GERMAN COUNCIL
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Market structure and competition in German banking
– Modules I and IV –

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Working Paper 06/2013*)
November 2013

*) Working papers reflect the personal views of the authors and not necessarily those of the German Council of Economic Experts.

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Report commissioned by the Council of Economic Experts and the Monopolies Commission

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October 30, 2013

Disclaimer

This report has been commissioned jointly by the German Council of Economic Experts and the German Monopolies Commission. I am grateful to the Bundesbank for providing access to data and infrastructural support. Comments received from Martin Hellwig, Roman Inderst, Jan Pieter Krahnen, and members of both the council and the commission on the proposal of the report are highly appreciated. Marie Vasamilliette provided research assistance. This report contains solely the view of the author and reflects by no means the position of any of the involved institutions. All errors are mine.

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Executive summary

Chapter 1 briefly reviews the structure of this jointly commissioned report, which consists of four modules that are scheduled for completion by fall 2013 (Modules I and IV for the Economic council) and summer 2014 (Module II for the Monopolies commission).

Chapter 2 presents a description of the German banking system regarding structure, performance, and competition. It is descriptive in nature. The number of banks contracted by 55% between 1993 and 2012. Most consolidation activity occurred prior to 2003, primarily among regional cooperative and savings banks. Branch presence declined by 23% between 1993 and 2004, which is only half the contraction rate of the number of banks over the same time horizon. Whereas mean bank size increased in all banking sectors over the entire sample period, the banking system as a whole stopped to grow after a significant contraction by 13% between 2008 and 2009. Since 1993, the group of large commercial banks gained market share the most, largely at the expense of the savings bank sector and mortgage banks. We document considerable heterogeneity in terms of business activities and performance across and within so-called banking pillars. Market shares, concentration ratios, and Hirschman-Herfindahl indicators all indicate increasing market power over time. Price-cost margins declined steadily until 2008, but rebounced substantially for selected banking groups. Next to simple market structure indicators, we estimate economic markups, so-called Lerner indices, and other empirical measures (H-statistic, Boone indicator). Geographically, competition is the lowest in (north-)eastern parts of Germany and most pronounced in (south-)western regions. Lerner indices confirm increasing market power over time, especially in the years after 2007. This result might indicate competitive distortions due to heterodox policy measures that subsidized banks' marginal costs. This hypothesis will be tested more formally in Module II, which is due by summer 2014. Multivariate correlations indicate that Lerner markups are larger:

- in more concentrated regional banking markets with more affluent households;
- if many banks in the region exit in the course of restructuring mergers;
- among banks that rely more heavily on wholesale funding,
- are less reliant on retail activities,
- hold diversified credit portfolios,
- do not hold HGB §340f reserves,
- provision less for credit and financial asset depreciations,
- and that are larger and more profitable.

Chapter 3 tests if regional differences in banking market competition explain aggregate industry output growth differentials across 96 economic agglomeration areas in Germany. Increased competition may reduce the abilities and the incentives of financial intermediaries to screen loan applicants efficiently. Alternatively, banks with market power may extract rents from 'locked-in' customers, thereby preventing exit of unproductive customers and blocking entry of potentially more productive contestants. We find evidence in support of the latter hypothesis. Larger bank market power, measured as mean Lerner indices per economic agglomeration area, reduces industry output growth per region. An increase of Lerner indices by 1% reduces output growth between 0.18%–0.28%. The magnitude of this effect is economically significant given a median industry growth per region of 1.7%. When accounting for neighboring banking market competition by means of spatially lagged Lerner indices, this effect increases to 0.2%–0.37%. At the same time, the explanatory power of regression analyses is generally low.

This aggregate output growth effect is mostly absent prior to 2008. After 2007, we find also a statistically significant and large negative effect on the growth component arising from the reallocation of factors from low to high productivity firms. An increase in average Lerner indices per region reduces output through a negative reallocation contribution of 0.4%. Results for alternative bank competition indicators confirm many results, but indicate as well that larger market shares and/or interest margins are not per se detrimental to growth. The results suggest that the ability of banks to extract economic margins is undesirable from a growth perspective.

Results are neither driven by the inclusion of structurally weaker regions in East Germany nor specific firms of different size categories. Results for separate banking groups further indicate that market power effects on growth also differ depending on which banks gain ability to realize economic margins. A general trend is that larger Lerner markups deter growth for firms with high structural dependence on finance.

Chapter 1

Introduction

This report presents contemporary empirical evidence on bank market structure and competition in Germany. The analyses pertain to all German universal banks reporting at least total assets to the supervisory department of Deutsche Bundesbank as well as mortgage banks during the period 1993-2012. The report comprises four modules:

- Module I – Market structure and competition

  This module is descriptive in nature. It documents differences regarding the structure of balance sheets, profit and loss accounts, and selected key-performance indicators of German banks over time, per banking group, and across German regions. We calculate simple measures of market structure and market power, such as market shares, concentration ratios, Hirschman-Herfindahl indicators, and price-cost margins. In addition, we estimate empirical measures of market power: Lerner indices, Panzar-Rose H-statistics, and Boone indicators. We use reduced form regression analysis to assess the multivariate correlation between the preferred measure of market power, Lerner indices, and an array of covariates. These covariates gauge differences in banks' business models, regional banking markets, and macroeconomic conditions, as well as bank risk traits to shed light on the determinants of bank market power.

- Module II: Competitive distortions due to bank bailouts

  Since the onset of the financial crisis in 2007, numerous heterodox policy measures

aim to stabilize the financial system and to ensure the functioning of monetary policy. Also German banks were subject to capital support and other bailout measures from conventional as well as special purpose insurance schemes like the Financial Market Stabilization Fund. Earlier literature investigates the presence and magnitude of resulting moral hazard effects in terms of increased risk taking. This module seeks to identify if and to what extent bailouts and other policy measures may also have distorted competition. One example of competitive distortions are increased margins due to subsidized marginal cost and a resulting misallocation of credit. Another example based on the Japanese experience could be the creation of 'zombie' banks.

- Module III: Market structure, competition, and the stability of the banking system

  This module considers the trade-off between competition and the stability of the financial industry. Whereas the nexus between competition and conventional risk taking by financial institutions is fairly well researched, it is in particular the relationship with systemic risk that is of interest in light of ongoing financial system turmoil. This module provides primarily an overview of contemporaneous measures of systemic risk and seeks to apply those where possible to the German situation. The module is executed by staff members of the German Economic Council of Advisors.

- Module IV: Bank market power and growth

  Changing regulation in response to the crisis, for instance regarding capital and liquidity requirements, will affect the competitive conditions under which banks operate. Changes in the competitive landscape, in turn, will affect how banks conduct their intermediation function. For example, excessive competitive pressure or the presence of competitive distortions due to bank rescue measures can reduce banks' incentives to screen potential investors intensively. We test in this module, whether differences in competitive conditions affect economic growth in general and the growth accruing from the re-allocation of production factors from low productivity to high-productivity firms in particular.

This version of the report contains results for Modules I and IV. Module II is primarily of interest to the Monopolies Commission and scheduled for the summer of 2014. Module III is drafted by the Economic Council of Advisors and therefore not part of this report.

Chapter 2

Module I – Market structure and competition

2.1 Banking pillars in Germany

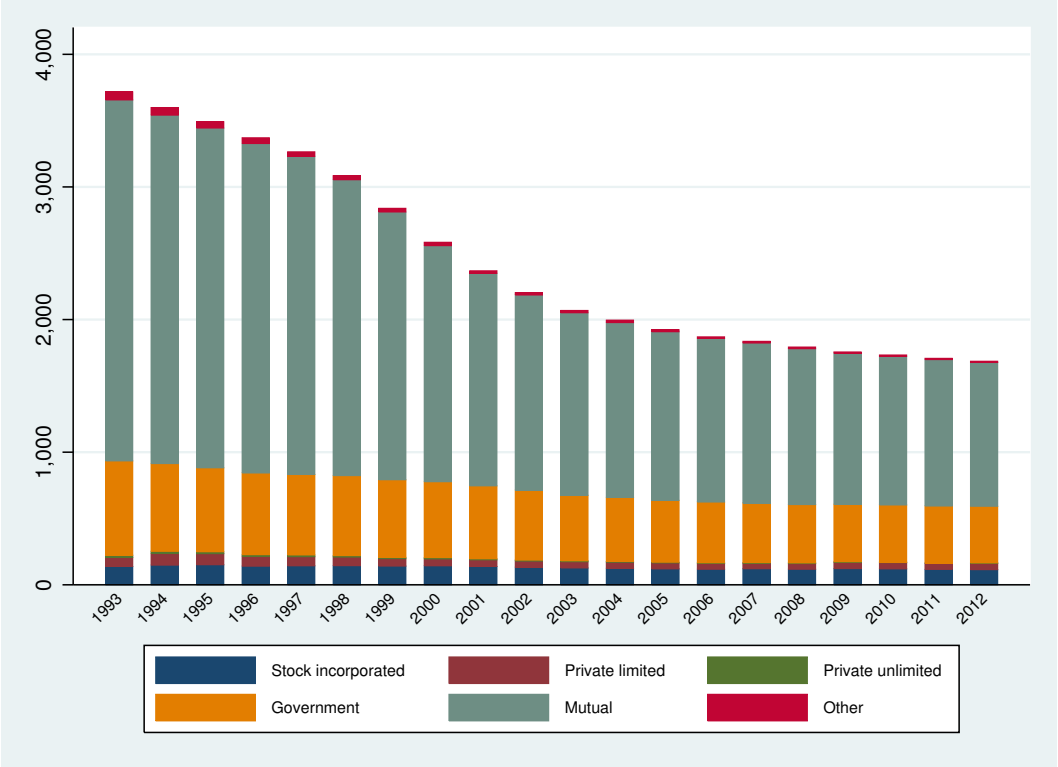
The German banking industry consists of three so-called pillars, or sectors: commercial, savings, and cooperative.[1] Banks in all three sectors are universal banks. They are permitted to collect deposits and grant loans alongside conducting financial market trading, both on own account and on behalf of customers. In addition to these universal banks, we consider in this report specialized mortgage banks. In line with the taxonomy of Deutsche Bundesbank (2013), we further distinguish large and regional banks within each pillar.

Commercial banks are privately owned and mostly incorporated as private limited partnerships (*Gesellschaft mit beschränkter Haftung, GmbH*) or as stock incorporated firms (*Aktiengesellschaft, AG*). Only around 5% of the banks considered in this report are such so-called Kapitalgesellschaften. An even smaller fraction of banks are publicly listed with free floating equity. The distribution of incorporation forms is shown in Figure 2.1.[2]

[1] Given the focus of this report to provide empirical evidence, the present description of the German banking system does not cover all relevant aspects, such as legal, regulation, or governance issues. More extensive descriptions can be found, for example, in Krahnen and Schmidt (2004), IMF (2004, 2009, 2011), Koetter et al. (2006), and various monthly reports of Deutsche Bundesbank (e.g., 2012).

[2] The groups are defined as follows: Stock incorporated includes: AG, KG a.A., AG & Co KG; Private limited: GmbH, GmbH & Co KG, KG; Private unlimited: Einzelunternehmen, OHG; Government: Anstalt

Figure 2.1: Distribution of incorporation forms over time



Large commercials are active in the entire Federal Republic of Germany as well as abroad. They offer retail and wholesale banking services, engage in investment banking activities, such as proprietary trading, advisory services, and the like. These banks are thus archetypical universal banks. Regional commercial banks are often both regionally and functionally confined in their activities, for instance offering private banking services to high net worth individuals in urban agglomeration areas or specializing in durable consumer good financing, such as auto loans.

The savings bank sector is a two-tiered system. We distinguish large, regional central institutions (*Landesbanken*) from smaller regional savings banks. The savings bank sector adheres to the principle of regional demarcation. As of 2013, there are 12 regional associations, which define regional markets of their local member savings banks. Regional governments own savings banks. Generally, municipalities own local savings banks, which

oder Körperschaft öffentlichen Rechtes; Mutual: eingetragene Genossenschaft.

in turn own together with one or more of the 16 German states the Landesbanken. Regional savings banks are primarily providers of retail banking services to private customers and mostly small and medium size enterprises (SME). However, some local savings are fairly large by now and also engage in wholesale banking activities directly. The responsible Landesbank frequently acts as a clearing house for their local counterparts, conducts wholesale activities, such as refinancing operations in bond markets, or engages in capital market activities, such as structuring financial products for the investment portfolio of local savings banks.

The pillar of cooperative banks is also a two-tiered system. Local cooperatives are the smallest banks in Germany and mutually owned by member-depositors. They focus also on SME and household lending, but also provide investment and other products that are structured by the central cooperatives. These cooperative central banks act like the Landesbanken as clearing houses and gateway to capital markets.

2.1.1 Number of banks and branches

The number of banks declined drastically in German banking over the last two decades as shown in Table 2.1. The decline from 3,717 banks reporting to the supervisory department of Deutsche Bundesbank at the end of 1993 to 1,686 banks reporting at year-end 2012 represents a contraction of 55%. Most of this reduction in the number of banks is due to intra-pillar mergers and acquisitions. Mergers and acquisitions across sectors are not permitted. Note that the number of banks differs slightly from those reported by the Bundesbank statistics because not all banks reported total assets to the supervisory department, which is the source of the data for this study.[3]

The reduction in the number of banks was most pronounced among regional cooperative banks (-60%), regional savings (-40%), and mortgage banks (-48%). It was also significant among regional commercial banks (-29%). A similar picture emerges when considering branches. Detailed information about the number and location of bank branches has

[3]Differences are negligible. For example at year-end 2012, we cover all large banks from all three pillars for example. The Bundesbank records 163 regional commercial banks as opposed to the 141 banks reporting total assets to the supervisory department that we sample here. Differences are very small for the remaining groups: 422 sampled regional savings as opposed to 423 in the Bundesbank statistics; 1,091 sampled regional cooperatives as opposed to 1,102; and 17 sampled mortgage banks as opposed to 18.

Table 2.1: Number of banks per banking pillar over time

Year	Commercial		Savings		Cooperative		Mortgage	Total
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*		
1993	4	199	13	703	4	2,761	33	3,717
1994	4	239	13	654	4	2,653	32	3,599
1995	4	234	13	624	4	2,579	34	3,492
1996	4	213	13	607	4	2,497	33	3,371
1997	4	206	13	598	4	2,407	33	3,265
1998	5	198	13	594	4	2,239	32	3,085
1999	5	184	13	576	4	2,026	31	2,839
2000	5	181	13	563	3	1,788	30	2,583
2001	5	170	13	541	2	1,611	26	2,368
2002	5	160	14	519	2	1,480	23	2,203
2003	5	153	13	487	2	1,386	23	2,069
2004	5	150	12	479	2	1,325	23	1,996
2005	5	143	12	462	2	1,279	21	1,924
2006	5	134	12	454	2	1,242	21	1,870
2007	5	136	12	445	2	1,215	21	1,836
2008	5	140	10	436	2	1,182	18	1,793
2009	4	147	10	430	2	1,146	17	1,756
2010	4	144	10	427	2	1,128	18	1,733
2011	4	138	10	425	2	1,111	18	1,708
2012	4	141	9	422	2	1,091	17	1,686
Change	0%	-29%	-31%	-40%	-50%	-60%	-48%	-55%

Notes: Data on all banks reporting to the supervisory department of Deutsche Bundesbank (BAKIS-W). Observations with missing data for total assets are excluded.

been collected only until 2004 in the branch database (*Bankstellenstatistik*) of Deutsche Bundesbank. Table 2.2 shows the evolution of branches over time.

Comparing the reduction of banks and branches for the period where both databases are available (1993-2004) shows, that the contraction of branches outpaced the contraction of banks the most among large commercial banks (a 25% increase in the number of banks vs. 20% reduction in branch numbers), central cooperative banks mortgage (27% bank reduction vs. 50% branch reduction), and mortgage banks (28% bank reduction vs. 58% branch reduction). Given the small absolute numbers of banks in these banking groups, faster branch than bank consolidation may indicate a shift of business models away from retail activities with a branch-based distribution of financial services towards wholesale and investment banking activities that dependent much less on local representations. Likewise, more standardized lending, for instance related to real estate financing, may have shifted

Table 2.2: Domestic branches of German banks per banking group

Year	Commercial		Savings		Cooperative		Mortgage	Total
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*		
1993	18,717	2,793	586	19,770	53	21,021	331	63,271
1994	18,735	3,042	599	19,583	52	20,582	328	62,921
1995	25,913	2,964	593	19,505	52	20,213	353	69,593
1996	25,780	2,795	583	19,207	52	19,966	356	68,739
1997	24,883	2,724	579	19,119	48	19,552	345	67,250
1998	20,179	2,996	572	18,838	47	19,108	331	62,071
1999	22,139	2,936	807	18,759	47	18,919	327	63,934
2000	19,536	3,193	814	18,311	30	18,082	271	60,237
2001	17,408	3,158	783	17,758	28	17,495	244	56,874
2002	16,608	2,923	767	17,153	27	16,809	216	54,503
2003	15,567	2,785	719	16,324	20	15,932	157	51,504
2004	15,048	2,358	652	15,536	14	15,024	137	48,769
Change	-20%	-16%	11%	-21%	-74%	-29%	-59%	-23%

Notes: Data on all banks reporting to the statistical department (*Bankstellenstatistik*). Observations for banks with missing data for total assets excluded. Postbank treated as large commercial bank throughout.

over time increasingly to alternative distribution channels, such as online banks.

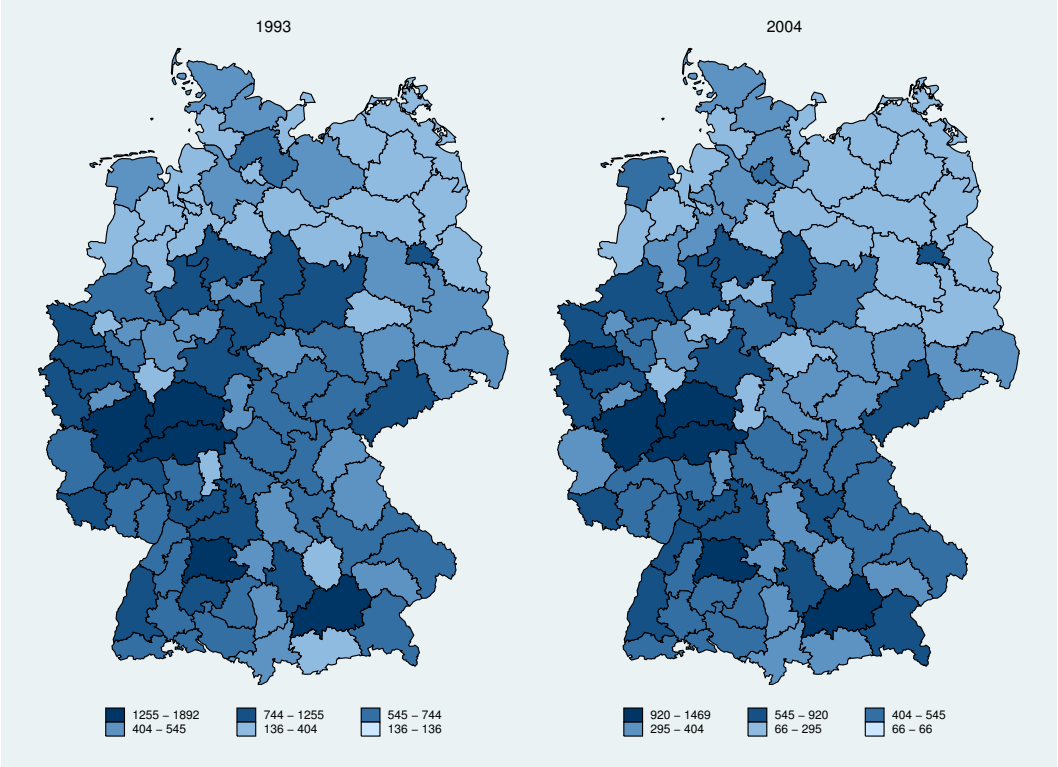
Among regional cooperatives, commercial, and savings banks, the rather substantial consolidation of banks (-37%, -27%, and -50%) was accompanied by comparatively mild branch network reductions (-23%, -21% and -27%). This development could indicate that regional banks have faced substantial market pressure to slash costly retail networks, but potentially identified scale economies in operating such branching networks more efficiently as merged banking entities that share, for example, centralized information technology (IT) services.[4]

At least during this pre-crisis period the spatial distribution of branches did not change significantly. Figure 2.2 shows the number of branches per economic agglomeration area, so-called *Raumordnungsregionen (ROR)*, in 1994 and 2004.[5] Northeastern regions are least populated by branches, whereas the major industrial and commercial agglomeration areas, such as the Cologne and Rhein-Main area in the West and Stuttgart and Munich in the South of Germany are home to most bank branches. To a lesser extent urban centres, such as Hamburg and Berlin, are also relatively densely populated with bank branches.We turn

[4]See Koetter and Noth (2013) on the effects of centralized IT centers in the savings bank sector on bank productivity.

[5]ROR are defined by the *Bundesbehörde für Raumwesen und Raumordnung*. They represent regions of spatial interdepence based on socio-economic indicators, such as commuter streams.

Figure 2.2: Branches per economic agglomeration area 1993 and 2004



next to size developments of the German banking industry.

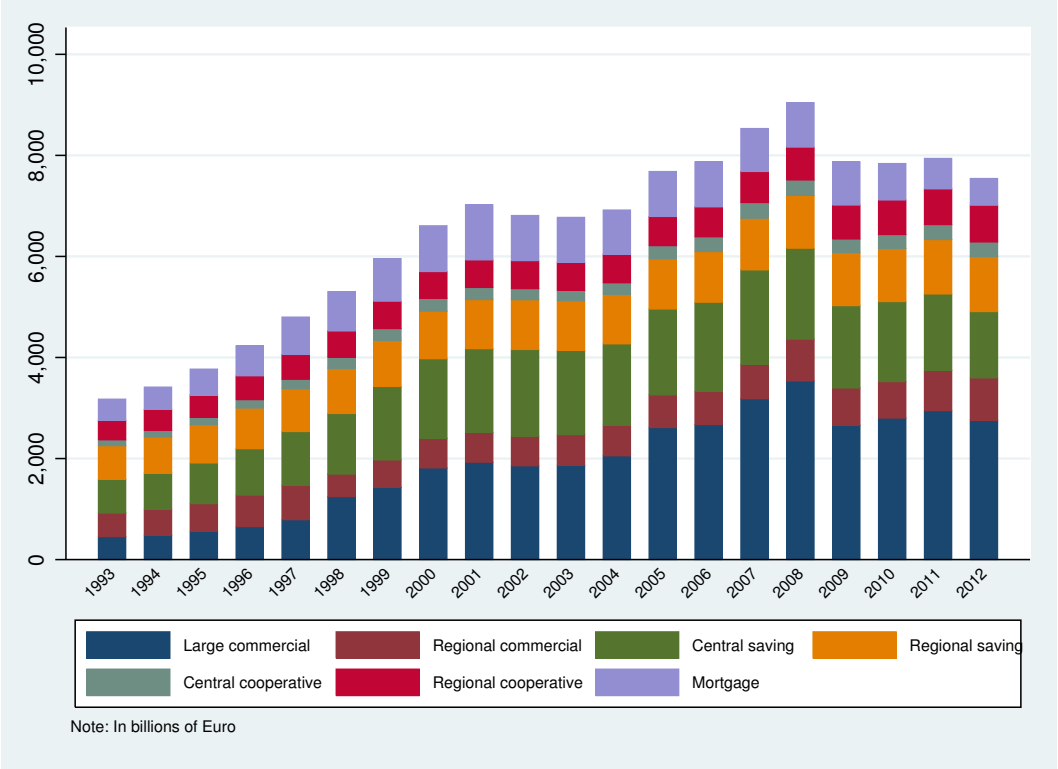
2.1.2 Size developments

Figure 2.3 shows that in contrast to the substantial contraction in terms of banks and branches, aggregate assets of the German banking sector grew substantially. Since 1993, aggregate total assets increased from €3,177 billion to €7,544 billion in 2012, a rate of 137%. The ratio of total assets to nominal GDP increased over the same period from 1.87 in 1993 to 2.85 in 2012, peaking at 3.66 in the crisis year of 2008.[6]

Hence, the decline in bank numbers did not imply per se less credit or other asset holdings. Instead the average size of banks increased, which we show below in Figure 2.4. The group of large commercial banks accounts for the by far largest increase in aggregate total assets.

[6] Relative to nominal gross domestic product (GDP series VGR014 of the Federal Statistical Office).

Figure 2.3: Size of the German banking system over time



Their aggregate market share increased from 14% in 1993 to 37% at the end of the sample period. Regional savings banks lost significant aggregate market share, exhibiting a decline from 21% in 1993 to 14% in 2012, only second to the mortgage bank sector, which declined from 13% to 7%. The latter aggregate market share is still sizeable and illustrates the importance of the relatively few mortgage banks. Aggregate market shares of central and regional cooperatives remained stable.

The 2008 turmoil in the banking system is clearly visible in Figure 2.3. The entire German banking system shrunk by 13% between 2008 and 2009 – or €1.17 trillion, which equals 47% of nominal GDP in 2008. The large institutions from the commercial (-25%), cooperative (-11%), and savings bank (-11%) pillar exhibit the largest losses. Table 2.1 showed that the number of banks in these pillars stayed almost constant. A fairly constant number of banks paired with aggregate banking asset contraction suggests that the latter is probably attributable to write-offs rather than exiting banks, which we investigate shortly in more

detail. However, three alternative explanations may also be relevant for this substantial size contraction of the banking industry.

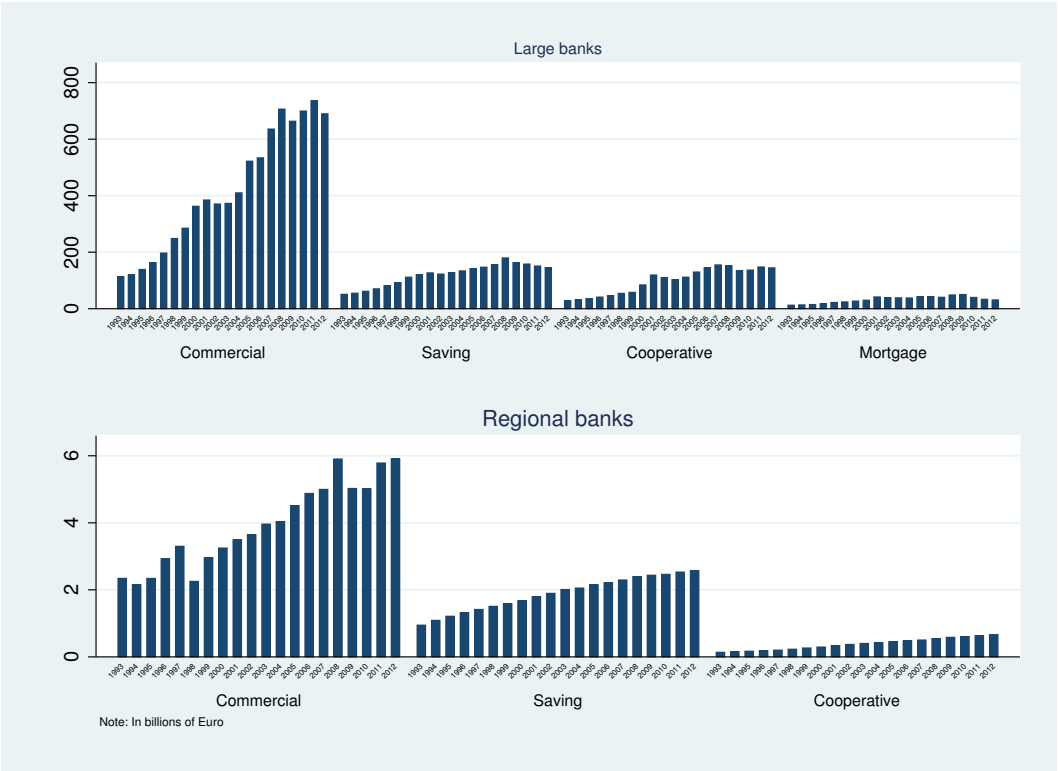
The first relates to changes in reporting standards, the Act Modernising Accounting Law of 2009 (*Bilanzrechtsmodernisierungsgesetz, BilMoG*), which came into effect in the reporting year 2010. The major change of *BilMoG* was the partial harmonization of accounting rules according to the German commercial code *(Handelsgesetzbuch, HGB)* with the International Financial Accounting Standard (IFRS). The main change is the requirement of on-balance sheet accounting of financial instruments, which are primarily derivates at current market value less a risk deduction. The implications for Bundesbank statistics are discussed in detail in Deutsche Bundesbank (2011). Since *BilMoG* required banks in general to report *more* assets and liabilities on the balance sheet that were treated previously as off-balance sheet items, and given that the Act became effective only in 2010, it seems unlikely that *BilMoG* explains the significant contraction in aggregate industry assets.

A second potential explanation is the possible off-shoring of certain activities in separate legal entities that are not required to report to the German supervisory authorities. Whereas such reorganizations are less likely for retail activities, which would have to report in all likelihood also to the German supervisor, they might be relevant regarding certain investment banking activities. We only observe in the available data single banking entities and have no information about the exact bank holding company structures. Therefore, we cannot rule out that some of the asset contraction is due this reason.

A third reason for the aggregate asset contraction could be a (sharply) declining number of banks between 2008 and 2009. We find that only 21 new banks entered the market and 58 exited. Entering banks accounted for a mere 16.5 billion Euros in bank assets. Exiting banks accounted for 428 billion Euros. The remainder of 758.5 billion Euros (=1,170 - 428 +16.5) in bank assets was thus lost in the so-called intensive margin, i.e. balance sheet contractions among existing banks. We document below in more detail changes in balance sheet structure to shed light on the question, which assets and liabilities in the banking system bore the brunt of the contraction.

Comparing before the three universal banking pillars jointly corroborates that commercial banks gained substantial market share (19%), mostly at the expense of mortgage banks (-6%) and the savings bank sector (-10%), between 1993 and 2012. The cooperative sector,

Figure 2.4: Mean bank size per banking group over time



in turn, exhibits a fairly constant aggregate market share dropping mildly from 15.8% to 13.5%.

Consistent with the constantly declining number of banks (and to a lesser extent branches) paired with overall growing market size, Figure 2.4 shows that the size of the average bank increased in all (sub)sectors. Large commercials clearly dominate the German banking industry in terms of both mean size and growth. Among regional banks, the smaller commercials also exhibit the fastest growth, although with markedly larger volatility in mean size. Regional savings and cooperative banks exhibit almost linear mean size growth.

2.1.3 Balance sheet composition

Table 2.3 shows the composition of bank balance sheets in terms of selected main aggregate assets and liability categories that reflect core functions of financial intermediaries.

Customer loans are the most important component of earning assets for any sector in German banking, accounting for 45% of total assets in the entire banking system. The only exception are central cooperatives, which hold only 16% of their assets in customer loans. The most important item for these banks are interbank loans, which account for 44%. This importance underpins the main function as a central clearing house for local cooperatives. Similarly, central savings banks second most important asset class are interbank loans as well. Aside from interbank activities, fixed income holdings account on average for 18% of aggregate total assets in the German banking system. On average, only 3% of assets are invested in stocks. Note that both fixed income and stocks held on the balance sheet are not trading assets, but are considered long-term investments.[7]

These 'conventional' asset categories cover almost all total assets for any banking sector. An important exception is the group of large commercial banks. Traditional asset categories cover only 74% of their reported total assets, the remainder are other assets. These other assets are to a lesser extent also important for the large banks from the savings (12%) and cooperative sector (8%). We investigate the composition of other assets below in more detail. We show for the years after *BilMoG* came into effect that trading assets account for an important fraction.

Regarding the funding structure of banking pillars in Germany, the leveraged nature of financial intermediaries is vividly illustrated by a share of book equity of total assets on the order of 3% for the system as a whole. Note that this gross capital ratio ignores risk-weights associated with different asset classes and therefore does not resemble regulatory capital requirements. The most important source of finance differs across sectors. Customer deposits are most important for regional cooperative and savings banks, accounting for roughly two third of total liabilities. They are also the primary source of funds for commercial banks, especially regional ones. Regional banks are thus retail-oriented not only regarding their investment activities, but also with respect to funding markets.

The central head institutions in the savings and cooperative sector, in turn, depend considerably on interbank funding, presumably originating from their member banks who collected retail deposits. This clearing house function is again most pronounced for central cooperatives, which hold 58% of their balance sheet total in interbank liabilities.

[7] Only since a change of reporting schemes in the course of *BilMoG* effective 2010, banks report explicit trading assets and liabilities.

Table 2.3: Aggregate balance sheet structure per pillar

Year	**Commercial**		**Savings**		**Cooperative**		**Mortgage**
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*	
Total assets	1,948.0	621.4	1,397.5	921.0	216.4	533.3	748.0
Assets							
Reserves	30.4	10.5	5.8	18.6	0.8	11.6	1.1
Interbank	369.9	142.9	452.1	89.6	94.3	67.7	130.5
Customer	681.8	307.9	509.3	545.7	34.9	311.1	464.3
Bonds	278.2	107.4	298.2	182.5	57.0	102.2	138.8
Stocks	78.9	13.7	15.2	48.8	3.1	17.8	1.6
Others	508.8	38.9	116.9	35.9	26.2	22.9	11.6
Liabilities							
Equity	53.0	30.1	38.1	42.7	5.8	26.5	15.3
Interbank	562.4	179.2	481.9	187.2	127.1	69.2	129.9
Deposits	648.4	292.0	324.0	612.1	27.8	393.1	155.2
Securitized	224.7	65.5	433.3	43.6	36.1	27.2	426.7
Others	459.6	54.5	120.2	35.5	19.5	17.3	21.0

Notes: The table shows averages across years of assets and liabilities that are aggregated per year and banking group. Numbers are billions of Euro. Based on 48,993 bank-year observations between 1993–2012.

Capital markets are most important as a source of finance for central savings banks (31%) and mortgage banks (57%). Overall, wholesale funding, i.e. interbank and capital market funding, accounts for 47% of the entire system's balance sheet total. Mortgage banks as well as large savings and cooperative banks exhibit shares well above this average, ranging from 65% to 74%. Global liquidity shocks can thus affect the German banking system quite directly through these large players.

In addition to the aggregate balance sheets of German banking sectors, we show in Table 2.4 balance sheet components for the average bank of each pillar. The data clearly illustrates the heterogeneity in the German banking system across pillars in terms of size and balance sheet composition.

The average cooperative bank is, for example, just 0.08% the size of an average large commercial bank. In addition to sheer size differentials, the balance sheet composition of the average bank per sector further illustrates important differences in terms of primary activities, i.e. business models.

