13] The model estimated is $Lerner_{it} = \alpha_i + \beta Rescue_{it} + \gamma X_{it} + \lambda_t + \delta\,(Bank_i\, x\, Trend_t) + \varepsilon_{it}$, with $Bank_i$ being a dummy variable for observations of bank i and $Trend_t$ being a linear time trend.

gards to market power arising from, for instance, size related characteristics (e.g. banks considered too big to fail might have funding advantages potentially leading to increased market power). Figure 3.4.1 contrasts the development of the average Lerner index for both the treatment and the control group. The figure suggests that prior to the financial crisis and even in 2008 when the financial crisis erupted, the trajectories of both groups were fairly similar. The first full crisis year 2009 caused a substantial drop in the Lerner index for rescued banks which remains persistently below the curve of non-rescued banks until the end of the observation period in 2018. Figure 3.4.1 also shows the development of the average HHI of the countries of origin of the banks included in the sample. The HHI follows the development of the estimated Lerner indices and confirms the findings of Maudos and Vives (2019) of both rising levels of market power and market concentration in European banking markets.

Further, Table 3.4.1 displays group averages and t-tests for significances in differences for the pre-crisis period for relevant bank characteristics including the Lerner index. Treated banks are on average larger in terms of total assets, total equity and borrowing activities. Control banks are on average lending more. The Lerner index is slightly larger for treated banks before the crisis. None of the selected variables is statistically different across groups however. In sum, the two groups of banks seem to be sufficiently similar prior to the financial crisis.

Figure 3.4.1: Development of the Lerner index by treatment status



Notes: This figure compares the development of the Lerner index for control and treated banks (scale on the left axis). Treatment time is individual as reported in Figure 3.4.2. The dotted line reports the average HHI for the countries of origin of the included banks (scale on the right axis).
Source: Bankscope, BankFocus and own calculations for the Lerner index and ECB Statistical Data Warehouse (Dataset: SSI: Banking Structural Financial Indicators).

Table 3.4.1: Comparison of groups

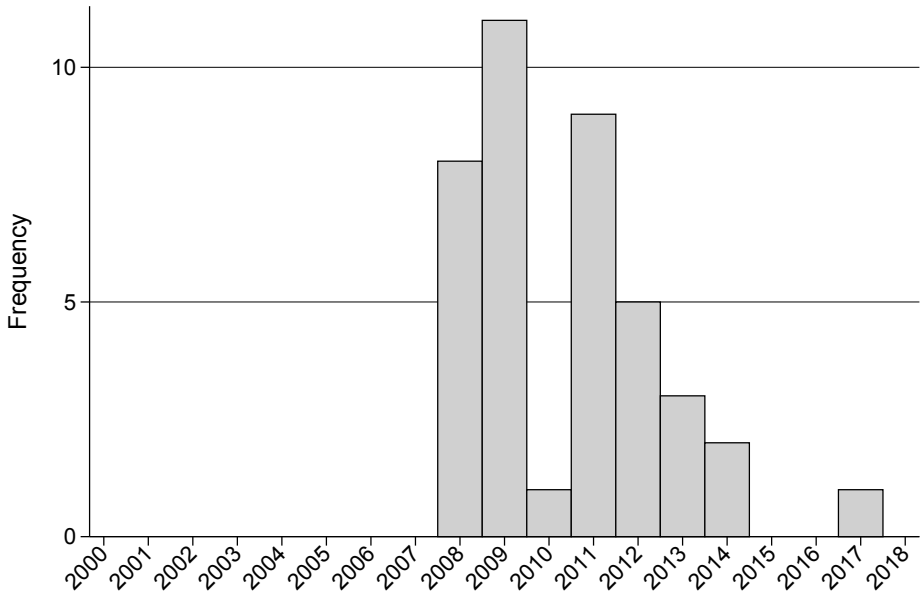
	mean (control)	mean (treated)	diff.	sd	obs.
Total assets	154,843	168,082	-13,239	23,162	528
Total equity	8,389	9,413	-1,025	1,149	528
Total loans	94,033	77,901	16,132	12,233	527
Total borrowing	98,502	112,760	-14,257	14,741	528
Lerner	.13	.14	-.012	.01	528

Notes: This table displays differences for a list of selected variables between the control and the treatment group for the period before the outbreak of the financial crisis (before 2008). Columns 2 and 3 present conditional averages for the two groups respectively. Column 4 displays the average differences between the control and the treatment group and column 5 the standard deviation of the differences. Differences labeled with asterisks are significant as derived from underlying t-tests with the following confidence levels * $p<0.1$, ** $p<0.05$, *** $p<0.01$. All variables except for the Lerner index are denoted in million euros.

Figure 3.4.2 displays the occurrences of aid measures in the sample (year of the initial intervention for each bank in the treatment group). Two peaks of interventions can be observed. One is shortly after the outbreak of the financial crisis with rescues in 2008 and 2009. A second wave of bank rescues starts in 2010. The two peaks coincide with the

narrative of a twin crisis for banks in Europe, which were affected by both the financial crisis and the European sovereign debt crisis.

Figure 3.4.2: Distribution of bank rescues



Notes: This figure displays the occurrences of initial aid measures in the sample (first intervention of each bank in the treatment group).
Source: EC press releases (see appendix 3.A.3) and own calculations.

I analyze heterogeneous effects across the two crises by estimating a split model, which is a slightly altered version of the baseline model (see equation 3.4.2), introducing two separate treatment dummies $Rescue_{it}^{2008}$ and $Rescue_{it}^{2010}$.[14] These indicators refer to bank rescues (since 2008 and) before 2010 and since 2010 respectively. Note that both *Rescue* dummies here are defined as above, indicating time periods for rescued banks for the year of the bailout and all periods thereafter. In a model with bank and time fixed effects, the coefficients β_1 and β_2 correspond to the effect of bank rescue on the Lerner index. Note also that the two bailout indicators are mutually exclusive for banks in the treatment group. Any rescued bank is uniquely assigned to one of the two sub-periods of treatment. Figure 3.A.1 shows the trajectory of the three different group of banks. It reveals that the Lerner index of banks treated after 2009 does not fall as strongly

[14]The group assignment by bank is collected in Table 3.A.2. In total, there are 47 banks in the control group, 19 banks were rescued before 2010 and 21 banks were rescued since 2010.

compared to banks rescued earlier but sharply decreases after 2010 suggesting a later impact of crisis conditions.

$$Lerner_{it} = \alpha_i + \beta_1 Rescue_{it}^{2008} + \beta_2 Rescue_{it}^{2010} + \gamma X_{it} + \lambda_t + \varepsilon_{it}. \tag{3.4.2}$$

In order to investigate further heterogeneity in treatment effects, I provide estimates of a model including interactions of the differences-in-differences dummy with bank size, year dummies and country dummies. The regression equation displayed in equation 3.4.3 formalizes this notion. Variable Z_i is one single variable at a time (out of the above mentioned) used for interaction.

$$Lerner_{it} = \alpha_i + \beta(Rescue_{it}\, x\, Z_i) + \lambda_t + \varepsilon_{it}. \tag{3.4.3}$$

3.5 Results

I present the results of different sets of estimations related to the baseline model, the split model including separate treatment dummies by rescue period and the model with interactions. All regressions employ bank-level fixed effects, time fixed effects and cluster standard errors at the country level. To test for robustness of the results, I include control variables related to both market power and soundness of a bank. As control variables I use the logarithms of the following vector $X = \{$*Total Assets, Total Equity, Total Loans, Total Borrowing*$\}$. In the last subsection, I test for indirect effects potentially arising from the purchase of aided banks by banks from the control group.

3.5.1 Baseline Model

Table 3.5.1 displays the results of the baseline model with column (1) showing the results of the parsimonious version excluding further controls. The estimated effect relates to

a decrease of six percentage points in the relative mark-up for rescued banks. This is substantial given the standard deviation of 0.14 for the Lerner index (see Table 3.3.3).

Table 3.5.1: Effects of bank rescue on market power (baseline)

	(1)	(2)	(3)	(4)	(5)
Rescue	-0.060**	-0.053*	-0.055	-0.057**	-0.057*
	(0.025)	(0.026)	(0.033)	(0.021)	(0.028)
Log(Total assets)				-0.089	
				(0.057)	
Log(Total equity)				0.059***	
				(0.018)	
Log(Total loans)				0.022	
				(0.022)	
Log(Total borrowing)				0.017	
				(0.039)	
N	1294	1145	846	1284	1294
Number of banks	87	87	87	87	87
Bank time trends	No	No	No	No	Yes
Years excluded	None	2008, 2012	2008 ± 1y, 2012 ± 1y	None	None

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the model presented in equation 3.4.1 with the Lerner index as the dependent variable. All specifications include bank fixed effects and year fixed effects. If not otherwise stated, the specifications include data from 2000 to 2018. The years omitted in the specification in column 3 are 2007-2009 and 2011-2013. The specification displayed in column (5) adds bank-specific time trends to the model. Standard errors clustered at the country level are presented in parentheses.

In order to disperse concerns about this effect being driven by particular crisis conditions, I omit immediate crisis years in columns (2) and (3). Column (2) reports the result of a regression omitting observations from 2008 and 2012 as major crisis years. In 2008, the global financial crisis erupted and in 2012 the European sovereign debt crisis was at its peak prompting Mario Draghi, as the president of the European Central Bank, to make a public commitment for far-reaching monetary interventions if necessary (see Draghi's "Whatever-it-takes" speech from July 26 in 2012[15]). The regression in column (3) additionally excludes the years in a 1-year window around 2008 and 2012. The results show that large negative effects on the Lerner index of bank rescues persist (specification in column (3) provides marginally insignificant results).

[15]See https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html (last accessed on April 14, 2021).

In column (4), I add control variables, most of which are not statistically significant. Total equity, however, has a positive effect on market power possibly reflecting that a larger equity base permits banks to realize smaller marginal costs through lower refinancing costs. Lastly, the introduction of bank-specific time trends in column (5) does not lead to a diminishing of the negatively estimated effects of bank rescues on market power. Obtaining qualitatively similar results after including control variables and bank-specific time trends provides confidence about the estimated effects not being the results of confounding bank heterogeneity beyond treatment.

3.5.2 Heterogeneity in Treatment Periods

Results in Table 3.5.2 relate to regressions with different treatment dummies employed according to when a bank was rescued. I want to discern whether the treatment effects estimated for the entire sample are driven by any of the treatment periods. Column (1) reveals that the negative effects are uniquely driven by banks rescued in the immediate aftermath of the outbreak of the financial crisis and before 2010. The estimated effects for this subgroup of treated banks are slightly more negative than the estimated treatment effects for all treated banks in the baseline model. Banks rescued in the European sovereign debt crisis, however, do not appear to be negatively affected in terms of market power.

To test the robustness of the notion that negative treatment effects are concentrated on banks rescued before 2010, I estimate regressions omitting one cohort of treated banks respectively in columns (2) and (3), adding control variables in column (4) and adding bank-specific trends in column (5). In none of these specifications the coefficient for bank rescues since 2010 exhibits a significant estimate. What could potentially explain heterogeneous treatment effects? Potentially long-term profitability and consequentially market power could have been impaired relatively stronger for banks rescued immediately after the financial crisis. Alternatively, the two groups of rescued banks might have been subjected to different menus of remedial actions. Possibly banks rescued in the sovereign debt crisis could have been subjected to more lenient remedial action leading

to no substantial drop in market power. I discuss these conjectures by comparing data on pre-crisis trends and treatment intensities across treated banks and provide anecdotal evidence for differing remedial approaches in Section 3.7.