Regional banks from any of the three pillars and mortgage banks are mostly invested in customer loans, ranging from 50% for commercials to 62% of total assets for mortgage

Table 2.4: Mean balance sheet structure per pillar

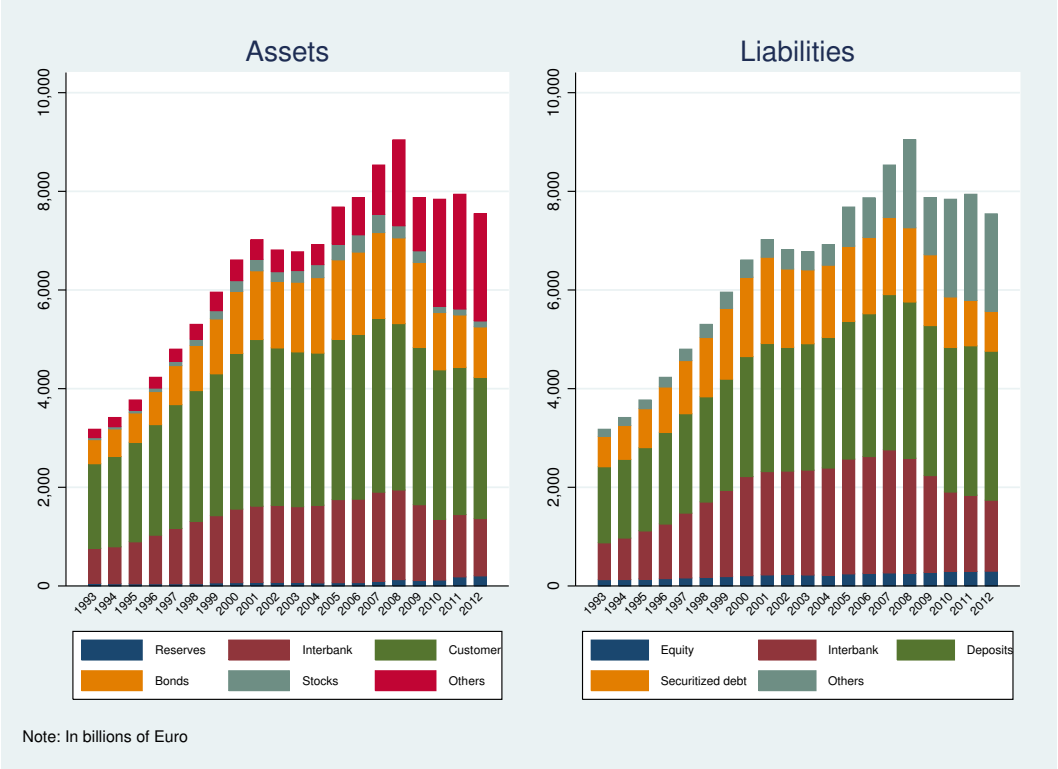
Year	**Commercial**		**Savings**		**Cooperative**		**Mortgage**
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*	
Total assets	420,582	3,784	117,093	1,799	84,226	329	30,278
Assets							
Reserves	6,912	67	521	36	311	7	46
Interbank	79,677	860	37,020	178	36,216	41	5,138
Customer	144,942	1,830	42,735	1,068	12,870	192	18,288
Bonds	58,349	682	25,068	350	22,962	63	6,308
Stocks	16,197	82	1,267	99	1,054	13	62
Others	114,505	233	10,482	69	10,813	14	461
Liabilities							
Equity	11,548	180	3,250	85	2,248	17	618
Interbank	118,909	1,091	39,811	367	48,227	44	5,624
Deposits	139,483	1,815	27,203	1,196	11,151	241	6,301
Securitized	47,509	361	36,058	82	14,301	17	16,879
Others	103,134	339	10,770	70	8,300	11	868

Notes: The table shows averages across years of mean assets and liabilities per bank. Numbers are millions of Euro. Based on 48,993 bank-year observations between 1993–2012.

banks. On average a quarter of total assets among commercial banks, in turn, are invested in other assets. Since 2009, these other assets are reported in greater detail to the Bundesbank. This more granular reporting shows that the major share of other assets (and liabilities) are trading assets among large commercials, Landesbanken, and central cooperative banks. Substantial shares of interbank loans for the latter two groups (32% and 44% of total assets, respectively) further corroborate the role of head institutions as central clearing houses and hubs in the internal capital markets of the savings bank and cooperative bank networks.

The average bank liability structure confirms systematic funding differences across and within pillars shown before at the aggregate level. Regional savings and cooperatives as well as mortgage banks rely mostly on retail funding from customer deposits. Among large banks, funding structures differ substantially. Large commercials rely equally on interbank funding and other liabilities, which are primarily trading liabilities. Liquidity freezes in money markets may therefore be particularly hazardous to this banking group. Central savings banks, in turn, rely to equal degrees on interbank and securitized funding, underpinning their reliance on wholesale funding markets rather than retail financing as their local counterparts. The by far most important source of interbank funding for cooperative

Figure 2.5: Aggregate asset and liability composition over time

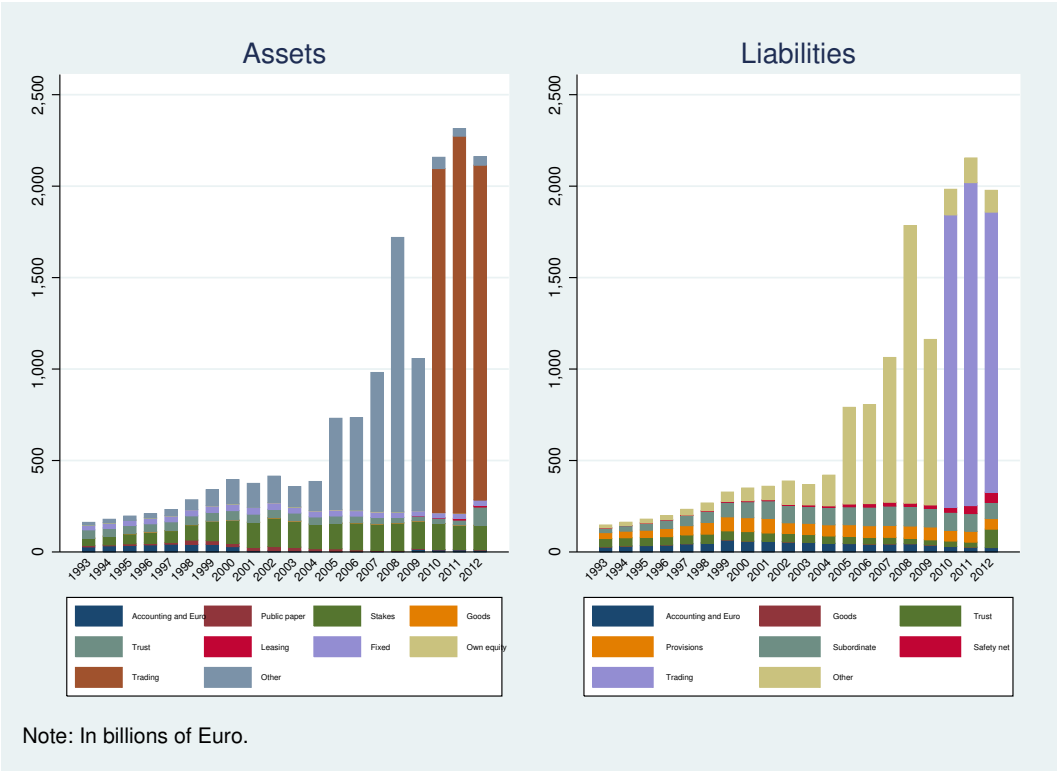


banks likewise indicates the function of the clearing house for this banking sector, although with a substantially smaller exposure to (international) capital markets via securitized debt compared to the savings bank sector.

The composition of balance sheets changed substantially over time. Figure 2.5 shows that the not further specified category of other assets expanded continuously until 2008. Most of the aggregate banking system contraction is due to these other assets, followed by collapsing interbank assets. Note that since 2009, these other assets continue to grow the most whereas assets related to more conventional intermediation activities remain flat or even contract.

Appendix A.1 shows these developments per banking group, highlighting three issues. First, the brunt of other aggregate assets are born by the large commercials and, to lesser extents, by the central savings and co-operative banks. We therefore investigate below in somewhat more detail the composition of these aggregate positions. Second, the regional

Figure 2.6: Details on other asset and liability components over time



Note: In billions of Euro.

savings and cooperative banks expanded in particular after 2008 both customer lending as well as deposit-based funding, which may indicate that these sectors of the banking system were perceived as more stable by retail customers in times of heightened uncertainty. Third, melting wholesale funding markets posed a problem especially to mortgage banks, which exhibit the sharpest decline in terms of both aggregate size and securitized funding.

Figure 2.6 details aggregate other assets and liabilities shown in Figure 2.5. Note that contrary to total balance sheet representations before, aggregate other assets need not to equal aggregate other liabilities. Details per banking group are in Appendix A.1.

Important other assets are direct stakes and shares in affiliated companies. Over time, however, the most important item became not further specified other assets, which accounted for approximately €764 billion in 2009, almost 10% of aggregate banking assets in that year. From 2010 onwards, banks report explicitly trading assets and liabilities to the supervisor and the left panel in Figure 2.6 shows that trading assets account for a sig-

nificant portion of other total assets. Likewise, the right-hand panel illustrates accordingly that most other liabilities after the more granular reporting required under the reformed Accounting Act pertain to trading activities.

Given that before the introduction of *BilMoG* in 2010 banks did not have to report a number of off-balance sheet activities, it is not per se possible to conclude that all other assets prior to 2010 were in fact trading assets. Likewise, we cannot rule out that trading activities were even larger before 2010, but simply not included in the reporting prior to *BilMoG*. In that (unobservable) case, certain banking groups may not necessarily have expanded their trading after 2008, but simply started to report more comprehensively.

Irrespective of changes in reporting schemes, the separation by banking groups in Appendix A.1 shows that especially large commercial banks started to expand other activities as early as 2005. Much of the aggregate banking asset reduction is due to customer loan contraction and a collapse of other assets in this banking group. The share of other assets for central savings and cooperatives, in turn, remained fairly constant up and until 2009.

Since 2010, aggregate assets remained more or less at their immediate post-2008 level. It is noteworthy that all large banks exhibit since then a sharp increase in trading assets and liabilities, which compensates for continuing contractions of interbank market activities. This pattern suggests that trading positions substituted for dried-up wholesale market funding. The available data does not permit a more detailed view on which types of trading assets and liabilities accounted for most of the expansion. A more granular analysis would certainly be warranted in light of almost half of the balance sheet of large commercial banks being classified as trading activities in recent years.

We describe next the main revenue and expense categories of German banks.

2.1.4 Profit and loss account structure

Table 2.5 shows that averaged over the last two decades, interest income is the by far most important source of revenues for all banking pillars. Interest income accounts for almost all revenues of mortgage banks (95%). It is significantly less important for regional and large commercial banks (62% and 67%). The data thus indicates that so-called disintermediation, the declining importance of the traditional transformation of deposits into credit, is reflected to varying degrees across banking sectors.

Table 2.5: Profit and loss account structure per pillar

Year	**Commercial**		**Savings**		**Cooperative**		**Mortgage**
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*	
Revenue shares (in % of total revenues)							
Interest	67%	62%	88%	80%	78%	79%	95%
Fees	12%	20%	4%	9%	7%	10%	1%
Financial assets	2%	2%	1%	0%	2%	0%	0%
Stakes	6%	2%	2%	4%	5%	1%	0%
Other operating	3%	5%	1%	2%	1%	2%	1%
Expense shares (in % of total cost)							
Interest	51%	40%	79%	47%	72%	43%	85%
Fees	2%	5%	2%	1%	3%	1%	1%
Financial liabilities	1%	1%	0%	0%	0%	0%	0%
Adminstrative	27%	33%	8%	30%	9%	35%	5%
Other operating	2%	1%	1%	2%	0%	1%	1%

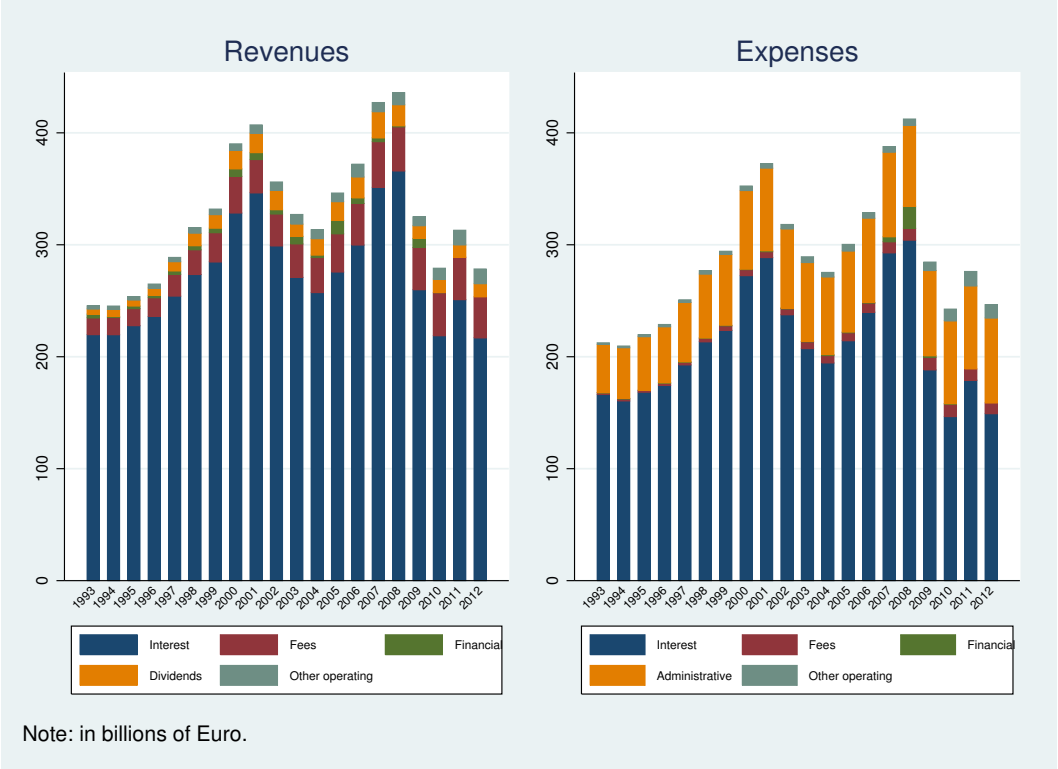
Notes: Average revenue and expense shares of total revenues and cost, respectively. Total cost are observed (EGV28). Revenues are imputed as the sum of total cost and the observed accounting result (EGV 58).

The second most important source of income are fees and provisions, which many studies argue to be an important substitute for decreasing interest income. The data in Table 2.5 shows that also the share of fee income differs vastly across banking groups, reflecting again the differences in business models across banks. Especially for regional commercial banks, fees account for about a fifth of total revenues. But also small cooperatives generate 10% of operating revenues from this source, similar to the 12% observed for large commercials. It is likely that the type of fees are very different across these groups. Transaction and advisory fees may be more relevant for commercial banks whereas account management and e.g. payment services fees seem more likely candidates for the regional cooperative and savings bank sectors. The data is not further detailed as to the sources of fees and does therefore not permit firmer inference.

Revenues from holding financial assets are fairly small across most groups of banks. Income from holding stakes in affiliated companies, in turn, accounts for 4% to 6% of total operating revenue for large commercials and central cooperatives, and notably also regional savings banks. Whereas not a major source of income, this magnitude indicates a non-negligible importance of equity ties in the financial industry in addition to well-known interdependencies via, for example, interbank markets.

Regarding expenses, interest paid mimics the importance of interest revenues. It exhibits

Figure 2.7: Profit and loss account components over time



Note: in billions of Euro.

an even wider dispersion across banking pillars and is by far the most important expense item for large savings and cooperatives as well as for mortgage banks (72%–85% of total expenses). The former data corroborates the clearing house function of these head institutions with respect to their regional second tier of savings and cooperative banks. Regarding mortgage banks, the dominance of interest rate expenditures underpins the business model to primarily serve long-run maturity matches by financing real estate of households.

Administrative cost, which contain mostly personnel expenditures, are the second most important operational expense for any bank. Fee expenditures are hardly relevant. Figure 2.7 shows the evolution of these most important components of banks' profit and loss accounts over time.

The relative importance of interest revenues and expenses is stable over time. The aggregate volume of both main operating revenue and expense categories increased in the run-up to 2008 just as it did prior to the stock market turmoil around the turn of the last century.

Only in 2008 a noticeable negative net result arose from financial asset holdings.

Figure 2.8 provides a more detailed glance at other expenses and revenues.[8] These categories highlight three important differences faced by banks during and after the crisis.

First, realized gains due to appreciating equity stakes and revenues from affiliations were a noticeable source of revenue prior to 2008. In 2008, however, disbursements from insurance fund for general banking risks accounted for a large portion of non-operating revenues. These revenues compensated in part for hiking depreciation expenses of financial assets and stakes held in other firms in the same year.

Second, since 2008 depreciation on financial assets continuously declined whereas especially in the last two years the banking system appears to have revalued certain financial assets, which generated the major share of other revenues in 2011 and 2012.

Third, contributions to the insurance fund for general banking risks continue to constitute a substantial share of other expenses until 2012. This pattern suggests that the consequences of the financial crisis in 2008 paired with ongoing strain on the financial system in the wake of the sovereign debt crisis are still felt among German banks.

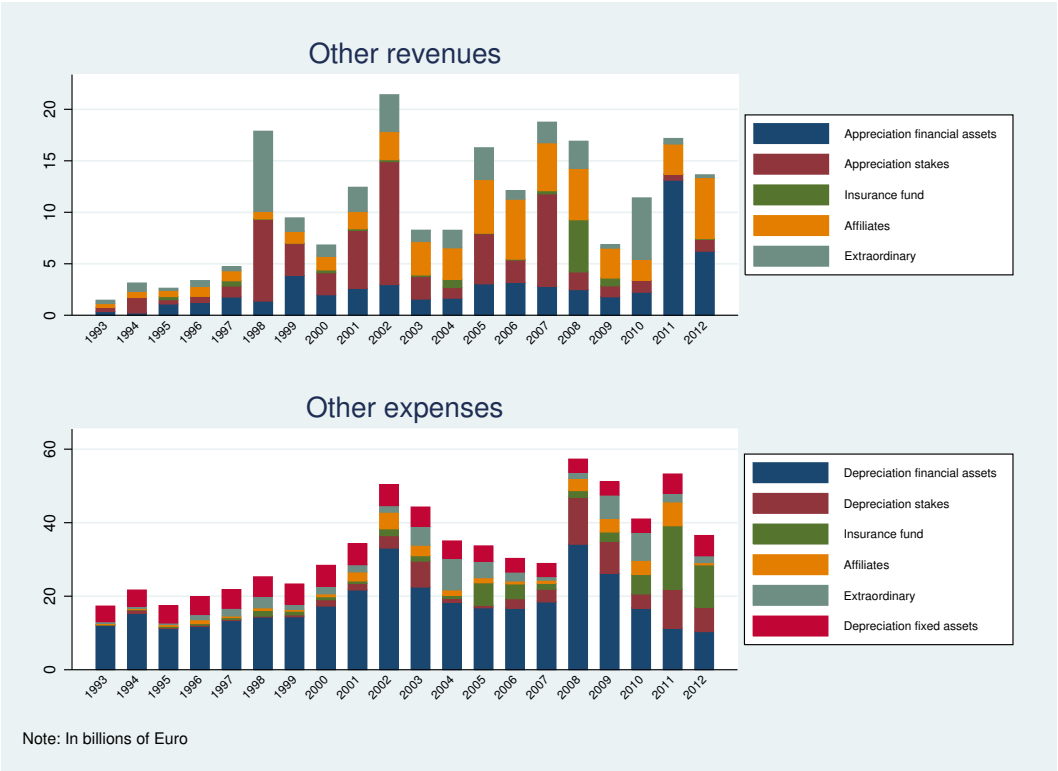
2.1.5 Key performance indicators

Table 2.6 shows descriptive statistics for six key performance indicators (KPI) across the different German banking sectors. All variables are winsorized at the top and bottom percentile to mitigate the influence of extreme outliers. The first two columns of Table 2.6 show capitalization ratios. The first relates Tier 1 equity capital to risk-weighted assets (RWA). Because of regulatory changes, RWA are only available as a consistent time series starting in 2008. We therefore also show Tier 1 equity to gross total assets.

Across banking groups, regulatory Tier 1 capital ratios are well above the minimum requirements and indicate that especially regional commercial banks are most capitalized. Average regulatory Tier 1 ratios are on the order of 12%. The comparison with Tier 1 capital ratios relative to gross total assets highlights substantial differences though. The latter are significantly lower compared to regulatory capital, averaging 5.3% for the system as a whole over the entire sample period 1993–2012. But also for the four last years

[8] Appendix A.2 provides details of the profit and loss account structure per banking group.

Figure 2.8: Details on other profit and loss account items over time



during which both ratios are available, Tier 1 to RWA is about twice as high compared to gross total asset ratios. The proper assignment of risk-weights thus has important implications for the description of bank capitalization. Figure 2.9 shows the development of mean capitalization over time. GTA-based capital increased constantly after a decline during the Great Financial crisis, which reflects efforts by banks and regulators to re-capitalize banks. Likewise, Tier 1 capitalization relative to risk-weighted assets increased substantially since 2008. It remains unclear though, whether this development results primarily from increasing core capital or from restructuring the asset composition of banks' balance sheets towards assets with low regulatory risk-weights. Issuing new equity is presumably expensive and difficult in the current capital market environment for listed banks, but also for mutually-owned cooperative and government-owned savings banks in times of fiscal austerity.

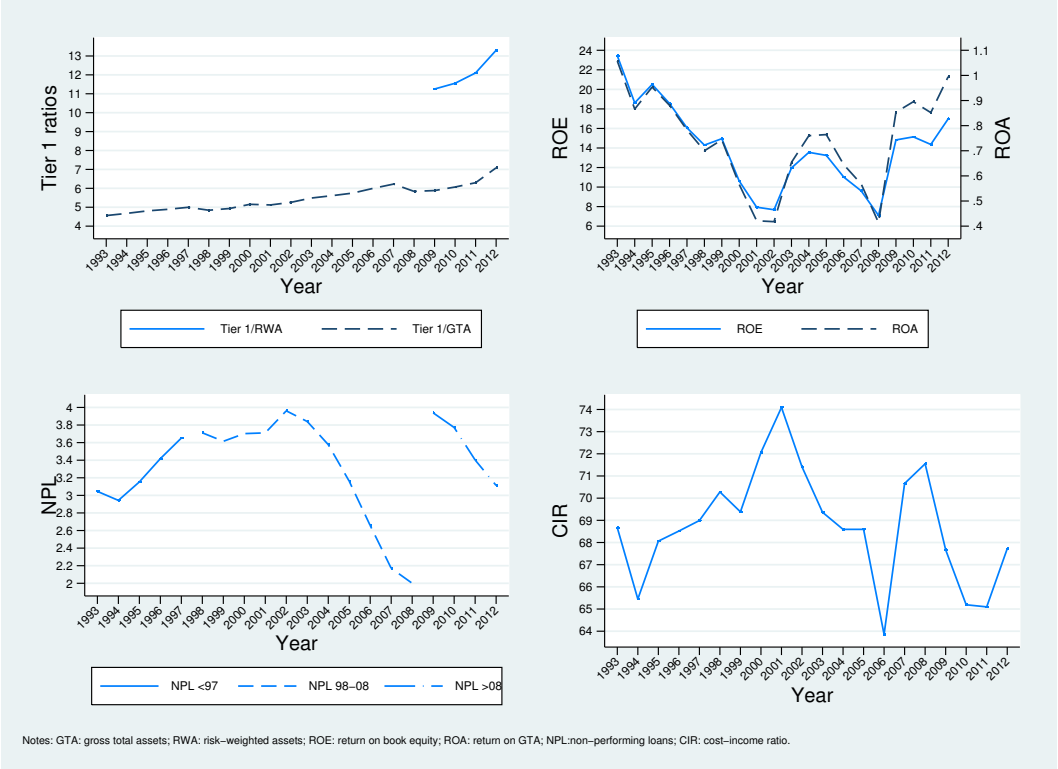
To compare the profitability of different banking groups, we consider return on equity

(ROE) and return on gross total assets (ROA). Returns are calculated from prudential audit report data and include besides net operating results from interest, fee, and trading activities the net depreciations on credit and security activities on the banking book. Across banking groups, both ratios indicate that regional savings and cooperatives realize the highest ROE on the order of 18% and 14%, respectively. Mortgage banks realise the lowest returns with approximately 4% on average, other banking groups score around 8%. ROA differences are qualitatively similar. The development over time shown in Figure 2.9 illustrates profitability pressure in the run-up to both the dot-com financial market turmoil at the turn of the century and the financial crisis of 2007/2008. Potentially, earnings pressure was part of the reason to take excessive risks that contributed to system-wide turmoil. After 2008, profitability increased steeply, where the higher level of ROA compared to ROE could indicate that especially smaller (regional savings and cooperative) banks were more successful in restoring stable earnings.

To gauge credit risk, we consider next non-performing loans (NPL). NPL are reported in prudential audit reports, but were subject to two statistical breaks in reporting schemes in 1998 and 2008. We therefore compare all three different NPL ratios, always relative to gross total assets. Each measure indicates that regional savings and, to a lesser extent, regional cooperatives exhibit the highest NPL-ratios. The pattern of higher credit risk for these banking groups is to some extent consistent with higher profitability reported earlier. But also regional commercials have on average around 3.7% non-performing loans on their credit portfolios, which is slightly above the entire system's average. Large banks from all three pillars and mortgage banks exhibit the lowest NPL ratios. Recall from the balance sheet structure though that for these banks it is presumably market risk, which is very important next to credit risk. The steep decline in mean NPL between 2001 and 2008 further raises the question to what extent NPL gauge the risk relevant to the going concern of all banks since they apparently did not contain an awful lot of early warning information about the Great Financial Crisis.

Finally, the last column of Table 2.6 shows so-called cost-income ratios (CIR), which are defined as administrative cost relative to operating revenue. CIR indicate managerial efficiency to the extent that they gauge the intensity of overhead use per Euro of revenues generated. The data in Table 2.6 suggests that among the universal banks, government-owned savings banks and mutually owned cooperative banks operate most efficiently. Specifically large head institutions in these sector exhibit significantly lower mean CIR compared to,

Figure 2.9: Key-performance indicators over time



Notes: GTA: gross total assets; RWA: risk–weighted assets; ROE: return on book equity; ROA: return on GTA; NPL:non–performing loans; CIR: cost–income ratio.

for example, large commercial banks. Note, however, that CIR may reflect instead of managerial efficiency to some extent competitive pressure if average revenues are increasingly driven down towards marginal cost in competitive markets. We therefore compare below econometric estimates of relative (cost) efficiency across banking groups, which according to some literature is a superior proxy of managerial skill.

During the crisis years 2007/2008, CIR increased sharply from fairly low levels that continuously declined from around 74% in 2001 to around 64% in 2006. The largest share of administrative expenses in CIR pertains to labor cost and this development might indicate, that banks tried to counter deteriorating profitability in the run-up to the crisis with cost-cutting efforts among staff members. Such a strive towards efficiency could undermine the quality of risk assessments during credit decisions and the monitoring of ongoing credit relationships. After a sharp reduction in CIR immediately after the crisis year 2008, the data shows moderate increases in the recent year again.

Appendix A.3 shows the development of all KPI over time per banking group.

Table 2.6: Key performance indicators per pillar

	$\frac{Tier1}{RWA}$	$\frac{Tier1}{GTA}$	ROE	ROA	$NPL_{<1997}$	NPL_{98-08}	$NPL_{>2009}$	CIR
Large commercial banks								
Mean	12.31	3.5	8.42	0.26	1.82	0.64	1.87	76.56
Sd	3.76	1.12	11.03	0.34	1.22	0.61	1.06	14.31
N	16	79	78	78	15	42	16	91
Regional commercial banks								
Mean	18.01	7.89	8.75	0.57	3.86	3.7	3.59	72.75
Sd	10.52	4.48	16.84	1.05	4.05	4.33	3.84	22.93
N	545	3236	3250	3250	791	1385	390	3410
Large savings banks								
Mean	11.5	2.96	8.22	0.19	1.38	1.25	2.79	53.62
Sd	2.42	0.73	9.4	0.21	0.75	0.87	2.66	14.19
N	39	240	240	240	64	137	39	241
Regional savings banks								
Mean	11.74	4.66	17.55	0.79	2.59	2.63	3.61	65.01
Sd	3.68	1.29	11.44	0.49	1.83	1.88	1.87	8.43
N	1704	10307	10152	10152	2912	5523	1666	10446
Large cooperative banks								
Mean	13.71	3.28	8.61	0.29	1.21	1.06	1.05	53.86
Sd	1.99	0.66	8.92	0.27	1.24	0.83	0.35	15.53
N	8	54	54	54	19	27	8	55
Regional cooperative banks								
Mean	11.45	5.3	14.2	0.76	3.39	3.61	3.63	70.03
Sd	3.59	1.45	10.13	0.52	2.72	2.75	2.44	9.66
N	4476	33717	32258	32258	11399	16516	3923	34146
Mortgage banks								
Mean	10.97	4.1	4.06	0.1	1.19	2.12	2.6	46.17
Sd	4.51	2.7	9.33	0.38	1.7	1.06	2.43	18.72
N	65	123	115	115	20	12	68	504
Total								
Mean	12.04	5.32	14.48	0.74	3.25	3.36	3.6	68.81
Sd	4.89	1.95	11.25	0.57	2.68	2.72	2.42	11.59
N	6853	47756	46147	46147	15220	23642	6110	48893

Notes: Summary statistics are based on a sample of German banks from 1993 until 2012 unless noted otherwise. All variablesare measured in percent. $\frac{Tier1}{RWA}$ denotes Tier 1 equity capital relative to risk-weighted assets according to Basel II definitions. The denominator is only available as a consistent time series since 2008. The ratio thus covers the years 2008–2012. $\frac{Tier1}{GTA}$ denotes Tier 1 equity capital relative to gross total assets (GTA). ROE denotes return on book equity. Return is calculated as the sum of net interest result, net fee result, net trading result, net appreciation of credit and banking book securities, and the net result from other non-interest operating activities less administrative expenses, which include primarily personnel expenditures. ROA: return on gross total assets. NPL: non-performing loans relative to gross total assets. The definition of non-performing loans changed twice during the sample period and is therefore not comparable over time. After 1998 and before 2008 the general position of audited interbank and customer loans subject to increased latent risks according to prudential audit reports is measured as the sum of value adjusted customer and interbank loans before individual haircut application. After 2007, banks were allowed to report credit risk according to internal rating based approaches or the standard approach. Accordingly, non-performing loan indicators are no longer comparable and indicated separately in the table. CIR: cost-to-income ratio defined as administrative expenses relative to operating revenue.

2.2 Market structure indicators

2.2.1 Market shares

The definition of what constitutes the regional market is crucial to put market shares as simple measures of market structure into perspective. Table 2.7 shows descriptive statistics for market shares of three different bank activity indicators (total assets, customer loans, and total deposits) and four alternative regional market definitions (federal, state, economic agglomeration area, county). Banks are allocated to regions based on the location of their headquarter reported to the prudential supervisor.[9]

Whereas even the large commercial banks have only a market share between 4.9% (customer loans) and 6.0% (total assets) at the federal level, the picture changes drastically when defining smaller regional markets. At the county level, for example, even the smallest regional cooperative banks exhibit average market shares on the order of 10%.

The level of market shares differs substantially depending on the definition of markets. But Table 2.8 shows that the ranking of banks in these markets based on market shares is highly and significantly correlated. Plain correlation coefficients in the left panel corroborate different mean levels of market shares shown before. But Spearman rank-order correlation coefficients in the right panel illustrate that market shares for different regional market definitions generate quite similar rankings.

[9] This approach clearly fails to gauge the true regional presence of federally active, large banks. We investigate the importance of alternative regional allocation schemes more extensively in subsection 2.2.3.

Table 2.7: Alternative market share definitions across regions and products

	Total assets			Customer loans			Deposits		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Large commercial banks									
Federal	6.03	5.39	91	4.85	3.19	91	5.43	3.05	91
State	19.81	11.80	91	17.67	10.18	91	20.56	7.86	91
ROR	38.38	29.70	91	33.36	26.29	91	40.28	28.70	91
County	41.29	31.10	91	38.10	27.08	91	43.27	30.01	91
Regional commercial banks									
Federal	0.06	0.21	3,410	0.07	0.27	3,410	0.07	0.25	3,362
State	0.65	2.41	3,410	0.66	2.82	3,410	0.74	2.39	3,362
ROR	2.25	7.23	3,410	2.10	7.06	3,410	2.29	6.76	3,362
County	5.37	13.83	3,410	4.97	13.36	3,410	5.26	13.07	3,362
Large savings banks									
Federal	1.82	1.29	241	1.48	1.09	241	1.07	0.87	241
State	33.02	17.24	241	26.07	15.86	241	19.41	14.22	241
ROR	45.09	23.71	241	37.59	22.15	241	30.22	18.02	241
County	49.98	26.33	241	43.45	25.16	241	36.09	21.17	241
Regional savings banks									
Federal	0.03	0.04	10,446	0.04	0.06	10,446	0.05	0.07	10,446
State	1.20	2.60	10,446	1.29	2.67	10,446	1.42	3.03	10,446
ROR	10.42	11.40	10,446	10.64	11.60	10,446	10.45	11.21	10,446
County	41.30	28.65	10,446	41.48	28.77	10,446	40.62	28.10	10,446
Large cooperative banks									
Federal	1.32	1.05	55	0.45	0.37	55	0.44	0.45	55
State	4.61	1.83	55	1.70	0.93	55	1.53	1.21	55
ROR	7.16	2.64	55	2.85	1.42	55	2.41	0.99	55
County	8.40	3.41	55	3.64	1.90	55	3.06	1.26	55
Regional cooperative banks									
Federal	0.01	0.01	34,146	0.01	0.02	34,146	0.01	0.02	34,145
State	0.13	0.39	34,146	0.15	0.44	34,146	0.19	0.54	34,145
ROR	1.59	2.36	34,146	1.59	2.30	34,146	1.76	2.50	34,145
County	9.54	13.79	34,146	9.55	13.99	34,146	9.95	13.78	34,145
Mortgage banks									
Federal	0.49	0.55	504	0.65	0.78	504	0.26	0.29	503
State	5.38	6.28	504	6.49	7.27	504	3.36	4.89	503
ROR	12.51	16.56	504	14.17	16.44	504	7.65	10.13	503
County	20.21	24.91	504	22.25	25.35	504	14.58	19.45	503
Total									
Federal	0.04	0.40	48,893	0.04	0.31	48,893	0.04	0.30	48,843
State	0.65	3.23	48,893	0.65	2.92	48,893	0.66	2.60	48,843
ROR	3.93	8.18	48,893	3.93	8.02	48,893	3.93	7.56	48,843
County	16.40	22.67	48,893	16.40	22.77	48,893	16.42	22.08	48,843

Notes: Summary statistics are based on a sample of German banks from 1993 until 2012 Market shares in percent for four different market aggregates (number of markets in brackets): Federal (1), state (16), economic agglomeration area (ROR, 96), and county (Kreis, 414). N denotes bank-years. The sample contains 48,993 bank-year observations between 1993–2012.

Table 2.8: Correlation between market shares across regional definitions

	Correlation			**Spearman**		
	Federal	*State*	*ROR*	*Federal*	*State*	*ROR*
State	0.519			0.801		
	0.000			0.000		
ROR	0.272	0.623		0.656	0.684	
	0.000	0.000		0.000	0.000	
County	0.090	0.285	0.639	0.604	0.618	0.767
	0.000	0.000	0.000	0.000	0.000	0.000

Notes: The left panel shows simple correlation coefficients for the level of market shares at different regional market definitions with p-values of significance underneath. The right panel shows rank-order correlations with associated p-values of significance. Based on 48,993 bank-year observations between 1993–2012.

Ideally, we would weigh market shares of total assets and any other activity of banks according to the regional location of the use of funds. Such information is not available in a comprehensive manner and would require, for instance in case of business lending, a credit register beyond the large exposure database of Bundesbank, which only records loans larger than €1.5 million. Alternatively, we would weigh market shares, and any of the other subsequently discussed measures, by regional representation of banks in terms of branch networks. However, the spatial distribution of branches according to the branching statistic of Deutsche Bundesbank has only been collected until 2004. Especially the large commercial banks no longer report these information.

We investigate below the implications for simple market shares when using for the available subsample branch location as weighting scheme. As the baseline, we prefer in this study however to use the regional definition of economic agglomeration areas (Raumordnungsregionen, ROR), which are constructed on the basis of social-economic dependencies.

Another choice besides the definition of regional market delineation concerns the type of bank activity for which to assess market structure and competition. Table 2.9 shows Spearman rank-order correlation coefficients between market shares at the ROR-level for balance sheet items described in subsection 2.1.3. With the exception of stock holdings, market shares based on different asset types correlate significantly and with at least 86%. Thus, total asset market shares capture the information contained in other asset-based market shares and off-balance sheet (OBS) activities very well. Market shares for different types of bank liabilities exhibit the same characteristic except for securitized debt. The somewhat

Table 2.9: Rank-order correlation of market shares for different bank activities

	TA	IL	CL	B	S	OBS	IB	D
Interbank loans (IL)	0.902							
	0.000							
Customer loans (CL)	0.988	0.863						
	0.000	0.000						
Bonds (B)	0.945	0.841	0.912					
	0.000	0.000	0.000					
Stocks (S)	0.684	0.546	0.685	0.645				
	0.000	0.000	0.000	0.000				
OBS	0.943	0.844	0.943	0.878	0.651			
	0.000	0.000	0.000	0.000	0.000			
Interbank borrowing (IB)	0.949	0.840	0.949	0.885	0.654	0.918		
	0.000	0.000	0.000	0.000	0.000	0.000		
Deposits (D)	0.985	0.878	0.977	0.935	0.703	0.925	0.912	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Securitized borrowing	0.616	0.499	0.632	0.572	0.559	0.607	0.596	0.607
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Spearman rank-order correlation coefficients with p-values underneath for different assets and liabilities as well as off-balance sheet activities (OBS). Regional market definition is ecnomic agglomeration area throughout. Based on 48,993 bank-year observations between 1993–2012.

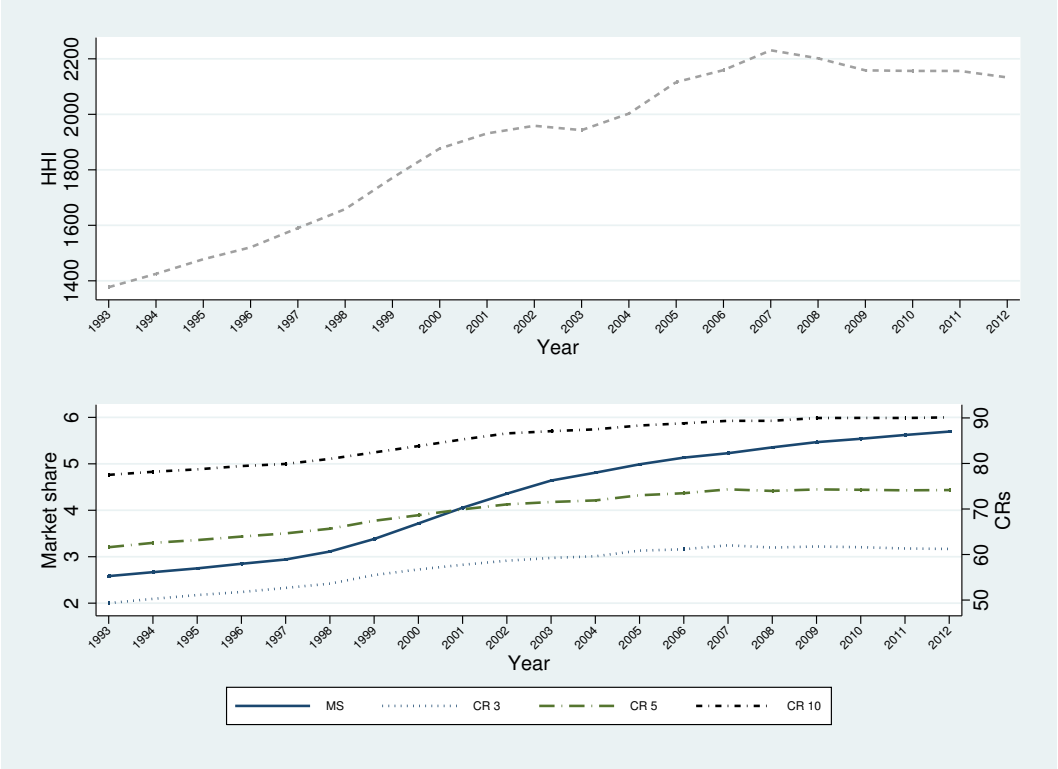
weaker correlations between total asset market shares and stocks (69.6%) and securitized debt (62.5%), respectively, indicate that probably only few banks engage in stock investment and wholesale funding. We will therefore assess below in reduced form multivariate regression analysis the effect of theses traits on structural measures of competition. For now, we continue to focus on total assets at the ROR-level to compare alternative indicators of market structure and competition.

2.2.2 Concentration ratios and Hirschman-Herfindahl indices

Market shares are an attractive indicator of market structure because of their simplicity and because they provide a bank-specific, time-variant measure. However, the discussion on the relevant market illustrates that market shares may be prone to outliers and fail to gauge the distribution of market power across firms in a market.

Two simple alternative measures are the Hirschman-Herfindahl Index (HHI) and concentration ratios (CR). The former equals the sum of squared market shares and the latter is defined as the share of aggregate assets of the n largest banks per market relative to

Figure 2.10: Market structure indicators per ROR over time



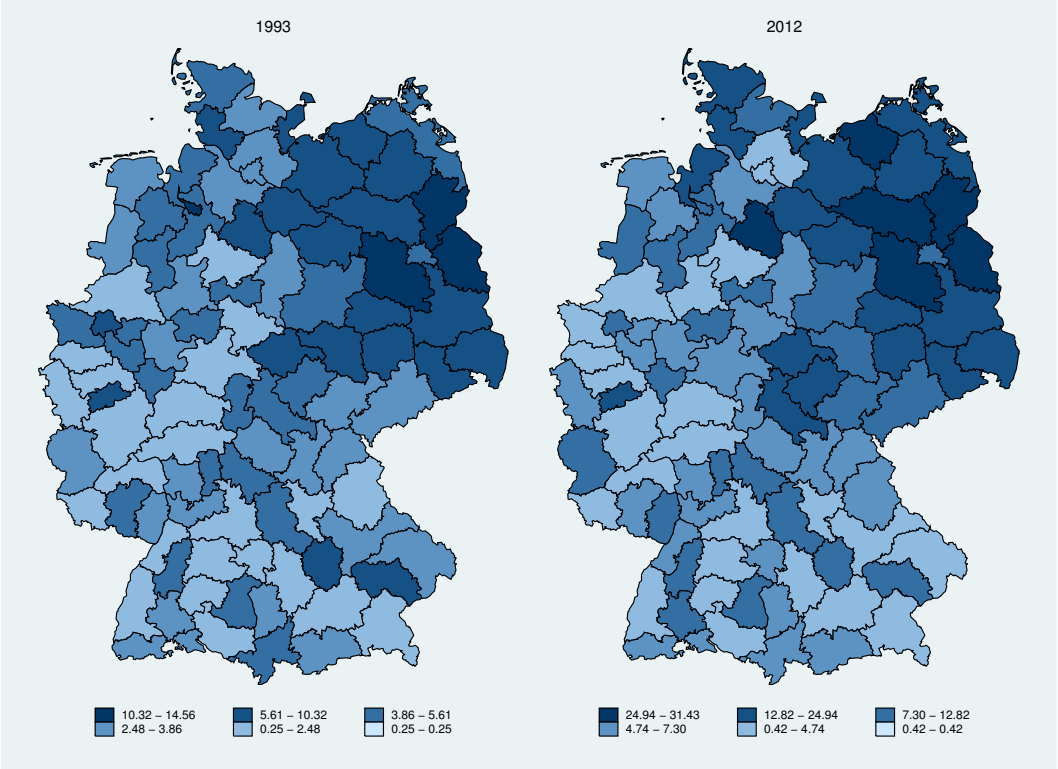
the market's total. Splits according to banking groups are fairly uninformative for these measures since CR and HHI describe regional market structure. Therefore we focus on the development over time according to all measures. As noted before, regional markets are defined as ROR.

Increases of HHI per ROR (upper panel), market shares per ROR (bottom panel, left axis) and concentration ratios per ROR (bottom panel, right axis) shown in Figure 2.10 are consistent with the overall growing banking sector size and a simultaneously shrinking number of banks.

To highlight the regional dispersion in market structure and competition indicators, Figures 2.11 through 2.13 show maps of German agglomeration areas ROR with mean market shares, HHI, and concentration ratios at the beginning and the end of the sample period. The distribution of each variable is divided into six classes based on the boxplot method.[10]

[10]This method to categorize the data means that class breaks are defined as follows: [min, p25 - 1.5*iqr],

Figure 2.11: Mean market share per ROR 1993 and 2012



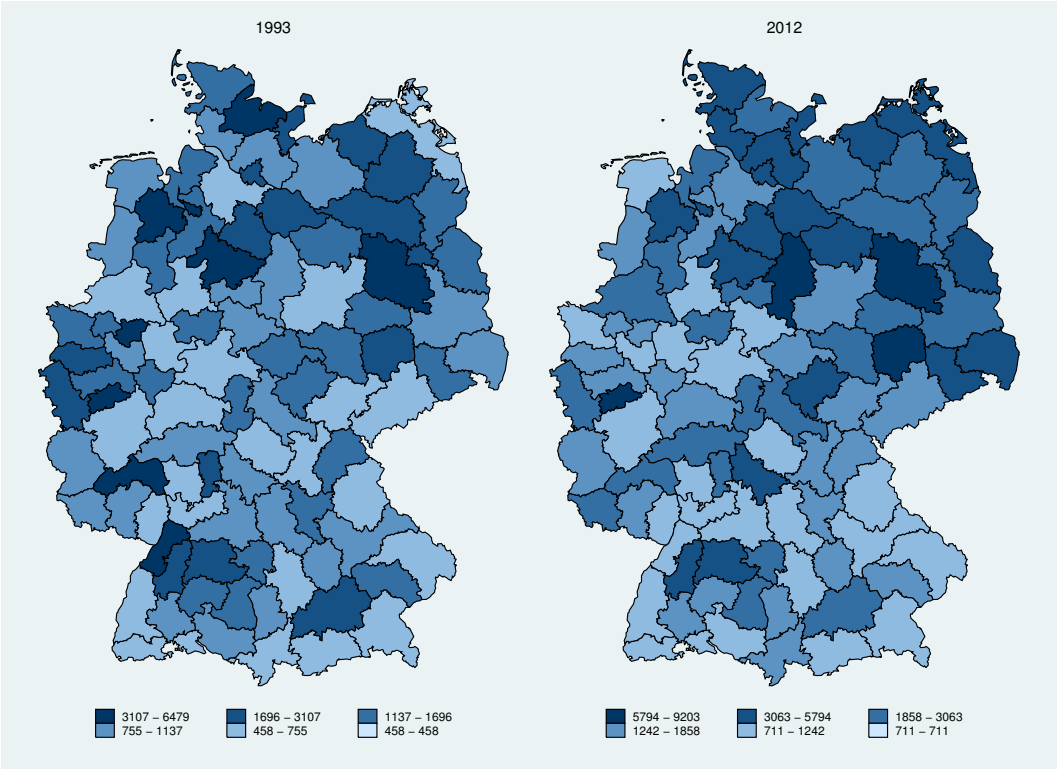
To varying degree, all measures indicate higher market shares and concentration in (north-)eastern regions compared to (south-)western regions, reflecting the regional dispersion of economic activity and population in the Federal Republic of Germany.

2.2.3 Regional demarcation of activities

Banks are allocated to regional units on the basis of the headquarter location reported to the structural database BAKIS-S of Bundesbank. The regional identifier is the municipality code (*Gemeindekennziffer*). This regional identifier clearly does not indicate the regional of activities of large banks. Ideally, one observes the location of the use of funds and the

(p25 - 1.5*iqr, p25], (p25, p50], (p50, p75], (p75, p75 + 1.5*iqr] and (p75 + 1.5*iqr, max], where iqr denotes the interquartile range and p indicates percentiles.

Figure 2.12: Mean Hirschman-Herfindahl index (HHI) per ROR 1993 and 2012



providers of bank debt, e.g. borrower location and depositor location. Such information is unavailable. An alternative approximation is to use the branching statistics, which collected the number of branches per municipality until 2004.

Aside from the obvious limitation that some branches are larger than others and offer different types of financial services, the approach to weigh market structure and competition indices per region by the spatial branch representation faces the challenge of a continuous consolidation of regional units. For instance, the BBR reported 16,216 different municipalities (*Gemeinden*) in 1990, which were consolidated into 12,066 municipalities by 2009. Likewise, the number of counties (*Kreise*) declined from 636 in 1990 to 415 in 2008.

We account for this changing regional demarcation by aggregating branches to our preferred spatial dimension, ROR. Throughout the period there were 96 ROR. Whereas the composition of nested counties and municipalities changed over time, these regions remained fairly stable.

Figure 2.13: Mean concentration of largest three banks (CR 3) per ROR 1993 and 2012

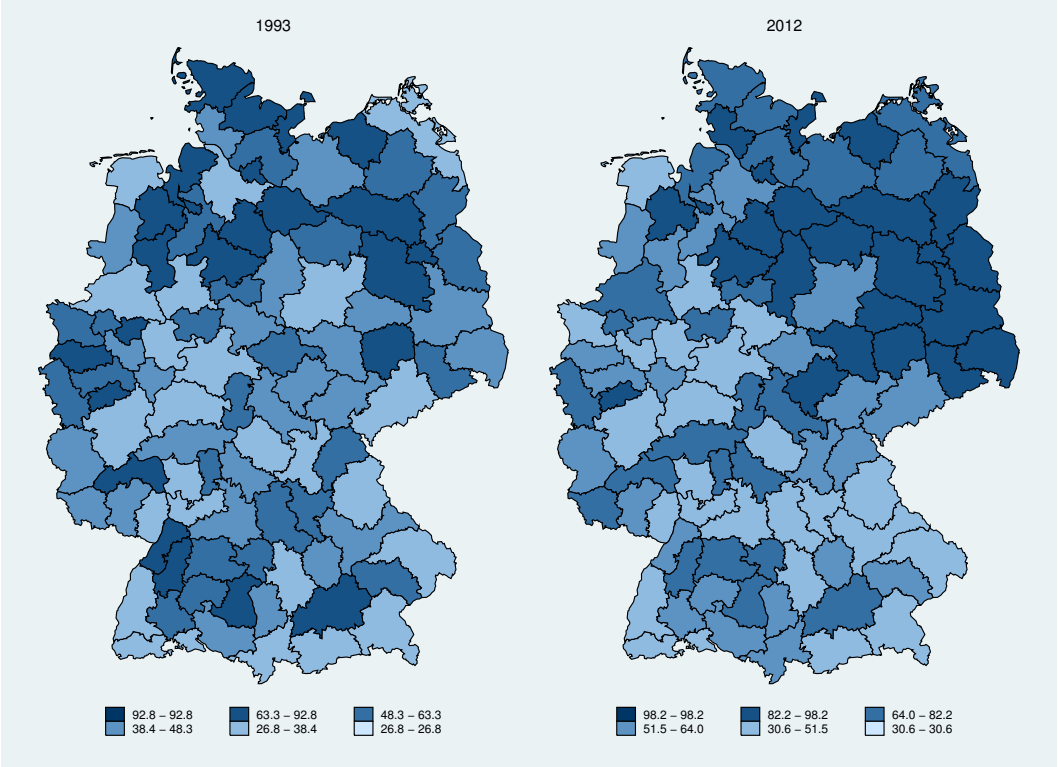
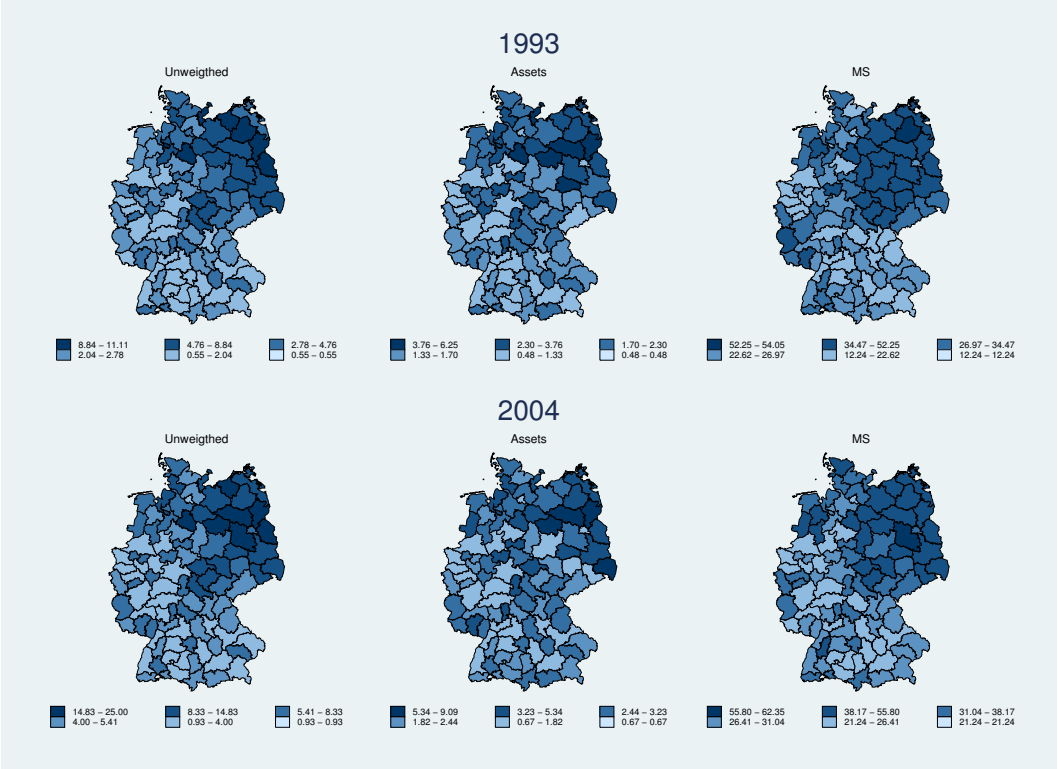


Figure 2.14 shows for the beginning of the sample period as well as the last available year with detailed branch data (2004) both market shares with and without weighting based on branches per county. We employ two alternative weighting schemes.

First, we allocate total assets of each bank i to a regional market r based on the number of branches of bank i as a share of its total number of branches. Regional markets are defined as economic agglomeration areas ROR. Weighted market shares are then calculated per bank i in region r as the ratio of weighted assets to total weighted assets across all banks i with a presence in region r. Finally, we collapse the data by region and year and take averages per region-year.

Second, we weigh baseline market shares shown in Table 2.7, i.e. those calculated as the ratio of bank i's total assets to the sum of assets across all banks *headquartered* in region r. Instead of allocating total assets to regions and then calculate market shares, we thus allocate market shares directly by weighing them with the share of branches of bank i in

Figure 2.14: Branch-weighted market shares 1993 and 2004



region r relative to the total number of branches of bank i. To generate market shares per region, we collapse the data and sum these weighted markets shares across all banks with a presence in region r.

Headquarter-based regional market shares do not differ significantly from those calculated from branch-weighted asset shares per region. But mean market shares per region are markedly higher when weighing market shares per ROR based on headquarter location with local branch shares of each bank. Whereas unweighted total asset market shares per ROR are on average 5.5% between 1993 and 2004, weighted market shares are on average 31.6%. The large difference in levels is primarily due to the branch dispersion of large commercial banks. In particular Postbank with a very large number of branch offices and a very large market share in its headquarter ROR contributes to this much higher mean market share.

Figure 2.14 illustrates though that the regional dispersion is fairly unaffected in comparison

Table 2.10: Alternative branch-weighted market shares over time

Year	**Unweighted**	**Weighted**	
		Assets	*MS*
1993	3.74	1.95	29.10
1994	4.13	1.94	29.41
1995	4.36	1.99	34.06
1996	4.51	2.04	33.30
1997	4.73	2.10	30.58
1998	5.15	2.14	29.61
1999	5.56	2.25	29.30
2000	6.11	2.34	32.35
2001	6.50	2.43	32.37
2002	6.80	2.53	33.60
2003	7.28	2.60	32.80
2004	7.42	2.68	32.93
Correlation			
Asset-weighted	0.806		
	0.000		
MS-weighted	0.752	0.635	
	0.000	0.000	

Notes: We use two type of weights. *Assets* indicates that assets are weighted by the branch share of bank i relative to all branches in ROR r. Market shares per bank are calculated relative to the sum of total weighted assets. MS indicates that each banks market share per ROR based on headquarter location is allocated to each ROR with a branch presence. The market share is weighted with the branch share of bank i in ROR r relative to all branches of bank i.

to the baseline market shares. This lack of huge differences simply illustrates that the vast majority of banks in Germany is not active in terribly many different ROR.

Table 2.10 confirms the substantial level differences between unweighted baseline market shares and those based on weighted assets allocated to regions versus market shares weighted with each bank's regional branch share. For this limited time period, the steady increase in average market shares is confirmed by all three measures, albeit at much less drastic growth rates for markets shares weighted with regional branch shares compared to unweighed and asset-weighted market shares.

The bottom panel of Table 2.10 further shows that rankings from all three market share

measures, even the most different branch share weighted ones, are highly correlated. We also tested these correlations for customer lending and deposits, which also yield large and significant positive correlations.

In sum, we continue henceforth to use headquarter-based indicators of market power for three main reasons. First, neither cross-sectional nor time-series rank differences of market shares appear to change fundamentally when taking into account the regional dispersion of branch networks of German banks. Second, reliable data on regional branch presence is only available until 2004, thus excluding the presumably important changes in retail networks during the financial crisis of 2008. As such, it remains unclear what additional information these data contain. We assume instead that it is the headquarter of banks where decisions relevant to gauge market power, such as pricing and loan creation, are taken. Third, even perfect knowledge of branch locations would not imply to gauge properly the actual (regional) source and destination of financial products and services.

2.2.4 Savings and cooperatives as single entities

One may argue that the two-tier savings and cooperative bank pillars act in fact as one large bank holding company. Table 2.11 shows how market shares change when treating the savings bank sector, the cooperative bank sector, and both as single entities, respectively. The top panel depicts the regional market shares per ROR treating each single bank as an independent entity (see Table 2.7). The panels below treat savings banks as one entity, co-operatives as one entity, and both pillars as one bank, respectively.

Merely adding up total assets for regional and central banks in the savings and cooperative pillar neglects intra-pillar exposures to other banks of the pillar. Double-counting of e.g. interbank exposures is therefore clearly an important caveat given the balance sheet structure of head institutions and regional savings and cooperatives shown in Tables 2.3 and 2.3. For example, interbank assets of regional cooperatives originating from retail deposits constitute interbank liabilities of central cooperative banks. Therefore, aggregating these positions overestimates the size of a synthetic, single co-operative banking entity.

We therefore show next to gross total asset market shares also customer loan and savings deposit market shares in Table 2.11, which should be less prone to such a bias.[11] Recall that

[11] Note that in contrast to Table 2.7, we consider here only savings deposits by non-bank customers with

Table 2.11: Market shares per ROR for savings and cooperatives as single entities

	Total assets	**Customer loans**	**Savings deposits**
Each bank individually			
Mean	3.93	3.93	4.09
SD	8.18	8.02	7.87
N	48,893	48,893	46,968
Savings sector as one bank			
Mean	5.02	5.02	5.02
SD	9.41	9.43	8.63
N	38,226	38,226	38,226
Cooperative sector as one bank			
Mean	13.05	13.05	13.05
SD	16.93	16.71	16.69
N	14,712	14,712	14,712
Savings and cooperative sector as one bank, respectively			
Mean	18.81	18.81	15.95
SD	33.98	34.14	33.02
N	4,045	4,045	3,907

Notes: Panel headings indicate, which banks are treated as one single entity. Market shares are calculated per economic agglomeration area ROR.

(regional) cooperative banks are by far most numerous in Germany, followed by (regional) savings banks. This dominance of savings and cooperative banks in the sample regarding the number of banks is reflected by the declining number of observations across which we average market shares as we move down the panels in Table 2.11. Treating both savings and cooperatives as single entities reduces observations from around 48,000 to around 4,000 observations.[12]

Market shares per ROR increase mildly from around 4% to approximately 5% when treating savings banks as single entity.[13] The increase in market shares is very similar across the three balance sheet items considered. Treating cooperatives as single entity implies a

stipulated periods of notice of at least three months (reporting position EJB 186). Deposits in Table 2.7 pertain to all savings deposits by non-bank customers (position EJB 200).

[12] A number of banks from all three pillars do report missing savings deposits with agreed notice periods.

[13] We allocate the synthetic single entities to the ROR hosting most of the large banks from each pillar. Allocating the synthetic banks randomly to alternative regions did not change the results qualitatively. Allocating synthetic banks using bank and branch presence as weights yields virtually identical results as those shown in subsection 2.2.3.

substantial increase in average market shares per ROR from around 4% to around 13%. Assuming that both pillars act as one single entity increases average market shares further to around 16% to 19%.

Table 2.12 shows differences in mean market shares per ROR averaged over the sample period of 20 years across (synthetic) banking groups. That is, the total corresponds with market shares shown in Table 2.11 when treating both savings and cooperatives as single entities. Consistent with the description of aggregate balance sheet totals per banking group over time in Figure 2.3, the table shows that both synthetic banks would resemble another large bank operating in Germany. Especially regarding customer deposits, a synthetic savings bank holding company would exhibit a dominant market share.[14]

However, the naive aggregation of savings and cooperative banks is subject to numerous caveats. First, each regional bank from either sector remains a legally independent unit that can, for example, fail individually. Second, regional banks make credit choices themselves, thereby exerting larger autonomy than a branch of a bank holding company merely executing orders of a headquarter. Third, proper consolidation of intra-pillar claims is anything but trivial and in all likelihood inappropriately approximated by simple aggregation.

Overall, the crucial question is whether the entire cooperative and savings bank sector are managed as one bank. We consider this unlikely given legally separate entities as well as the lack of just one group of delegated monitors, e.g. one (federal) board of executive managers, that can order individual savings and cooperative banks to conduct operations, such as lending and funding choices. Moreover, the governance within a banking sector where legally separate entities own stakes of another, as for example regional savings banks holding shares in Landesbanken, renders it impossible to regard such a network at par with say a large stock incorporated bank holding company with regional branch managers that are merely delegated agents of clearly separated owners. Most likely, coordination within each sectors' banks is of a higher intensity compared to, say, coordination among regional commercial banks. An example are shared back-office services provided to all member banks, such as information technology (IT) data warehousing or credit risk ratings.[15] But it remains unclear if it is of a sufficient degree to consider banks from either sector as a single entity. Therefore, we continue henceforth to treat each bank as individual entity.

[14] Market shares do not add up to 100% because they are averaged over time and banks per ROR.
[15] See Koetter and Noth (2013) for a study on the influence of IT in the German savings bank sector.

Table 2.12: Synthetic market shares per ROR per banking group

	Total assets	**Customer loans**	**Savings deposits**
Large commercials			
Mean	38.8	36.8	37.6
SD	38.9	39.1	45.9
N	91	91	91
Regional commercials			
Mean	15.5	15.4	16.9
SD	32.1	32.2	33.9
N	3,410	3,410	3,327
Synthetic savings entity			
Mean	45.8	47.9	59.3
SD	5.2	3.0	0.9
N	20	20	20
Synthetic cooperative entity			
Mean	15.7	16.4	32.2
SD	2.5	2.0	1.7
N	20	20	20
Mortgage banks			
Mean	36.8	37.5	2.2
SD	39.4	39.6	12.7
N	504	504	449
Total			
Mean	18.8	18.8	16.0
SD	34.0	34.1	33.0
N	4,045	4,045	3,907

Notes: Average market shares per economic agglomeration area ROR across years and (synthetic) banks.

Table 2.13: Price-cost margins per banking group 1993-2012

Statistic	Commercial		Savings		Cooperatives		Mortgage	Total
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*		
Mean	1.32	-0.50	0.49	2.74	0.49	2.99	0.41	2.65
Median	1.14	1.47	0.43	2.64	0.46	2.94	0.39	2.83
SD	0.77	80.61	0.29	0.66	0.22	0.66	0.36	21.32
N	91	3,410	241	10,446	55	34,146	504	48,893

Notes: Price-cost margins are defined as the difference between the ratio of interest revenue to interest bearing assets (interbank loans, customer loans, bonds) and the ratio of interest expenses to interest bearing liabilities (interbank debt, customer debt, securitized debt). All numbers in percent.

2.3 Empirical measures of market power

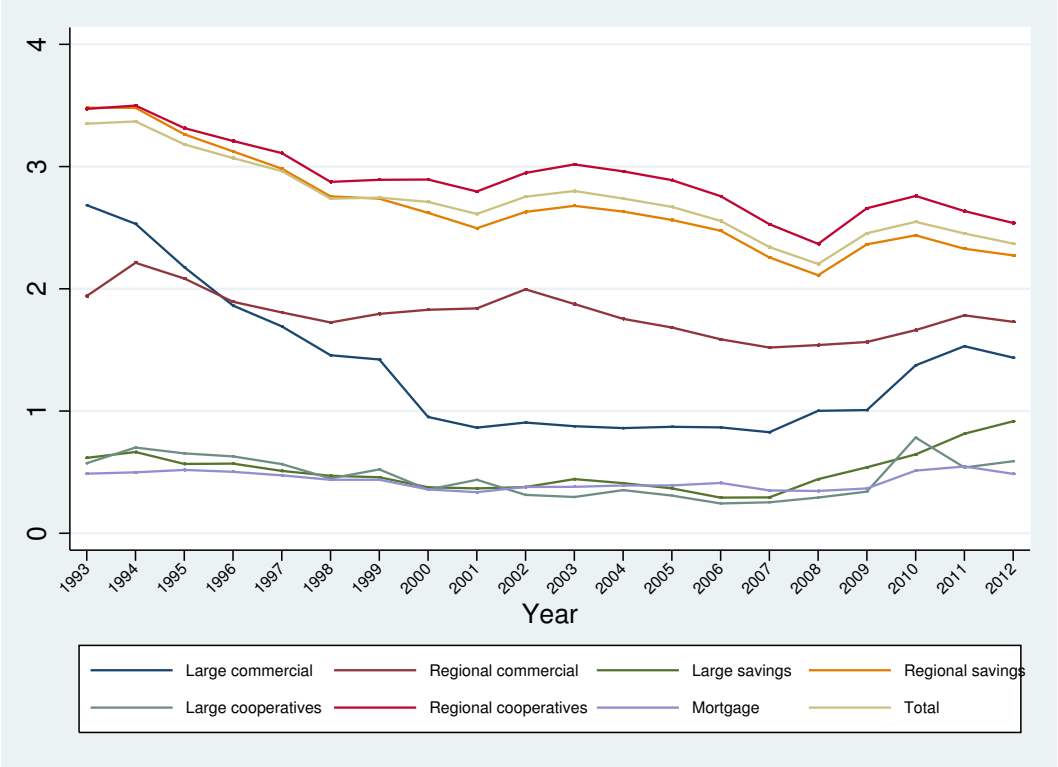
2.3.1 Price-cost margins

We define price-cost margins as the spread between charged interest rates on banks assets, such as loans, and interest rates paid on borrowed funds, such as deposits and securitized debt (see, for example, Cowling and Waterson, 1976; Ogura, 2012). Charged and offered interest rates are only observed directly for a subset of banks reporting to the Interest Rate Statistics of Bundesbank (*Zinsstatistik*), which is a stratified sample gauging various asset and liability interest rates. We impute interest rates from balance sheet and profit and loss account data by subtracting the ratio of interest expenses to interest bearing liabilities from the ratio of interest income to interest bearing assets. Table 2.13 shows descriptive statistics for the price-cost margin (PCM) across banking groups averaged over time.

For the entire German banking system, PCMs average 2.6%. Margins are the largest for regional cooperative and savings banks. The largest banks from any sector do not exhibit the widest spreads. This observation does therefore not support the notion that size is per se an indicator of higher interest rates charged. Note that only for 364 bank-year observations the PCM is negative, mostly within the group of regional commercial banks. These occasions may reflect extraordinary events and we winsorize below the PCM variable at the 1st percentile to plot the evolution over time, to illustrate difference across regions, and to show the correlation with market shares.