Table 3.5.2: Effects of bank rescue on market power (split in treatment periods)

	(1)	(2)	(3)	(4)	(5)
Rescue (2008-2009)	-0.067***	-0.079***		-0.067***	-0.064**
	(0.023)	(0.025)		(0.021)	(0.027)
Rescue (2010-2017)	-0.046		-0.052	-0.038	-0.034
	(0.039)		(0.041)	(0.037)	(0.036)
Log(Total assets)				-0.086	
				(0.057)	
Log(Total equity)				0.059***	
				(0.018)	
Log(Total loans)				0.023	
				(0.022)	
Log(Total borrowing)				0.012	
				(0.040)	
N	1294	1052	993	1284	1145
Number of banks	87	66	68	87	87
Bank time trends	No	No	No	No	Yes
Group excluded	None	$\text{Rescue}^{>2009}$	$\text{Rescue}^{<2010}$	None	None

* p<0.1, ** p<0.05, *** p<0.01

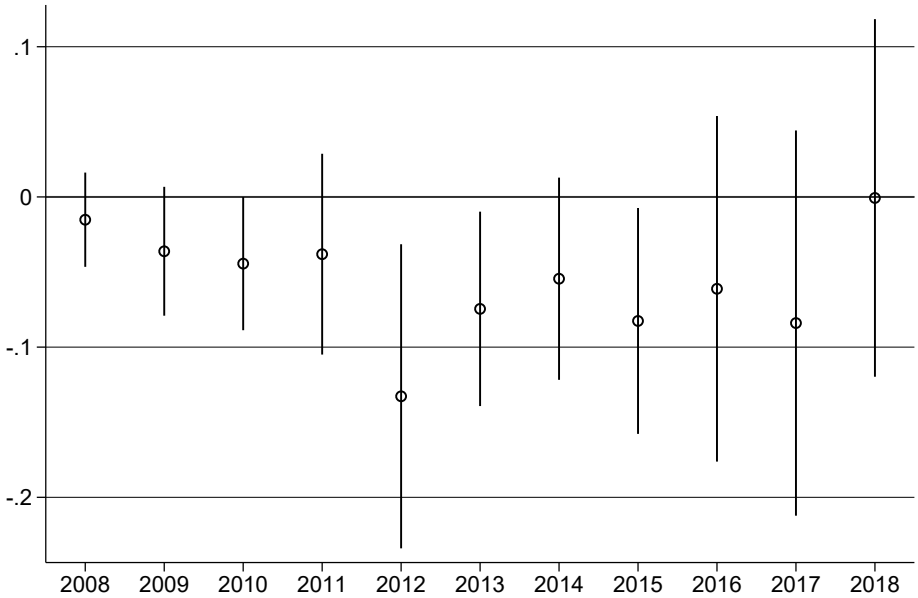
Notes: This table presents the results of estimating the model presented in equation 3.4.2 with the Lerner index as the dependent variable. All specifications include bank fixed effects and year fixed effects. All specifications include data from 2000 to 2018. The specifications in columns (2) and (3) exclude banks with rescues after 2009 and banks with rescues before 2010 respectively. The specification displayed in column (5) adds bank-specific time trends. Standard errors clustered at the country level are presented in parentheses.

3.5.3 Interactions

I provide additional insights into heterogeneity in treatment by employing a model with interactions with the treatment dummy as in equation 3.4.3. Coefficient plots in Figures 3.5.1, 3.5.2 and 3.5.3 sum up the results. Interacting the treatment dummy with time dummies reveals that the persistent differences in the Lerner index between rescued and non-rescued banks are mainly established between 2012 and 2015, indicated by a period with mostly significant negative coefficients. In light of the previous finding that banks rescued in 2008 and 2009 account for the negative treatment effect, such a finding points at

lagged effects from bank rescues on market power. One reason could be that restructuring obligations accompanying state interventions might have obstructed the reversion to pre-crisis levels of market power in contrast to non-rescued peers.

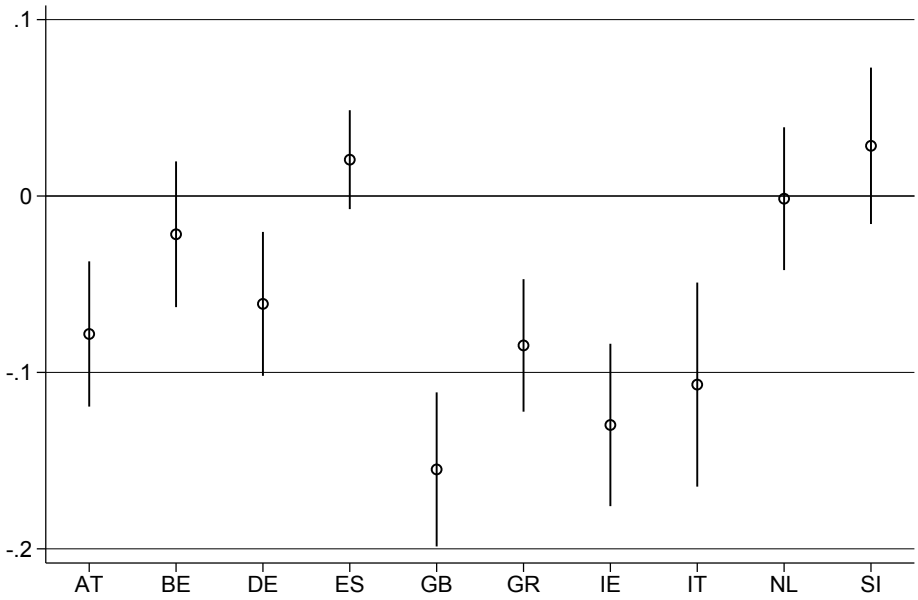
Figure 3.5.1: Effects of bank rescues on market power by year



Notes: This figure displays the estimated coefficients for interactions of the treatment dummy and time dummies for each year post treatment as displayed in equation 3.4.3. Both point estimates and 95% confidence intervals are displayed.

The second take-away regards the country of origin of banks. The coefficient plot in Figure 3.5.2 illustrates that treated banks in the United Kingdom, Ireland and Italy were affected most in terms of the drop in market power. Interestingly, no significant negative effect is estimated for the Netherlands and Spain despite large-scale interventions in both countries. Potentially, consolidation of smaller savings banks into larger new entities like in Spain shielded the affected banks from persistent drops in market power.

Figure 3.5.2: Effects of bank rescues on market power by countries

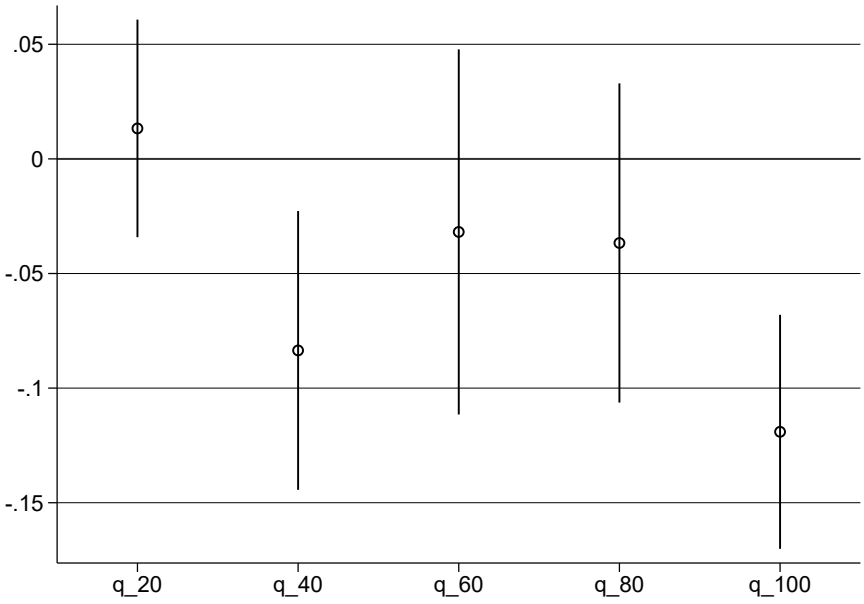


Notes: This figure displays the estimated coefficients for interactions of the treatment dummy and country dummies as displayed in equation 3.4.3. Coefficients are only estimable if a country has both treated and non-treated banks and observations from the pre-treatment period for both groups. Both point estimates and 95% confidence intervals are displayed.

Lastly, the coefficient plot in Figure 3.5.3 casts light on how institution size interacts with treatment. Treatment seems to have had a negative effect on market power only for small-to-medium-sized banks and for the largest institutions.[16]

[16] I also experimented whether membership in the euro area influenced the treatment effect by interacting the treatment dummy with a dummy indicating euro area membership. In fact, the treatment effect for banks not from euro area countries is much stronger (more negative effect on the Lerner index). This finding, however, is not very informative as the United Kingdom is the only country with treated banks in the sample not from the euro area.

Figure 3.5.3: Effects of bank rescues on market power by bank size



Notes: This figure displays the estimated coefficients for interactions of the treatment dummy and group dummies created according to size as displayed in equation 3.4.3. I rank banks using the bank-level averages of total assets for the entire sample. I use 20%-quantiles. Both point estimates and 95% confidence intervals are displayed.

3.5.4 Indirect Effects

In some cases, aided banks were wound down and sold to competitors. In such cases competitive advantages could have been conferred to the purchasing banks. In a smaller sample consisting of all banks not having received individual aid (the control group in all previous specifications), I investigate whether transfer of assets from aided banks to non-aided banks could have resulted in an advantage with respect to market power. The model in equation 3.5.1 introduces the corresponding model.

$$Lerner_{it} = \alpha_i + \beta Transfer_{it} + \gamma X_{it} + \lambda_t + \varepsilon_{it}, \tag{3.5.1}$$

where $Transfer_{it}$ is a dummy variable equal to 1 for the year a bank has purchased another distressed bank from the sample and all periods afterwards. The rest of the

model is identical to the models previously discussed. Note that the treatment group in this case consists only of non-rescued banks from the sample having purchased aided banks from the sample. Table 3.A.2 lists all banks with such a transfer with a superindexed T. The results of the exercise are illustrated in Table 3.5.3. The model does not identify any significant effect of aid transferred to otherwise non-rescued competitors through a transfer of assets. A cautious interpretation of these results, however, is warranted given the small number and selective country origin of banks in the transfer category (banks are either from Spain, Cyprus or Italy).

Table 3.5.3: Effects of transfers on market power

	(1)	(2)
Transfer	-0.020	-0.004
	(0.034)	(0.030)
Log(Total assets)		-0.152*
		(0.076)
Log(Total equity)		0.058
		(0.047)
Log(Total loans)		0.039
		(0.028)
Log(Total borrowing)		0.030
		(0.053)
N	751	750
Number of banks	47	47

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the model presented in equation 3.5.1 with the Lerner index as the dependent variable. All specifications include bank fixed effects and year fixed effects. All specifications include data from 2000 to 2018. Standard errors clustered at the country level are presented in parentheses.

3.6 Robustness

3.6.1 Propensity Score Matching

One concern with the analysis so far is that bailed-out banks might have been inherently different compared to the control group. This could have interfered with the trajectory of market power after treatment period and thus bias the estimates. In order to improve

comparability of banks, I use propensity score matching (PSM) for bank rescue and subsequently repeat the analysis of the baseline model with a smaller subsample. Following Inhoffen et al. (2019), I estimate propensity scores using pre-treatment averages of variables likely to influence bank rescue. Having identified different effects of the two crises in the previous analysis, I carry out the analysis in split samples. The first sample includes banks which were rescued before 2010 and all control banks. The second sample includes all banks rescued since 2010 and all control banks. Bank rescue is deterministically linked to bank distress. To estimate propensities for bank rescue, I test for significant explanatory power of risk related covariates such as changes in borrowing and lending. For the second sample, I include sovereign debt exposures in 2011[17] which potentially drive bank rescues during the sovereign debt crisis. The model for estimating propensities for bank rescues reads as follows.

$$Rescue_i^t = \alpha + \overline{X}_{i,pre\,crisis} + \varepsilon_i, \tag{3.6.1}$$

in which α is a constant and $Rescue_i^t$ is either one of two indicator variables with $t \in \{< 2010, > 2009\}$ depending on the subsample. The indicator variables are equal to 1 if a bank has been rescued, and 0 otherwise. $\overline{X}_{i,pre\,crisis}$ is a vector of explanatory variables employed as pre-treatment averages and ε_i is the error term. I estimate the binary outcome model described in equation 3.6.1 using a logit estimator.

I obtain propensity scores for the first sample as follows. I create 5-year averages from 2003 to 2007 of the variables *Total Assets, Total Borrowing, Total Loans, Total Equity* and of its average annual changes Δ *Total Assets,* Δ *Total Borrowing,* Δ *Total Loans,* Δ *Total Equity.* The economic reasoning behind employing these variables is that both levels and changes of risk related variables can potentially track the built-up of financial risk before the financial crisis. Size of a bank, measured in total assets, and its swift increase, for example, could indicate increasing exposure in risky businesses. Similarly, differences in borrowing and lending might reflect different exposures to refinancing risk and credit risk respectively. Differentials in the equity buffer relate to the resilience to

[17]Figure 3.A.2 reports average domestic sovereign debt exposures for the sample.

shocks and more generally to precautionary behavior of banks. I also include a dummy for euro area membership of the country of the bank's origin in order to account for potential heterogeneity in market dynamics related to the common currency. Following Angrist and Pischke (2008) I only employ variables which are statistically significant for prediction. I, however, use a generous cutoff criterion of around 20% confidence accounting for the relatively small sample size.

Table 3.6.1 shows the results when estimating equation 3.6.1 with different control variables. In several testing rounds I have narrowed down the selection of relevant variables and column (4) provides the specification with which I will proceed. *Total Assets* does not provide explanatory power in any form, whereas the other described variables enter the model. The change in total equity enters negatively which could indicate a negative effect of bank stability of decreasing equity buffers before the financial crisis. The change in total lending enters negatively which could be interpreted as increasing risky positions prior to the crisis. Lastly, banks harboring in euro area countries are more likely for failure in most specifications but not in the relevant one in column (4). As one observation enters per bank, the number of observations is only 59. The rate of the correct predictions by the model is substantially high being above 80%. I consider the model to deliver a correct prediction if the predicted probability of rescue is above the naive rate of prediction (i.e. the ratio of banks rescued in the sample being 28.8%) and vice versa for non-rescued banks.

I apply a radius matching procedure with replacement using a caliper width of 0.05. That is, I keep each treated bank if there is at least one control bank within (absolute) distance of 0.05 with respect to the propensity score. After matching my sample consists of all treated banks for which at least one match could be established and all non-treated banks tagged as matched peers at least once. Figure 3.A.3 displays the distribution of predicted propensity scores across treatment and control group, as well as the outcome of the sample size reduction after PSM. The reduced sample consists of 20 banks (9 control, 11 treatment) down from originally 59 banks (42 control, 17 treatment) for the subsample

Table 3.6.1: Propensity score matching (rescue before 2010)

	(1)	(2)	(3)	(4)
Rescue				
Total assets	0.027	0.007		
	(0.022)	(0.007)		
Δ Total assets	-0.100		0.025	
	(0.128)		(0.048)	
Total borrowing	-0.021	-0.023****		
	(0.025)	(0.006)		
Δ Total borrowing	-0.163*		-0.195***	-0.211**
	(0.120)		(0.080)	(0.124)
Total equity	0.385*	-0.135**		0.234*
	(0.253)	(0.079)		(0.174)
Δ Total equity	-3.655**		-1.311****	-2.552***
	(1.873)		(0.284)	(1.252)
Total loans	-0.034	0.028***		
	(0.028)	(0.013)		
Δ Total loans	0.396**		0.196****	0.229***
	(0.213)		(0.041)	(0.114)
Euro area	2.952**	2.116***	1.793*	3.362
	(1.699)	(1.020)	(1.138)	(2.915)
Correct prediction rate	0.898	0.627	0.678	0.831
Observations	59	59	59	59

* p<0.2, ** p<0.1, *** p<0.05, **** p<0.01

Notes: This table presents the results of a logit estimation of the model presented in equation 3.6.1. The explanatory variables are averages of a 5-year window before 2008. Each bank enters only with one observation. The dependent variable is a dummy variable indicating whether the bank was rescued in 2008 or 2009. Banks which received bailout after 2009 are omitted from the sample. A correct prediction is defined as a propensity score above the naive rate of prediction for rescued banks (i.e. the ratio of banks rescued in the subsample being 28.8%) and below the naive prediction rate for non-rescued banks. All variables except for the dummy variables enter the regression in billion euros. Standard errors clustered at the country level are presented in parentheses.

consisting of control banks and banks rescued before 2010.[18]

I apply the baseline regression model on the reduced sample after PSM. Table 3.6.2 reports the results. The specification in column (1) reports the result of the model without controls. The estimated effects of bank rescue on the Lerner index are close to the results in the baseline model and amount to a 6.4 percentage points decrease in the relative mark-up. The estimated effects are slightly larger when control variables are added (see column (2)) and when control banks from countries without any bank rescue are omitted (see column (3)). In sum, the PSM exercise provides robustness for the finding that banks rescued during the financial crisis experienced a drop in market power.

Table 3.6.2: Estimation results (PSM - rescue before 2010)

	(1)	(2)	(3)
Rescue	-0.064***	-0.075**	-0.073***
	(0.015)	(0.023)	(0.013)
Log(Total assets)		-0.039	
		(0.068)	
Log(Total equity)		0.028	
		(0.023)	
Log(Total loans)		0.053	
		(0.046)	
Log(Total borrowing)		-0.043	
		(0.041)	
Number of Banks	20	20	16

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the model presented in equation 3.4.1 with the Lerner index as the dependent variable using only matched observations obtained from propensity score matching. All specifications include bank fixed effects and year fixed effects. All specifications include data from 2000 to 2018 and exclude banks which received rescue after 2009. The specification in column (3) omits control banks from countries in which no bank was rescued at all. Standard errors clustered at the country level are presented in parentheses.

In the following, I repeat the analysis for the subsample consisting only of control banks and banks rescued after 2009. Table 3.6.3 shows the results of the estimation used for propensity score matching. I use the specification in column (3) for the proceeding

[18]Compared to the banks included in the main regressions (see Table 3.A.2), some banks do not enter the regressions for determining propensity scores as data is not available for the 5 years prior to 2008 for all banks.

analysis. The level of debt held in the domestic sovereign does not appear to be significant. Predicting bank failure within the sample of banks rescued after 2009 proves to be more difficult than for the other subsample. The rate of correct predictions is rather poor being around 60%. Nevertheless, it might be worthwhile to consider regression results of a narrowed sample. Figure 3.A.4 reveals that propensity score matching mainly excludes control banks at the lower end of the propensity distribution. The original sample for control banks and banks treated after 2009 consists of 60 banks (44 control and 16 treated) and is reduced after PSM to 31 banks (16 control and 15 treated). Table 3.6.4 shows that the coefficients of rescue remain insignificant for the subsample rescued after 2009.

3.6.2 Miscellaneous

In order to test the robustness of my findings, I explore potential confounding effects arising from different scenarios. Firstly, I exclude banks which either did not survive the financial crisis (e.g. Dexia or Hypo Real Estate) or were created in the course of the two crises (e.g. Catalunya Banc or Belfius). Arguably, banks which disappeared from the market were affected substantially more by the events unfolding during the crises and therefore might not be representative for banks continuing their business. Also, banks founded or rebranded in the crisis either through mergers of existing banks or nationalizations appear to be special cases. I exclude a total of 12 banks disappearing from the dataset until 2011 and five banks appearing in the data after 2010 for the first time. Table 3.6.5 reports regression results for this case. Negative and significant estimates persist for the rescue dummy. Once a split into treatment periods is included, only banks rescued in the first of the two crises experience a drop in market power following rescue.

Next, I exclude control banks from countries which did not have any bank failures within the sampled banks (e.g Poland or Sweden). National banking markets are heterogeneous in Europe. Potentially, markets having weathered the financial crisis reasonably well do not serve as a natural control for affected markets. Table 3.6.6 presents the results. Across specifications, the effect is at least substantially mitigated with the estimated effect of bank rescues amounting to around -3 percentage points.

Table 3.6.3: Propensity score matching (rescue after 2009)

	(1)	(2)	(3)
Rescue			
Total assets	-0.021	-0.021	
	(0.054)	(0.051)	
Δ Total assets	-0.369		-0.364*
	(0.491)		(0.235)
Total borrowing	-0.035	-0.036	
	(0.066)	(0.067)	
Δ Total borrowing	0.009		0.221
	(0.519)		(0.178)
Total equity	0.465	-0.015	
	(0.477)	(0.097)	
Δ Total equity	-2.567		-1.827**
	(2.404)		(1.090)
Total loans	-0.018	0.047**	
	(0.061)	(0.026)	
Δ Total loans	0.639*		0.326****
	(0.402)		(0.119)
Domestic sovereign debt exp.	-0.977		
	(1.848)		
Correct prediction rate	0.633	0.650	0.600
Observations	60	60	60

* p<0.2, ** p<0.1, *** p<0.05, **** p<0.01

Notes: This table presents the results of a logit estimation of the model presented in equation 3.6.1. The explanatory variables are averages of a 7-year window before 2010. Each bank enters only with one observation. The dependent variable is a dummy variable indicating whether the bank was rescued after 2009. Banks which received bailout before 2010 are omitted from the sample. A correct prediction is defined as a propensity score above the naive rate of prediction for rescued banks (i.e. the ratio of banks rescued in the sample being 26.7%) and below the naive prediction rate for non-rescued banks. All variables except for the dummy variables enter the regression in billion euros. Standard errors clustered at the country level are presented in parentheses.

Table 3.6.4: Estimation results (PSM - rescue after 2009)

	(1)	(2)	(3)
Rescue	-0.063	-0.044	-0.014
	(0.048)	(0.034)	(0.040)
Log(Total assets)		-0.014	
		(0.063)	
Log(Total equity)		0.067**	
		(0.023)	
Log(Total loans)		0.015	
		(0.029)	
Log(Total borrowing)		-0.066	
		(0.055)	
Number of banks	31	31	23

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the model presented in equation 3.4.1 with the Lerner index as the dependent variable using only matched observations obtained from propensity score matching. All specifications include bank fixed effects and year fixed effects. All specifications include data from 2000 to 2018 and exclude banks which received rescue before 2010. The specification in column 3 omits control banks from countries in which no bank was rescued at all. Standard errors clustered at the country level are presented in parentheses.

In Table 3.6.7, I provide results for alternative ways of calculating the Lerner index. Previous results hold also when the Lerner index is estimated using random effects or pooled OLS regressions.[19] Additional robustness tests not reported include the exclusion of Spain which is oversampled in my sample and regressions winsorizing the Lerner index at 1% at the lower and upper tail of the distribution to check whether outliers are driving the results. None of the mentioned analyses reveals different patterns in the coefficients than previously identified.

Lastly, I provide results of placebo tests along both dimensions of the panel. Table 3.6.8 shows that placebo tests along the time dimension (columns (2) to (5)) provide either insignificantly or slightly positively estimated coefficients when all treatments are artificially shifted forward in 1-year intervals. For these placebo tests, I only use data

[19] I also tried country by country estimation of the Lerner index in order to capture differences in technologies across countries as suggested by the literature. However, due to the small sample, estimates are rather imprecise. Note that the estimation of the Lerner index as in equation 3.3.3 includes a multitude of coefficients and most of the countries in the sample have less than five banks.

Table 3.6.5: Effects of bank rescues on market power (exclusion of failed and newly created banks)

	(1)	(2)	(3)	(4)
Rescue	-0.066**		-0.063***	
	(0.026)		(0.022)	
Rescue (2008-2009)		-0.074***		-0.072***
		(0.024)		(0.021)
Rescue (2010-2017)		-0.052		-0.044
		(0.040)		(0.038)
Log(Total assets)			-0.087	-0.083
			(0.061)	(0.061)
Log(Total equity)			0.053**	0.053**
			(0.019)	(0.019)
Log(Total loans)			0.021	0.022
			(0.025)	(0.025)
Log(Total borrowing)			0.019	0.013
			(0.046)	(0.046)
Number of banks	70	70	70	70

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the models presented in equations 3.4.1 and 3.4.2 with the Lerner index as the dependent variable. All specifications omit banks which either disappeared from the sample before 2012 or were introduced after 2010. All specifications include bank fixed effects and year fixed effects and include data from 2000 to 2018. Standard errors clustered at the country level are presented in parentheses.

from before the financial crisis (i.e. t<2008) in order to test for pre-treatment trends. If at all, there is a positive effect of fake earlier treatments indicating some earlier built-up of market power of treated banks. The effect, however, is small and not robust across the four specifications. Once the placebo tests are applied along the cross-sectional dimension, results are insignificant backing the robustness of the model. Results are displayed in columns (6) and (7). I implement the cross-sectional placebo tests by splitting up the sample in two groups according to their treatment periods and allocate treatment randomly for half of the sample respectively. I further exclude the major crisis years 2008 and 2009 for the specification for the financial crisis treatments in column (6) and the years 2011 and 2012 for the specification for the euro crisis treatments in column (7) to rule out timely variation in the actual treatment schedule. I find that randomization across the cross-sectional dimension does not provide significance in the estimates.

Table 3.6.6: Effects of bank rescues on market power (exclusion of control banks from unaffected countries)

	(1)	(2)	(3)	(4)
Rescue	-0.024		-0.028*	
	(0.016)		(0.015)	
Rescue (2008-2009)		-0.031*		-0.025
		(0.016)		(0.015)
Rescue (2010-2017)		-0.010		0.011
		(0.032)		(0.029)
Log(Total assets)			-0.080	-0.087
			(0.062)	(0.057)
Log(Total equity)			0.039**	0.050**
			(0.017)	(0.019)
Log(Total loans)			0.013	-0.013
			(0.024)	(0.024)
Log(Total borrowing)			0.020	0.043
			(0.050)	(0.051)
Number of banks	74	74	74	74

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the models presented in equations 3.4.1 and 3.4.2 with the Lerner index as the dependent variable. All specifications omit control banks from Denmark, Finland, Hungary, Luxembourg, Malta, Poland and Sweden which did not have any bank failure within the group of sampled banks. All specifications include bank fixed effects and year fixed effects and include data from 2000 to 2018. Standard errors clustered at the country level are presented in parentheses.

3.7 Potential Sources of Treatment Heterogeneity

Having established heterogeneous effects of crisis intervention on market power across treatment periods, the question about the origin of heterogeneity is natural to ask. Potential sources are different origins of bank distress leading to bailout, different scopes and degrees of intervention and a different menu of remedies imposed.

When comparing banks from the control group and banks which were treated in general, previous findings suggest that the two groups of banks were fairly similar in the pre-crisis period on the basis of comparing relevant descriptives (see Table 3.4.1). What can be learned from comparing banks treated at different points in time? Table 3.7.1

Table 3.6.7: Effects of bank rescues on market power (alternative Lerner index calculations)

	(1)	(2)	(3)	(4)
Rescue	-0.050**		-0.061**	
	(0.023)		(0.025)	
Rescue (2008-2009)		-0.058**		-0.068***
		(0.023)		(0.023)
Rescue (2010-2017)		-0.037		-0.049
		(0.035)		(0.039)
Number of Banks	87	87	87	87
Lerner index calculation	RE	pooled OLS	RE	pooled OLS

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the models presented in equations 3.4.1 and 3.4.2 with differently estimated Lerner index measures as the dependent variable. Column 1 and column 3 employ the Lerner index estimating equation 3.3.3 with random effects (RE) and column 2 and column 4 use the Lerner index estimated in pooled OLS regressions employing country and year dummies. All specifications include bank fixed effects and year fixed effects. Standard errors clustered at the country level are presented in parentheses.