Figure 2.15 illustrates that PCMs of regional cooperatives and savings are consistently higher compared to any of the other banking groups. Up and until the complete unfolding of the financial crisis in 2008, margins declined steadily in all sectors except for regional

Figure 2.15: Price-cost margins per banking group over time

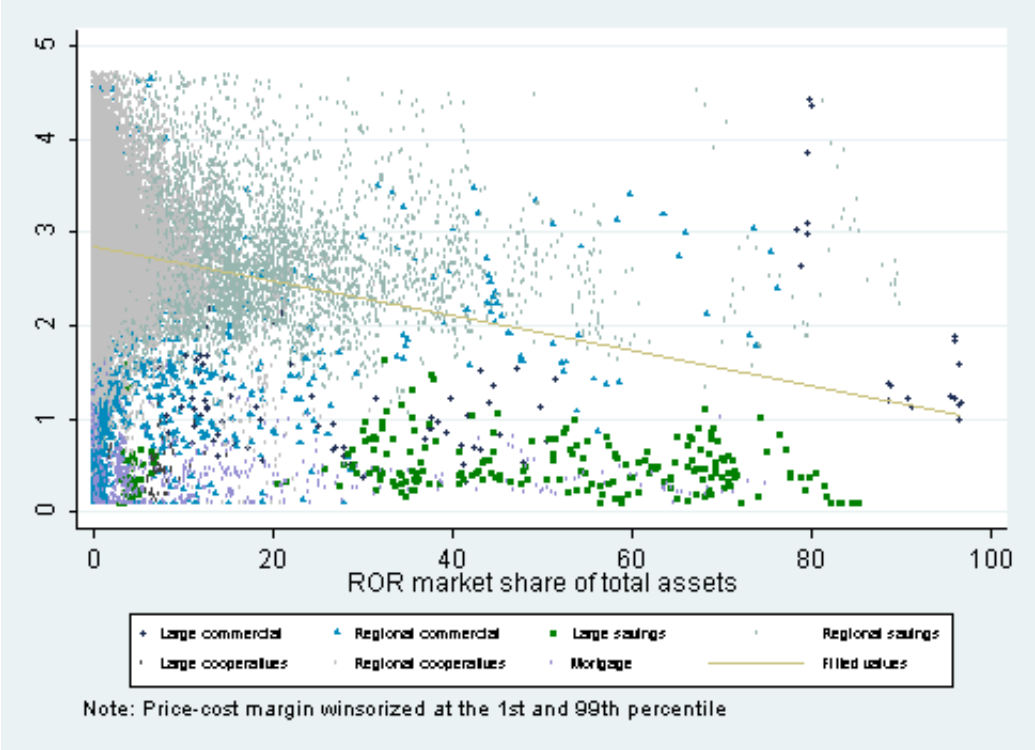


commercial banks. These more specialized institutions exhibit fairly flat developments of PCM over time, possibly underpinning their activities in certain niche markets, e.g. auto finance.

The correlation between PCM and regional market shares per ROR corroborate this impression. The rank-order correlation coefficient between (unwinsorized) PCM and market shares is -0.118 and significantly different from zero. Figure 2.16 shows a scatter plot of (winsorized) PCMs per banking group and market shares. The negative slope of the fitted values depicted by the yellow line confirms the negative correlation shown above.

Figure 2.17 shows this relationship between regional market shares and price-cost margins per banking group and highlights some important differences. The overall negative relationship arises in the subsamples of regional savings (rank-order correlation coefficient: -4.5%), regional cooperatives (-13.6%), and mortgage banks (-14.1%). Market shares of larges savings and cooperatives as well as regional commercial banks do not correlate signif-

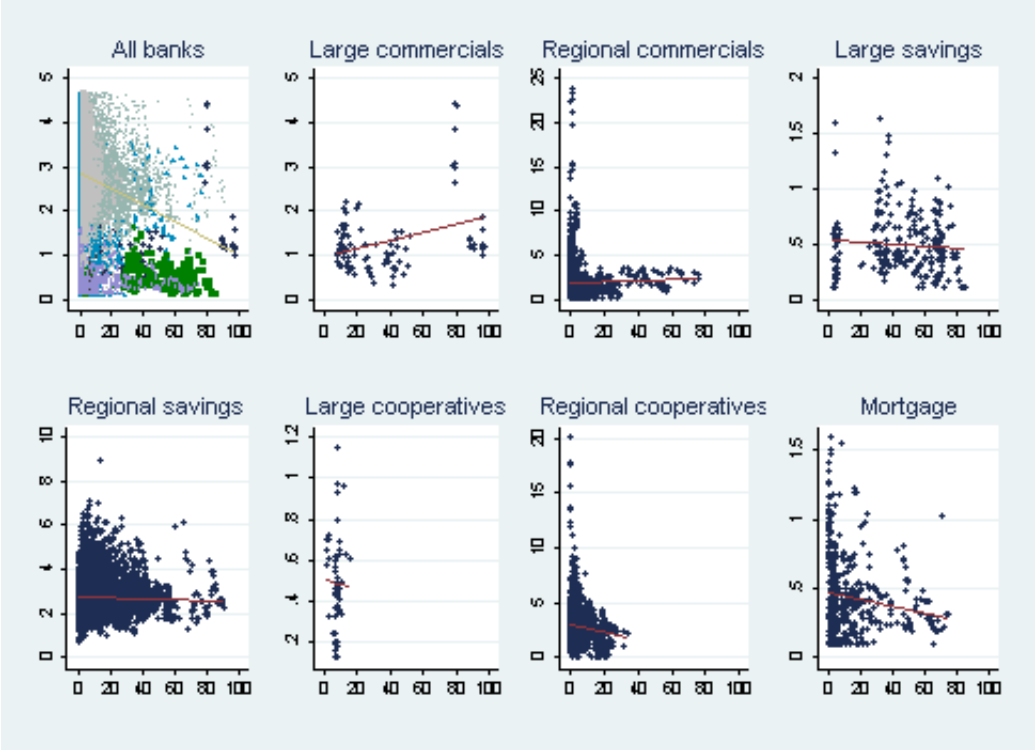
Figure 2.16: Correlation between PCM and market shares



icantly with price-cost margins. For large commercial banks, in turn, we find a significant correlation coefficient of 35.7% at the 1%-confidence level.

Price-cost margins also vary substantially across German regions as shown in Figure 2.18. Differences between mean asset and liability interest rates averaged over all banks in a region tend to be systematically higher in the East of Germany, Berlin being the exception. Southern German regions exhibit the lowest PCM. This regional divide is persistent over the sample period and the level of PCM did not change significantly either. Whereas higher PCM are indicative of market power, part of these regional differences may also reflect systematically riskier projects that banks can finance in the Eastern parts of Germany. We therefore have to consider below the multivariate relationship between bank-specific risk proxies and PCM as well as other indicators of bank market power.

Figure 2.17: Correlation between PCM and market shares per banking group

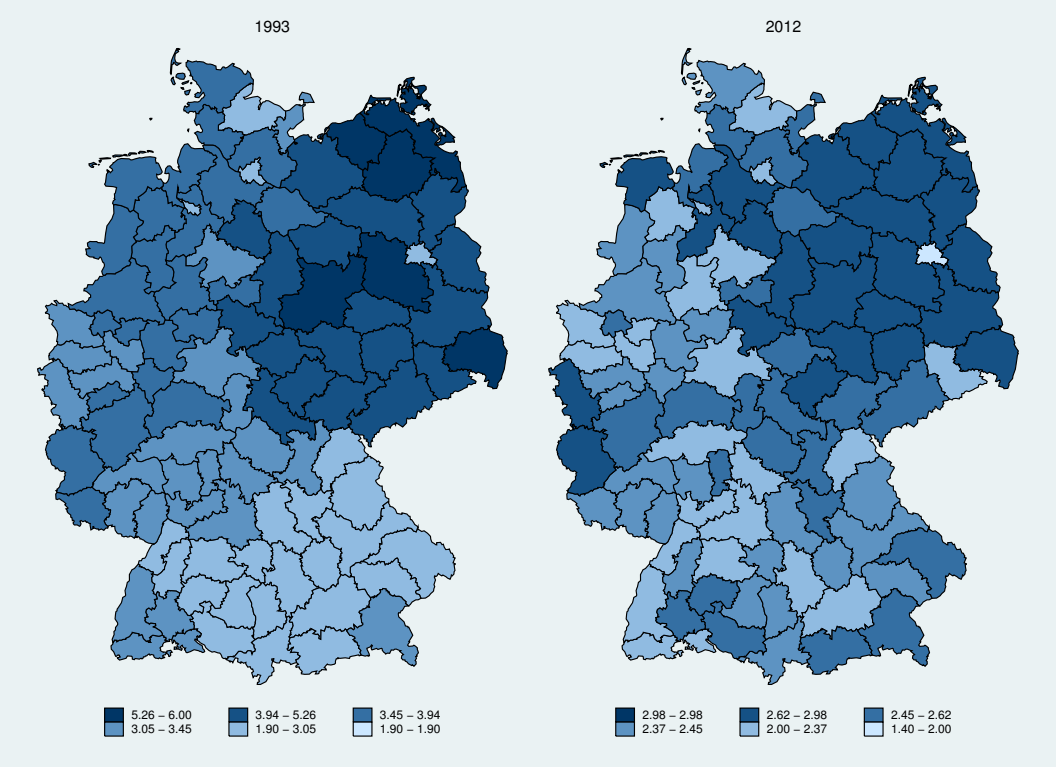


2.3.2 Lerner indices

Lerner indices are defined as the difference between average revenues and marginal cost of the firm scaled by average revenues (Lerner, 1934). Average revenues equal marginal cost in perfectly competitive markets. Thus, larger values of Lerner indices indicate more market power for the bank in question. Numerous empirical studies for German banking as well as other markets use the Lerner index because it provides a time-variant, bank-specific indicator of market power that accounts for measurement error and gauges economic markups.[16] Thereby, it provides a more granular view on individual bank market power as opposed to aggregate indicators gauging competitive conditions per market, such as HHI, concentration ratios, and empirical indicators like Boone and H-statistic estimated below.

[16]Studies that estimate Lerner indices for German banks are Kick and Prieto (2013), Buch et al. (2013), and Koetter and Poghosyan (2009). Selected international studies that include Germany as well are, for example, Guevara et al. (2005), Maudos and Guevara (2007), Carbó et al. (2009).

Figure 2.18: PCM across ROR in 1993 and 2012



We obtain marginal cost (MC) as in Koetter et al. (2012) as the derivative of a bank cost function that we estimate using stochastic frontier analysis.[17] Average revenues (AR) are approximated with implied prices, calculated as operating revenues divided by earning assets. Table 2.14 shows means and standard deviations for these variables across banking groups.

[17] See also Delis and Tsionas (2009), Ariss (2010), Kutlu and Sickles (2012), Kick and Prieto (2013) for the use of stochastic frontier analysis to estimate Lerner indices.

Table 2.14: Descriptive statistics cost frontier arguments 1993-2012

Variable	**Statistic**	**Commercial**		**Savings**		**Cooperatives**		**Mortgage**	**Total**
		Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*		
	N	91	3,410	241	10,446	55	34,146	504	48,893
Fixed assets (w1)	Mean	22.04	321.22	25.97	16.57	23.37	17.41	25.28	38.56
	SD	15.01	11,994.60	29.13	206.34	8.35	279.85	53.99	3,178.24
Labor (w2)	Mean	95.86	92.96	83.09	51.35	79.36	52.93	215.48	57.32
	SD	55.12	411.27	24.89	180.01	25.12	20.66	364.07	144.09
Borrowed funds (w3)	Mean	3.27	6.14	4.78	3.32	3.88	3.22	5.34	3.47
	SD	1.01	80.76	1.78	0.94	1.15	1.00	1.92	21.36
Interbank loans (y1)	Mean	79,677	860	37,020	178	36,216	41	5,138	551
	SD	61,656	2,950	32,758	350	31,622	114	7,378	5,886
Customer loans (y2)	Mean	144,942	1,830	42,735	1,068	12,870	192	18,288	1,173
	SD	106,556	6,852	33,934	1,701	11,319	560	24,047	9,360
Bonds and stocks (y3)	Mean	74,546	735	26,335	448	24,016	76	6,345	561
	SD	69,479	2,949	23,160	612	28,568	237	11,046	5,385
Off-balance sheet (y4)	Mean	62,728	427	18,964	110	8,597	21	1,142	300
	SD	43,178	1,700	23,762	211	8,362	92	1,914	3,957
Operating cost (TOC)	Mean	15,105	193	5,594	90	3,000	17	1,637	120
	SD	10,630	584	5,330	129	2,526	40	2,327	1,022
Profits before tax (PBT)	Mean	1,006	30	371	19	234	3	92	13
	SD	1,504	116	383	26	235	10	155	95
Gross total assets (TA)	Mean	420,582	3,725	117,093	1,799	84,226	329	30,278	2,641
	SD	448,411	11,674	93,124	2,628	81,689	903	39,447	29,268
Equity (Z)	Mean	11,548	180	3,250	85	2,248	17	618	89
	SD	8,047	499	3,261	128	1,868	41	1,082	718

Notes: Cost and profit function arguments in levels for all 3,912 banks and 48,839 bank-year observations between 1993 and 2012. Factor prices are in percent except for the price of labor, which is in thousands of Euros. All other variables are in millions of Euro.

We follow the abundant literature on estimating cost and profit functions in banking and assume that a bank i at year t employs fixed assets x_1, labor x_2, and borrowed funds x_3, which it demands in complete factor markets at price w_i. These inputs are used to generate four outputs: interbank loans (y_1), customer loans (y_2), bonds and stocks (y_3), and off-balance sheet activities (y_4), comprising credit guarantees and irrevocable credit commitments. The objective function of the bank is to minimize total operating cost (TOC) given its technology constraint. We abstain in this study from estimating a profit frontier to generate AR because (i) it is not clear that all banks in Germany maximize profits before tax (PBT), for example government owned banks, and (ii) because required output prices are not observed. To control for different risk-preferences across banks and the ability to absorb balance sheet shocks, we specify also equity (z) as a control variable.

Empirically, we specify the following log cost function, which is estimated with maximum-likelihood as a latent class stochastic frontier model (see Greene, 2005; Orea and Kumbhakar, 2004):

$$\ln TOC_{it|j} = f(\ln Y_{it|j}, \ln W_{it|j}, \ln Z_{it|j}, \text{trend}; \beta_j) + v_{it|j} + u_{it|j} \tag{2.1}$$

Note the following issues concerning Equation (2.1). First, we assume a composed total error term $\epsilon_{it|j} = v_{it|j} + u_{it|j}$, where $v_{it|j}$ is a random term and $u_{it|j}$ denotes a non-random error component, which is $u_{it|j} \sim |N(0, \sigma_{u|j})|$. This non-random component captures systematic deviations from minimum cost, for example due to excessive employment of factors at given prices or suboptimal factor allocation given relative prices. Such deviations can occur, for example, if managers pursue empire building and employ more workers than needed to generate a given output vector. Therefore, this term is also coined X-(in)efficiency in the stochastic frontier literature since it gauges Leibensteins (1966) idea that managers can deviate from optimal cost either in pursuit of private, non-value maximizing objectives or due to inability. From the Jondrow et al. (1982) point estimate of technical efficiency given by $E(u_{it|j}|\epsilon_{it|j})$, we calculate bank-specific and time-variant cost efficiency (CE) as $\exp(-u_{it|j})$. CE is equal to one for a fully efficient bank whereas e.g. CE=0.9 indicates a bank, which could have provided an identical output vector at only 90% of observed operating cost. We report below next to Lerner indices average CE.

Second, note that we allow technology parameters β to vary across different groups j. This is important for the Lerner index as a measure of market power because marginal costs

Table 2.15: Descriptive statistics latent class determinants

Variable	Mean	SD	Min	Max
Large bank	0.01	0.09	0	1
Regional cooperatives	0.7	0.46	0	1
Size quintile	3	1.41	1	5
East indicator	0.09	0.29	0	1
Government ownership	0.22	0.41	0	1

Notes: 48,893 observations for all banks in Germany between 1993 and 2012. The Large bank indicator is one for large commercials, central savings, and central cooperative banks. Size quintiles are based on gross total assets per year. The East indicator is equal to one if the bank's headquarter is located in the Eastern states of the Republic. Government ownership is an indicator equal to one for central and regional savings banks.

equal the derivative of Equation (2.1) with respect to outputs and thus depend on these parameter estimates. Given the substantial heterogeneity across banks in Germany discussed in subsections 2.1.3 and 2.1.4, group-specific parameters permit to gauge this heterogeneity due to, for instance, different business models or regional macroeconomic conditions when estimating markups. Such differences are disregarded in simple accounting-based measures, such as price-cost margins (PCM) as in Section 2.3.1. The membership of a bank i in group j is furthermore not determined a priori, but estimated conditional on such environmental traits M_{irt} that capture bank- and region-specific effects. Technology regime membership probabilities (RMP) are estimated with a multinomial probit model as:

$$RMP_{ij} = \frac{\exp(\delta_j M_{irt})}{\Sigma_{j=1}^{J} \exp(\delta_j M_{irt})} \tag{2.2}$$

The likelihood functions of Equations (2.1) and (2.2) are maximized jointly. This approach ensures that we determine banks' technology group memberships conditional on observable environmental characteristics rather than imposing a priori assumptions on sufficiently homogenous groups. Table 2.15 shows descriptive statistics of the specified determinants, which are the result from extensive log-likelihood ratio tests across alternative group determinant vectors, number of possible technology groups, and different functional forms.

In a nutshell, these specification choice tests yield a latent class model with four technology regimes and a Cobb-Douglas functional form and five RMP determinants as the statistically preferred model. RMP determinants are: banking group dummies for large

and mortgage banks, and indicators for location of the bank in the East of Germany, government ownership, and a size decile indicator. Single frontier models or plain OLS without a composed error term, irrespective of functional form, are rejected. More complex models, for instance stochastic LCM models with a translog functional form, more extensive environmental vectors of RMP determinants M, and inefficiency determinants suffered from overspecification problems.

Recall that the Lerner index is defined as average revenues less marginal cost scaled by average revenues. Marginal cost equal the derivative of the cost function in Equation (2.1) with respect to outputs, multiplied by average cost:

$$MC_{it|j} = \Sigma_{m=4} \frac{\delta \ln TOC_{it|j}}{\delta \ln Y_{mit|j}} \times \frac{TOC_{it|j}}{\Sigma_{m=4} Y_{mit|j}}, \tag{2.3}$$

Parameter estimates of the preferred latent class stochastic frontier models (LCM) are shown in Table A.1 in Appendix A.5. Table 2.16 shows resulting Lerner indices, the according components average revenue and marginal cost, as well as cost efficiency estimates.

For the entire sample, Lerner indices equal 39% on average, which is somewhat higher compared to the estimates of Kick and Prieto (2013), who analyze the years until 2009. Lerner indices indicate that markups of larger banks within each pillar dominate those of regional banks. Large commercial and central savings and cooperative banks exhibit substantial mean markups that range between 58% and 76%. Higher markups of larger banks therefore indicate market power compared to regional peers. This result also differs from Kick and Prieto (2013), who do not consider mortgage banks and do not permit technology parameters used to estimate Lerner indicators to vary across banks.[18]

Figure 2.19 depicts the development of mean Lerner indices and its components over time. Whereas average revenues and marginal costs declined steadily over time, Lerner indices exhibit a more volatile pattern that reflects the different growth rates of the aforementioned components. Until 2001, markups did not change substantially. Thereafter, they increased continuously until the beginning of the global financial crisis in 2007. This pattern is is in

[18] Unreported Lerner indices estimated with a single frontier model for the present sample yield lower market power for larger banks from each pillar as in Kick and Prieto (2013). This result underscores the importance of specification tests of the preferred cost function.

Table 2.16: Lerner index and components across banking groups

Statistic	Commercial		Savings		Cooperatives		Mortgage	Total
	Large	*Regional*	*Central*	*Regional*	*Central*	*Regional*		
N	91	3,410	241	10,446	55	34,146	504	48,893
Lerner index								
Mean	0.762	0.541	0.651	0.396	0.579	0.368	0.478	0.390
Median	0.830	0.587	0.621	0.352	0.509	0.344	0.526	0.352
SD	0.146	0.275	0.169	0.130	0.137	0.101	0.167	0.138
Marginal cost								
Mean	0.013	0.045	0.019	0.040	0.021	0.045	0.031	0.044
Median	0.010	0.034	0.017	0.042	0.020	0.046	0.028	0.045
SD	0.010	0.063	0.010	0.011	0.009	0.011	0.015	0.020
Prices								
Mean	0.055	0.110	0.054	0.066	0.050	0.072	0.059	0.073
Median	0.056	0.077	0.053	0.066	0.051	0.071	0.057	0.070
SD	0.017	0.164	0.015	0.011	0.013	0.014	0.019	0.046
Cost efficiency								
Mean	0.948	0.958	0.974	0.941	0.951	0.932	0.953	0.936
Median	0.986	0.986	0.987	0.945	0.954	0.938	0.986	0.942
SD	0.089	0.069	0.062	0.035	0.032	0.039	0.074	0.043

Notes: Sample of 3,732 banks between 1993 and 2012.

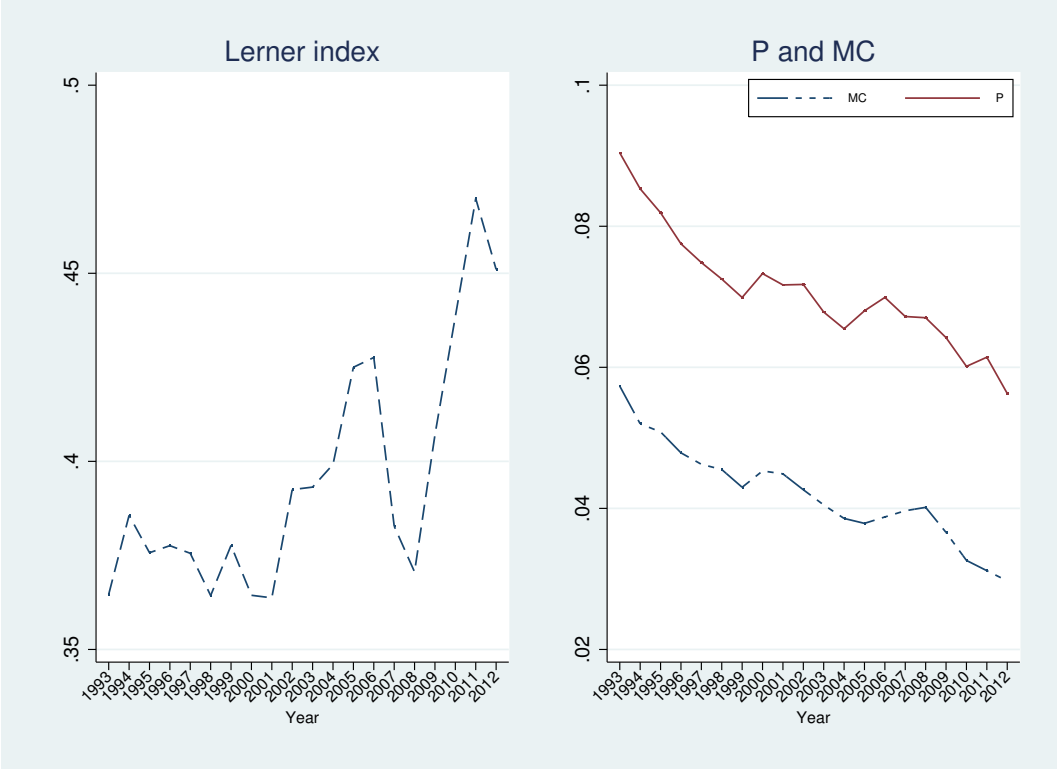
line with the dynamics reported in Koetter and Poghosyan (2009) and in Kick and Prieto (2013) for commercial banks.

During the turmoil in international banking markets in 2007/2008, markups contracted massively due to reduced average revenues at constant marginal costs. After the peak year of the crisis in 2008, marginal costs declined substantially, leading to a steep increase in Lerner indices beyond the levels of the beginning of the sample period. Potentially, extraordinary monetary policy measures have slashed the main component of banks marginal cost, namely refinancing costs, which outpaced the reduction of average bank revenues. This result raises the question, whether policy measures to provide assistance to distressed banks induced competitive distortions, which we investigate in greater detail in Module II.

Separate plots of Lerner indices and components over time per banking group in Appendix A.4 highlight again the heterogeneity of market power measure developments across banking sectors.

The regional dispersion of market power according to the Lerner index is shown in Figure

Figure 2.19: Lerner index and components over time

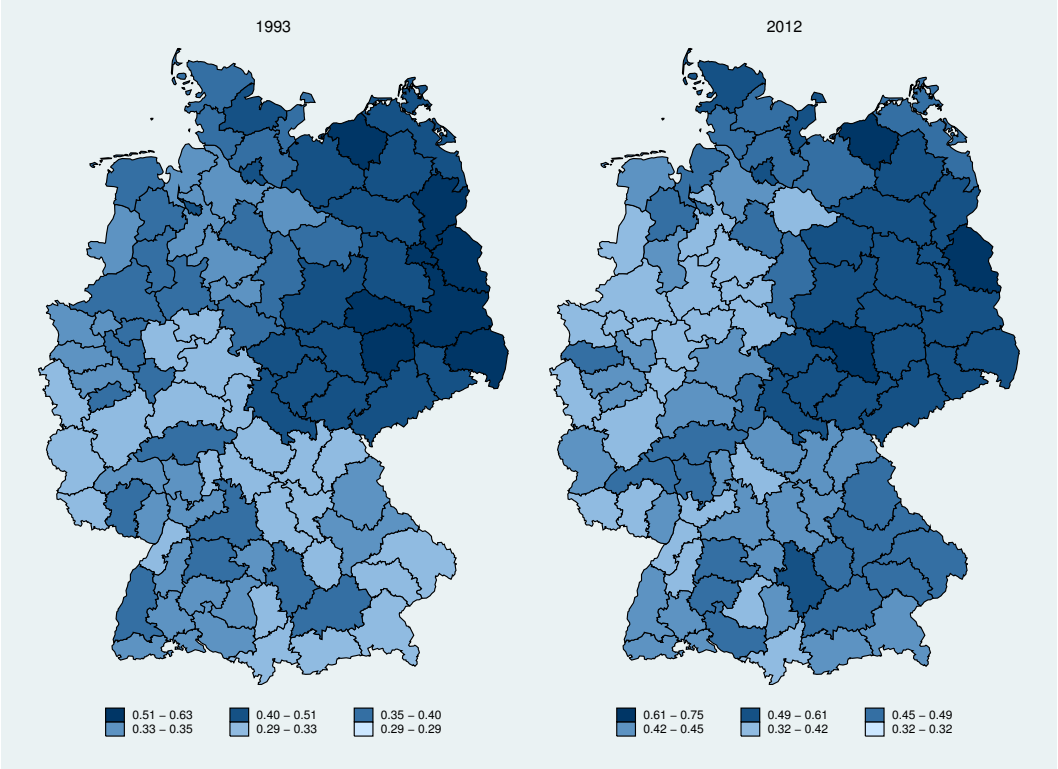


2.20 and mimics that of the other two bank-specific indicators of market power: market shares and PCM. The least bank-populated areas in Germany in the Northeast also exhibit higher average markups. Over time, the level of Lerner indices increased just as previous indicators. This increase seems to have been larger in the southern parts of Germany.

2.4 Correlation of Lerner indices, bank, and regional traits

The preferred measure of market power is the Lerner index because it is bank-specific, accounts for measurement error, and captures economic conditions reflected by intermediation technologies that are allowed to differ across banking groups. To shed light on the potential determinants of bank market power, we regress in this subsection Lerner markups as well its components on various bank- and region-specific covariates. We try to mitigate endogeneity concerns by lagging all explanatory variables by one period. However, we

Figure 2.20: Lerner index across ROR in 1993 and 2012



emphasize that regression results should be interpreted as multivariate correlations that do not permit causal inference. All regressions include bank-, pillar, and year-fixed effects and are estimated with robust standard errors.

2.4.1 Market structure

Consider first Table 2.17, which shows panel regression estimates of lagged aggregate and bank-specific market structure indicators on Lerner indices, marginal cost, and average revenues. These regressions show that simple bank-specific indicators do not necessarily convey information on economic margins. (Lagged) market shares per ROR correlate for example only weakly with the marginal cost of banks, but not all with Lerner indicators. Likewise, coefficients for HHI do not indicate that more concentrated markets entail more market power at the individual bank level.

Table 2.17: Lerner indeces, components, and market structure

	LI	**MC**	**AR**
Market shares	0.023	0.005*	0.007
	(0.022)	(0.003)	(0.005)
PCM	1.250***	-0.014	0.248*
	(0.237)	(0.056)	(0.147)
HHI	-1.875	-0.223*	-0.549**
	(1.204)	(0.131)	(0.246)
CR 3	0.045***	0.003*	0.008**
	(0.012)	(0.001)	(0.003)
Constant	42.079***	0.133	0.895**
	(0.756)	(0.145)	(0.392)
R^2	0.268	0.319	0.133

Notes: Dependent variables are the Lerner index (LI), marginal cost (MC), and average revenues (AR) obtained from the conditional latent class stochastic frontier model in Equations (2.1) and (2.2). Market share per ROR in terms of total assets. PCM denotes the price cost margin discussed in section 2.3.1. HHI is short for the Hirschman-Herfindahl and CR 3 is the aggregate share of the largest three banks per ROR, both defined in section 2.2.2. Fixed effects for banks, years, and banking groups specified but not reported. All covariates lagged by one period. Robust standard errors in parentheses. 44,898 bank-year observations for 3,717 banks between 1993 until 2012. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Clearly, indicators of market structure like concentration ratios and HHI are correlated, which explains the insignificance of some measures. Table 2.17 provides evidence that in a multivariate context larger price-cost margins as well as a high concentration of assets among the largest three banks per region correlate positively with Lerner indices. This positive correlation is in line with expectations and the separate regressions for Lerner components further indicate that economic markups follow primarily from banks' better abilities to charge higher prices.

2.4.2 Business model indicators

Table 2.18 shows regression results for five different indicators of business models inspired by the description of balance sheet and profit and loss account structures in sections 2.1.3 and 2.1.4.

More retail intensive banks possess less market power. Retail intensity is approximated by the number of branches per thousand Euros of total assets.[19] The component regressions show that marginal cost increase significantly for an increase in branching networks, which confirms the intuition that maintaining retail networks is costly.

Whereas some universal banks cater to a wide array of credit customers from different sectors of the economy, other banks like mortgage banks specialize by definition to a more narrow clientele. Based on the borrower's statistic of Deutsche Bundesbank (*Kreditnehmerstatisktik*), we calculate Hirschman-Herfindahl indices of credit exposures to 23 different sectors of the German economy for each bank-year. More concentrated credit portfolios, reflected by larger HHIs, correlate significantly positively with Lerner indices. This result suggests that more specialized banks are able to extract larger economic rents, potentially due to better screening expertise.

Studies such as Huang and Ratnovski (2011) show that refinancing choices, wholesale versus retail, bear important implications for the stability and competitiveness of banks from a theoretical perspective. Money market freezes, like those during the financial crisis of 2008, can exert sudden stress on banks refinancing costs if institutional investors retreat from capital markets en masse. We measure retail funding intensity as the share of non-financial customer deposits with agreed terms of notice of at least three months as a share of total external bank finance from non-financial counterparties. The significantly negative coefficient for Lerner indices indicates that retail-financed banks possess less market power. This negative correlation follows from marginal cost increasing stronger in response to a larger time deposit base compared to the also positive effect the latter has on average revenues. Again, maintaining large branch networks to collect customer deposits is apparently sufficiently cost-intensive to reduce economic markups significantly.

The perhaps most extreme alternative in terms of business models to retail-based, specialized credit providers are universal banks with extensive proprietary trading (Boot and Ratnovski, 2013). The description of aggregate balance sheet structures showed that especially large commercial, but also central savings and cooperative banks hold a significant share of their balance sheet total in trading assets. We measure the trade share here as the

[19] Whereas the regional location of branches is not reported by many banks after 2004, the aggregate number of branches still is by most. We linearly interpolate the aggregate number of branches for those banks that do not report at all anymore, which are mostly the large commercial ones.

Table 2.18: Lerner indices, components, and business model indicators

	LI	**MC**	**AR**
Branches per assets	-0.019***	0.006**	0.002*
	(0.002)	(0.003)	(0.001)
Loan portfolio diversity	0.016**	-0.001	0.010
	(0.008)	(0.003)	(0.009)
Retail funding	-0.024***	0.005***	0.004*
	(0.006)	(0.001)	(0.002)
Trade share	-0.129***	-0.001	-0.033
	(0.037)	(0.015)	(0.039)
Stock	-1.733	0.667	0.508
	(1.555)	(0.721)	(1.491)
Constant	48.313***	-0.277	1.219
	(0.848)	(0.400)	(0.804)
R^2	0.269	0.453	0.188

Notes: Dependent variables are the Lerner index (LI), marginal cost (MC), and average revenues (AR) obtained from the conditional latent class stochastic frontier model in Equations (2.1) and (2.2). Branches relative to thousand Euros of assets. Loan portfolio diversity is measured as the HH index across exposures to 23 industries. Higher values indicate more concentrated loan portfolios. Retail funding is the share of demand deposits by non-financial customers relative to total external funds from non-financial counter parties. Trade share is the imputed net trading book, i.e. trading assets minus liabilities, as a share of gross total assets. Stock is an indicator equal to one for stock incorporated banking firms. Fixed effects for banks, years, and banking groups specified but not reported. All covariates lagged by one period. Robust standard errors in parentheses. 44,860 bank-year observations for 3,711 banks between 1993 until 2012. ***,**,* indicate significance at the 1%, 5%, and 10% level.

imputed net balance of trading assets and liabilities relative to gross total assets.[20] Higher trade shares reduce economic markups.

Finally, we include a dummy if banks are publicly listed stock incorporated companies to control, for example, for differences across banks regarding reporting requirements, resulting transparency, and governance. This variable has no statistically effect on Lerner indices and components, potentially reflecting the fact that markups are derived from a latent class framework that is conditioned on banking pillar-specific traits already.

[20] That is, the variable is based on the reporting of other assets and liabilities prior to explicit reporting starting in 2010.

2.4.3 Regional macro and banking market conditions

Next, we consider the correlation of six regional conditions with Lerner indices in Table 2.19. Four covariates relate to the real economy and regional public finances. The remaining two relate to the health of the local banking industry.

First, we consider real GDP per capita growth at the county level. These data are observed until 2010 and extrapolated until 2012 on the basis of state-level data. Faster regional growth correlates significantly negatively with Lerner indicators. Lower market power originates in particular from the negative impact on average revenues, which banks are able to realize. This result might indicate that firms and households in expanding regions can compare more actively credit offers and face more alternatives if banks consider these markets attractive.

Second, we measure the size of regional market as the log of GDP per capita, which is also extrapolated for the two most recent years in the sample. Wealthier regional markets also permit banks to charge higher prices as indicated by a significantly positive effect of log GDP per capita on average revenues, and thereby also Lerner indices.