Table 3.6.8: Effects of bank rescues on market power (placebo tests)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rescue	-0.060**	0.039**	0.027	0.020	0.030*		
	(0.025)	(0.016)	(0.018)	(0.017)	(0.017)		
Rescue (2008-2009)						-0.013	
						(0.024)	
Rescue (2010-2017)							0.015
							(0.041)
Number of banks	87	77	77	77	77	66	68
Placebo dimension	none	time	time	time	time	cross-section	cross-section
Treatment shifted		-1y	-2y	-3y	-4y		

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table presents the results of estimating the model presented in equation 3.4.1 with the Lerner index as the dependent variable. The specifications feature placebo tests in the time and in the cross-sectional dimension of the panel. Column (1) is the baseline estimation without placebos. Columns (2) to (5) shift the treatment 1 year, 2 years, 3 years and 4 years forward for each treated bank and use data for t<2008. Columns (6) and (7) randomize treatment for the split samples of the control banks and banks treated in the financial crisis and of the control banks and the banks treated in the European sovereign debt crisis respectively. All specifications include bank fixed effects and year fixed effects. The specifications in columns (1) to (5) include data from 2000 to 2007. The specifications in columns (6) and (7) omit immediate crisis years 2008 and 2009 and 2011 and 2012 respectively. Standard errors clustered at the country level are presented in parentheses.

reveals that banks rescued in the first crisis of the European twin crisis were substantially larger in all dimensions tested (total assets, total equity etc.). That being said, recovery from the negative impact on the financial crisis and imposed remedies might have been a longer process for larger banks. Striking is the larger share of sovereign debt issued by the domestic sovereign held by the second treatment group (although not statistically significant). This hints at different origins of financial distress for banks across groups and potentially at different impacts on market power.

Table 3.7.1: Comparison of pre-crisis characteristics between treatment groups

	mean(Rescue$^{<2010}$)	mean(Rescue$^{>2009}$)	diff.	sd	obs.
Total assets	299.9	41.7	258.28***	90.5	32
Total loans	186.9	33.0	153.91**	56.5	32
Total equity	15.7	3.60	12.13**	4.92	32
Total borrowing	180.2	25.7	154.49***	52.3	32
Dom. sov. debt exp.	0.65	0.76	-0.12	0.097	32

Notes: This table displays differences for a list of selected variables between the two treatment groups for the period before the outbreak of the financial crisis (before 2008). Columns 2 and 3 present conditional averages for the two groups respectively. Column 4 displays the average differences between the two groups and column 5 the standard deviation of the latter. Differences labeled with asterisks are significant as derived from underlying t-tests with the following confidence levels * p<0.1, ** p<0.05, *** p<0.01. All variables except for domestic sovereign debt exposure are denoted in billion euros. Domestic sovereign debt exposure represents the share of domestic sovereign debt out of all sovereign debt held by the banks.

With regards to the second suggestion, I provide an overview of the intensity of aid and distribution of the three major aid types liquidity support, capital injections and asset relief measures. Table 3.7.2 juxtaposes for both treatment groups treatment intensities for different aid measures. Treatment intensities are calculated as follows. I have collected total admitted aid volumes by treatment category (see appendix 3.A.3) and divided these by the average pre-crisis level of total assets respectively. Treatment intensities are calculated in percent. On average, it seems that bank rescues before the European sovereign debt crisis relied relatively more on providing liquidity provision and protecting banks from the fallout on their asset side through asset relief measures. Relatively more capital injections were used for bank rescues after 2009 with an average level of public recapitalization of almost six percent of the pre-crisis bank size. Corresponding t-tests, however, suggest that none of the differences are statistically significant. For instance,

the large difference in the aid intensity from asset relief measures comes about from the outlier Hypo Real Estate, which saw assets almost the size of its entire stock of assets protected. As a result, it does not seem likely that differences in treatment effects on market power result from differences in aid intensities.

Table 3.7.2: Comparison of treatment intensities between treatment groups

	mean(Rescue$^{<2010}$)	mean(Rescue$^{>2009}$)	diff.	sd	obs.
Intensity liquidity	5.24	1.73	3.51	2.57	38
Intensity capital	4.84	5.60	-0.77	2.31	38
Intensity asset relief	8.52	0.47	8.05	5.23	38

Notes: This table displays differences for treatment intensities between the two groups of treated banks having been rescued before 2010 and after 2009. Treatment intensities are calculated by relating total admitted aid in the three aid categories to total assets. I use average total assets of a 5-year period before the start if the financial crisis in 2008. If data are not available for the pre-crisis period, I resort to the amount of total assets in the first year available. Intensities are displayed in percent. Columns 2 and 3 present conditional averages for the two groups respectively. Column 4 displays the average differences between the two groups and column 5 the standard deviation of the latter. Differences labeled with asterisks are significant as derived from underlying t-tests with the following confidence levels * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Thirdly, banks might have been subjected to remedial actions to different degrees across treatment periods. For example, obligations to downsize a bank's balance sheet or to divest whole business units should have had a negative effect on market power. This notion, however, is hard to test with the data at hand. Downsizing obligations were imposed in many cases, but rarely precisely quantified in the EC press releases. In some cases, references can be found on forced divestments of whole business units (e.g. often forced separations of insurance and banking units). Such cases were rare and sometimes the divestment obligations were later repealed when no fair sales price could be realized. Nevertheless, I want to provide some anecdotal evidence. The EC allowed for limited downsizing after receiving state aid for some banks rescued in the sovereign debt crisis (see for example appendix 3.A.3 for aid to Greek banks). The EC argued that the source of bank distress was not excessive risk taking but the link to a weak sovereign state not giving rise to "punitive" measures by regulators to curb moral hazard issues.

3.8 Conclusions and Outlook

Bank bailouts remain highly controversial. Political debate arises over the use of large amounts of taxpayer's money to rescue banks for the sake of safeguarding financial stability. Another less discussed side effect of bank bailout concerns its potential effects on competition. I have analyzed the effects of bank bailouts on market power. In a differences-in-differences setting I have shown that rescued banks have lost market power vis-à-vis non-aided banks. I identify heterogeneous effects with regards to treatment period, bank size and country of origin. Most importantly, the significant drop in market power is driven by banks which had to be rescued during the financial crisis and not in the course of the European debt crisis beginning in 2010. I conduct a large set of robustness checks including propensity score matching and placebo tests confirming my findings.

I find contrary results compared to others who have shown that bank bailouts coincide with increases of market power by aided banks in the U.S. (see Berger and Roman (2015) and Koetter and Noth (2016)). While it is difficult to isolate the impact of rescue measures alone from financial distress leading to bailout in the first place, my findings cast positive light on EU competition policy having succeeded in preventing rescued banks from abusing public funds to distort competition in their favor. Protecting competition in the banking markets however remains a topical policy issue. Market power and market concentration measures are rising in my sample covering the European banking markets. Both rising levels of market power and the looming threat of bank rescues in the context of the ongoing COVID-19 pandemic call for an active role of competition policy in the future.

3.A Appendix

3.A.1 Tables

Table 3.A.1: Estimation results translog cost function

	(1)
ln(w1/w3)	0.188***
	(0.038)
ln(w2/w3)	0.341***
	(0.084)
ln(TA)	1.310***
	(0.099)
0.5 ln(TA) x ln(TA)	-0.024***
	(0.009)
0.5 ln(w1/w3) x ln(w1/w3)	0.113***
	(0.006)
0.5 ln(w2/w3) x ln(w2/w3)	0.050***
	(0.007)
ln(w1/w3) x ln(w2/w3)	-0.038***
	(0.006)
ln(w1/w3) x ln(TA)	0.013***
	(0.004)
ln(w2/w3) x ln(TA)	-0.007
	(0.007)
trend	-0.034***
	(0.009)
$trend^2$	0.001***
	(0.000)
ln(w2/w3) x trend	-0.002**
	(0.001)
ln(w1/w3) x trend	0.005***
	(0.001)
ln(TA) x trend	0.001
	(0.001)
constant	-0.757
	(0.530)
Observations	1296

* p<0.1, ** p<0.05, *** p<0.01

Notes: This table displays the results of the regression of the translog cost function in equation 3.3.3 using a fixed effects panel estimator.

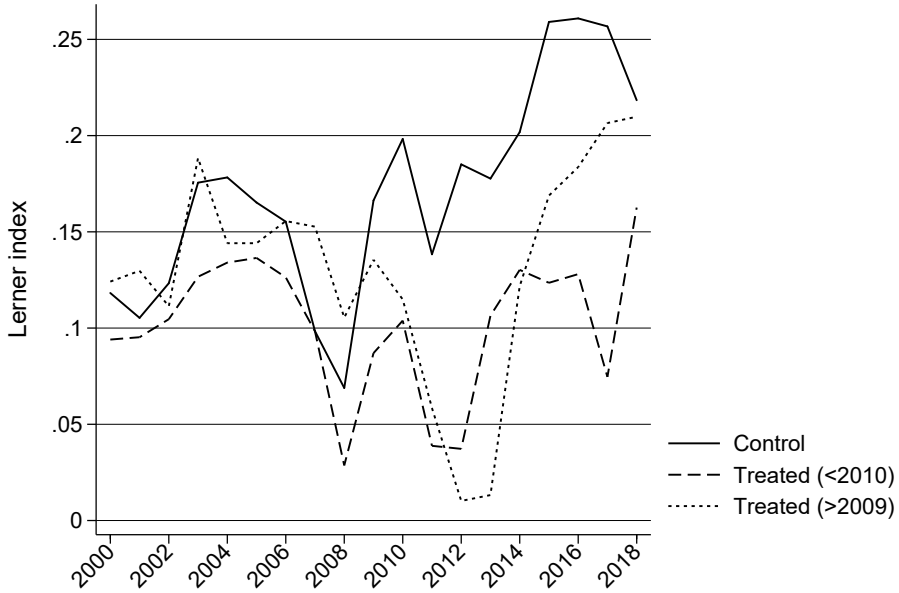
Table 3.A.2: Group assignment of banks

Country Total (87)	Control 47	Treated (<2010) 19	Treated (>2009) 21
Austria (3)	Erste Bank, Raiffeisen Bank		Ö. Volksbank AG
Belgium (2)		Dexia (later Belfius), KBC Bank	
Cyprus (2)	Bank of Cyprus^T		Marfin Popular Bank
Denmark (4)	Danske Bank, Jyske Bank, Sydbank, Nykredit		
Finland (1)	OP-Pohjola Group		
France (4)	BNP Paribas, Credit Agricole, Societe Generale	BPCE	
Germany (11)	Deutsche Bank, DekaBank, DZ BANK, Landesbank Berlin AG, WGZ Bank	Bayerische Landesbank, Commerzbank, Hypo Real Estate, HSH Nordbank, Landesbank Baden-Württemberg, Norddeutsche Landesbank	
Greece (6)		Alpha Bank, EFG Eurobank Ergasias, Piraeus Bank	Agricultural Bank of Greece, TT Hellenic Postbank, National Bank of Greece
Hungary (1)	OTP Bank		
Ireland (3)		Allied Irish Banks, Bank of Ireland	Irish Life and Permanent
Italy (5)	Intesa Sanpaolo^T, Unicredit, Banco Popolare, Ubi Banca		Banca Monte dei Paschi di Siena
Luxembourg (1)	Banque et Caisse d'Epargne de l'Etat		
Malta (1)	Bank of Valletta		
Netherlands (4)	Rabobank	ING, ABN Amro, SNS	
Poland (1)	Powszechna Kasa Oszczędności Bank Polski		
Portugal (4)			Caixa Geral de Depósitos, Banco Comercial Português, Espírito Santo Financial, Banco BPI
Slovenia (2)			Nova Ljubljanska Banka, Nova Kreditna Banka Maribor
Spain (24)	Banco Santander^T, BBVA^T, [...]		Bankia, Banco Grupo Caja3, Banco Mare Nostrum, Caixa d'Estalvis Unio de Caixes de Manlleu, Caixa de ahorros de Galicia, Vigo, Ourense e Pontevedra, Caja de Ahorros del Mediterraneo, Effibank
Sweden (4)	Nordea Bank, Skandinaviska Enskilda Banken (SEB), Svenska Handelsbanken, Swedbank		
United Kingdom (4)	HSBC, Barclays	Royal Bank of Scotland, Lloyds	

Notes: This table gives an overview of included banks in the EBA sample. The number in brackets behind the country name indicates the total of banks from the respective countries. Listed are all banks from EU countries which took part in the stress test exercise of the EBA in 2011. WestLB is excluded as no data is available on Bankscope. A superindexed T refers to a bank having purchased an aided bank from the sample. The Spanish banks which are omitted from the table for illustrative purposes are Caja de Ahorros y Pensiones de Barcelona, Banco Popular Español, Banco de Sabadell^T, Caixa d'Estalvis de Catalunya, Tarragona i Manresa, Bankinter, Caja España de Inversiones, Caja de Ahorros y Monte de Piedad, Banca Civica, Caja de Ahorros y m.p. de Zaragoza, Aragon y Rioja, Monte de Piedad y Caja de Ahorros de Ronda, Cadiz, Almeria, Malaga, Antequera y Jaen, Banco Pastor, BBK Bank, Sabadell i Terrassa, Caja de Ahorros y m.p. de Gipuzkoa y San Sebastian, Banca March, Caja de Ahorros de Vitoria y Alava, Caja de Ahorros y m.p. de Ontinyent, Colonya - Caixa d'Estalvis de Pollensa.

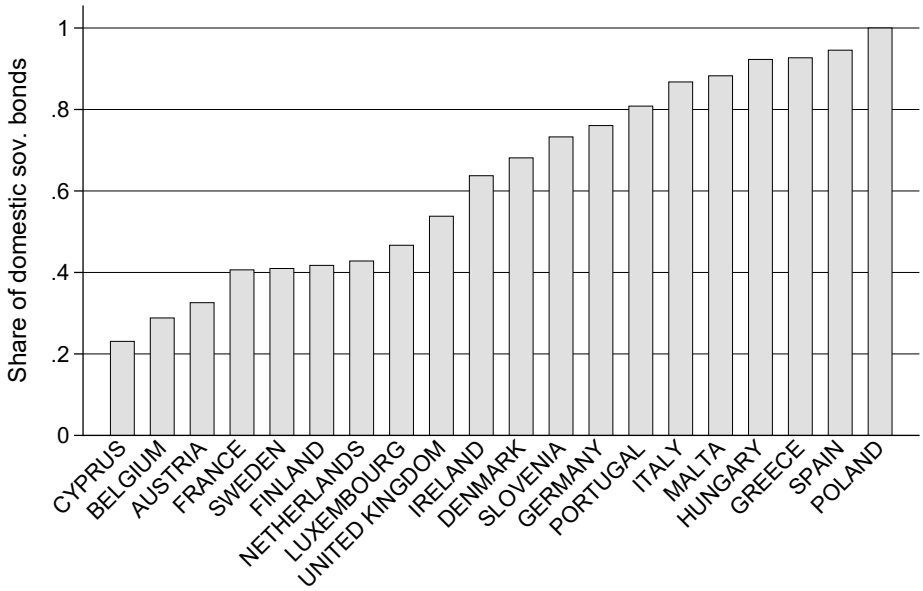
3.A.2 Figures

Figure 3.A.1: Development of the Lerner index by treatment status (split model)



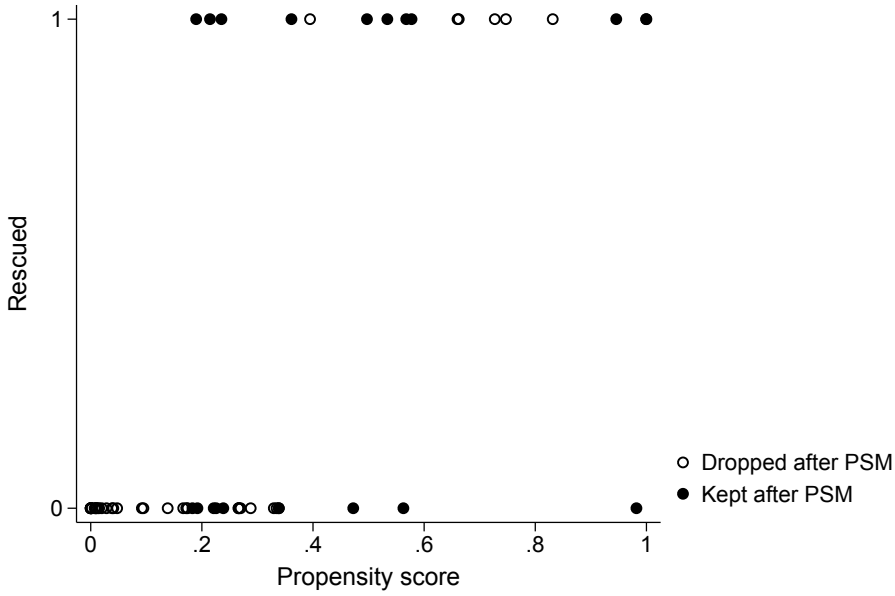
Notes: This figure compares the development of the Lerner index for control and differently treated banks. The dashed line reports the trajectory of banks being treated before 2010 and the dotted line the trajectory of banks being treated after 2009.
Source: Bankscope, BankFocus and own calculations.

Figure 3.A.2: Share of domestic sovereign bonds



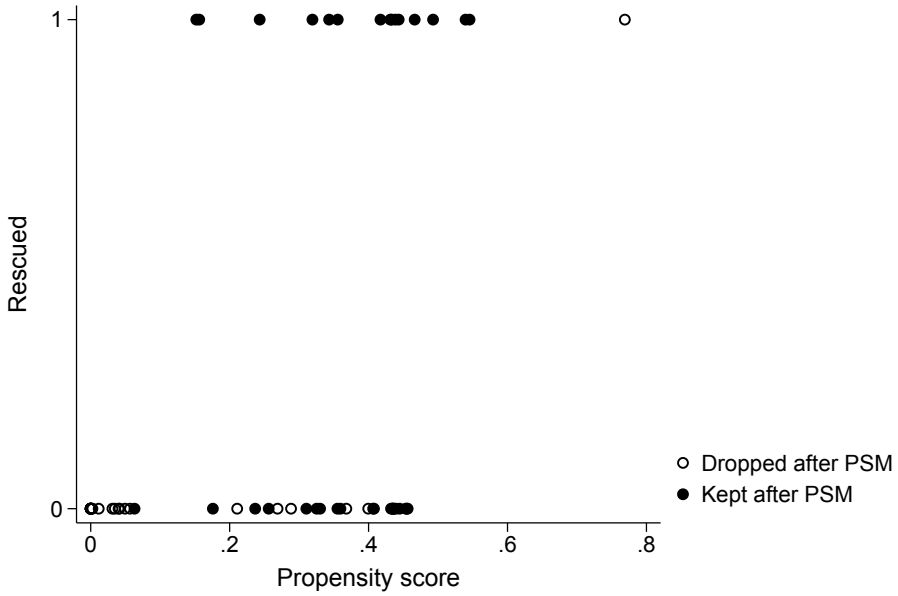
Notes: This figure displays the share of domestic sovereign bond holdings of all sovereign bond holdings aggregated on the country level at the end of 2011.
Source: EBA stress test exercise 2011.

Figure 3.A.3: Propensity score matching (rescue before 2010)



Notes: This figure illustrates the distribution of predicted propensity scores across treatment and control group. Each dot represents one bank in the sample. I apply a radius matching procedure with replacement using a caliper width of 0.05. Propensity scores are estimated based on the regression results displayed in equation 3.6.1. Banks represented by filled dots remain in the sample after PSM.

Figure 3.A.4: Propensity score matching (rescue after 2009)



Notes: This figure illustrates the distribution of predicted propensity scores across treatment and control group. Each dot represents one bank in the sample. I apply a radius matching procedure with replacement using a caliper width of 0.05. Propensity scores are estimated based on the regression results displayed in equation 3.6.1. Banks represented by filled dots remain in the sample after PSM.

3.A.3 Aid measures

In this section, I present an overview of public interventions to individual banks in the European Union. The main source are press releases from the European Commission.[20] More detailed information can usually be retrieved from the legal documents accompanying aid announcements or decisions regarding the legality of aid which are collected in the EC state aid register.[21]

The usual order of events during the financial crisis was a member state announcing that it has implemented aid to a bank which the EC usually approved conditional on a follow-up restructuring plan (or resolution plan). Restructuring plans had to address the viability, burden-sharing and the protection of competition of aid measures, being

[20]The website https://ec.europa.eu/competition/recovery/banking_case_list_public_en.pdf (last accessed on April 14, 2021) lists all press releases regarding individual aid measures by country.

[21]See https://ec.europa.eu/competition/elojade/isef/index.cfm?clear=1&policy_area_id=3 (last accessed on April 14, 2021) using the respective case numbers.

the three pillars of the EC's state aid guidelines. Restructuring plans were subject to the approval of the EC and could be amended. The urgency of events explains why aid measures were often approved temporarily before restructuring plans with conditions for the aid were presented.

Sometimes banks had to be rescued in a joint effort of several member states (e.g. Fortis with the involvement of Belgium, the Netherlands and Luxembourg and Dexia with the involvement of Belgium, France and Luxembourg). For such cross-border rescue efforts, I usually describe and list all the measures in the subsection of the country in which the aided bank was headquartered and refer to it in the subsections of other countries for completeness and tractability.

Besides aid measures to banks which had to be notified individually to the EC, there were aid measures to banks which were applicable under a national aid scheme, as for example the German Special Fund for Financial Market Stabilisation (FMSA). Aid provided within the scope of national aid schemes usually was of smaller magnitude and did not require banks to provide and follow restructuring plans. As my analysis mainly draws on aid measures requiring individual clearance of the EC, I only provide information on aid received under national schemes in special circumstances (e.g. France or Greece), which preceded larger treatments. In the following, I provide detailed information on banks having received individual aid in my sample and shortly list all other banks having received individual aid in the specific country sections. The following list collects individual aid measures for the sample of systemically important banks from the European Banking Authority stress test exercise in 2011.

Austria

Table 3.A.3 gives an overview of the state aid measures received by Austrian banks. Austria saw a series of state aid interventions and bank resolutions including the lengthy wind-down of Hypo Alpe Adria. In many cases, remedial action as a response to aid measures included down-sizing of business activities outside of Austria especially in Central

and Eastern Europe.

- Österreichische Volksbanken AG (ÖVAG), which is the central institute to Austrian cooperative banks, received a capital injection of 1,250m euros, a loan guarantee covering 3,000m euros and an asset relief measure covering 100m euros in 2009. The restructuring plan included an acquisition ban, a price leadership ban for the online banking sector and the withdrawal from non-core businesses such as real estate investment. ÖVAG needed to discontinue large parts of its Central and Eastern Europe activities.

- Other banks receiving individual aid: BAWAG, Kommunalkredit, Hypo Group Alpe Adria and Hypo Tirol.

Table 3.A.3: State aid received by individual banks - Austria

Bank	Date	Type of Aid	Amount	Source
Österreichische Volksbanken AG	9/12/2011	loan guarantee	3000	IP/11/1522
Österreichische Volksbanken AG	9/12/2011	asset relief	100	IP/11/1522
Österreichische Volksbanken AG	9/12/2011	recapitalization	1250	IP/11/1522
Österreichische Volksbanken AG (R)	19/9/2012			IP/12/982

Notes: This table presents state aid measures to banks in Austria. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Belgium

Table 3.A.4 gives an overview of the state aid measures received by Belgian banks.

- Dexia received a first round of aid in 2008 and 2009 consisting of loan guarantees of 150bn euros (reduced to 100 bn euros in November 2009) and a capital injection of 6.4bn euros both jointly provided by the governments of Belgium, France and Luxembourg, as well as asset relief support amounting to 16.6bn euros provided by Belgium and France. The restructuring plan for this set of interventions foresaw structural and behavioral remedies such as the ceasing of proprietary trading and the

sale of Dexia's US subsidiary FSA. However, the bank went into distress again and in October 2011 it was announced that Dexia would be wound down. Throughout the resolution process, Dexia benefited from a 45bn euros loan guarantee scheme. In the process of resolving Dexia, the Belgian state purchased Dexia Bank Belgium (DBB) for 4bn euros in October 2011. DBB was later renamed and now operates in the Belgian market as Belfius. Belfius faced behavioral and structural remedies including the ban on marketing its received state aid and limitations in emitting new loans and insurance contracts. Other parts of the Dexia group were sold off. Dexia Municipal Agency (DMA) was incorporated into the newly created French development bank Caisse Française de Financement Local (CAFFIL) under the participation of the French state. Dexia BIL was transformed into the Luxembourg based Banque Internationale à Luxembourg (BIL) under the participation of the state of Luxembourg.

- KBC received two capital injections of 3.5bn euros each, in December 2008 and January 2009 respectively. Additionally, asset relief support amounting to the magnitude of 20bn euros was granted to the bank's portfolio of collateralized debt obligations. The bank's restructuring was subject to down-sizing its international business activities including the sales of a banking business unit (Centea) and an insurance business unit (Fidea) in the Belgian market. Further behavioral remedies included a ban on marketing received state aid and a price leadership ban.

- Other banks receiving individual aid: Ethias and Fortis.