Third, we specify regional debt of local governments (*Gemeindeverschuldung*) per capita at the county level in prices of the year 2000. These data is also interpolated for the last periods in the sample. It has no statistically significant impact on bank market power according to Table 2.19.

Fourth, we measure the health of local non-financials by the ratio of firms filing for insolvency at the county level relative to all corporations registered with the tax revenue service. The variable is only observed as sector aggregate until 2007 and extrapolated for the years after. A riskier corporate sector does also not correlate significantly with bank market power.

Fifth, we use the sum of restructuring mergers occurring per county in a given year as recorded by the distress database of Deutsche Bundesbank (see Kick and Koetter, 2007). This variable captures the health of the local banking market and correlates significantly positive with Lerner indices and components. Arranged mergers that potentially ensure the smooth exit of distressed banks without jeopardizing the entire system may thus come at the expense of endowing surviving incumbents with additional market power in terms of economic markups.

Table 2.19: Lerner indices, components, and regional macro and banking markets

	LI	**MC**	**AR**
GDP growth	-0.045***	-0.003***	-0.008***
	(0.007)	(0.001)	(0.002)
Log of GDP per capita	3.973***	0.075	0.453***
	(0.708)	(0.099)	(0.164)
Sovereign debt per capita	0.217	-0.059	0.027
	(0.159)	(0.042)	(0.071)
Corporate insolvencies	-0.319	-0.060	-0.001
	(0.438)	(0.304)	(0.685)
Restructuring mergers	0.201**	0.055***	0.105**
	(0.084)	(0.020)	(0.052)
Distress events	-0.034	-0.043*	-0.048
	(0.074)	(0.025)	(0.050)
Constant	1.258	0.544	-1.780
	(7.241)	(1.180)	(1.977)
R^2	0.236	0.285	0.117

Notes: Dependent variables are the Lerner index (LI), marginal cost (MC), and average revenues (AR) obtained from the conditional latent class stochastic frontier model in Equations (2.1) and (2.2). Real GDP (Gross domestic product) and the log of GDP per capita pertain to the county level (Kreis). Sovereign debt pertains to securitised regional government debt issues. Corporate insolvencies are measured relative to the number of non-financial firms registered with the tax revenue service. Restructuring mergers is a count of bank mergers initiated by pillar-specific insurance schemes to restructure distressed banks. Distress events is a count of any of the six official events considered indicators of distress by the prudential supervisor (see Kick and Koetter, 2007). Fixed effects for banks, years, and banking groups specified but not reported. All covariates lagged by one period. Robust standard errors in parentheses. 42,451 bank-year observations for 3,696 banks between 1993 until 2012. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Sixth, we specify the count of any of the six possible distress events in the Bundesbank distress database. These events are the following. First, a decline of annual operating profits of more than 25 percent. Second, a notification by banks of losses amounting to 25 percent of liable capital. Third, notifications by banks about events that may jeopardize the existence of the bank as a going concern. The latter two incidents are compulsory notifications as stipulated in §24(1) and §29(3) of the Banking Act. Fourth, capital injections by the responsible insurance scheme of the banking sector. Fifth, restructuring mergers arranged by the responsible banking association and/or insurance scheme. And sixth, moratoriums pursuant to §46a of the Banking Act (see Porath, 2006; Koetter et al., 2007; Kick and Koetter, 2007, for early studies using the distress database of Bundesbank). Most of these

events are fairly weak in nature and amount to merely informing the regulator. The count of these broader distress events has no effect on the competition of banks as measured by the Lerner index.

2.4.4 Bank traits gauging CAMEL proxies

Both prudential supervisors in the US as well as an abundant empirical literature investigate the determinants of bank failures, the ultimate realization of bank risk, using so-called CAMEL covariates, see for example Wheelock and Wilson (1995), Oshinsky and Olin (2006) and Wheelock and Wilson (2000). CAMEL covariates measure the capitalization, asset quality, managerial abilities, earnings, and liquidity characteristics of banks to explain bank risk.

A large theoretical literature suggests that bank risk can be considered the flip side of competition in banking to the extent that the project choices of banks depend on the competitive environment in which a financial institution operates (see, for example, Keeley, 1990; Marquez, 2002; Allen and Gale, 2004; Boyd and De Nicolo, 2005; Repullo and Martinez-Miera, 2010; Gropp et al., 2011; Buch et al., 2013).

Table 2.20 therefore correlates lagged CAMEL indicators with Lerner indices and components. We measure capitalization with two variables. First, the equity ratio defined as book equity to gross total assets and, second, an indicator equal to one if a bank holds so-called hidden reserves according to §340f of the German commercial code. Whereas gross equity ratios have no significant effect on markups and components, the use of hidden reserves is significantly negatively correlated with Lerner indicators. The component regressions show that this effect is due to higher marginal cost. Hidden reserves are used especially by regional savings and cooperative banks to smooth profits over time.

Following the empirical literature, one measure of asset quality is the share of customer loans relative to gross total assets. Larger customer loan shares correlate positively with Lerner markups by increasing average revenues more compared to higher marginal cost. This result might indicate that non-bank counterparties and fewer capital market assets are more likely to permit banks the extraction of economic rents.[21]

[21] Degryse and Ongena (2005) provide evidence for increasing loan rates charged by relationship lenders if the distance between firms and other competing banks is larger.

As a second proxy of asset quality, we specify the difference between revenues due to the appreciation of receivables and selected securities as well as revenue generated from the liquidation of credit allowances and expenses due to corresponding depreciations and appropriations of allowances.[22] We call the net position credit reserve flow and relate it to gross total assets. It is on average negative for the sample, i.e. expenses are on average larger than revenues. Larger credit reserve flows reduce Lerner markups, reflecting that provisioning may reduce the riskiness of the banking firm, but is costly in terms of economic markups earned.

The third proxy of asset quality is the share of off-balance sheet activities, which contains irrevocable lines of credit and other credit commitments, as a share of total assets. According to e.g. Stiroh (2004) increasing competition caused U.S. banks already in the 1990s to increasingly substitute conventional deposit and credit based business with off-balance sheet activities to compensate for declining interest rate margins. The result in Table 2.20 indicates in line with this notion that more intensive OBS activities correlate positively with economic markups as measured by Lerner indices. Fee income relative to total operating revenue does not correlate significnatly. As such, OBS activities of German banks may fulfil other functions than generating fee income as for US banks, for example, helping to tie SME customers to their local relationship lenders.

To measure managerial skill, we first follow the literature and regress cost-to-income ratios as defined in section 2.9 on Lerner indices and components. This covariate does not correlate significantly. As an alternative measure, we specify cost efficiency estimates obtained from the estimation of Equation (2.1). Contrary to CI ratios, cost efficiency is a relative measure that indicates the ability to minimize cost. Whereas higher cost efficiency has no effect on Lerner markups, the component regressions indicate that it correlates negatively with both marginal cost and average revenues.

The profitability of banks is measured by operating return on gross equity as in section 2.9. Consistent with most earlier studies, more profitable banks also earn larger economic rents. Component regressions show that this strong positive correlation follows from reduced marginal cost and increased average revenues.

Liquidity is defined as cash and central bank assets relative to total assets. Holding larger liquidity buffers helps to insure against sudden funding or asset price deterioration shocks.

[22] The corresponding items in the profit and loss account reporting forms are EGV 48 and EGV 18.

But give the low yield nature of these assets, they depress the generation of revenue-generating assets, such as e.g. credit. Accordingly, the estimated coefficient indicates a negative correlation between higher liquidity buffers and Lerner indicators.

Finally, we specify the log of total assets, which is positively correlated with Lerner indices. Thus, even after accounting for various fixed effects, larger banks seem to be able to extract some additional economic rents compared to smaller peers.

Table 2.20: Lerner indices and CAMEL covariates

	LI	**MC**	**AR**
Equity ratio	-0.041	0.021	-0.007
	(0.056)	(0.014)	(0.066)
Hidden reserve indicator	-0.854***	0.073***	-0.024
	(0.123)	(0.016)	(0.030)
Customer loan share	0.017**	0.008***	0.012***
	(0.008)	(0.001)	(0.003)
Credit reserves flow	-0.316***	0.017	-0.066**
	(0.107)	(0.023)	(0.030)
OBS share	0.058***	-0.002	0.029***
	(0.019)	(0.003)	(0.009)
Fee income share	0.005	0.025*	0.059**
	(0.039)	(0.014)	(0.026)
CI ratio	-0.007	0.001	0.000
	(0.005)	(0.001)	(0.000)
Cost efficiency	-0.008	-0.013***	-0.014***
	(0.015)	(0.003)	(0.004)
ROE	0.070***	-0.006***	0.009**
	(0.017)	(0.001)	(0.004)
Liquidity	-0.027*	0.007	0.019*
	(0.015)	(0.005)	(0.010)
Log TA	1.086***	-0.074	-0.115
	(0.243)	(0.065)	(0.236)
Constant	40.778***	1.471***	3.216*
	(2.401)	(0.546)	(1.815)
R^2	0.286	0.528	0.242

Notes: Dependent variables are the Lerner index (LI), marginal cost (MC), and average revenues (AR) obtained from the conditional latent class stochastic frontier model in Equations (2.1) and (2.2). Fixed effects for banks, years, and banking groups specified but not reported. All covariates lagged by one period. Robust standard errors in parentheses. 44,587 bank-year observations for 3,675 banks between 1993 until 2012. ***,**,* indicate significance at the 1%, 5%, and 10% level.

2.5 Other empirical measures of market power

We prefer the Lerner indicator to gauge market power and competition, but the empirical literature features of course a plethora of possible alternatives. Therefore, we present two of the more often employed measures in this subsection. A concise review of both theory and empirical measures of market power is presented in, for example, Shaffer (2004).

2.5.1 Panzar-Rose H-statistic

A frequently used measure of competition is the so-called H-statistic (Panzar and Rosse, 1982, 1987).[23] The H-statistic is the sum of the revenue elasiticities with respect to banks' factor prices. This metric is conventionally referred to as the H-statistic. The intuition to interpret the H-statistic is that in perfectly competitive markets, any increase in factor prices must be passed on to consumers by means of higher prices if the firm should remain solvent. This relationship follows from the assumptions that cost functions are homogenous of degree one and that competitive firms are constrained by zero economic profits in equilibrium. Thus, perfect competition would be reflected by $H = 1$.

For a monopolist, gross revenues are expected to contract in response to increasing marginal factor cost. Marginal revenues are already positive for a monopolist or a duopolist because of positive marginal cost and the maximizing condition that the two are equal. Hence, any attempt by the firm to pass on higher factor prices reduces gross revenue and therefore $H < 0$. The range in-between, i.e. $0 < H < 1$, indicates monopolistic competition. An important limitation of the specific value of the H-statistic is that it cannot be interpreted unambiguously (Shaffer, 2004). To obtain the H-statistic, we estimate the following reduced-form revenue function:

$$\ln REV_{it} = \alpha_i + \Sigma_{m=1}^{3} \beta_m \ln w_{im} + \Sigma_{j=1}^{J} Z_{ij} + \epsilon_{it} \tag{2.4}$$

Factor prices w_{im} are identical to those described in Table 2.14. Bikker et al. (2012) provide a critical review of previous empirical applications and argue that most studies, which estimate the H-statistic, suffer from bias due to the specification of unscaled control

[23] An application to regional German banking markets is Hempell (2004).

variables. Therefore, we present below estimates for Equation (2.4) with and without control variables Z. Control variables are the ones specified in Tables 2.17 through 2.20, except the log-level of total assets.

2.5.2 Boone indicator

Boone (2008) suggests to measure the sensitivity of bank performance with respect to indicators of productivity as an indicator of the competitiveness of a market. The intuition of this measure is that more productive firms should possess more market power. Less productive banks should incur higher marginal cost, which in turn should depress profits and market share. Accordingly, less market power in more competitive markets is reflected by a larger negative magnitude of this elasticity of bank performance with respect to marginal cost, the so-called Boone indicator. We estimate

$$\ln y_{it} = \alpha_i - \beta \ln MC_{it} + \epsilon_{it}, \tag{2.5}$$

and follow the literature in specifying both profits before tax π as well as market shares per ROR MS as measures of bank performance.

This so-called Boone indicator has been applied to banks by, for example in, Schaeck and Cihak (2013), Buch et al. (2013), and Delis (2012). Whereas it represents in contrast to the H-statistic a continuous measure of market power, it is in principle of an aggregate nature. Put differently, estimated coefficients represent an average response for a panel of banks and are thus not per se bank-specific and time varying.

Similar to Claessens and Laeven (2004), we estimate Equations (2.4) and (2.5) not only for the pooled sample of bank-year observations, but also separately per year. We do not estimate banking group or even bank-specific Boone indicator regressions like, for example, Buch et al. (2013) due to too few degrees of freedom to obtain consistent estimates.

2.5.3 Pooled and annual indicators

Table 2.21 reports results from panel estimations for the pooled sample. We specify bank-, banking group, and time-fixed effects and use robust standard errors. The first two columns show that the elasticity of either bank performance measure, profits before tax or regional

Table 2.21: Boone indicator and Panzar Rose H-statistic

	Boone indicator		**Panzar Rose H-statistic**	
Dependent	log profits	log market share	log revenue	
ln MC	-0.254***	-0.489***		
	(0.049)	(0.058)		
ln w_1			0.013	0.017**
			(0.010)	(0.007)
ln w_2			0.064**	-0.006
			(0.032)	(0.025)
ln w_3			0.278***	0.238***
			(0.048)	(0.034)
Constant	0.161	-1.762***	2.290***	3.155***
	(0.186)	(0.184)	(0.147)	(0.500)
Controls	no	no	no	yes
R^2	0.222	0.170	0.254	0.399
Boone indicator:	-0.254	-0.489		
H-statistic:			0.354	0.249

Notes: Fixed effect panel regressions with bank, banking group, and time fixed effects. The sample comprises 48,893 bank-year observations for 3,912 banks in Germany between 1993 and 2012 except for the Panzar Rose specification including lagged control variables (N: 42,154; i: 3,651). The Boone specification based on profits also incldes the negative profit dummy as explanatory variable, which is not reported. Control variables in the Panzar Rose specification are identical to those explaining Lerner indices and components in Tables 2.17 through 2.20, but are not reported. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

market share, with respect to marginal cost exhibit the expected significantly negative coefficient.

Decreasing productivity, as measured by marginal cost, by 1% reduces profits by 0.26% and market share by 0.49%. The Boone indicator thus provides evidence for competition among German banks. However, the degree of market power is larger compared to indicators ranging between -0.89 for domestic banks and -0.64 for internationally active banks between 2003 and 2006 (p. 1413, Buch et al., 2013). Different effects for profits and market share are in line with, for example, the imperfect correlation between price-cost margins and market shares discussed in Section 2.3.1.

The last two columns show reduced-form revenue estimation results to obtain the Panzar-Rose H-statistic with and without control variables. Note that control variables are specified with a lag of one period. The sum of revenue elasticities with respect to factor prices

is between 0 and 1, thus indicating monopolistic competition. Note, however, that not all factor prices correlate significantly with revenues, a well-known problem in many empirical studies that estimate H-statistics in banking (Bikker et al., 2012).

The mere documentation of market imperfection of some degree at the aggregate level is not terribly informative, which is one of the reasons why we prefer Lerner indices. To shed some light on the dynamics according to these alternative measures, Table 2.22 shows the four measures resulting from annual estimations.

Table 2.22: Boone indicator and Panzar Rose H-statistic over time

Year	**Boone indicator**		**H-statistic**	
	Profits	*Market share*	*no controls*	*controls*
1993	-0.150	-0.293	1.516	n/a
1994	-0.145	-0.455	1.127	0.526
1995	-0.321	-0.675	1.149	0.175
1996	-0.335	-0.729	1.006	0.200
1997	-0.325	-0.689	1.283	0.340
1998	-0.310	-0.543	0.417	-0.081
1999	-0.323	-0.683	0.851	0.078
2000	-0.267	-0.637	1.388	0.116
2001	-0.248	-0.708	1.330	0.273
2002	-0.192	-0.817	1.481	0.417
2003	-0.221	-0.814	0.491	0.291
2004	-0.218	-0.817	1.252	0.257
2005	-0.285	-0.788	1.293	0.862
2006	-0.347	-0.869	0.919	0.570
2007	-0.272	-0.885	1.251	0.440
2008	-0.177	-0.980	1.175	0.361
2009	-0.263	-1.034	0.611	-0.006
2010	-0.296	-0.943	0.632	-0.073
2011	-0.282	-0.932	0.492	-0.153
2012	-0.327	-0.889	0.675	-0.081

Notes: Fixed effect panel regressions with bank, banking group, and time fixed effects. The total sample comprises 48,893 bank-year observations for 3,912 banks in Germany between 1993 and 2012 except for the Panzar Rose specification including lagged control variables (N: 42,154; i: 3,651). The Boone specification based on profits also includes the negative profit dummy as explanatory variable, which is not reported. Control variables in the Panzar Rose specification are identical to those explaining Lerner indices and components in Tables 2.17 through 2.20.

Both versions of the Boone indicator suggest in contrast to market shares, concentration measures, PCM, and Lerner indicators that average market power of banks declined. Increasing profit and market share sensitivities with respect to deteriorating bank productivity signals according to Boone (2008) that markets became more competitive to the extent that poor performance is penalized. Statistical tests show, however, that only the increase in competition according to the market share specification is significant.

The second pair of columns illustrates the specification challenges faced by the Panzar-Rose methodology discussed in Bikker et al. (2012). Without control variables, resulting H-statistics are at times significantly larger than 1, namely in 1993 as well as the years 2000 until 2002 as well as 2005. Recall that the H-statistics should equal 1 if markets are complete. The last column shows that the specification of control variable changes inference considerably. Based on these results, the H-statistic ranged between 0 and 1 for virtually all years prior to 2009, indicating monopolistic competition. However, after the main crisis year 2008, the sum of revenue elasticities is significantly lower than 0, thereby indicating a monopolistic or oligopolistic structure of German banking markets. This result is consistent with the market power measures shown above that exhibit at times steep increases in recent years.

2.6 Conclusion

This chapter described the structure and performance of German universal and mortgage banks and provided contemporary empirical evidence on indicators of market power and market structure. Since 1993, the number of banks contracted by 55%, primarily due to mergers and acquisitions among regional cooperative and savings banks. The banking system as a whole grew steadily until 2008, when aggregate assets of the considered banks represented 366% of nominal GDP in Germany. After a contraction by 13% between 2008 and 2009, the system remained approximately of the same size. The major share of the aggregate asset contraction after the financial crisis occurred among commercial banks and concerned mostly interbank activities and other assets and liabilities, which are likely to comprise a large share of trading assets and liabilities.

Business models differ considerably across and within pillars regarding investment activities and refinancing patterns. Regional banks, in particular savings and cooperatives, engage primarily in retail-based activities, such as deposit collection and customer lending. Head institutions in these pillars hold large balance sheet shares in interbank assets and liabilities, underpinning their clearing house function. Especially large commercial banks, but also Landesbanken and central cooperatives, invest a substantial share of their assets in trading and direct participations. Funding is largely reliant on wholesale markets. Mortgage banks also rely heavily on wholesale refinancing and while accounting for a sizeable 8% of aggregate banking assets, exhibit the steepest decline of aggregate market share.

Regional cooperative and savings banks are on average the most profitable banking groups in terms of return to equity and assets whereas mortgage banks are the least profitable. Regulatory capital ratios are around twice the size of capitalization relative to gross total assets, which shows the importance of risk-weights when gauging the capitalization of the banking system. Regional commercial banks are on average most capitalized. Somewhat in line with profitability differences, regional savings and cooperatives, but also commercials exhibit the highest shares of non-performing loans. Cost-income ratios are lowest for government-owned savings banks.

A number of robustness checks on alternative market definitions in terms of regional and product scope show that market share levels can differ significantly depending on alternative definitions. At the same time, most alternatively defined market shares yield very

high rank-order correlations. Weighting schemes based on the location of bank branches rather than headquarter location also indicate that rank-order correlations are high, yet imperfect. Clearly, information on the regional source and use of banking products would thus be desirable.

A range of simple market structure and competition measures indicate that bank market power increased over time and declines geographically from (North-)East to (South-)West. These patterns hold for (almost) all observed and estimated measures of market power. Regarding differences across banking groups, alternative measure convey different information though. Measured at the level of economic agglomeration areas, market shares are on average the largest for large commercials, central savings, and regional savings banks. Implicit price-cost margins are, in turn, the largest for small, regional savings and cooperatives.

In addition to these simple indicators, we also estimate economic markups, measured as the scaled difference between average revenues and marginal cost, the so-called Lerner index. The estimation explicitly accounts for the pervasive heterogeneity among German banks. Lerner indices exhibited a fairly flat development until the start of the last century before constantly increasing until 2006. Lerner indices declined considerably during the financial crisis years 2007 and 2008, but increased since then fairly sharply. They are largest for large commercial banks, followed by central savings and co-operatives. Reduced-form regressions correlate Lerner indices with a range of covariates gauging differences in regional macroeconomic and banking market conditions, banks' business models, and indicators of the financial health of banks.

Chapter 3

Module IV – Bank market power and growth

This module presents evidence on the implications of bank market power for the real economy at the mezzo level of regions and industries. Methodologically, it is based on Inklaar et al. (2012), who use data mostly on small and medium enterprises that are customers of German regional savings banks until 2006. The present study, in contrast, covers a substantially larger share of aggregate German output by analyzing firms that reported financial accounts to Deutsche Bundesbank (USTAN). The sample considers also the recent years after the crisis until 2011.

3.1 Introduction

Chapter 2 showed that according to a wide range of competition measures, German banks gained market power since 1993. Indicators of market power increased in particular in recent years after the financial crisis of 2008. This chapter investigates whether differences in market power across regions and time can help to explain differences of sectoral, or industry growth in German economic agglomeration areas.

These so-called real implications of banking market competition have been analyzed pre-

viously at the level of individual firms[1], for aggregate industry growth across [2] and within countries (Huang, 2008), as well as aggregate regional growth (Fernández de Guevara and Maudos, 2011). The empirical evidence is rather mixed, reflecting a plethora of sample and methodological choices. More importantly in light of the present study, none of these analyses permit inference on the current state of affairs in the German economy and all of them ignore an important source of aggregate growth: the reallocation of resources from low to high productivity firms.

The novelty of this study is to explicitly consider the effect that bank market power may have on growth due to a core function of financial intermediaries: the efficient selection of the most promising projects among loan applicants. One of the main comparative advantages of banks relative to other providers of (external) finance is the generation and use of private information about borrowers from relationship-lending and from accumulating industry expertise due to lending to many borrowers. Therefore, banks should possess better abilities to identify the most promising applicants for credit. This ability is in particular crucial if applicants are opaque and small firms that face larger information asymmetries compared to e.g. listed, large corporations. Put differently: banks may be the most suited experts to facilitate the reallocation of production resources from less productive to more productive firms based on their better informed lending decisions.

Recent empirical macro literature suggests that such reallocation effects from low to high productivity firms contribute a significant portion to aggregate economic growth.[3] Intuitively, even absent technological progress or factor accumulation, economies grow if scarce resources are reallocated from enterprises that employ them with slack towards entrepreneurs that use these factors more productively. Theoretical work by Aghion et al. (2007) and Herrera et al. (2011) suggests that financial market imperfections are a likely candidate to hamper such a reallocation and thereby growth.

The link between project selection, economic growth due to reallocation, and bank market power relates to the ability and willingness of banks to generate the private information that constitutes their comparative advantage. Theoretically, the effect of increased com-

[1] See, for example, Petersen and Rajan (1995); Demirgüç-Kunt and Maksimovic (1998, 2002); Beck and Demirgüç-Kunt (2006); Canales and Nanda (2012).

[2] See, for example, Cetorelli and Gambera (2001); Cetorelli (2004); Claessens and Laeven (2005); Cetorelli and Strahan (2006).

[3] See for example Basu and Fernald (2002), Hsieh and Klenow (2009), Basu et al. (2009), Syverson (2011), and Petrin et al. (2011).

petition is a priori ambiguous. Bank market power may depress growth if it implies the extraction of rents from borrowers that face constrained access to alternative sources of finance and are 'locked-in', see Rajan (1992), Petersen and Rajan (1995), or Zarutskie (2006). Alternatively, excessive banking competition can harm the ability and willingness of banks to generate the necessary private information to properly conduct their screening function (Marquez, 2002) and Hauswald and Marquez (2003, 2006). Consequently, credit may be mis-allocated to agents in the economy that are not the most productive ones (Dell'Ariccia and Marquez, 2004).

The main contribution of this chapter is thus to explicitly test whether regional differences in banking market competition, and hence associated incentives to screen loan applicants efficiently, can explain aggregate growth components in general and the growth contribution due to reallocation in particular. We find that larger bank market power measured with average Lerner indices per economic agglomeration area ROR reduces industry output growth per region. An increase of Lerner indices by 1% reduces aggregate output growth between 0.18% and 0.28%, which is economically significant given a median industry growth per region of 1.7%. For the pooled sample including all years and 21 industries, we do not find statistically significant effects of Lerner indices on any of the three individual growth components. Estimations for pre and post Lehman periods show, however, that the aggregate output growth effect arises in particular prior to 2008. After 2007, we find also a statistically significant and large negative effect on the reallocation component of growth. An increase of average Lerner indices per region reduces output through a negative reallocation contribution by 0.4%. Regressions for the pooled sample using alternative bank competition indicators qualitatively confirm almost all results and are, if anything, statistically even more significant.

3.2 Method and data

3.2.1 Reduced form

To identify the effects of differences in regional banking market competition on industry growth per region, we follow the set-up of Rajan and Zingales (1998). That is, we use a simple difference-in-difference framework to regress the structural dependence on external finance ED of $k = 21$ industries (EU KLEMS, see O'Mahony and Timmer, 2009) together

with banking market competition indicators LI in $r = 96$ economic agglomeration areas ROR for each year $t = 1994, \ldots, 2011$ to explain four alternative growth components V_{rkt} per region-industry and year:[4]

$$V_{rkt} = a_{rk} + a_t + b_1 ED_{kt} + b_2 LI_{rt} + b_3 (ED_{kt} \times LI_{rt}) + \epsilon_{rkt}. \tag{3.1}$$

Rajan and Zingales (1998) argue that the dependence on external finance differs across industries for structural reasons. If bank market power fosters growth, we expect that industries with a higher ED grow at a different rate in regions with less competitive banking markets, after controlling for industry-region and time specific effects. We measure equilibrium dependence on external finance using Compustat data for approximately 100,000 U.S. firms because we assume that they face the least financing constraints.[5]

The identification strategy requires two assumptions. Regarding the real side, firms should face a structural need for external finance that differs across industries.[6] Regarding the banking side, banks should also operate primarily in the region they are allocated to on the basis of their headquarter location to ensure that market power in one region does not determine market power in another region. The latter seems to be a reasonable assumption given the discussion in Chapter 2. Inside each ROR, however, firms can demand financial services from different banks. Therefore, we consider differences in average market power between regional markets and (weighted) average growth of industries within these regional markets.

Table 3.1 shows summary statistics of the variables specified in Equation (3.1) and we explain in the remainder of this subsection how to obtain the data for aggregate growth and its three components V. Market power is primarily measured using the Lerner index LI, but also alternative indicators, which are described in Chapter 2.

[4] We specify throughout robust standard errors at the region-industry level using the Huber/White/sandwich estimator (White, 1980).

[5] As in Rajan and Zingales (1998), ED equals capital expenditures less cash flow from operations divided by capital expenditure. Cash flows are the sum of operational cash flow plus increases in inventories and payables less decreases in receivables. ED is calculated for 113,099 US firm-year observations classified in the corresponding NAICS (ver. 2012) sectors in Compustat that correspond to the 21 EU KLEMS industries considered here. The Compustat sample ranges from 1993 to 2012. We also tested the robustness of results using French and UK firms as benchmark economies of external dependence. Qualitatively, results remain unaffected.

[6] Table B.1 show the industries, which are sourced from the EU KLEMS database.

Table 3.1: Descriptive statistics industry-region regressions

Variable		Mean	Median	SD	Min	Max
Output growth	$\Delta \ln Y$	0.095	0.017	0.333	-0.654	1.584
Factor growth	$\Delta \ln X$	0.08	0.013	0.326	-0.729	1.53
Technology growth	$\Delta \ln A$	0.037	0.005	0.181	-0.412	0.853
Reallocation growth	$\Delta \ln R$	-0.03	-0.002	0.198	-0.909	0.5
Lerner index	LI	0.402	0.38	0.073	0.298	0.629
Spatial weighted LI	SLI	0.788	0.793	0.150	0.450	0.980
External dependence	ED	4.026	2.839	5.893	-5.562	30.49
Market share	MS	0.062	0.045	0.051	0.009	0.25
HHI	HHI	0.207	0.159	0.15	0.053	0.782
CR 3	CR	0.608	0.601	0.179	0.292	0.977
PCM	PCM	0.029	0.028	0.005	0.017	0.043

Notes: 28,425 observations for 1,850 region-industries between 1994 and 2001. Growth components, dependence on external finance, and PCM winsorized at the top and bottom percentile after collapsing firm data to industry-regions.

3.2.2 Output growth decomposition

Conventional macroeconomic growth accounting distinguishes between growth due to factor accumulation and growth due to technological progress (Ark et al., 2008). The former resembles a move along the economy's production function when more production factors, such as capital and labor, are employed. The latter represents an upward shift of the economy's production function due to improved technology to process those factors.

Whereas this decomposition holds in general also for firms (Kumbhakar and Lovell, 2000), the important difference is that *aggregate* growth depends in addition on *which* firms grow. Aggregate growth will also increase in addition to the conventional two components if firms with higher marginal products relative to marginal cost accumulate factors, i.e. those firms with high productivity (Basu et al., 2009). Likewise, the economy will expand if firms with marginal products above marginal cost contract input use. Hence, merely reallocating factors from low productivity to high productivity firms can generate aggregate output growth while holding constant aggregate factor employment.

Empirically, the consideration of this reallocation component of aggregate growth requires information on the marginal factor products of firms as well as information on factor use of low and high productivity firms. Put differently, estimating aggregate growth contributions

due to reallocation is only possible with micro information at the firm level, which is what this study does. The three growth components, technological change, factor accumulation, and reallocation, are measured as follows.

For firm i at time t, we denote output as Y, labor as L, capital as K, materials and other intermediate inputs as M, and technology as A. Variables are described per industry in Table B.1 of Appendix B.2 and are further discussed in subsection 3.2.3 below. The output elasticity β of each input gauges firm production technology. We specify for each industry k a Cobb-Douglas production function and use the Wooldridge (2009) GMM variant of the Levinsohn and Petrin (2003) estimator to account for simultaneity of factor demand and productivity at the firm-level.

$$\ln Y_{it} = \beta_0 + \beta^L \ln L_{it} + \beta^K \ln K_{it} + \beta^M \ln M_{it} + \epsilon_{it}. \tag{3.2}$$

To aggregate firm-level dynamics to industry growth (components), we estimate Equation (3.2) for each of the 21 industries separately, for which we omit the industry subscript k to conserve on notation here. Table B.2 in Appendix B.2 shows the parameter estimates of Equation (3.2) together with each industry's measure of dependence on external finance.[7] Intermediates exhibit on average the largest elasticities, followed by labor and capital.

Next, we decompose output growth into the two "conventional" components and a reallocation component. The latter reflects the argument of Basu et al. (2009) that the growth of aggregate output in excess of the cost-weighted growth in inputs is relevant for welfare. Denoting the cost share of each input by c, we decompose firm output growth as:

$$\Delta \ln Y_{it} = \underbrace{\Sigma_k c_{it}^k \Delta \ln X_{it}^k}_{\text{Factor growth}} + \underbrace{\Sigma_X [(\beta_{it}^k - c_{it}^k) \Delta ln X_{it}^k]}_{\text{Reallocation}} + \underbrace{\Delta \ln A_{it}}_{\text{Technology}} \qquad \text{for } k = L, K, M. \tag{3.3}$$

The first term in Equation (3.3) is the contribution of a change in inputs to output growth. The second term compares the marginal product β to the marginal cost c of each input. It is a measure of reallocation since a shift of one unit of input from a low-marginal product

[7] We report only direct terms of the Wooldridge estimation and suppress higher-order polynomials specified as well to conserve on space. Alternative estimations using plain OLS, fixed-effect panel, and dynamic panel estimators yield qualitatively identical results.

firm to a high-marginal product firm is beneficial for the economy. The third term of Equation (3.3) is the contribution of technical change to output growth.

Growth components in Equation (3.3) are all defined at the level of the firm whereas we identify in Equation (3.1) the impact of regional bank market power on *industry* growth by exploiting between-region differences. Therefore, we aggregate firm-level growth components to the industry level using so-called Domar weights v_{it}, which is the two-period average ratio of nominal output over aggregate value added.[8] After the aggregation to the regional level, all growth variables are winsorized at the top and bottom percentile.

We decompose output growth rates at the industry level into the contributions of total input growth, reallocation and technical change for each region $r = 1, ..., 96$ as:

$$\Delta \ln X_{rkt} = \sum_i v_{it} \left(\sum_k c_{it}^k \Delta \ln X_{it}^k \right) \tag{3.4a}$$

$$\Delta \ln R_{rkt} = \sum_i v_{it} \left(\sum_k \left[(\beta_{it}^k - c_{it}^k) \Delta \ln X_{it} \right] \right) \tag{3.4b}$$

$$\Delta \ln A_{rkt} = \sum_i v_{it} \Delta \ln A_{it} \tag{3.4c}$$

Our empirical analysis therefore uses $\Delta \ln Y_{rkt}$, $\Delta \ln X_{rkt}$, $\Delta \ln R_{rkt}$ and $\Delta \ln A_{rkt}$ as dependent variables in the estimation of Equation (3.1).

3.2.3 Firm-level data

Financial accounts data of non-financial firms are assembled in the corporate balance sheet statistics of Bundesbank. Most of the data originates from the so-called USTAN database, which comprises corporate financial statement information for any company that discounted letters of credit (*'Wechsel'*). Given the decreasing importance of letters of credit and the associated attrition in the sample, the data is complemented with financial accounts data from the Amadeus database. The data ranges from 1993 until 2011. We exclude all firms that report missing or zero values for any of the production function

[8] See Appendix B.1 for details on Domar weights.

variables Y, K, L, M. We keep only end-of-year, unconsolidated financial statements and require each firm to be present in the sample for at least two consecutive years to allow for the calculation of annual growth rates.