Table 3.A.4: State aid received by individual banks - Belgium

Bank	Date	Type of Aid	Amount	Source
Dexia Group	19/11/2008	loan guarantee	150000	IP/08/1745
Dexia Group	13/3/2009	asset relief	16900	IP/09/399
Dexia Group	13/3/2009	recapitalization	6400	IP/09/399
Dexia Group (R)	26/2/2010			IP/10/201
Dexia Group	17/10/2011	recapitalization (N)	4000	IP/11/1203
Dexia Group	21/12/2011	loan guarantee	45000	IP/11/1592
Dexia Group (R)	28/12/2012			IP/12/1447
KBC Group N.V.	18/12/2008	recapitalization	3500	IP/08/2033
KBC Group N.V.	30/6/2009	recapitalization	3500	IP/09/1063
KBC Group N.V.	30/6/2009	asset relief	20000	IP/09/1063
KBC Group N.V. (R)	18/11/2009			IP/09/1730

Notes: This table presents state aid measures to banks in Belgium. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Cyprus

Table 3.A.5 gives an overview of the state aid measures received by banks in Cyprus. The Cypriot banking sector experienced significant consolidation with, for instance, the Bank of Cyprus acquiring the formerly second largest institution Cyprus Popular Bank and the Cyprus Cooperative Bank being sold to Hellenic Bank.

- Cyprus Popular Bank (formerly Marfin) which suffered from substantial losses on the Greek banking market required additional capital following the European Banking Authority's stress testing exercise in 2011. As the bank was not able to raise funds from private investors, the Cypriot state had to underwrite most of the required capital in June 2012 and consequentially became the majority owner. In the temporary approval of the recapitalization as aid, the EC stipulated structural and behavioral remedies such as dividend and advertising bans. However, in 2013 the decision to wind down the bank came about. Cyprus Popular Bank was split into a good and a bad bank, and the good bank was integrated into Bank of Cyprus which itself was under restructuring.

- Other banks receiving individual aid: Cyprus Cooperative Bank.

Table 3.A.5: State aid received by individual banks - Cyprus

Bank	Date	Type of Aid	Amount	Source
Cyprus Popular Bank	13/9/2012	recapitalization	1800	IP/12/958

Notes: This table presents state aid measures to banks in Cyprus. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

France

Table 3.A.6 gives an overview of the state aid measures received by banks in France. France initially responded to the crisis by setting up two major national aid schemes, the Société de Financement de l'Economie Française (SFEF) for refinancing and the Société de Prise de Participation de l'Etat (SPPE) for recapitalization. The SFEF, a vehicle of shared ownership between banks and the French state, provided loan guarantees of up to 5 percent of the respective bank's balance sheet upon certain behavioral commitments. In total, the SFEF lent 77bn euros to almost all large French banks during its operation, however individual state aid that required notification to the EC were rare. SPPE, the state own investment company spent 19.75bn euros in recapitalizations in two rounds. Beneficial institutions were six large financial institutions (Laprévote et al., 2017).

- Caisse d'Epargne (CE) and Banque Populaire (BP): Both institutions held 35 percent of the investment bank Natixis which had realized huge losses during the crisis. Both banks benefited from the two rounds of recapitalization through the SPPE and had to pass on the majority of the new capital to address liabilities arising from Natixis. When both banks merged, France notified an additional capital injection into CE and BP to cover consolidation costs.[22] With the last capital injection of 2.05bn euros which was notified as individual aid, total recapitalization amounted to 7.05bn euros. Despite the third recapitalization being outside of the French recapitalization scheme, the French authorities did not have to provide a restructuring plan for the merged entity.

[22]BP and CE received a joint capital injection of 2.45bn euros to facilitate the merger between the two entities.

- Other banks receiving individual aid: Crédit Immobilier de France (CIF).

Table 3.A.6: State aid received by individual banks - France

Bank	Date	Type of Aid	Amount	Source
Caisse d'Epargne*	1/9/2008	recapitalization	1100	ECB
Caisse d'Epargne	8/5/2009	recapitalization	2450	IP/09/722
Banque Populaire*	1/9/2008	recapitalization	950	ECB
Banque Populaire	8/5/2009	recapitalization	2450	IP/09/722

Notes: This table presents state aid measures to banks in France. In May 2009, Banque Populaire and Caisse d'Epargne jointly received recapitalization aid of 2.45bn euros as support for the merger of the two institution. The table lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). Rows in which the bank name is indexed with "*" refer to measures which were granted within a national credit guarantee scheme. I gathered information for these incidents from the ECB Legal Working Paper by Petrovic and Tutsch (2009) explaining the label "ECB" for the source. In the other rows the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Germany

Table 3.A.7 gives an overview of the state aid measures received by banks in Germany. Germany was among the countries in the EU most affected by the financial crisis in terms of bank distress. Already before the collapse of Lehman Brothers, two financial institutions, Sachsen LB and IKB, needed state support. After the collapse of Hypo Real Estate in September 2008, Germany provided a comprehensive framework to stabilize and restructure the banking sector. Within the national aid scheme FMSA, 480bn euros were made available for liquidity provision, recapitalization and asset relief measures. The failure of Commerzbank required additional individual aid approved by the EC in May 2009. Further turmoil was prevented by nationalizing Hypo Real Estate and liquidating WestLB. HSH Nordbank, was yet another regional bank (Landesbank in German) being distressed during the financial crisis, which needed to be rescued. After long negotiations between the EC and German authorities, its case finally came to a close when it was sold to a private investor at the end of 2018 (Laprévote et al., 2017).

- Bayern LB received both individual aid in the form of a 10bn euros recapitalization and a 4.8bn risk shield on parts of its asset backed securities (ABS) portfolio approved in December 2008 by the EC, but also loan guarantees provided by the FMSA.

The bank's restructuring plan included a set of both structural and behavioral remedies. Bayern LB had to implement a balance sheet reduction to almost half of the size of its balance sheet in 2018. Downsizing included the sale of subsidiaries such as Hypo Alpe Adria (Austria) and Saar LB. The bank was forbidden to run business with ABS and real estate lending and only allowed to engage in secured lending within strict perimeters. Behavioral limitations included a dividend and acquisition ban and an executive salary cap.

- Commerzbank received capital injections totaling 18bn euros in 2008 and 2009. In order to prevent distortions of competition, Commerzbank was, among other things, obliged to reduce its size through large-scale divestments including the sale of its subsidiary Eurohypo, a real estate and public finance lending specialist. Further, behavioral restrictions such as price leadership bans and a ban on acquisition were imposed. After it turned out that Eurohypo could not easily be divested, an amended restructuring plan was agreed upon in March 2012. Eurohypo's core business activities could be continued on a highly reduced scope for limited time. In compensation for Eurohypo's prolonged market activities, Commerzbank was subjected to a prolongation of the original acquisition ban. Eurohypo eventually left the market in 2016.

- HSH Nordbank received aid in form of recapitalization, an asset relief measure and loan guarantees. As a consequence, the bank was obliged to reduce its balance sheet by 61 percent, for example, in the financing of aircraft production, real estate and shipping. In particular, in the shipping market HSH Nordbank had been a strong player and reductions in that market were aimed at remedying potential anti-competitive effects of the received aid but also at improving the bank's liability by withdrawing from the highly volatile sector. The bank's performance, however, did not sufficiently improve after initializing restructuring. After lengthy negotiations between the EC and German authorities, the bank eventually was wound down. In November 2018, it was sold to private investors and since then operates under the name Hamburg Commercial Bank.

- Hypo Real Estate (HRE) was severely hit by the financial crisis and received substantial support measures. By 2011, Hypo Real Estate had benefited from 145bn euros of liquidity guarantees, 10bn euros of capital including its nationalization and an asset relief measure with an aid element around 20bn euros. As part of its restructuring, the bank's impaired assets amounting to 200bn euros were loaded into a bad bank. The core bank pbb (Deutsche Pfandbriefbank) was privatized while the rest of the group was subject to wind-down. Concerning pbb the EC argued that the substantial down-scaling of the bank was a sufficient remedy against potential distortions of competition resulting from the massive state support HRE had received. Further, pbb had to abide by a comprehensive set of structural and behavioral remedies including limits on its loan pricing, an acquisition ban, a ban on advertising state aid and limitations of its business activities to public investment finance and real estate finance only.

- LBBW benefited from an asset relief measure and a recapitalization. In order to remedy potential anti-competitive effects from the aid, LBBW had to reduce its balance sheet by 40 percent compared to 2008, focus on its core regional banking business and reduce proprietary trading.

- NordLB received loan guarantees in December 2008 and two rounds of recapitalization in 2012 and 2013 totaling 2.6bn euros. The original restructuring plan approved by the EC in July 2012 forced the bank to gear its business activities towards more stable business segments and implement a reduction of total assets by 15 percent. Further an acquisition ban was imposed as well as several behavioral limitations such as a ban on dividend and hybrid coupon payments. Shortly after the 2012 decision was made, the EC was informed about some of the bank's coupon payments which would violate the rules laid down in the restructuring plan. In order not to issue a new restructuring plan, the original one was amended in 2013 and included inter alia further balance sheet reductions.

- West LB: By 2009, West LB had received asset relief and had transferred impaired assets into a bad bank supported by a recapitalization. The EC, however, found the transfer of toxic assets incompatible with its guidelines on bank restructuring as it was conferring economic advantages to West LB above those compensated for in the original restructuring plan. West LB could not meet further restructuring demands and needed to be wound down. In this process, it was barred from engaging in new banking business and turned into a servicing platform and wind-down agency named Portigon.

- Other banks receiving individual aid: Aareal Bank, IKB, Sachsen LB and Sparkasse Köln-Bonn.

Table 3.A.7: State aid received by individual banks - Germany

Bank	Date	Type of Aid	Amount	Source
Bayern LB	18/12/2008	asset relief	4800	IP/08/2034
Bayern LB	18/12/2008	recapitalization	10000	IP/08/2034
Bayern LB (R)	25/7/2012			IP/12/847
Commerzbank (R)	7/5/2009	recapitalization	18000	IP/09/711
Commerzbank (R)	30/3/2012			EXME/12/03.30
Hypo Real Estate	2/10/2008	loan guarantee	35000	IP/08/1453
Hypo Real Estate	21/12/2009	loan guarantee	18000	IP/09/1985
Hypo Real Estate	24/9/2010	asset relief in bad bank	200000	IP/10/1172
Hypo Real Estate	18/7/2011			IP/11/898
HSH Nordbank	29/5/2009	asset relief	10000	IP/09/854
HSH Nordbank	29/5/2009	recapitalization	3000	IP/09/854
HSH Nordbank	20/9/2011	loan guarantee	17000	IP/11/1047
HSH Nordbank (R)	20/9/2011			IP/11/1047
HSH Nordbank	2/5/2016			IP/16/1643
HSH Nordbank	26/11/2018			IP/18/6561
LBBW	30/6/2009	recapitalization	5000	IP/09/1058
LBBW	30/6/2009	asset relief	12700	IP/09/1058
LBBW (R)	15/12/2009			IP/09/1927
Nord LB	23/12/2008	loan guarantee	20000	IP/08/2056
Nord LB (R)	25/7/2012			IP/12/838

Notes: This table presents state aid measures to banks in Germany. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Greece

Table 3.A.8 gives an overview of the state aid measures received by banks in Greece. The Greek banking sector witnessed some substantial consolidation over the course of the financial crisis. Some of the larger banks purchased distressed competitors despite needing state aid themselves (e.g. Alpha Bank purchased Emporiki Bank, Eurobank purchased the two bridge banks Nea Proton Bank and Hellenic Postbank and Piraeus Bank purchased Agricultural Bank of Greece, Millennium Bank Greece and Greek branches of banks based in Cyprus as for instance from Hellenic Bank). Further, remedial downsizing requirements for receiving state aid were limited mostly to international business activities in these cases. In all cases, the EC justified this by referring to substantial exposure to Greece as an ailing sovereign and not excessive risk taking as the reason for the bank's distress. The most often used form of aid was through recapitalizations. The third economic adjustment program for Greece, under which it received financial assistance from the European Stability Mechanism (ESM), provided for direct financial assistance for the banking system. Consequently, the Greek banks were sufficiently capitalized following comprehensive assessments of the Single Supervisory Mechanism (SSM).

- Alpha Bank received capital injections in 2009, 2012 and 2013. In 2012 and 2013, the Greek state invested 4bn euros into the bank. In 2012, Alpha Bank bought Emporiki Bank. The EC did not see state aid being involved in the takeover in which Alpha Bank was an aided bank. At the same time, no non-aided bank submitted a bid in an open tender. Alpha Bank had to commit to several remedies such as downsizing requirements, which, however, were of limited scope. The EC argued that in the case of Alpha Bank financial distress did not result from excessive risk taking but from exposure to sovereign debt obligations.

- Eurobank Ergasias needed several capital injections in 2009, 2012 and 2013. Since 2012 the Greek state had injected 6bn euros into the bank. Although Eurobank Ergasias was a beneficiary of state aid measures, it purchased Nea Proton Bank and Hellenic Postbank in 2013. The EC defended the sale of the two bridge banks to

an aided bank by stating that no other non-aided market participant issued a valid offer in an open tender procedure. Further, aid for Nea Proton Bank and Hellenic Postbank was approved on the basis of Eurobank's restructuring plan. The EC also argued that the acquisition of the two bridge banks would bolster the viability of Eurobank due to synergies and its solid deposit bases. Eurobank's restructuring plan foresaw divestments in business outside of Greece and downsizing of non-core activities in Greece. Interestingly, the EC agreed to lower downsizing requirements than in other restructuring cases arguing that Eurobank had not suffered from excessive risk taking but rather from negative effects of its exposures to sovereign debt. In November 2015, the EC approved minor amendments to Eurobank's restructuring plan, remarking positively that the bank had been successful in raising capital on the market to meet capital shortfalls identified by the comprehensive assessment of the SSM.