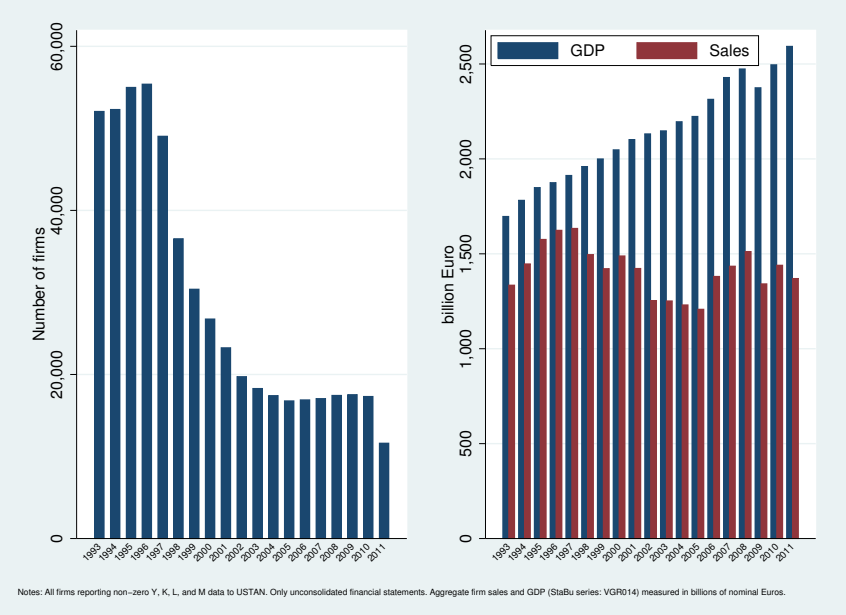
After this culling, the sample comprises 96,642 individual firms and 519,230 firm-year observations between 1993 and 2011. All data is deflated with the Value Added price index per industry obtained from EU KLEMS, which are available until 2010. Prices for 2011 are extrapolated using cumulative annual growth rates of industry-specific price series between 1991 and 2010. Firms report to Ustan various industry codes. We match the most frequently available WZ 2003 industry classification code manually to the EU KLEMS nomenclature (ver. 2012).

Table B.3 in Appendix B.2 shows mean firm growth rates for each production factor across industries as well as average Domar weights and factor shares used to calculate reallocation components of growth. The data clearly illustrate the heterogeneity prevailing across firms in different industries. Domar weights illustrate that with the exception of the sectors 'coke and petroleum manufacturing' and 'utilities', the average firm contributes only very small shares to aggregate industry output, overall 0.2% on average. (Real) average firm growth is on the order of 3.8% for this sample, but with considerable variation across sectors (e.g. 11.1% in telecommunications versus 0.6% in mining and quarrying). Unreported standard deviations also show substantial heterogeneity within each industry.

Figure 3.1 shows that the corporate data cover a large share of aggregate German output. The number of firms submitting financial data to the Bundesbank more than halved between the start of the sample and 2002. While coverage of aggregate nominal sales of sampled firms declined, it still accounted for approximately 58% of nominal GDP in 2010. As such, these data appear to be much less exposed to selection bias concerns compared to the sample employed by Inklaar et al. (2012), which is confined to SME customers of savings banks.

The sample therefore seems unique regarding the coverage of economic activity in Germany. According to the definition of the EU, we show in Figure 3.2 the distribution of firms per size class over time. For the entire sample period, 23% of our sample consists of micro firms (up to €2 million sales). Another 37% are small firms (up to €10 million sales) and a further 28% are medium-sized firms (up to €50 million sales). A fairly large share of 12% of the firms in the sample are large.

Figure 3.1: Number of firms and aggregate sales from USTAN



Note that over time, the share of micro and small firms declined from 70% to just below 8%. Thus, especially in more recent years, the composition of the sample changed considerably and may cast doubt on the assumption that most firms operated only in one ROR. We will test below the robustness of results when considering aggregate growth of firms in different size class definitions separately.

3.4% of the firms are active in the primary sector, manufacturing covers 42% of all firms in the sample, which is only second to retail and wholesale trade, which accounts for 44.5% of all firms. The construction sector accounts for 6.2% of the firms (see Table B.2).

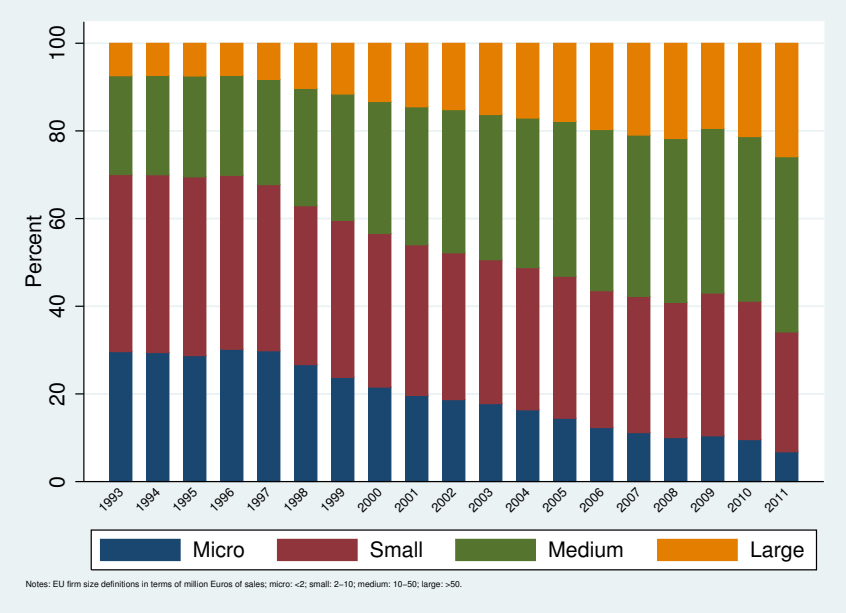
3.3 Results

3.3.1 Pooled sample: 21 industries 1994–2011

We begin by estimating Equation (3.1) for all 21 industries residing in up to 96 economic agglomeration areas during the period 1994–2011.[9] Table 3.2 shows the results for the four

[9] We loose the year 1993 because of taking growth rates.

Figure 3.2: Firm size categories



specifications of Equation (3.1), where we replace in each column the dependent variable V with aggregate growth and growth components according to Equations (3.4a) through (3.4c). The upper panel reports coefficient estimates after including fixed effects for each region-industry pair and years. Consider first the left-hand panel, which specifies bank competition for each regional market separately.

In line with Inklaar et al. (2012), a larger dependence on external finance is associated with larger overall output growth. This effect is also statistically significant for the growth attributable to factor accumulation, but none of the other two remaining growth components. Higher Lerner markups exert a negative direct effect on aggregate output growth, which is statistically significant at the 10%-level but not at all for any growth component. The interaction effect between larger markups in banking markets and the dependence on external finance is negative for overall output growth as well as growth due to factor accumulation. Technological change and reallocation are not statistically significantly affected. Overall, these specifications explain fairly little of aggregate growth and growth components as reflected by R-squared ranging between 1.6% and 6.3%.

Coefficients of this difference-in-difference model do not reflect the total marginal effect

Table 3.2: Competition, dependence on finance, and growth components 1994–2011

	Own market only				Spatial lags			
	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	0.029***	0.031***	0.006	-0.003	-0.020	-0.020	0.001	0.001
	(0.010)	(0.012)	(0.007)	(0.007)	(0.015)	(0.016)	(0.008)	(0.011)
LI	-0.175*	-0.079	-0.045	-0.062	-0.280***	-0.162	-0.088	-0.040
	(0.098)	(0.097)	(0.055)	(0.058)	(0.104)	(0.105)	(0.059)	(0.060)
LI×ED	-0.051**	-0.048*	-0.009	-0.004	-0.043*	-0.039	-0.009	-0.004
	(0.024)	(0.028)	(0.016)	(0.016)	(0.024)	(0.028)	(0.016)	(0.016)
Spatial lag LI					0.473***	0.351**	0.225**	-0.112
					(0.159)	(0.160)	(0.090)	(0.105)
Spatial lag LI×ED					0.055***	0.058***	0.006	-0.005
					(0.013)	(0.014)	(0.007)	(0.009)
R-squared	0.063	0.052	0.027	0.016	0.064	0.053	0.027	0.016
Marginal effects of Lerner Indices conditional on alternative ED-levels								
5th	-0.073	0.016	-0.027	-0.055	-0.195***	-0.085	-0.071	-0.031
t-statistic	-0.696	-0.558	-0.472	-1.068	-2.867	-1.362	-1.505	-0.452
25th	-0.148	-0.054	-0.040	-0.060	-0.257**	-0.142	-0.084	-0.038
t-statistic	-1.517	-1.500	-0.871	-0.827	-2.479	-0.759	-1.191	-0.616
50th	-0.177*	-0.081	-0.045	-0.062	-0.281***	-0.163	-0.089	-0.040
t-statistic	-1.802	0.149	-0.900	-1.082	-2.694	-1.924	-1.433	-0.665
75th	-0.207**	-0.109	-0.051	-0.064	-0.306*	-0.186	-0.094	-0.043
t-statistic	-2.057	-1.079	-0.823	-1.109	-1.764	-1.716	-1.513	-0.703
95th	-0.281**	-0.178	-0.064	-0.070	-0.368***	-0.242	-0.106	-0.049
t-statistic	-2.459	-0.828	-0.751	-1.032	-3.069	-1.556	-1.463	-0.725

Notes: The dependent variables are aggregate growth and growth components according to Equations (3.4a) through (3.4c). Spatial lags are Lerner indices and interactions terms weighted with an inverse distance matrix between counties as in Anselin (1988). The sample comprises 28,425 observations for 1,850 region-industries between 1994 and 2011. Panel regressions with region-industry and year fixed effects. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

of an increase in competition though. To this end, the lower panel of Table 3.2 shows the derivative of Equation (3.1) with respect to Lerner indices, evaluated at five different percentiles of the ED distribution. Larger bank market power may affect firms with a higher structural dependence on external finance more negatively if lock-in effects for these firms are more prevalent compared to those with structurally lower needs for external funds.

Conditional marginal effects confirm the significant reduction of output growth in response to less regional banking market competition for industries with a higher structural dependence on external finance. Starting at the median of the ED-distribution, aggregate industry-region output growth, an increase of average regional Lerner indices by 1% reduces aggregate industry output growth per region by approximately 0.2%. Recall from Table 3.1 that median industry growth was 1.7%. Therefore, a 20 basis point growth reduction seems also economically significant. The effect of regional bank Lerner indices remains

insignificant for the individual growth components. The negative effect of increasing bank market power on aggregate growth contradicts the results reported in Inklaar et al. (2012), who find for lower levels of dependence on external finance a positive growth effect of Lerner markups on growth. The two major difference between their study and the present one are (i) the exclusion of years characterized by financial turmoil and numerous extraordinary rescue measures and (ii) that the majority of firms considered here are medium and large firms, in particular in more recent years of the sample. In contrast, around 2/3 of their sample are micro firms. We address these differences more explicitly below.

An important concern in these baseline specifications, which we tackle before, is that banks do not operate solely in just one economic agglomeration area, an important assumption for the Rajan-Zingales approach. Whereas this assumption is reasonable for the vast majority of regional banks, it is certainly less appropriate for large banks that operate branches all over the Republic. Aside from the ultimately unobservable geographical confinement of banking markets, it is also reasonable to expect that creditors access to finance may not only depend on banking market power in their home market, but also on the competitive stance in neighboring markets.

To address these concerns, we show in the right panel of Table 3.2 specifications with so-called spatial lags of the Lerner index and the interaction term. We follow Anselin (1988) and test if economic growth (components) in region r depend(s) also on banking market competition in neighbouring regions $s \in R$, where R is the set of all ROR. We generate these spatial lags of Lerner indices as described in Anselin (1988) and use the inverse of a geographical distance matrix W between counties to weigh Lerner indices of all neighbouring regions. That is, we allow banking competition in close-by markets to exert a stronger influence on a region compared to the effect of more distant markets. We aggregate spatially lagged Lerner indices from the county to the ROR-level to test, if economic growth in region r is affected by banking market competition in regions s.

The right-hand panel in Table 3.2 confirms significantly negative direct effects of higher Lerner indices as well as a significantly negative interaction term for aggregate output growth. Spatial lags, in turn, are significantly positive for aggregate output growth, but also other growth components. This result indicates that more competitive own local markets may represent an advantage for corporates relative to competitors that face banks with more market power in their respective home markets. The marginal effects depicted in the

bottom panel, however, emphasize again that only aggregate growth is affected significantly. The magnitude of growth reduction in response to increasing market power in regional home markets is now evident across the entire range of dependence on external finance. The effect is increasingly negative as dependence increases and ranges between 19 to 38 basis points of growth. Henceforth, we continue to specify spatially lagged competition indicators as well as interaction terms as the baseline specification.

3.3.2 Growth effects during different time periods

Recall that banking market competition increased over time in particular after the financial crisis culminated in 2008 (see Figure 2.19). Therefore, the absence of significant relationships between regional banking competition and individual growth components may also be blurred by opposing effects before and after 2008. In addition, Figures 3.1 and 3.2 show substantial firm sample attrition until around the turn of the century, in particular with respect to micro and small firms for which growth due to a reallocation component is presumably most relevant. We therefore present separate regressions for three sub-samples.

Table 3.3 shows results for the period 1999–2007, that is, after the Euro introduction and before the Great Financial Crisis. For this pre-crisis period and sample that is increasingly dominated by medium and especially large firms underlying the industry data, we find only significant interaction terms of (spatial lags of) Lerner indices per region and dependence on external finance for aggregate growth and factor accumulation. As before, larger markups of banks in firms' own regional markets are detrimental to growth whereas less competition in neighboring markets is beneficial. The total marginal effect of Lerner indices in the home market is, however, only weakly significant at very low levels of financial dependence, amounting to a mere 4 basis points.

Whereas banking market competition in the period between 1999 and 2007 apparently did not affect growth and its components a great deal, Table 3.4 shows that in particular spatial spillovers in terms of banking competition played an important role for growth. Coefficient estimates suggest that increasing market power in neighboring regional markets consistently increased aggregate growth as well as its factor accumulation and technical change component. Total marginal effects of home-market bank market power on aggregate growth are only weakly significant for very high levels of financial dependence. The explanatory power for this sub-period increases markedly compared to the aggregate sample and other

Table 3.3: Pre-crisis and post-Euro period: 1999-2007

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	0.008	0.004	0.020	-0.021
	(0.024)	(0.027)	(0.014)	(0.019)
LI	-0.181	0.078	0.026	-0.012
	(0.174)	(0.163)	(0.107)	(0.098)
LI×ED	-0.070*	-0.091**	-0.023	0.014
	(0.040)	(0.042)	(0.031)	(0.028)
Spatial lag LI	0.389	0.157	0.071	-0.276
	(0.291)	(0.282)	(0.165)	(0.179)
Spatial lag LI×ED	0.059***	0.068***	-0.001	0.013
	(0.022)	(0.025)	(0.013)	(0.017)
R-squared	0.048	0.04	0.023	0.015
5th	-0.042*	0.259	0.072	-0.040
t-statistic	-1.666	-0.609	0.365	0.161
25th	-0.144	0.126	0.039	-0.020
t-statistic	-1.054	1.374	0.632	-0.119
50th	-0.183	0.075	0.026	-0.012
t-statistic	-0.827	0.462	0.239	-0.336
75th	-0.224	0.022	0.012	-0.003
t-statistic	-1.270	0.135	-0.161	-0.034
95th	-0.325	-0.109	-0.021	0.017
t-statistic	-0.225	0.759	0.108	-0.192

Notes: 13,990 observations for 1,758 industry-regions between 1999 and 2007. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

sub-periods.

Regarding reallocation as a source of growth, this sample split reveals a significant and substantial negative growth effect due to reallocation of resources. This result suggests that increasing bank market power after the crisis reduced the ability, or willingness, of banks to facilitate the reduction of factor use at unproductive firms and foster instead factor employment at more productive agents. The magnitude of this effect is economically meaningful, around 40 basis points of growth, but does not differ significantly across different degrees of dependence on external finance.

Table 3.5 addresses the fact that since 1999 increasingly few micro firms are contained in the Ustan database of Deutsche Bundesbank. As argued in Inklaar et al. (2012), especially small, young, and fairly opaque firms should be affected the most by banks' abilities and willingness to generate and process private information. We therefore expect that especially in the early sample years regional differences in bank market competition should correlate

Table 3.4: Financial crisis period: 2008-2011

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.038	-0.028	-0.009	0.002
	(0.030)	(0.030)	(0.014)	(0.016)
LI	-0.355	-0.158	-0.143	-0.427**
	(0.274)	(0.259)	(0.163)	(0.178)
LI×ED	-0.063	-0.064	-0.001	-0.004
	(0.047)	(0.047)	(0.022)	(0.023)
Spatial lag LI	0.846***	0.573**	0.492***	0.048
	(0.243)	(0.235)	(0.144)	(0.153)
Spatial lag LI×ED	0.071***	0.072***	0.007	-0.011
	(0.023)	(0.023)	(0.012)	(0.013)
R-squared	0.152	0.126	0.06	0.031
5th	-0.231	-0.031	-0.141	-0.418**
t-statistic	-0.779	-0.475	-0.863	2.232
25th	-0.322	-0.125	-0.142	-0.424**
t-statistic	-1.301	-0.765	-0.817	-2.401
50th	-0.357	-0.160	-0.143	-0.427**
t-statistic	-1.162	-1.075	-0.873	-2.423
75th	-0.394	-0.198	-0.143	-0.429**
t-statistic	-1.437	-0.619	-0.879	-2.416
95th	-0.484*	-0.290	-0.144	-0.435**
t-statistic	-1.699	-0.110	-0.868	-2.368

Notes: 6,047 observations for 1,601 industry-regions between 2008 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

significantly with growth in general and the reallocation term in particular.

Coefficient estimates do confirm this notion to some extent. Increasing competition in home markets reduces growth due to the reallocation of resources significantly whereas increasing competition in neighbouring markets has the opposite effect. Interaction terms, however, are not significantly different from zero. Likewise, also direct terms are insignificantly correlated with almost all other growth components but reallocation. Marginal effects in the bottom panel of Table 3.5 confirm an overall negative effect of increasing Lerner markups on reallocation on the order of 30 basis points, albeit exhibiting only weak statistical significance.

In sum, we find that the relationship between competition in both home and neighboring regions and growth changes across time periods oftentimes fails to exhibit statistical significance. Whenever marginal effects are significantly different from zero though, they indicate consistently that more market power of banks in the home market is detrimental to

Table 3.5: Pre-Euro period: 1994-1998

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	0.032	-0.090	0.026	0.019
	(0.057)	(0.074)	(0.040)	(0.046)
LI	0.130	0.059	-0.171	-0.332**
	(0.308)	(0.355)	(0.171)	(0.195)
LI×ED	-0.088	0.212	-0.121	0.019
	(0.109)	(0.164)	(0.084)	(0.099)
Spatial lag LI	-0.687	-1.486**	0.146	0.976**
	(0.622)	(0.718)	(0.378)	(0.439)
Spatial lag LI×ED	-0.033	0.007	0.012	-0.033
	(0.050)	(0.058)	(0.036)	(0.038)
R-squared	0.015	0.013	0.01	0.005
5th	0.304	-0.360	0.070	-0.369
t-statistic	0.709	-0.630	0.261	-1.168
25th	0.176	-0.052	-0.107	-0.342*
t-statistic	0.532	0.188	-1.027	-1.725
50th	0.127	0.066	-0.175	-0.332
t-statistic	0.414	1.315	-1.485	-1.246
75th	0.076	0.190	-0.246	-0.321*
t-statistic	0.257	-0.129	-2.005**	-1.708
95th	-0.051	0.496	-0.421	-0.294
t-statistic	-0.160	0.583	-0.574	-1.579

Notes: 8,388 observations for 1,774 industry-regions between 1994 and 1998. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

aggregate growth and/or the reallocation component of growth. Larger markups in neighboring regions exert, in turn, positive growth effects. These effects are most noticeable in the period 2008-2011, are statistically robust, and economically relevant.

3.3.3 Alternative competition measures

Given the different information that is conveyed by the alternative measures of competition discussed in Chapter 2, we also specify market shares, HHI, CR 3, and price-cost margins as alternatives to Lerner indices in Equation (3.1). The lower panel of Table 3.1 shows descriptive statistics for these four measures at the industry-region level for the estimation sample and Tables 3.6 through 3.9 show according results.

Average market shares per region shown in Table 3.6 exhibit statistically significant effects on aggregate growth and individual growth components. In line with the inference drawn on the basis of Lerner indices, larger market shares reduce aggregate output growth. This

Table 3.6: Market shares per ROR and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	0.030***	0.030***	0.011**	-0.007
	(0.010)	(0.011)	(0.005)	(0.006)
MS	-0.271**	-0.361**	-0.145*	0.247***
	(0.136)	(0.166)	(0.080)	(0.086)
MS×ED	-0.253***	-0.257***	-0.065***	0.046**
	(0.036)	(0.049)	(0.023)	(0.021)
Spatial lag MS	-0.007	-0.011**	-0.002	0.005
	(0.005)	(0.005)	(0.002)	(0.003)
Spatial lag MS×ED	-0.000	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.000)	(0.000)
R-squared	0.065	0.054	0.027	0.016
5th	0.231*	0.149***	-0.017	0.156***
t-statistic	1.727	-2.855	-0.222	1.750
25th	-0.139	-0.226**	-0.111**	0.223***
t-statistic	-1.052	-2.218	-2.577	2.622
50th	-0.280**	-0.369	-0.147**	0.249***
t-statistic	-2.047	-1.458	-2.136	2.874
75th	-0.428***	-0.520	-0.185	0.276***
t-statistic	-2.961	1.018	-1.459	3.294
95th	-0.794***	-0.891***	-0.278*	0.342***
t-statistic	-4.557	-3.851	-1.831	3.072

28,425 observations for 1,850 industry-regions between 1994 and 2011. Market share per ROR based on total assets. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

negative effect tends to be larger for firms that operate in industries with higher structural dependence on external funds and is, in fact, positive for firms in industries with very little dependence on external finance. For the median-dependent industry, an increase in regional market shares reduces output growth by 28 basis points.

The negative effect of increasing regional market shares is also confirmed, contrary to the analysis based on Lerner indices, for industry growth due to factor accumulation and technological change. Significantly reduced output growth due to slower factor accumulation and obstructed technological progress for very dependent sectors of the economy is in line with Cetorelli (2004). He finds for a cross-country, cross-industry study of European manufacturing growth that increased market power and higher concentration of banking markets prevents entry of innovative, young firms to shelter incumbent bank customer relationships. In contrast, increasing bank market shares spur aggregate output and factor growth of the least dependent industries. This result may indicate the benefits from sufficient bank market power arising from increased abilities of banks to generate private

information if customers are not locked into bank relationships due to too high dependence on external finance.

Related to the notion that higher bank market shares may be conducive to the generation of valuable private information is the result that the reallocation component exhibits a positive response to increasing market shares across any level of dependence. This result underpins again that market shares and Lerner markups gauge different aspects of market power. Comfortable market shares of banks may be conducive to generate private information, thereby enhancing reallocation.[10] However, the informational benefits from larger market shares are outweighed if banks generate also large markups, which reflects rent extraction more directly than mere market shares.

Consider next the results for the price-cost margin (PCM) in Table 3.7. Coefficient estimates for PCM and interaction terms in home markets are significant for aggregate growth and almost any growth component. The results indicate in contrast to Lerner indices that banks earning higher implied interest margins spur output growth, factor accumulation, and technical change, but reduce output via reallocation. Interaction terms indicate at the the same time that higher margins are detrimental to growth if paired with high dependence on external finance. This result contradicts those obtained for Lerner indices and therefore corroborates the important difference between interest margins and economic markups that include operations of the entire bank. Sufficient interest rate margins seem important for economic growth, for instance to enable banks to conduct efficient maturity transformation also in a low-interest rate environments. However, if larger accounting margins are also associated with increasing economic markups, growth suffers for example due to rent extraction from locked-in customers.

Marginal effects in the bottom panel confirm indeed that the effect of increasing PCM is positive regarding aggregate output growth for the most part of the ED distribution, but turns negative among industries that depend extensively on external finance. Whereas factor accumulation and technical change exhibit significantly positive effects across different levels of dependency, the reallocation term further confirms that large accounting margins, like Lerner indices, reduce growth significantly for any level of ED. Hence, aggregate growth seems to benefit from banks earning "healthy" interest margins as long as firms do not depend extremely on external finance. A reduced ability, or willingness, to

[10] One mechanism in line with theoretical considerations in Hauswald and Marquez (2003) could be that larger market shares imply larger customer pools, which enhance the quality of such information generation.

Table 3.7: Price-cost margins per ROR and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	0.006	0.009	0.000	0.004
	(0.017)	(0.018)	(0.009)	(0.010)
PCM	0.031**	0.043***	0.012*	-0.027***
	(0.013)	(0.013)	(0.007)	(0.009)
PCM×ED	-0.020***	-0.020***	-0.005**	0.001
	(0.005)	(0.005)	(0.003)	(0.003)
Spatial lag PCM	-0.023	-0.049**	-0.003	0.021*
	(0.018)	(0.020)	(0.010)	(0.012)
Spatial lag PCM×ED	0.010***	0.010***	0.003***	-0.002
	(0.002)	(0.002)	(0.001)	(0.001)
R-squared	0.065	0.054	0.027	0.016
5th	0.071***	0.082***	0.023*	-0.028***
t-statistic	2.951	3.198	1.848	-2.937
25th	0.041	0.053**	0.015**	-0.027***
t-statistic	1.459	2.414	2.348	-3.114
50th	0.030***	0.042***	0.012	-0.027***
t-statistic	3.867	4.343	1.458	-2.796
75th	0.018	0.030	0.009	-0.026**
t-statistic	-0.809	0.125	0.228	-2.459
95th	-0.011**	0.002***	0.002**	-0.025***
t-statistic	2.314	3.729	2.096	-3.064

28,425 observations for 1,850 industry-regions between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

facilitate the reallocation of resources to high-productivity firms appears to be the cost of such margins.

Tables 3.8 and 3.9 specify regional Hirschman-Herfindahl indices (HHI) and top-3 concentration ratios based on gross total assets as proxies for market structure. By and large, the result resemble those obtained for Lerner indices to a large extent.

The effects of larger HHI is mostly confined to aggregate output growth. Coefficient estimates exhibit significant correlation between HHI at home and in neighboring regions for aggregate output growth and factor growth. But marginal effects indicate only for industries with high structural dependence on external finance a negative aggregate growth effect on the order of 8 to 12 basis points in response to a 100 point increase in HHI.[11] Marginal effects for any of the three growth components are insignificant.

Also for concentration ratios per ROR we find neither significant coefficient nor marginal

[11] For estimation purposes, we rescale the HHI to range between 0 and 100.

Table 3.8: HHI per ROR and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.033***	-0.030**	-0.003	-0.003
	(0.011)	(0.012)	(0.006)	(0.007)
HHI	-0.078*	-0.032	-0.032	-0.004
	(0.043)	(0.044)	(0.022)	(0.027)
HHI×ED	-0.022*	-0.024*	-0.004	0.003
	(0.013)	(0.014)	(0.007)	(0.008)
Spatial lag HHI	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Spatial lag HHI×ED	0.000***	0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.064	0.053	0.027	0.016
5th	-0.034	0.016	-0.025	-0.010
t-statistic	-1.562	0.335	-1.411	-0.204
25th	-0.067	-0.019	-0.031	-0.005
t-statistic	-0.727	-0.753	-1.062	-0.343
50th	-0.079**	-0.033	-0.033	-0.004
t-statistic	-2.316	-1.464	-1.473	-0.062
75th	-0.092*	-0.047	-0.035	-0.002
t-statistic	-1.832	-0.453	-1.381	-0.136
95th	-0.124**	-0.082	-0.040	0.003
t-statistic	-2.052	-1.025	-1.486	0.093

28,425 observations for 1,850 industry-regions between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

effect estimates for growth due to technological change and reallocation. Only output and factor growth respond negatively to increasing home market concentration. Interaction terms are only significantly positive, but minuscule, in neighboring markets. Marginal effects on aggregate growth and factor accumulation are, in contrast to HHI, significantly negative for various levels of dependence. An increase in concentration appears to reduce growth increasingly for those industries that depend more heavily on external finance. Whereas the growth reduction due to a 1% increase in CR is on the order of 4-5 basis points for the least dependent ones, the effect is on the order of 11-12 basis points for the most dependent industries.

In sum, alternative measures of market power yield a variety of results that differ at times from those obtained from Lerner indices. Larger regional market shares of banks do not impede growth per se for as long as the the structural industry dependence on external finance is not very large. Likewise, "healthy" implied interest margins seem beneficial to growth as well. A possible reconciliation with the negative growth effect of larger Lerner

Table 3.9: Concentration ratios per ROR and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.039***	-0.036**	-0.009	-0.001
	(0.015)	(0.016)	(0.008)	(0.010)
CR3	-0.075*	-0.084**	-0.022	0.008
	(0.039)	(0.042)	(0.020)	(0.027)
CR3×ED	-0.016	-0.016	0.001	-0.001
	(0.012)	(0.013)	(0.006)	(0.007)
Spatial lag CR3	0.000	0.001	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Spatial lag CR3×ED	0.000***	0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.064	0.053	0.027	0.016
5th	-0.043*	-0.052**	-0.024	0.009
t-statistic	-1.918	-2.185	-1.086	0.281
25th	-0.066*	-0.076	-0.022	0.008
t-statistic	-1.680	-1.051	-1.016	0.284
50th	-0.075	-0.085**	-0.022	0.008
t-statistic	-0.956	-1.997	-1.054	0.270
75th	-0.085**	-0.094*	-0.021	0.007
t-statistic	-2.303	-1.762	-1.118	0.213
95th	-0.108**	-0.118**	-0.019	0.006
t-statistic	-2.109	-2.366	-0.766	0.291

28,425 observations for 1,850 industry-regions between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

indices is that the latter measure economic markups comprising multiple bank activities and not only interest rate business. Thus, banks with larger market shares and accounting margins must not necessarily be detrimental to firm growth as long as no economic rents are extracted. But irrespective of positive effects on aggregate growth, both larger market shares as well as interest margins seem to imply a cost in terms of growth arising from a negative reallocation growth component. This result is in line with the indications provided by Lerner index effects on reallocation. Negative reallocation may reflect either less ability or less willingness of banks with high margins and market shares to facilitate the reallocation of resources to high-productivity companies. Higher concentration, in turn, affects aggregate growth consistently negative, primarily via a significant correlation with factor growth.

3.3.4 Bank traits subject to regulation and growth

The ongoing debate on reforming micro- and macro prudential bank regulation focuses in light of the Great Financial Crisis on a number of bank traits beyond regulatory capital requirements. In particular, the liquidity, funding structure, and capitalization of banks are important aspects to gauge individual bank stability monitored by regulators and financial markets alike. This section therefore specifies according proxies instead of market power to explain the industry-region variation in aggregate growth and growth components. Descriptive statistics of these proxies are shown in Table B.5 in the appendix at the industry-region level for the estimation sample.

3.3.4.1 Liquidity

Larger liquidity buffers enable banks to mitigate asset price and other financial shocks and should therefore enable a smooth provision of financial services to their customers. At the same time, low-yield liquidity reserves reduce banks' abilities to grant credit and finance investments.

To assess the effect on industry growth per region, we measure liquidity at the bank level as the share of cash, central bank reserves, and short term interbank assets relative to gross total assets as in subsection 2.4.4. Like bank-specific indicators of market power, we aggregate liquidity, and all of the subsequent measures, to the ROR-level by taking the average across all banks that reside with their headquarter in the respective region. Table 3.10 shows the relationship between bank liquidity per region as well as spatial lags thereof and growth (components).

The results for marginal effects provide weak evidence that higher liquidity provisioning by banks in home markets affects growth via factor accumulation for firms with modest dependence on external finance positively.

But overall, both coefficient and marginal effect estimates indicate little significant correlation between this proxy of liquidity and growth. Rather than indicating hat bank liquidity is unimportant for regional economic conditions, the absence of significant results may very well reflect the inadequacy of simple balance sheet indicators to properly gauge differences in liquidity risk faced by banks. Alternative measures, such as the liquidity

Table 3.10: Bank liquidity and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.025***	-0.016**	-0.015***	-0.003
	(0.008)	(0.008)	(0.004)	(0.005)
Liquidity	-0.049	0.203	-0.062	-0.111
	(0.207)	(0.198)	(0.104)	(0.132)
Liquidity×ED	-0.115	-0.151	0.071	0.003
	(0.105)	(0.104)	(0.057)	(0.062)
Spatial lag Liquidity	-0.103	-0.418	-0.074	-0.221
	(0.402)	(0.395)	(0.220)	(0.266)
Spatial lag Liquidity×ED	0.301***	0.278***	0.095***	-0.016
	(0.063)	(0.064)	(0.035)	(0.039)
R-squared	0.064	0.053	0.027	0.016
5th	0.180	0.503	-0.204	-0.118
t-statistic	0.615	0.540	-1.374	-0.841
25th	0.012	0.282	-0.100	-0.113
t-statistic	0.054	1.693**	-0.574	-0.812
50th	-0.053	0.198	-0.060	-0.111
t-statistic	-0.253	1.002	0.522	-0.622
75th	-0.120	0.110	-0.018	-0.109
t-statistic	-0.550	1.347	-0.162	-0.812
95th	-0.286	-0.108	0.085	-0.105
t-statistic	-0.948	-0.387	-0.935	-0.594

28,425 observations for 1,850 industry-regions between 1994 and 2011. Liquidity is measured at the bank level as the sum of cash, central bank reserves, and short term interbank assets relative to gross total assets, averaged across banks per ROR. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

coverage ratio (Bank for International Settlement, 2013) or the ability to create liquidity (Berger and Bouwman, 2009), are not available for the entire sample of German banks, but are certainly more appropriate proxies in future research.

3.3.4.2 Funding structure

Whether banks refinance themselves primarily through wholesale markets or by means of collecting retail deposits has important implications for the stability of the bank. Huang and Ratnovski (2011) show that reliance on the former may be less costly, but also more prone to sudden and large withdrawals in times of increased uncertainty.

Wholesale funding in Table 3.11 equals the share of securitized debt relative to gross total assets. The former includes issued asset backed securities (*Hypothekenpfandbriefe*), public

Table 3.11: Wholesale funding and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.026***	-0.017***	-0.006**	-0.009**
	(0.006)	(0.006)	(0.003)	(0.004)
Wholesale	-0.347	-0.721**	-0.217	0.557***
	(0.344)	(0.334)	(0.169)	(0.196)
Wholesale×ED	0.164	0.080	0.108	0.007
	(0.135)	(0.122)	(0.086)	(0.074)
Spatial lag Wholesale	-0.908	-0.684	-0.503	-0.239
	(0.618)	(0.640)	(0.314)	(0.410)
Spatial lag Wholesale×ED	0.518***	0.478***	0.108	0.075
	(0.118)	(0.122)	(0.067)	(0.072)
R-squared	0.065	0.053	0.027	0.016
5th	-0.672	-0.880	-0.430	0.544***
t-statistic	-0.024	-1.915*	-1.505	2.849
25th	-0.433	-0.763	-0.273	0.553***
t-statistic	-0.995	-1.525	-0.971	2.640
50th	-0.342	-0.718	-0.213	0.557**
t-statistic	-1.186	-2.078**	0.029	1.991
75th	-0.246	-0.671	-0.150	0.561***
t-statistic	-0.729	-2.147**	-1.418	2.955
95th	-0.010	-0.555	0.005	0.570***
t-statistic	-1.408	-2.159**	-1.268	2.643

28,425 observations for 1,850 industry-regions between 1994 and 2011. Wholesale funding is measured as the share of securitised debt relative to gross total assets. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

debt securities (*Öffentliche Pfandbriefe*), other bonds, and money market paper. Coefficient estimates indicate that larger wholesale funding shares of banks in the home market affect factor accumulation significantly negative whereas reallocation increases. Larger wholesale funding shares of banks in neighboring regions, in turn, increase factor accumulation and also correlate significantly with aggregate output growth in home markets.

Marginal effects in the bottom panel indicate, however, that only the relationship with factor accumulation and reallocation is significant. An increase of bank refinancing via capital markets reduces growth via factor accumulation between 55 and 88 basis points. Negative growth effects are larger if industries depend less on external finance. Reallocation, in turn, responds significantly positive to more intensive refinancing of banks in their region through capital markets. The magnitude of this effect is fairly insensitive to the level of dependence, amounting to approximately 55 basis points of growth.

Table 3.12 shows the results for the flip side of wholesale funding, namely retail-based

Table 3.12: Retail funding and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.012	-0.011	0.005	-0.005
	(0.014)	(0.014)	(0.008)	(0.008)
Retail	-0.003	-0.034	0.036	-0.032
	(0.075)	(0.082)	(0.036)	(0.048)
Retail×ED	-0.082***	-0.067**	-0.042**	0.010
	(0.030)	(0.032)	(0.018)	(0.019)
Spatial lag Retail	-0.016	-0.052	-0.017	0.086
	(0.097)	(0.102)	(0.049)	(0.060)
Spatial lag Retail×ED	0.063***	0.058***	0.017**	-0.005
	(0.012)	(0.013)	(0.007)	(0.007)
R-squared	0.064	0.053	0.027	0.016
5th	0.159	0.098	0.119	-0.052
t-statistic	-0.082	-0.438	-0.954	-0.174
25th	0.040	0.001	0.058	-0.038
t-statistic	0.516	0.013	0.957	-0.513
50th	-0.006	-0.036	0.035	-0.032
t-statistic	-0.696	-0.873	1.551	-0.775
75th	-0.054*	-0.075	0.010**	-0.026
t-statistic	1.673	-1.567	2.345	-0.888
95th	-0.172*	-0.171	-0.050***	-0.011
t-statistic	-1.753	0.984	0.269	-0.661

28,425 observations for 1,850 industry-regions between 1994 and 2011. Retail funding is measured as the share of fixed term customer savings deposits relative to total customer deposits. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

refinancing. Retail funding is measured as the share of savings deposits with agreed cancelation terms of total customer deposits. This variable therefore measures more directly the share of the presumably most inelastic fund supply to a bank. Such funds should be a stable source of refinancing to banks, for instance during crises times. But they are probably associated with larger fixed costs due to the need to maintain branch-intensive retail banking networks, as well as higher variable transaction cost to administer many relatively small denomination accounts of many suppliers of finance rather than managing a few wholesale funding relationships in fixed income markets.

Coefficient estimates are only significantly different from zero for interaction terms between average retail funding intensity of banks per region and industry dependence on external finance. The coefficient is negative regarding home market banks retail funding, and positive with respect to spatial lags of retail funding. Marginal effects provide evidence, that increased retail funding intensity at home by 1% reduces aggregate output growth at levels

of ED beyond the 75th percentile significantly. Growth due to technological progress is reduced for industries with the highest dependence on external finance, potentially indicating that retail-funded banking is less suited to finance the most innovative and external-finance dependent firms. Factor accumulation and reallocation are not significantly correlated with more intensive bank retail funding.

3.3.4.3 Capitalization

Higher regulatory capital ratios serve just like liquidity as a buffer against sudden asset price, but also funding shocks. Likewise, larger equity capital ratios also imply that banks can create less loans, which may enhance financial stability at the cost of reduced output growth (Martinez-Miera and Suarez, 2012). As noted in section 2.1.5, a consistent time series of regulatory core equity capital is unavailable. Therefore, we show first the relationship between book equity relative to gross total assets in Table 3.13.

Coefficient estimates indicate that only gross capitalization of banks in neighboring regions has a positive effect on growth and growth components in home markets. Conditional marginal effect of bank capitalization in home markets, in turn, highlight the absence of a significant relationship with growth. The only exception concerns extremely dependent industries, which exhibit a negative reallocation component in response to a 1% increase of equity ratios on the order of 6 basis points. These results indicate that tighter leverage ratios that are currently advocated by numerous scholars, are not significantly correlated with output growth for this sample of German banks, industries, and regional markets.

A more direct measure of strain on the banking system compared with gross equity capital ratios is the share of capital injections by banking-pillar specific insurance schemes, so-called distress events (Kick and Koetter, 2007; Dam and Koetter, 2012). We calculate per ROR the ratio of the stock of aggregate capital injections, both actual payouts as well as guarantees, relative to book equity of all banks in the region. This bailout variable per regional market is specified in Table 3.14

Similar to equity ratios, only interaction effects between dependence on external finance and more intensive bailouts in neighboring regions exhibit a significant effect with growth components, except reallocation. The marginal effects in the lower panel of Table 3.14 show that more bailout activity in local banking markets exhibits some effects for technological

Table 3.13: Gross equity ratio and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.050***	-0.053***	-0.011*	0.009
	(0.015)	(0.014)	(0.007)	(0.007)
Equity	-0.546	-0.799	0.261	0.368
	(0.647)	(0.587)	(0.302)	(0.368)
Equity×ED	-0.073	0.062	0.070	-0.205
	(0.285)	(0.242)	(0.108)	(0.138)
Spatial lag Equity	2.889***	2.456**	1.066*	-0.990
	(1.025)	(1.106)	(0.545)	(0.619)
Spatial lag Equity×ED	0.543***	0.533***	0.087	-0.019
	(0.106)	(0.111)	(0.059)	(0.065)
R-squared	0.065	0.054	0.027	0.016
5th	-0.401	-0.922	0.123	0.774
t-statistic	-0.856	-0.794	0.949	1.349
25th	-0.508	-0.832	0.225	0.475
t-statistic	-0.793	-1.353	0.393	0.595
50th	-0.548	-0.797	0.263	0.361
t-statistic	-0.634	-1.446	0.868	0.975
75th	-0.591	-0.761	0.304	0.240
t-statistic	-0.841	-1.198	0.774	-0.104
95th	-0.696	-0.671	0.405	-0.055
t-statistic	-0.659	-1.359	0.925	2.026**

28,425 observations for 1,850 industry-regions between 1994 and 2011. Equity is measured as total equity reported to the supervisor relative to gross total assets. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

and reallocation growth components. The statistical significance of these effect varies somewhat depending on external financing needs of the industry. Overall, a more bailout-reliant regional banking market depresses growth due absent technological advances and reallocation.

3.3.5 East and West German regions and banking market competition

Regional macro conditions continue to differ across German regions. Likewise, any indicator of bank market power and market structure differed systematically across regions. Therefore, Table 3.15 shows separate growth regression results for West and East German regions.

Results for West German ROR in the left-hand panel confirm the negative effect of increasing economic margins in banking for aggregate industry growth documented earlier for the

Table 3.14: Bailout ratio and growth

	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.006	0.001	-0.005**	-0.004
	(0.005)	(0.005)	(0.003)	(0.003)
Bailout	-0.037	-0.015	0.033	-0.050
	(0.050)	(0.042)	(0.026)	(0.031)
Bailout×ED	0.036	0.007	0.050***	-0.012
	(0.026)	(0.030)	(0.016)	(0.016)
Spatial lag Bailout	0.221	-0.112	0.110	-0.164
	(0.225)	(0.235)	(0.114)	(0.137)
Spatial lag Bailout×ED	0.201***	0.169**	0.103***	-0.010
	(0.075)	(0.078)	(0.038)	(0.044)
R-squared	0.064	0.052	0.028	0.016
5th	-0.108	-0.028	-0.066***	-0.027
t-statistic	-0.706	-0.014	3.001	-0.563
25th	-0.055	-0.018	0.007*	-0.044*
t-statistic	-1.432	-0.388	-1.695	-1.831
50th	-0.035	-0.015	0.035**	-0.051
t-statistic	0.550	-0.357	2.185	-1.623
75th	-0.014	-0.011	0.064	-0.057*
t-statistic	-0.278	-0.246	1.319	-1.744
95th	0.038	-0.001	0.136	-0.074
t-statistic	-1.039	-0.348	0.255	-1.312

28,425 observations for 1,850 industry-regions between 1994 and 2011. Bailout is measured as the stock of capital injections in cash and as guarantees provided to banks in a region relative to total equity reported to the regulator. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

entire sample. Consistent with a smaller sample size, statistical significance is generally weaker compared to the aggregate sample. But also the negative effects on growth due to reallocation is confirmed in West German regions only.

Results for the sample based on East German regions provide only very weak evidence regarding a significant relationship between growth components and banking market competition. Note, however, that point estimates of marginal effects exhibit similar effects in terms of direction. Statistical insignificance may thus very well reflect primarily the smaller sample size.

Bearing the weak significance for the 'East ROR' sample in mind, the results indicate qualitatively that banking market competition affects structurally weaker regions primarily regarding growth accruing from technological progress whereas more mature regions' growth seems to be depressed due to slower factor accumulation in response to larger Lerner

Table 3.15: West and East German ROR

	West German ROR				East German ROR			
	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
ED	-0.059***	-0.056***	-0.009	0.008	-0.012	-0.034	0.007	-0.000
	(0.020)	(0.021)	(0.011)	(0.015)	(0.024)	(0.033)	(0.022)	(0.019)
LI	-0.243*	-0.105	-0.023	-0.149*	-0.227	-0.134	-0.183*	0.096
	(0.138)	(0.133)	(0.073)	(0.081)	(0.181)	(0.189)	(0.109)	(0.095)
LI×ED	0.067	0.066	0.022	-0.025	0.024	0.062	-0.009	-0.013
	(0.050)	(0.051)	(0.028)	(0.032)	(0.042)	(0.064)	(0.046)	(0.034)
Spatial lag LI	0.226	0.122	0.113	-0.046	0.413	0.331	0.164	-0.212
	(0.208)	(0.209)	(0.118)	(0.137)	(0.261)	(0.245)	(0.147)	(0.148)
Spatial lag LI×ED	0.051***	0.052***	0.004	-0.005	0.004	0.011	-0.004	0.007
	(0.017)	(0.018)	(0.009)	(0.012)	(0.018)	(0.017)	(0.010)	(0.010)
R-squared	0.072	0.06	0.028	0.018	0.041	0.033	0.03	0.014
Observations		22,479					5,946	
Industry-regions		1,439					411	
5th	-0.375	-0.236	-0.067	-0.099	-0.274	-0.257	-0.166	0.121
t-statistic	-2.428***	-1.051	-0.481	-2.041**	-1.254	-0.024	-1.671*	1.065
25th	-0.278	-0.140	-0.034	-0.135	-0.239	-0.166	-0.179	0.102
t-statistic	-2.053**	-0.775	-0.109	-0.907	-1.290	-0.696	-1.605	1.007
50th	-0.241	-0.103	-0.022	-0.149	-0.226	-0.131	-0.184	0.095
t-statistic	-1.749*	-1.485	-0.296	-2.025**	-1.193	-0.867	-1.283	0.899
75th	-0.202	-0.064	-0.009	-0.164	-0.212	-0.095	-0.189	0.088
t-statistic	-1.383	-0.463	-0.828	-1.846*	-0.957	-0.492	-1.682*	0.582
95th	-0.106	0.031	0.024	-0.200	-0.178	-0.006	-0.202	0.070
t-statistic	-0.572	0.174	0.230	-1.597	-1.299	-1.129	-1.294	1.072

Observations and industry-regions as indicated for East and West German ROR between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

margins of banks.

3.3.6 Firms of different size and growth

To the extent that bank market power affects the ability and willingness of financial intermediaries to generate and process private information (Hauswald and Marquez, 2003, 2004, 2006), differences in regional Lerner indices should affect firms that face different information asymmetries also differently. Conventionally, young, non-listed, and small firms are more opaque and are therefore subject to more pronounced information asymmetries. Therefore, we generate four separate samples at the region-industry level by aggregating firms of four different size classes separately: micro firms (€<2 million sales), small firms (€2-10 million sales), medium size firms (€10-50 million sales), and large firms (€>50 million sales).

Tables B.6 through B.9 in Appendix B.5 show according regression results for each of the four growth components. The results are practically insignificant for any firm-size sample and growth component.

3.3.7 Bank market power per pillar and growth

The descriptive analysis in Module I of this report highlighted systematic differences of banks across and within pillars in terms of balance sheets, revenue and expense structure, and various competition measures. Differences in terms of ownership and governance structure represent another reason to suspect that growth effects due to bank market competition differences may differ across banks from different banking groups.

Therefore, we aggregate Lerner indices per region for each banking group separately. We generate average Lerner indices per county using the branching network of each bank as a weighting scheme to account for the fact that, for example, large commercial banks are present in more than just the ROR where the headquarter is located.[12] As explained earlier, compulsory reporting to the branching statistics of Deutsche Bundesbank stopped in 2004. We therefore linearly extrapolate missing values for those banks that discontinued reporting, mostly large commercial banks. Tables 3.16 through 3.19 depict growth regression results for each growth component across (spatially weighted) Lerner indices per banking

[12]The branches of Postbank dominate the bank branch statistics by a very large margin. Therefore, we winsorize the spatial presence of Postbank branches to the maximum number of branches of other commercial banks per region and year in the weighting scheme.

group.

Coefficient estimates for the relationship between regional banking market competition and aggregate output growth are shown in Table 3.16. Coefficients differ across banking groups regarding the direction, magnitude, and significance of effects.[13] Direct terms of increasing bank market power are only weakly significant for large commercial and large cooperative banks. Note that larger branch-weighted Lerner indices for large commercials exhibit a positive effect on aggregate output growth whereas the effect is negative for the large cooperatives. Interaction terms indicate that given dependence on external finance, an increase of the economic margins of regional savings and cooperative banks in home markets reduces output growth. This result confirms the indication in Inklaar et al. (2012) that even the smallest German banks may exert market power that is detrimental to growth.[14] Spatial lags, both direct and interaction terms, suggest that geographical interdependence of banking market competition is of significance for virtually all banking groups. For the most part, these coefficient estimates provide evidence in line with earlier results that more market power in neighboring regions helps to spur aggregate industry output growth in home markets.

The marginal effect estimates of increasing competition per banking group in home markets are depicted in the bottom panel of Table 3.16, and allude to potentially important differences across banking groups. Increasing branch-weighted Lerner indices in home markets of large commercial banks spur output growth significantly up and until median levels of industry-dependence on external finance. For regional savings bank market power, we find in contrast that increasing economic margins hamper growth significantly beyond median dependence on external finance. This result also emerges for central cooperatives and regional co-operatives, albeit with positive effects until the 50th percentile of the *ED* distribution.

[13] The presented results are based on separate specifications of banking-group specific averages of Lerner indices. Joint specification of seven different Lerner indices including according spatial lags and interactions terms yields qualitatively similar results. We treat regions without any branch of banks from a certain banking group as zero to sample the same number of industry-regions and years in each regression. Consequently, we deal with many zeros in the regressions for banking groups with relatively sparse branching networks. This choice explains the (large) point estimates of coefficients for e.g. central cooperatives and mortgage banks. Treating regions without branches as missing yields qualitatively very similar results.

[14] A recent survey of around 1,600 banks and branches by Stiftung Warentest (**?**), a German consumer protection agency, provides anecdotal evidence. Especially cooperative banks charge extremely high interest rates of up to 14% for current account overdrafts, see http://www.test.de/Girokonto-Die-Abzocke-mit-den-Dispozinsen-4590217-0/.

Table 3.16: Aggregate industry output growth across banking group market power

	Commercial banks		Savings banks		Cooperative banks		Mortgage
	Large	*Regional*	*Large*	*Regional*	*Large*	*Regional*	
ED	-0.018*	-0.035***	0.007	-0.017	0.022***	0.000	0.007
	(0.009)	(0.009)	(0.007)	(0.011)	(0.005)	(0.011)	(0.005)
LI	0.142*	-0.069	-0.419	-0.244	-6.926*	0.052	-1.576
	(0.079)	(0.236)	(0.477)	(0.153)	(3.580)	(0.150)	(2.127)
LI×ED	-0.074	0.036	-0.052	-0.051*	-2.027	-0.261***	0.576
	(0.056)	(0.077)	(0.082)	(0.027)	(2.377)	(0.056)	(0.813)
Spatial lag LI	0.564*	-0.228	-0.529	0.464*	28.815*	0.846***	4.784
	(0.341)	(0.432)	(1.114)	(0.253)	(16.024)	(0.306)	(8.197)
Spatial lag LI×ED	0.236***	0.474***	0.090	0.091***	-22.075***	0.153***	-0.047
	(0.072)	(0.113)	(0.382)	(0.026)	(6.071)	(0.032)	(1.609)
R-squared	0.064	0.065	0.063	0.064	0.064	0.065	0.063
5th	0.288**	-0.141	-0.316	-0.142	-2.909**	0.569	-2.718
t-statistic	1.986	-0.285	-0.881	-0.912	-2.309	1.281	-0.736
25th	0.181**	-0.088	-0.392	-0.217	-5.866	0.189	-1.878
t-statistic	2.042	-0.358	-0.704	-1.431	-1.449	0.289	-0.628
50th	0.139*	-0.067	-0.421	-0.246	-6.995	0.043***	-1.557
t-statistic	1.762	-0.474	-0.845	-1.609	-0.445	3.352	-0.845
75th	0.096	-0.046	-0.452	-0.276**	-8.183**	-0.110**	-1.219
t-statistic	1.171	0.024	-0.946	-2.089	-2.070	-2.371	-0.797
95th	-0.011	0.006	-0.527	-0.350*	-11.110**	-0.486	-0.387
t-statistic	-0.083	-0.196	-0.910	-1.777	-1.964	-0.686	-0.194

The dependent variable is $\Delta \ln Y$. Lerner indices per banking group weighted with branch share per bank per ROR. Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

These results suggest that higher bank market power can be beneficial to growth if selected banking groups (large commercials, regional co-operatives) are able to realize higher economic margins *and* if firms are not structurally dependent on external finance to a large degree.

Table 3.17 focuses next on the growth due to factor accumulation. The results mimic to some extent those obtained for aggregate output growth, but are generally weaker in terms of statistical significance. Interaction terms of home market Lerner indices and dependence on external finance are negative for large commercials, large savings, and regional cooperative banks, albeit only at the 10%-level for the former two banking groups. Interaction terms in neighboring regions, in turn, are significantly different from zero for all but mortgage banks. Except for large cooperative banks, these coefficients are consistently positive.

Marginal effects provide some evidence that at low levels of structural dependence on external finance, higher Lerner indicators of large commercial banks are conducive to factor growth. For regional cooperative banks we find that an increase in home market Lerner

Table 3.17: Factor growth across banking group market power

	Commercial banks		Savings banks		Cooperative banks		Mortgage
	Large	*Regional*	*Large*	*Regional*	*Large*	*Regional*	
ED	-0.014	-0.031***	0.010	-0.014	0.024***	-0.007	0.007
	(0.011)	(0.010)	(0.007)	(0.011)	(0.005)	(0.011)	(0.005)
LI	0.053	-0.081	0.679	-0.140	-2.295	0.005	-2.595
	(0.064)	(0.205)	(0.618)	(0.131)	(3.986)	(0.148)	(1.855)
LI×ED	-0.106*	-0.041	-0.047	-0.051*	-1.665	-0.199***	0.084
	(0.057)	(0.073)	(0.078)	(0.029)	(2.469)	(0.059)	(0.755)
Spatial lag LI	0.088	0.412	-0.495	0.155	-2.229	0.596*	-6.728
	(0.367)	(0.427)	(1.132)	(0.236)	(17.737)	(0.313)	(8.700)
Spatial lag LI×ED	0.245***	0.508***	0.109	0.093***	-20.098***	0.156***	1.272
	(0.080)	(0.122)	(0.375)	(0.028)	(5.992)	(0.033)	(1.639)
R-squared	0.052	0.054	0.052	0.053	0.053	0.053	0.052
5th	0.262	0.001	0.772	-0.039	1.003	0.399	-2.761
t-statistic	-1.252	-0.285	1.159	-1.079	-0.593	-0.015	-1.273
25th	0.108**	-0.060	0.704	-0.113	-1.425	0.109	-2.639
t-statistic	1.990	0.003	1.095	-0.289	-0.321	0.743	-1.407
50th	0.049	-0.083	0.678	-0.142	-2.352	-0.002***	-2.592
t-statistic	1.510	-0.512	1.306	-0.874	-0.990	2.290	-1.378
75th	-0.013	-0.107	0.650	-0.172	-3.328	-0.119**	-2.543
t-statistic	-0.174	-0.403	0.853	-1.610	0.145	-1.990	-0.956
95th	-0.165	-0.167	0.583	-0.246	-5.729	-0.406	-2.422
t-statistic	0.771	-0.664	1.025	-1.270	-0.839	-0.757	-1.513

The dependent variable is $\Delta \ln X$. Lerner indices per banking group weighted with branch share per bank per ROR. Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

indices paired with moderate levels of dependence reduces factor growth. Economically, this effect is negligible at the median levels of dependence, but accounts for 12 basis points at the 75th percentile. Remaining banking groups exhibit no significant marginal effects.

Table 3.18 considers the technical change component of output growth per banking group. Marginal effects indicate across all but two banking sectors, namely large commercial and regional savings banks, a negative influence of increasing home market power of banks on growth arising from technological progress. The significance of these effects varies substantially across the distribution of dependence on external finance, but is fairly consistent regarding the direction of effects. The magnitude of these effects is large, ranging from around 17 basis points growth reduction for regional commercials at the median of the ED distribution to 2.5 percentage points for mortgage bank market power increases at low levels of external dependence.

Table 3.19 shows that growth due to the reallocation of resources is largely unaffected when considering market power per banking group separately. Paired with the absence of results when separating aggregate growth components for firms of different size classes,

Table 3.18: Technical change across banking group market power

	Commercial banks		Savings banks		Cooperative banks		Mortgage
	Large	*Regional*	*Large*	*Regional*	*Large*	*Regional*	
ED	0.005	-0.013***	0.001	0.001	0.007***	0.015**	0.004
	(0.006)	(0.005)	(0.003)	(0.006)	(0.002)	(0.006)	(0.003)
LI	0.029	-0.177	-0.548*	-0.011	-3.508*	-0.005	-2.084
	(0.048)	(0.127)	(0.322)	(0.084)	(2.126)	(0.075)	(1.333)
LI×ED	0.010	0.099**	0.004	-0.016	1.221	-0.124***	0.848*
	(0.034)	(0.048)	(0.050)	(0.014)	(1.317)	(0.032)	(0.509)
Spatial lag LI	0.442**	-0.064	-0.879	0.304**	19.097**	0.389**	3.451
	(0.180)	(0.232)	(0.557)	(0.136)	(9.493)	(0.175)	(4.700)
Spatial lag LI×ED	-0.022	0.125**	0.090	0.012	-7.257**	0.019	-1.090
	(0.043)	(0.062)	(0.186)	(0.015)	(3.017)	(0.017)	(0.925)
Observations	0.027	0.028	0.027	0.027	0.027	0.028	0.027
5th	0.009	-0.373*	-0.556	0.0207	-5.926	0.242	-3.765
t-statistic	0.670	-1.688	-1.634	0.237	-1.636	-1.003	-1.361
25th	0.024	-0.229	-0.550*	-0.003	-4.146	0.060	-2.528*
t-statistic	0.101	0.197	-1.836	-0.491	-1.634	-0.117	-1.658
50th	0.029	-0.173**	-0.548*	-0.012	-3.466	-0.009	-2.055
t-statistic	0.426	-2.107	-1.751	-0.031	-0.313	-2.378	-0.334
75th	0.035	-0.115	-0.546*	-0.021	-2.751	-0.082	-1.558
t-statistic	0.745	-0.940	-1.698	-0.247	-1.280	0.826	-1.555
95th	0.049	0.0275	-0.540	-0.044	-0.990*	-0.261***	-0.334*
t-statistic	0.611	-1.372	-1.459	-0.137	-1.772	2.781	-1.755

The dependent variable is $\Delta \ln A$. Lerner indices per banking group weighted with branch share per bank per ROR. Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

this outcome my indicate that it is especially the reallocation of corporates' resources across firms of different size (and sectors) due to competition between, rather than within banking pillars. A more detailed modeling of resource reallocation that relies on observed bank credit-firm investment relationships therefore seems useful for future research.

3.4 Conclusion

This module tests whether regional differences in banking market competition and other bank traits can explain differences in regional industry output growth. For identification we rely on the assumptions that different sectors of the economy require structurally different levels of external finance as in Rajan and Zingales (1998) and that banking markets are regionally delineated. In addition to aggregate industry growth, we decompose output growth into three components as suggested in Basu et al. (2009) and applied to primarily German micro firms in Inklaar et al. (2012).

Table 3.19: Reallocation across banking group market power

	Commercial banks		Savings banks		Cooperative banks		Mortgage
	Large	*Regional*	*Large*	*Regional*	*Large*	*Regional*	
ED	-0.019***	0.006	-0.005	-0.000	-0.003	-0.010	-0.002
	(0.007)	(0.006)	(0.003)	(0.007)	(0.002)	(0.007)	(0.003)
LI	-0.114	0.023	0.087	-0.047	1.091	-0.018	2.086
	(0.098)	(0.147)	(0.500)	(0.095)	(2.418)	(0.096)	(1.397)
LI×ED	0.038	-0.027	-0.018	0.003	-1.326	0.051	-0.304
	(0.040)	(0.048)	(0.034)	(0.014)	(1.377)	(0.037)	(0.537)
Spatial lag LI	-0.274	-0.015	-0.290	0.050	11.618	-0.238	4.590
	(0.238)	(0.274)	(0.732)	(0.163)	(10.644)	(0.216)	(5.357)
Spatial lag LI×ED	0.092*	-0.105	0.017	-0.013	-1.404	-0.008	-0.794
	(0.050)	(0.076)	(0.173)	(0.018)	(3.296)	(0.020)	(1.055)
R-squared	0.016	0.016	0.016	0.016	0.016	0.016	0.016
5th	-0.189	0.076	0.122	-0.053	3.719	-0.119	2.688
t-statistic	-1.232	0.442	0.173	-0.400	0.647	-0.460	1.349
25th	-0.134	0.0369	0.097	-0.049	1.784	-0.0449	2.245
t-statistic	-1.149	-0.178	0.196	-0.494	0.119	-0.173	1.492
50th	-0.113	0.022	0.087	-0.047	1.046	-0.0167	2.075
t-statistic	-0.989	0.042	0.096	-0.554	0.876	0.132	0.970
75th	-0.090	0.006	0.076	-0.045	0.268	0.0131	1.897
t-statistic	-0.360	0.150	0.257	-0.469	0.435	0.693	1.491
95th	-0.036	-0.032	0.051	-0.041	-1.646	0.0862	1.458
t-statistic	-1.272	0.250	0.150	-0.515	-0.549	-0.991	1.419

The dependent variable is $\Delta \ln R$. Lerner indices per banking group weighted with branch share per bank per ROR. Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

For the complete sample of 21 industries in 96 German agglomeration areas between 1994 and 2011, we find that increasing regional Lerner margins reduce aggregate output growth per region-industry. An increase of average Lerner indices reduces output growth by 18 to 28 basis points for higher than median structural dependence on external finance of the industry. This magnitude is economically significant given median industry growth on the order of 1.7%. Because strict geographic segmentation of regional banking markets is a critical assumption regarding large banks from any banking pillar, we also specify so-called spatial lags as in Anselin (1988). Spatially lagged Lerner indices resemble (inverse) distance-weighted indicators of competition in neighboring regions. The specification of spatial lags further amplifies the negative magnitude of marginal effects to the range 20 to 37 basis points in growth reduction. Individual growth components are barely significantly related to regional differences in competition, and the explanatory power of the regressions is even for panel regressions mediocre at most.

The negative growth effects are largely absent for the period prior to the Great Financial Crisis. During the years 2008-2011 we find, however, that especially growth due to the re-

allocation of resources from unproductive to productive corporates responded significantly negative to increasing banking market competition.

Analyses using alternative indicators of market structure and competition confirm a number of these findings. Larger market shares, and for high levels of dependence on external finance also price-cost margins (PCM), yield a negative aggregate growth effect as well. Negative aggregate growth effects are also born out by simple concentration indicators. But both former measures highlight also numerous differences regarding the influence on growth components. Larger market shares reduce growth due to factor accumulation and technical change but increase growth due to reallocation. The results of PCM on growth components is exactly opposite to these findings. Consequently, different measures of market power and market structure convey different information. Neither market shares nor PCM are per se an impediment to real growth for as long banks do not extract economic rents as approximated by Lerner indices.

Next, we consider various bank traits that gauge contemporary regulation, namely simple proxies for liquidity, funding structure, and capitalization. Differences in average regional bank liquidity differences do not correlate with growth. For firms facing high structural dependence on external finance, larger average wholesale funding shares indicate a negative effect for factor accumulation, but more growth due to positive reallocation contributions. A larger reliance on fixed term deposit funding, in turn, reduces both aggregate output growth as well as technological progress, again though only for the most dependent industries. Gross equity ratios do not correlate strongly with growth components, but the share of capital support of total equity in regional banking markets provides some indications of inferior reallocation growth and technological progress.

We further document the results are neither driven by East German regions or firms of a particular size group alone. Banking market competition indicators per banking group indicate, however, some qualitatively differences regarding their growth impact. A general pattern appears to be that increasing Lerner margins paired with high industry dependence on external finance depresses growth.

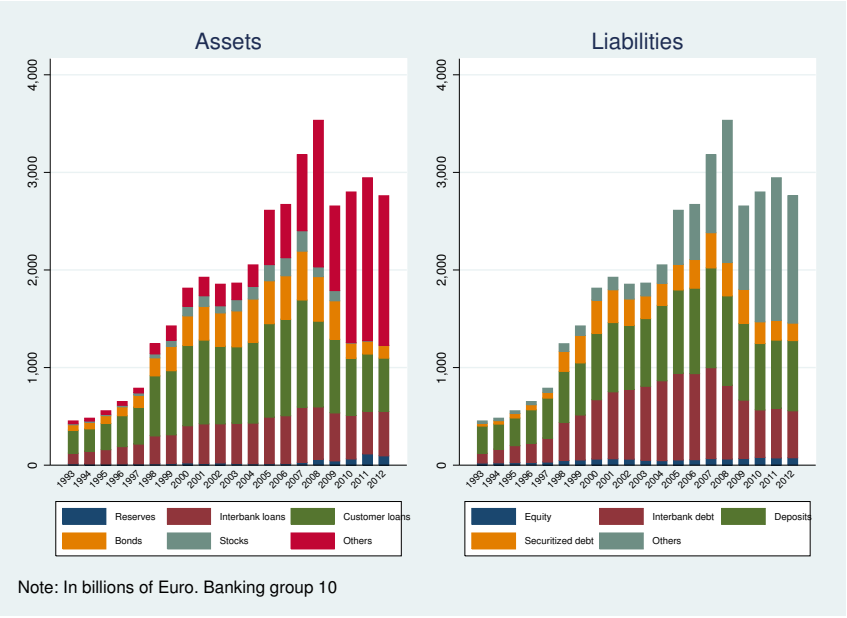
Appendix A

Appendix Module I

A.1 Balance sheet composition over time per banking group

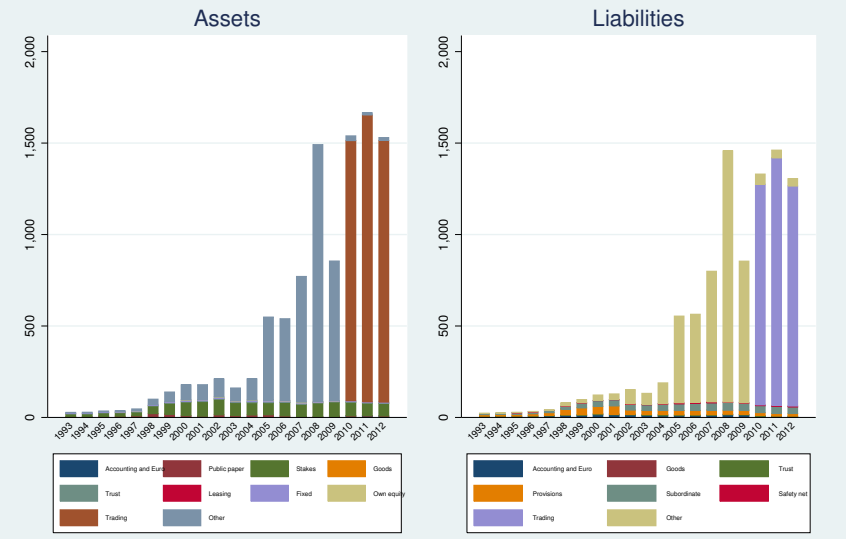
This appendix shows for each banking group aggregate balance sheet compositions over time for the main asset and liability categories as well as a more detailed view on other assets and liabilities.