- National Bank of Greece (NBG) received several rounds of capital injections, most notably one tranche amounting to 9.8bn euros in 2012. Following the assessment of the SSM in 2015, NBG needed to cover a capital shortfall of 4.6bn euros from which 2.71bn euros were used from public money. In the course of its restructuring, NBG underwent downsizing as for instance reducing its international operations. However, as in other cases (e.g. Alpha Bank, Eurobank, Piraeus), the EC argued that the bank's distress did not result from excessive risk taking but substantial exposure to sovereign debt and therefore did not require substantial downsizing activities in the bank's Greek operations as remedies.

- Piraeus Bank received several rounds of recapitalization in 2009, 2012 and 2013. In 2012 and 2013, the Greek state invested 7.3bn euros. During the crisis, Piraeus Bank purchased the resolved Agricultural Bank of Greece, Millennium Bank Greece and Greek branches of banks based in Cyprus as for instance from Hellenic Bank. In 2015, triggered by the SSM assessment, Piraeus Bank needed 4.93bn euros of new capital out of which it received 2.72bn euros from public sources. As remedies,

Piraeus divested several foreign activities, but was however not requested to downscale on domestic banking activities. The EC highlighted that the Piraeus Bank's distress did not result from excessive risk taking but rather from exposure to the Greek sovereign.

- Other banks receiving individual aid: Proton Bank and T Bank (formerly Aspis Bank).

Table 3.A.8: State aid received by individual banks - Greece

Bank	Date	Type of Aid	Amount	Source
Alpha Bank*	12/1/2009			ECB
Alpha Bank	27/7/2014			IP/14/790
Agricultural Bank of Greece (R)	23/5/2011	loan guarantee		IP/11/626
Agricultural Bank of Greece (R)	23/5/2011	recapitalization	1145	IP/11/626
Agricultural Bank of Greece (R)	23/5/2011	recapitalization	675	IP/11/626
Agricultural Bank of Greece (R)	27/7/2012			IP/12/860
Eurobank Ergasias*	23/1/2009	recapitalization	950	ECB
Eurobank Ergasias (R)	29/4/2014			IP/14/495
Eurobank Ergasias (R)	26/11/2015			IP/15/6184
National Bank of Greece	22/12/2011	recapitalization	1000	EXME/11/22.12
National Bank of Greece (R)	23/7/2014			IP/14/869
National Bank of Greece (R)	4/12/2015	recapitalization	2710	IP/15/6255
Piraeus Bank (R)	23/7/2014			IP/14/870
Piraeus Bank (R)	29/11/2015			IP/15/6193

Notes: This table presents state aid measures to banks in Greece. The table lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). Rows in which the bank name is indexed with "*" refer to measures which were granted within a national credit guarantee scheme. I gathered information for these incidents from the ECB Legal Working Paper by Petrovic and Tutsch (2009) explaining the label "ECB" for the source. In the other rows the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Ireland

Table 3.A.9 gives an overview of the state aid measures received by banks in Ireland. The Irish banking sector and as a consequence the Irish state were severely hit by the financial crisis. Ireland was among the top four countries in the EU regarding the volume of approved state aid across all categories. As a result, Ireland became the first program country and received joint financial assistance from the so-called Troika consisting of

the International Monetary Fund (IMF), the European Central Bank (ECB) and the European Commission (Laprévote et al., 2017). Handling the state aid cases, the Irish authorities in coordination with the European Commission issued the so-called market opening measures, remedies which were rarely used by other countries. These remedies obliged some recipients of aid (e.g. Allied Irish Banks and Bank of Ireland), for instance, to let competitors access their cash networks and to pass on product information of market rivals to their own customers. Ireland was the first country to enter the joint program by the IMF and the European institutions, and it was also the first to exit from it.

- Allied Irish Banks (AIB) received several aid measures over the course of the crisis. Total capital support amounted to approximately 20.8bn euros leading to the Irish state to own almost all of its shares. AIB also benefited from a guarantee scheme covering its off-balance activities. In July 2011, AIB acquired Educational Building Society (EBS) prompting capital support by the Irish government. Parts of Anglo Irish Bank's (Anglo) deposits were transferred to AIB in the course of Anglo's wind-down. The authorities agreed to make the legality of the received state aid contingent on several structural and behavioral remedies including so-called market opening measures designed to benefit smaller competitor banks. For instance, AIB had to allow competitors access to its cash supply network and share market intelligence. Further, AIB was obliged to distribute advertising material for other banks to its own customer base. Structural remedies included the closing down of its operations in non-domestic markets such as Poland (Laprévote et al., 2017).

- Bank of Ireland (BoI) received its first recapitalization of 3.5bn euros in March 2009. It further participated in the Irish asset relief guarantee scheme (NAMA). A first restructuring plan was approved in July 2010 and included similar market opening measures as for Allied Irish Banks (see paragraph above). Also, the bank was obliged to sell several business units and participations in the Irish market. These were the New Ireland Assurance Company, its mortgage brokering business ICS Building Society and its share in Irish Credit Bureau. BoI required a second recapitalization of 5.35bn euros in July 2011. The second recapitalization required

a second restructuring plan which was later amended. Eventually, the bank was stripped from the obligation to sell New Ireland Assurance Company. The major argument was that the given market conditions were not conducive for a profitable sale.

- Irish Life & Permanent Group Holdings consisted of a life insurer (Irish Life) and a bank (ptsb). The group received 3.8bn euros of recapitalization. Subsequently, the life insuring part of the group was sold. Furthermore, the bank had to remedy the receipt of state aid by committing to similar market opening measures as were issued in other cases, for example, for Allied Irish Banks.

- Other banks receiving individual aid: Anglo Irish Bank and Irish Nationwide Building Society (INBS).

Table 3.A.9: State aid received by individual banks - Ireland

Bank	Date	Type of Aid	Amount	Source
Allied Irish Banks	12/5/2009	recapitalization	3500	IP/09/744
Allied Irish Banks	21/12/2010	asset relief		IP/10/1765
Allied Irish Banks	21/12/2010	recapitalization	4946	IP/10/1765
Allied Irish Banks	15/7/2011	recapitalization	13100	IP/11/892
Bank of Ireland	26/3/2009	recapitalization	3500	IP/09/483
Bank of Ireland (R)	15/7/2010			IP/10/954
Bank of Ireland	11/7/2011	recapitalization	5350	IP/11/854
Bank of Ireland (R)	20/12/2011			IP/11/1572
Bank of Ireland (R)	9/7/2013			IP/13/669
Irish Life & Permanent Group Holdings	20/7/2011	recapitalization	3800	IP/11/913

Notes: This table presents state aid measures to banks in Ireland. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Italy

Table 3.A.10 gives an overview of the state aid measures received by Italian banks. Bank rescues were conducted relatively late in Italy compared to other member states. Starting from 2015, first a couple of small regional banks (e.g. Banca delle Marche) were rescued and later in parts sold to the large bank UBI Banca. Banca Popolare di Vicenza and

Veneto Banca were wound down and sold to Intesa Sanpaolo in 2017. Also in 2017, the Italian state had to make a large commitment to provide a so-called precautionary recapitalization to Banca Monte dei Paschi di Siena (MPS). Both state involvements for Banca Popolare di Vicenza and Veneto Banca and MPS constituted exceptions to the Bank Recovery and Resolution Directive (BRRD), which otherwise calls for private financing of bank support and bank resolution.

- Monte dei Paschi di Siena: After negotiations between EC officials, the ECB and Italian authorities in 2017, the EC authorized measures for a so-called precautionary recapitalization. Under the BRRD, such public recapitalization is possible outside of resolution (as precaution) if the receiving institution is solvent. The recapitalization measure amounted to 5.400bn euros. Aid was accompanied by private recapitalization of similar scope and a restructuring plan aimed to foster the bank's prospect for profitability, for instance including the disposal of a large portfolio of non-performing loans. The restructuring plan also included remedies against undue distortions of competition such as an advertising ban regarding state aid and against predatory commercial practices.

- Other banks receiving individual aid: Banca delle Marche, Banca Popolare dell'Etruria e del Lazio, Cassa di Risparmio di Ferrara (Banca Carife), Cassa di Risparmio della Provincia di Chieti (Banca Carichieti), Banca Tercas, Banco Popolare di Vicenza (BPVI) and Veneto Banca.

Table 3.A.10: State aid received by individual banks - Italy

Bank	Date	Type of Aid	Amount	Source
Banca Monte dei Paschi di Siena	1/6/2017			IP/17/1502
Banca Monte dei Paschi di Siena	4/7/2017	recapitalization	5400	IP/17/1905

Notes: This table presents state aid measures to banks in Italy. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Netherlands

Table 3.A.11 gives an overview of the state aid measures received by Dutch banks.

- ABN AMRO: In October 2008, the Dutch state nationalized the Dutch business parts of ABN AMRO which had been purchased by Fortis before. Funds used for the nationalization were later classified as state aid in the form of recapitalization. ABN AMRO was subjected to several remedies in the form of a requirement to achieve certain profit margin levels in the private banking sector, where the bank had a strong position, a ban on acquiring other firms and a price leadership ban.

- ING Groep N.V. (ING) received several aid measures ranging from recapitalization, loan guarantees within the Dutch credit guarantee scheme and asset relief support. The restructuring plan foresaw that ING would divest its business unit responsible for insurances Westland Utrecht Hypotheekbank (WUB) and included bans on acquiring other firms and price leadership. The restructuring plan had to be amended following a complaint of a competitor in the Italian market. Subsequently, the restriction on aggressive pricing was reiterated and the deadline for divesting WUB was extended due to difficulties in the process. Further, the EC forbid ING to pay back debt to private investors.

- SNS REAAL N.V.: The bank received both recapitalization and a loan. The recapitalization measures in 2013 amounted to the nationalization of the institution. Remedies included a ban on marketing state aid, ban on acquiring other firms and the divestment of the group's insurance unit.

- Other banks receiving individual aid: Aegon N.V., Leaseplan Corp. N.V. and NIBC Bank N.V.

Table 3.A.11: State aid received by individual banks - Netherlands

Bank	Date	Type of Aid	Amount	Source
ABN AMRO Group	1/10/2008	recapitalization (N)	5450	IP/11/406
ABN AMRO Group (R)	5/4/2011			IP/11/406
ING Groep N.V.	13/11/2008	recapitalization	10000	IP/08/1699
ING Groep N.V.	31/3/2009	asset relief	27500	IP/09/514
ING Groep N.V. (R)	18/11/2009			IP/09/1729
ING Groep N.V. (R)	19/11/2012			IP/12/1226
SNS REAAL N.V.	11/12/2008	recapitalization	750	IP/08/1951
SNS REAAL N.V.	11/12/2008	recapitalization	500	IP/08/1951
SNS REAAL N.V. (R)	28/1/2010			IP/10/82
SNS REAAL N.V.	22/2/2013	loan guarantee	1100	IP/13/150
SNS REAAL N.V.	22/2/2013	recapitalization (N)	1900	IP/13/150
SNS REAAL N.V.	22/2/2013	recapitalization	300	IP/13/150
SNS REAAL N.V. (R)	19/12/2013			IP/13/1280

Notes: This table presents state aid measures to banks in the Netherlands. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Portugal

Table 3.A.12 gives an overview of the state aid measures received by banks in Portugal. Portuguese banks needed state support relatively late compared to banks in other EU member states. Both Banco Português de Negócios (BPN) and Banco Privado Português (BPP) were rescued in 2008. However, these can be considered separate cases as both banks were found to engage in illegal activities (e.g. maintaining hidden off-balance-sheet activities in the case of BPN) and thus maneuvered themselves into distress rather than being affected by domestic market conditions. In the other cases (e.g. Caixa Geral de Depósitos or Banco Comercial Português) refinancing issues resulting from the drying up of wholesale funding and exposure to the sovereign debt market were among the reasons for financial difficulties and aid was allocated mostly starting from 2012 (Laprévote et al., 2017).

- Banco Espirito Santo (BES) was the third largest banking group in Portugal and was the only bank among the five largest institutions which had not asked for capital support in 2012. After entering financial difficulties, BES had to be resolved in

August 2014. The bank was split up into a good and a bad bank. The Portuguese state injected 4.9bn euros of new capital to support the resolution. The viable part was renamed to Novo Banco and a sale was intended. 75 percent of Novo Banco were sold to Lone Star Funds in the beginning of 2017. Several behavioral remedies applied to Novo Banco. Further, the EC argued as in other cases that distortions of competition would be limited by general down-sizing during the process of the sale.

- Banco Comercial Português (also know as Millennium BCP) as one of the largest banks in Portugal needed recapitalization of 3bn euros and benefited from 7.5bn euros of state guaranteed lending and several other issues between 2012 and 2017. As remedial action, among others, BCP had to divest BCP Poland, its well operating subsidiary and substantially down-size on the domestic market. BCP had come into distress due to exposure to Greek sovereign bonds.

- Banco Portugues de Investimento (BPI) as Portugal's fourth largest bank in 2013 received recapitalization amounting to 1.5bn euros in June 2012. Similar to BCP, BPI was negatively affected by exposure to Greek sovereign bonds. The restructuring plan submitted in November 2013 included several behavioral remedies such as an acquisition ban and an advertising ban on the received state aid and structural remedies such as targets for balance sheets and a reduction of the amount of branches. By October 2016, BPI was the only bank to fully repay the received aid measures.

- Caixa Geral de Depósitos (CGD) being the largest banking group in Portugal received 1.5bn euros in recapitalization in June 2012. Remedies for the received aid included traditional behavioral restrictions and divestment and downsizing obligations. For instance, CGD had to divest its insurance business subsidiary. Despite measures to strengthen the bank's viability an additional recapitalization of 3.9bn euros was necessary in March 2017. The EC pointed at ongoing bad market conditions causing the slow recovery of the bank.

- Other banks receiving individual aid: Banco Privado Português (BPP), Banco Português de Negócios (BPN) and Banco Internacional do Funchal (Banif).

Table 3.A.12: State aid received by individual banks - Portugal

Bank	Date	Type of Aid	Amount	Source
Banco Comercial Português	29/9/2013			EXME/13/02.09
BPI (R)	24/7/2013			IP/13/738
Caixa Geral de Depósitos	18/7/2012	recapitalization	1650	IP/12/805
Caixa Geral de Depósitos (R)	24/7/2013			IP/13/738
Caixa Geral de Depósitos	10/3/2017	recapitalization	3900	IP/17/556
Banco Espírito Santo	4/8/2014	recapitalization	4900	IP/14/90
Banco Espírito Santo	19/12/2015			IP/15/6381
Banco Espírito Santo (R)	11/10/2017			IP/17/3865

Notes: This table presents state aid measures to banks in Portugal. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Slovenia

Table 3.A.13 gives an overview of the state aid measures received by Slovenian banks.

- Nova Kreditna Banka Maribor (NKBM) was the second largest bank in Slovenia as of the end of 2013. It received recapitalization measures in 2012 (100m euros) and the restructuring plan of 2013 foresaw additional recapitalization amounting to 870m euros and a transfer of impaired assets to a state funded bad bank amounting to 1,149m euros. NKBM was obliged to refocus on its core operations as a remedy to receiving state aid.

- Nova Ljubljanska Banka (NLB) was the largest banking group in Slovenia as of the end of 2017. It received three recapitalizations in March 2011, July 2012 and December 2013 respectively, totaling 2.34bn euros. Additionally, NLB benefited from an impaired asset measure covering 1,149m euros of assets. The restructuring plan of December 2013 included the narrowing of the bank's business on its core activities, the divestment of non-performing loans to a bad bank facility and the sale of shares owned by Slovenia to private investors. In January 2018, the EC

opened again investigations on NLB as the sale of the shares owned by Slovenia was delayed. In August 2018, the authorities agreed upon updated deadlines for realizing the sale. It was reiterated that NLB would not re-enter abandoned business areas and will continue to comply with an acquisition ban. The renewed restructuring plan included additional sales of branches and the sale of NLB's involvement in the insurance subsidiary NLB Vita.

- Other banks receiving individual aid: Abanka, Factor Banka and Probanka.

Table 3.A.13: State aid received by individual banks - Slovenia

Bank	Date	Type of Aid	Amount	Source
Nova Kreditna Banka Maribor (R)	18/12/2013			IP/13/1276
Nova Ljubljanska Banka	7/3/2011	recapitalization	250	IP/11/264
Nova Ljubljanska Banka	2/7/2012	recapitalization	383	IP/12/724
Nova Ljubljanska Banka (R)	18/12/2013	recapitalization	1558	IP/13/1276
Nova Ljubljanska Banka	26/1/2018			IP/18/482
Nova Ljubljanska Banka (R)	10/8/2018			IP/18/4961

Notes: This table presents state aid measures to banks in Slovenia. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

Spain

Table 3.A.14 gives an overview of the state aid measures received by Spanish banks. The Spanish banking sector was severely hit by the financial crisis and the collapse of the domestic real estate market. In June 2009, the Spanish state set up the *Fondo de Reestructuración Ordenada Bancaria* (FROB), a national fund for the rescue and restructuring of financial institutions. In July 2012, the European Commission and Spain signed an agreement under which the Spanish government could receive financial assistance provided by the European Financial Stability Facility (EFSF). Unlike other program countries in the EU, financial assistance was exclusively earmarked for the financial sector and not for other parts of the economy meaning that Spain did not have to commit to austerity measures. Resources from the EFSF were directly channeled to FROB (Laprévote et

al., 2017). In many cases, Spanish officials took control of defaulted banks through the FROB and decided to sell these banks mostly to national competitors arguing this would be the most efficient form of bank restructuring and resolution compared to an orderly wind-down.

- Bankia/BFA: BFA and its banking arm Bankia was formed in 2010 as a result of the merger of seven spanish savings bank: Caja de Ahorros y Monte de Piedad de Madrid, Caja de Ahorros de Valencia, Castellón y Alicante, Caja Insular de Ahorros de Canarias, Caixa D'estalvis Laietana, Caja de Ahorros y Monte de Piedad de Ávila, Caja de Ahorros y Monte de Piedad Segovia and Caja de Ahorros de La Rioja. Bankia/BFA received a total of approximately EUR 36bn euros of rescue aid including capital injections, loan guarantees and impaired asset measures. As remedies, the bank had to substantially downscale its business both in scope and size. For instance, the total balance sheet had to be less than 40 % of the 2010 value by 2017. Also, Bankia/BFA had to exit from the real estate developing business and foucs on its core business of lending to SME.

- Banco Mare Nostrum (BMN) was formed by the merger of the four Spanish savings banks Caja Murcia, Caixa Penedès, Caja Granada and Sa Nostra in 2010. It has benefited from state aid in all three major forms (recapitalization, loan guarantees, impaired asset measures). State aid was provided contingent on remedies such as a reduction of 40% of the 2010 balance sheet by 2017 latest, refocus on the core business of retail banking and SME financing and withdrawal from the development real estate sector. Aid was also subject to an acquisition ban.

- Caja de Ahorros de Mediterraneo (CAM): After receiving both recapitalization measures and loans in July 2011, CAM ran into difficulties in providing the agreed remuneration for these aid measures and failed the EBA stress test. As a consequence, CAM was sold off to Banco Sabadell for one euro creating one of the five largest banks in Spain.

- Catalunya Banc resulted from the merger of Caixa Catalunya, Caixa Tarragona and

Caixa Manresa in July 2010 which was facilitated with public funds from FROB. In the 2012 restructuring plan, the parties agreed on the sale of Catalunya Banc subject to certain remedies (e.g. reduction of scale and scope of its business such as the restriction to conduct SME lending and abstain from the real estate business). In the further course of the crisis, however, Catalunya Banc needed more aid including newly granted capital and guarantees amounting to 12.05bn euros and 10.76bn euros by 2014 respectively. In 2015, Catalunya Banc was sold to Banco Bilbao Vizcaya Argentaria (BBVA). The European Commission did not have any concerns about anti-competitive effects of the sale to BBVA, a competitor which had not received any state aid.

- Caja3 has benefited from state aid in all three major forms (recapitalization, loan guarantees, impaired asset measures), and in 2014, it was sold to Ibercaja which had not received any aid.

- Liberbank was formed in 2011 as the result of the merger between CajAstur, Caja de Extremadura and Caja Cantabria. After the merger, Liberbank extended its business from retail banking and financing SMEs to real estate developing and needed aid in form of recapitalization, loan guarantees and impaired asset measures. State aid was provided contingent on remedies such as a reduction of 25% of the 2010 balance sheet by 2017 latest, refocus on the core business of retail banking and SME financing and withdrawal from the development real estate sector. Aid was also subject to an acquisition ban.

- NCG Banco (NCG): The bank was created from its predecessor bank Novacaixagalicia after it needed a second round of recapitalization in 2011. In 2014, NCG Banco was merged to the Spanish bank Banco Echeverria owned by the Venezuelan Banesco Group and renamed to Abanca.

- UNNIM Banc was the successor of UNNIM which resulted from the merger of the three savings banks Caixa Manlleu, Caixa Sabadell and Caixa Terrassa. UN-

NIM/UNNIM Banc benefited from two recapitalization measures. In 2012, UNNIM Banc was sold to BBVA subject to its restructuring.

- Other banks receiving individual aid: Banco Gallego, Caja de Ahorros y Monte de Piedad de Cordoba (CajaSur), Caja Castilla La Mancha (CCM), Banco CEISS.

Table 3.A.14: State aid received by individual banks - Spain

Bank	Date	Type of Aid	Amount	Source
BFA/Bankia	27/6/2012	recapitalization	4465	IP/12/699
BFA/Bankia	27/6/2012	loan guarantee	19000	IP/12/699
BFA/Bankia (R)	28/11/2012			IP/12/1277
Banco Mare Nostrum (R)	20/12/2012	loan guarantee	4424	IP/12/1432
Banco Mare Nostrum (R)	20/12/2012	asset relief	2100	IP/12/1432
Banco Mare Nostrum (R)	20/12/2012	recapitalization	1645	IP/12/1432
Caja3 (R)	20/12/2012	loan guarantee	654	IP/12/1432
Caja3 (R)	20/12/2012	recapitalization	407	IP/12/1432
Caja3 (R)	20/12/2012	asset relief	770	IP/12/1432
Caja de Ahorros de Mediterraneo	25/7/2011	recapitalization	2800	EXME 11/25.07
Caja de Ahorros de Mediterraneo	25/7/2011	liquidity line	3000	EXME 11/25.07
Catalunya Banc	30/9/2011	recapitalization	1718	IP/11/1143
Catalunya Banc (R)	28/11/2012			IP/12/1277
Catalunya Banc (R)	17/12/2014			IP/14/2741
Liberbank (R)	20/12/2012	recapitalization	124	IP/12/1432
Liberbank (R)	20/12/2012	asset relief	1000	IP/12/1432
Liberbank (R)	20/12/2012	loan guarantee	3875	IP/12/1432
NCG Banco	30/9/2011	recapitalization	2465	IP/11/1143
NCG Banco (R)	20/6/2014			IP/14/704
Unnim Banc	30/9/2011	recapitalization	948	IP/11/1143
Unnim Banc (R)	25/7/2012			IP/12/839

Notes: This table presents state aid measures to banks in Spain. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

United Kingdom

Table 3.A.15 gives an overview of the state aid measures received by banks in the United Kingdom.

- Lloyds Banking Group (LBG) was formed in January 2009 by Lloyds TSB acquiring HBOS. While the business of Lloyds TSB proved to be sound, LBG inherited the

risky portfolio of HBOS. As a result, LBG needed state support and received a capital injection of 17bn pounds in January 2009 and participated in the U.K. credit guarantee scheme. Similar to the case of the Royal Bank of Scotland, LBG had to commit to divest parts of its business namely divest 600 branches and reduce its presence in the retail market by 4.6 percent.

- Royal Bank of Scotland (RBS) entered the financial crisis in a vulnerable position as it had tied up a considerable amount of resources in the takeover of parts of the Dutch bank ABN AMRO in 2008. RBS was recapitalized in December 2008 with 20bn pounds and participated in the state backed asset guarantee scheme. After the submission of a restructuring plan in June 2009, RBS received a second round of recapitalization worth 25.5bn pounds. The bank also used loan guarantees provided by the U.K. government. The restructuring plan foresaw that RBS would divest several of its entities both in the U.K. and abroad. In order to establish a fair level of competition after the interventions, RBS would divest 5 percent of its market share in the highly concentrated corporate banking sector to smaller competitors.

- Other banks receiving individual aid: Bradford & Bingley, Dunfermline Building Society and Northern Rock.

Table 3.A.15: State aid received by individual banks - United Kingdom

Bank	Date	Type of Aid	Amount	Source
Lloyds Banking Group	18/11/2009			IP/09/1728
Lloyds Banking Group	13/5/2014			IP/14/554
Royal Bank of Scotland (R)	14/12/2009	recapitalization	22000	IP/09/1915
Royal Bank of Scotland (R)	14/12/2009	asset relief	282000	IP/09/1915
Royal Bank of Scotland (R)	9/4/2014			IP/14/410
Royal Bank of Scotland (R)	4/4/2017			IP/17/863
Royal Bank of Scotland (R)	18/9/2017			IP/17/3307

Notes: This table presents state aid measures to banks in the United Kingdom. It lists incidents referring either to the temporary approval of aid measures or the final approval of aid measures and the corresponding restructuring or resolution plans (indexed by (R)). In each row the EC press release number represents the source of the respective information. The date displayed refers to the date of the press announcement. The amount of the provided aid is reported in million euros.

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