Figure A.1: Balance sheet composition large commercial banks



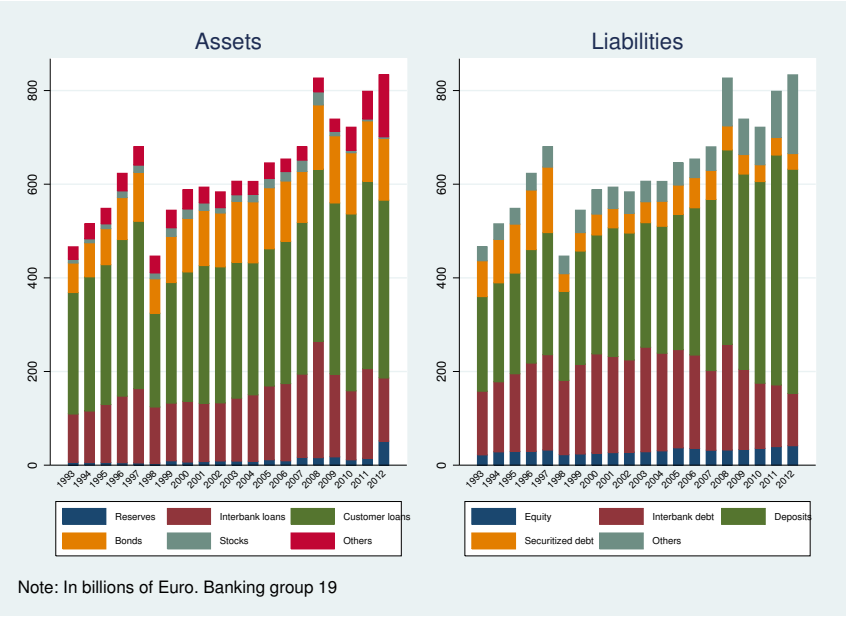
Note: In billions of Euro. Banking group 10

Figure A.2: Detail on other assets and liabilities large commercial banks



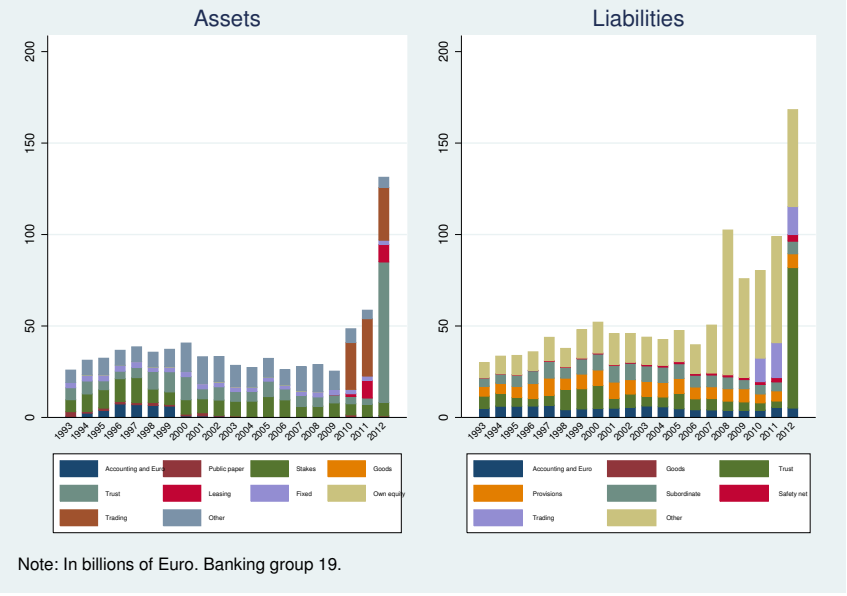
Note: In billions of Euro. Banking group 10.

Figure A.3: Balance sheet composition regional commercial banks



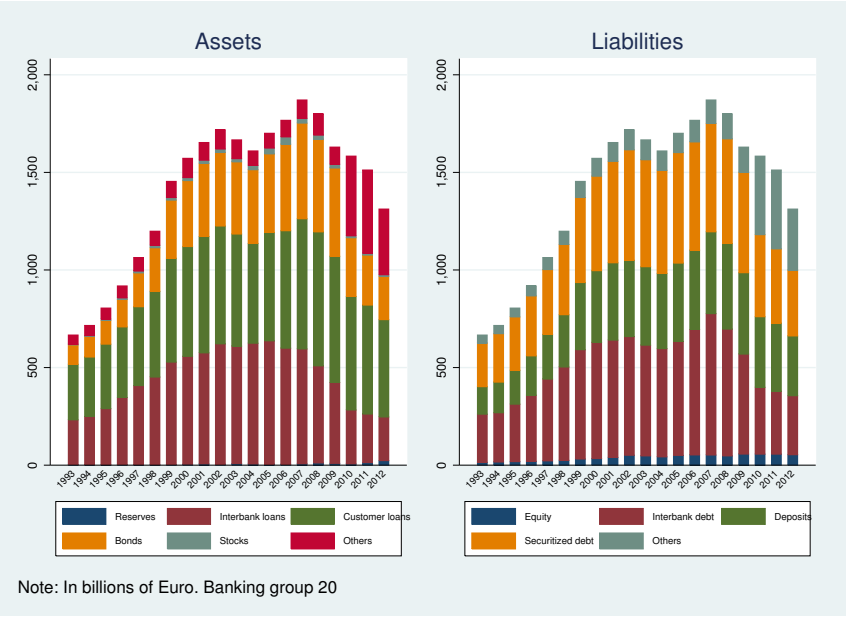
Note: In billions of Euro. Banking group 19

Figure A.4: Detail on other assets and liabilities regional commercial banks



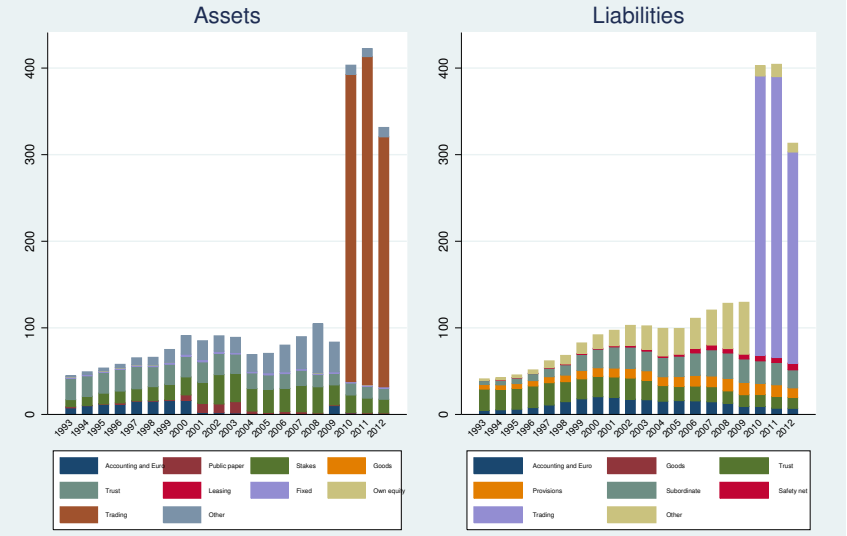
Note: In billions of Euro. Banking group 19.

Figure A.5: Balance sheet composition large savings banks



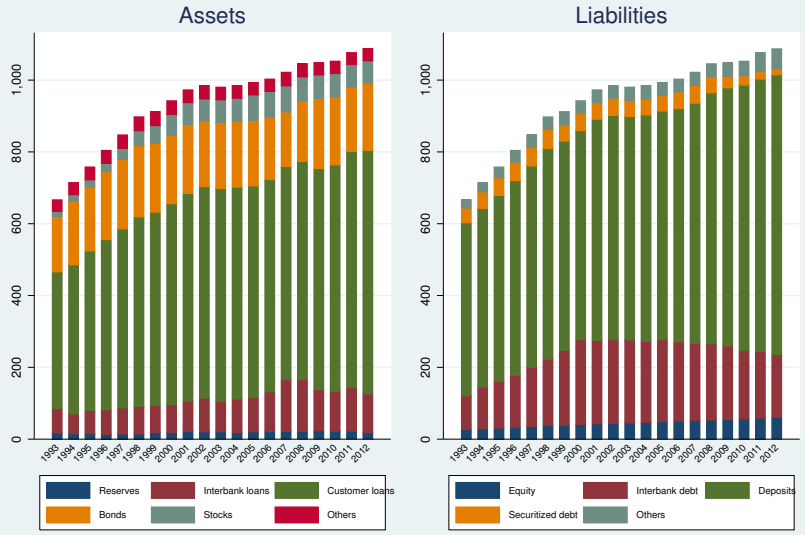
Note: In billions of Euro. Banking group 20

Figure A.6: Detail on other assets and liabilities large savings banks



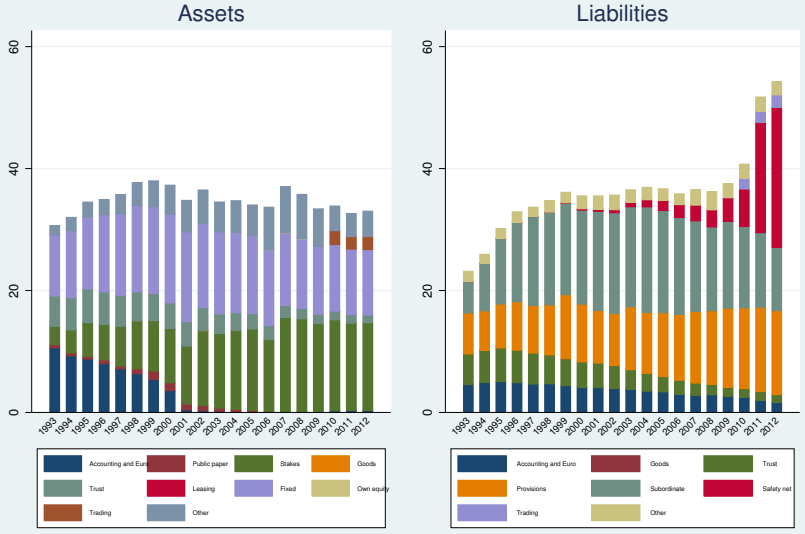
Note: In billions of Euro. Banking group 20.

Figure A.7: Balance sheet composition regional savings banks



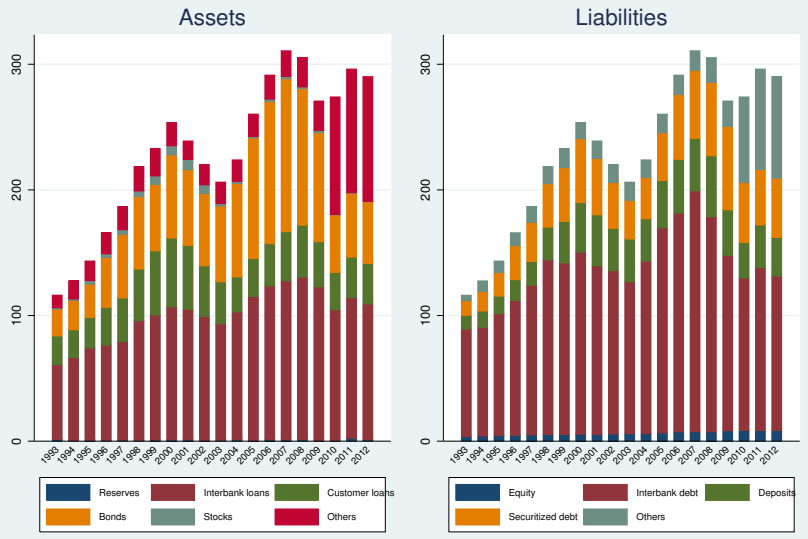
Note: In billions of Euro. Banking group 29

Figure A.8: Detail on other assets and liabilities regional savings banks



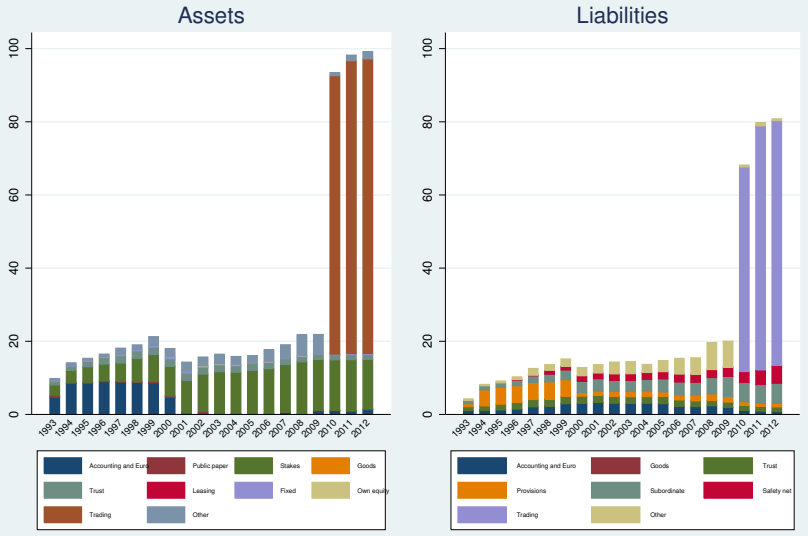
Note: In billions of Euro. Banking group 29.

Figure A.9: Balance sheet composition large cooperative banks



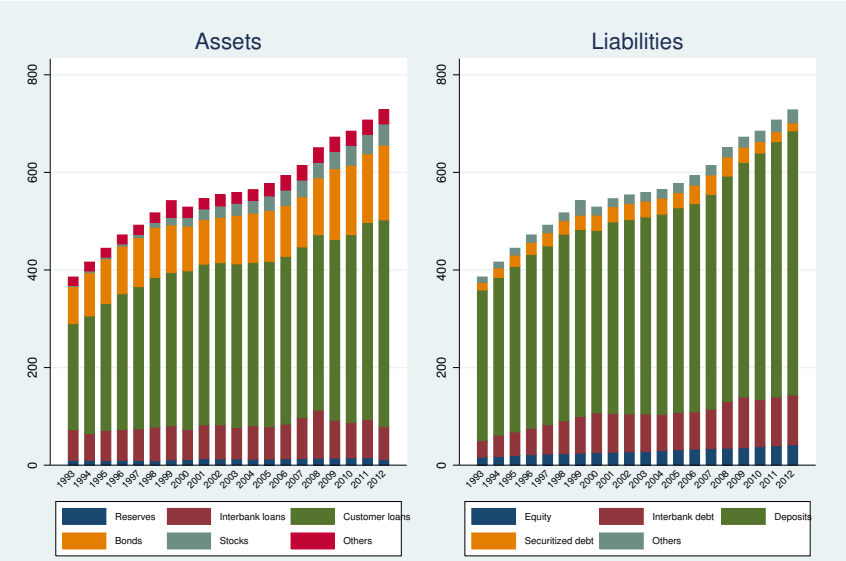
Note: In billions of Euro. Banking group 30

Figure A.10: Detail on other assets and liabilities large cooperative banks



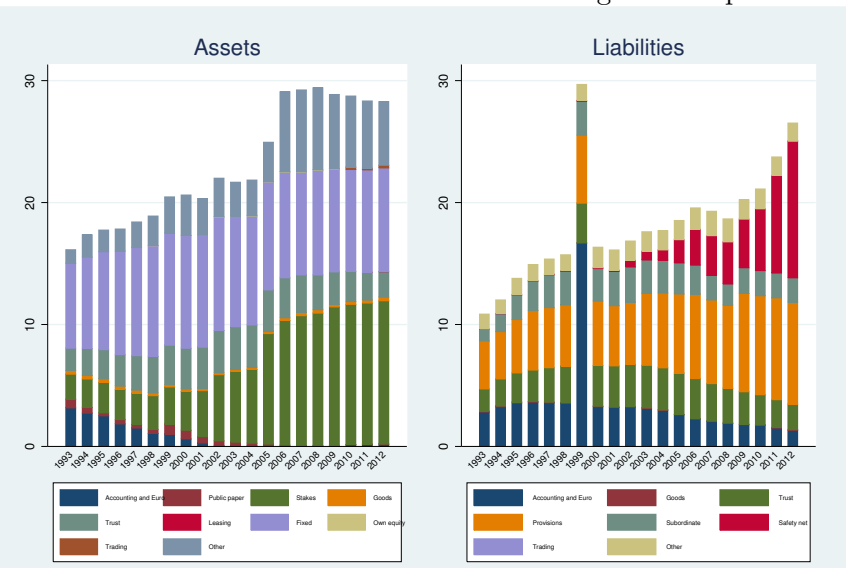
Note: In billions of Euro. Banking group 30.

Figure A.11: Balance sheet composition regional cooperative banks



Note: In billions of Euro. Banking group 39

Figure A.12: Detail on other assets and liabilities regional cooperative banks

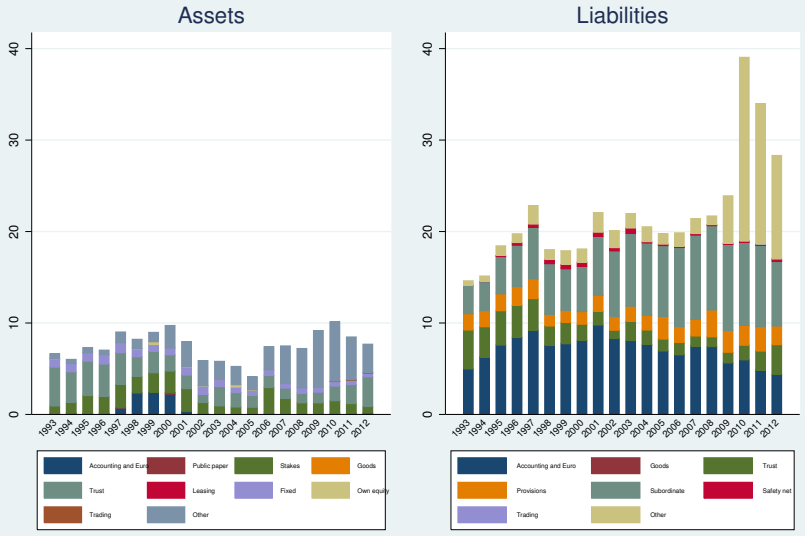


Note: In billions of Euro. Banking group 39.

Figure A.13: Balance sheet composition mortgage banks

Note: In billions of Euro. Banking group 40

Figure A.14: Detail on other assets and liabilities mortgage banks

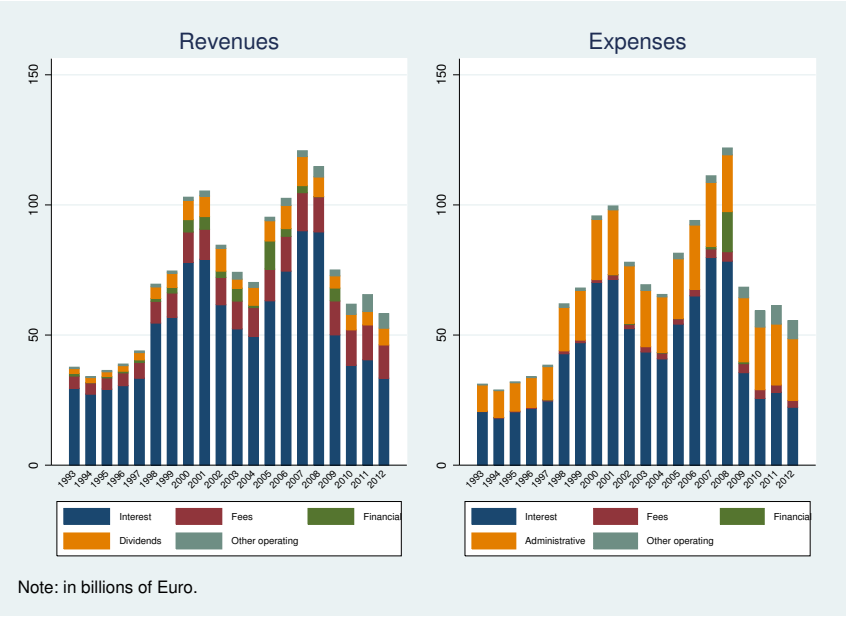


Note: In billions of Euro. Banking group 40.

A.2 Profit and loss account composition over time per banking group

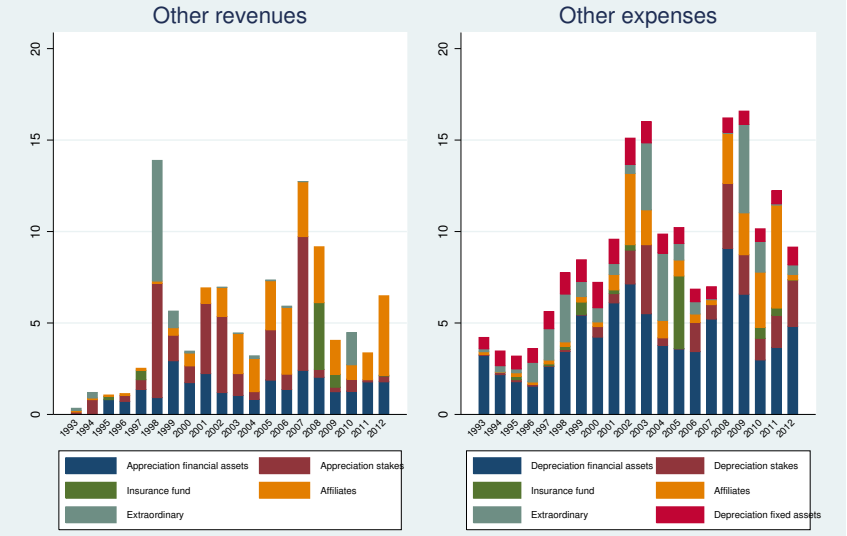
This appendix shows for each banking group aggregate profit and loss account compositions over time for the main revenue and expense categories as well as a more detailed view on other revenues and expenses.

Figure A.15: Revenues and expenses large commercial banks



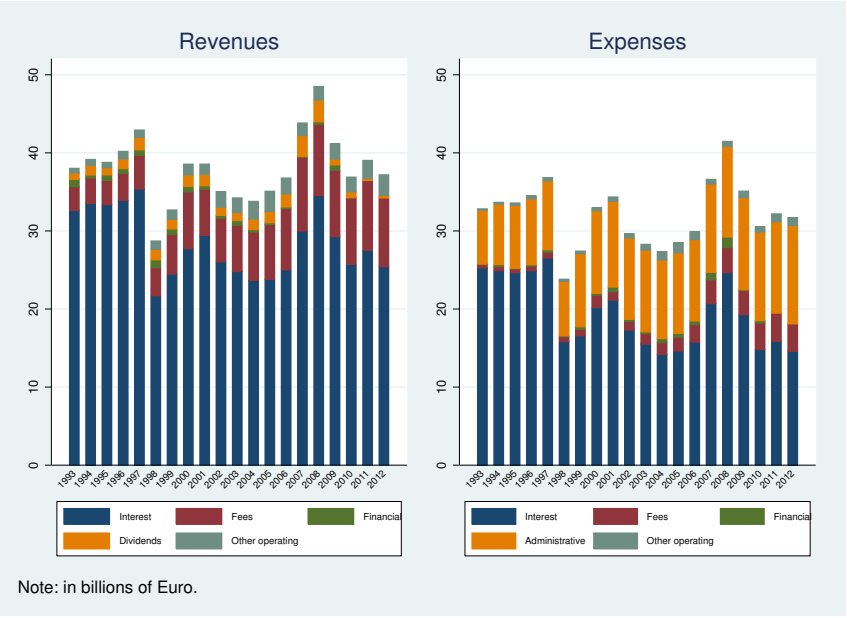
Note: in billions of Euro.

Figure A.16: Other revenues and expenses large commercial banks



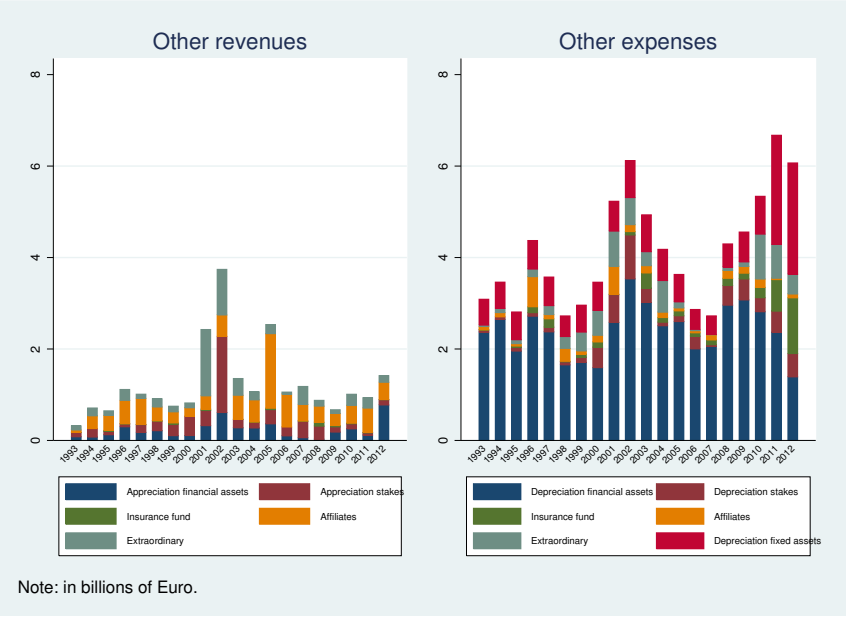
Note: in billions of Euro.

Figure A.17: Revenues and expenses regional commercial banks



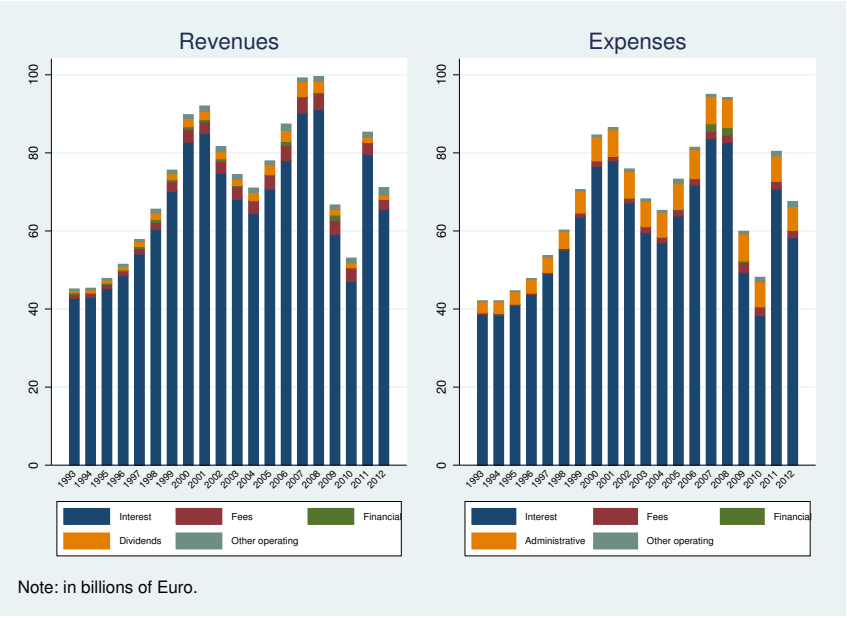
Note: in billions of Euro.

Figure A.18: Other revenues and expenses regional commercial banks



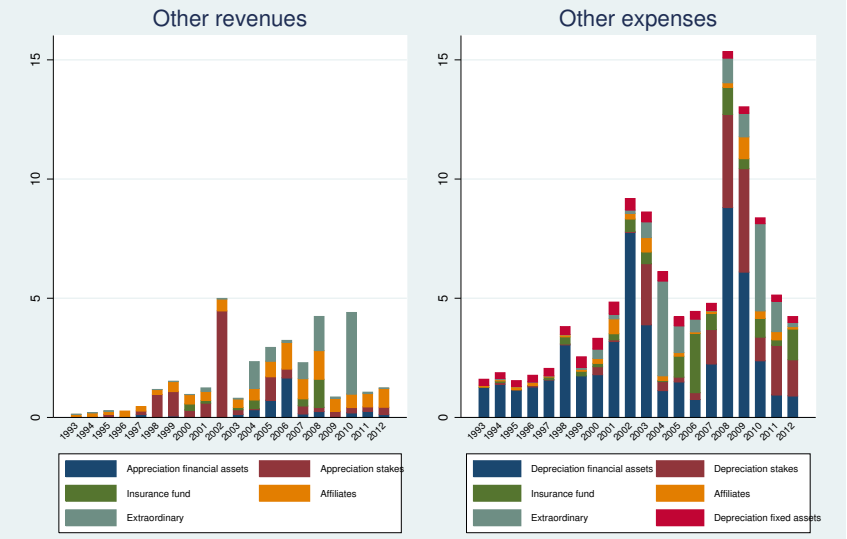
Note: in billions of Euro.

Figure A.19: Revenues and expenses large savings banks



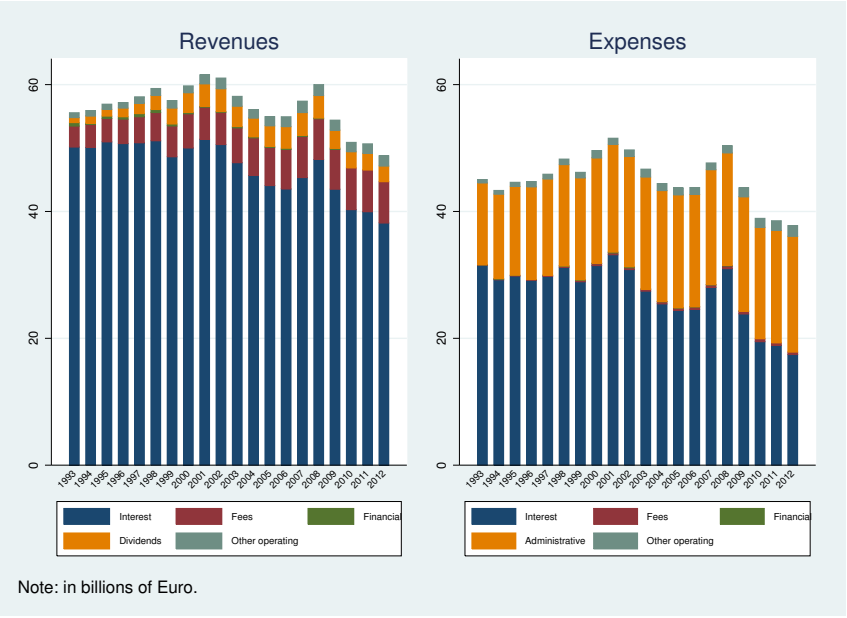
Note: in billions of Euro.

Figure A.20: Other revenues and expenses large savings banks



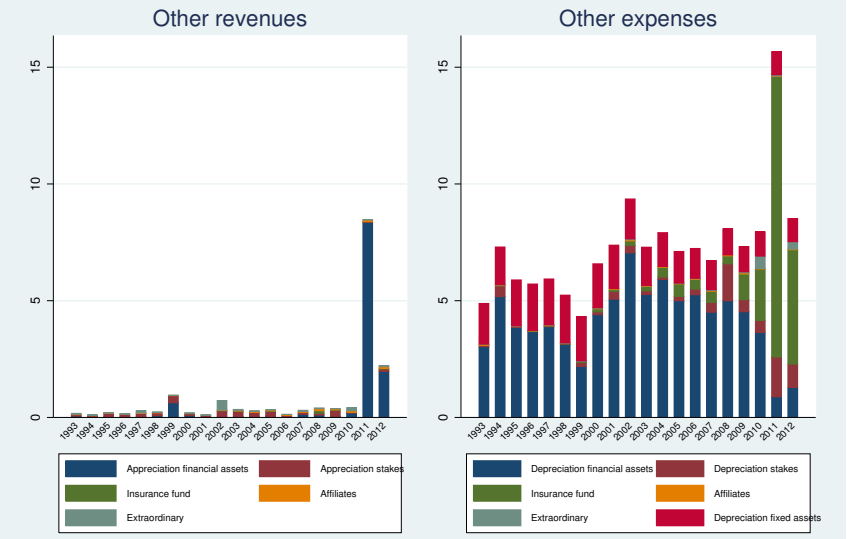
Note: in billions of Euro.

Figure A.21: Revenues and expenses regional savings banks



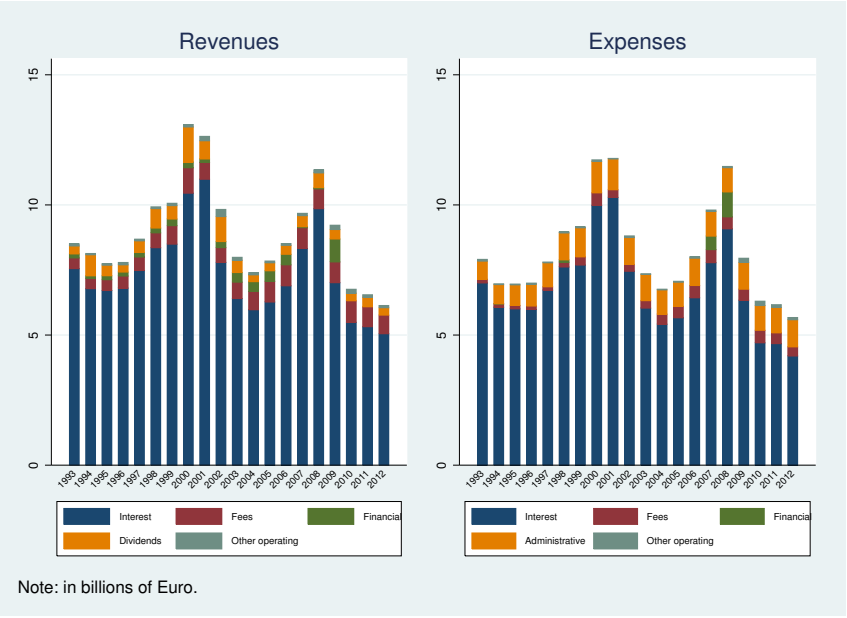
Note: in billions of Euro.

Figure A.22: Other revenues and expenses regional savings banks



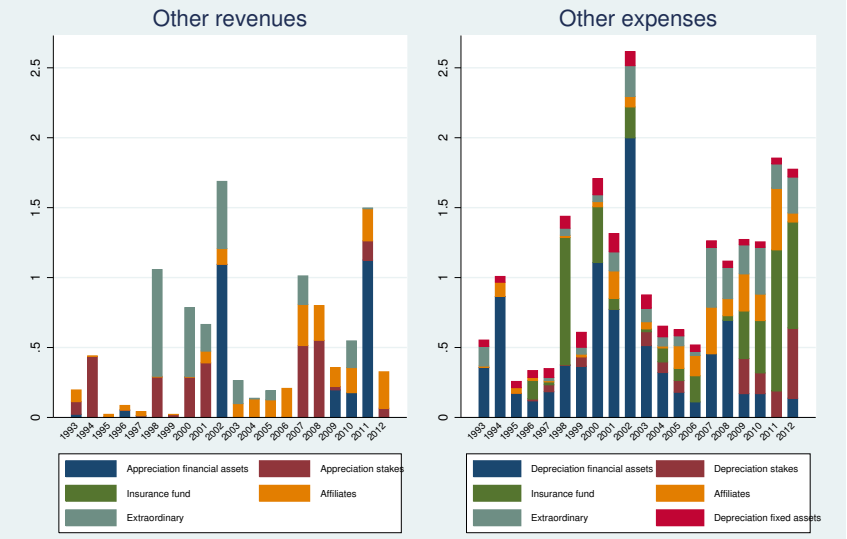
Note: in billions of Euro.

Figure A.23: Revenues and expenses large cooperative banks



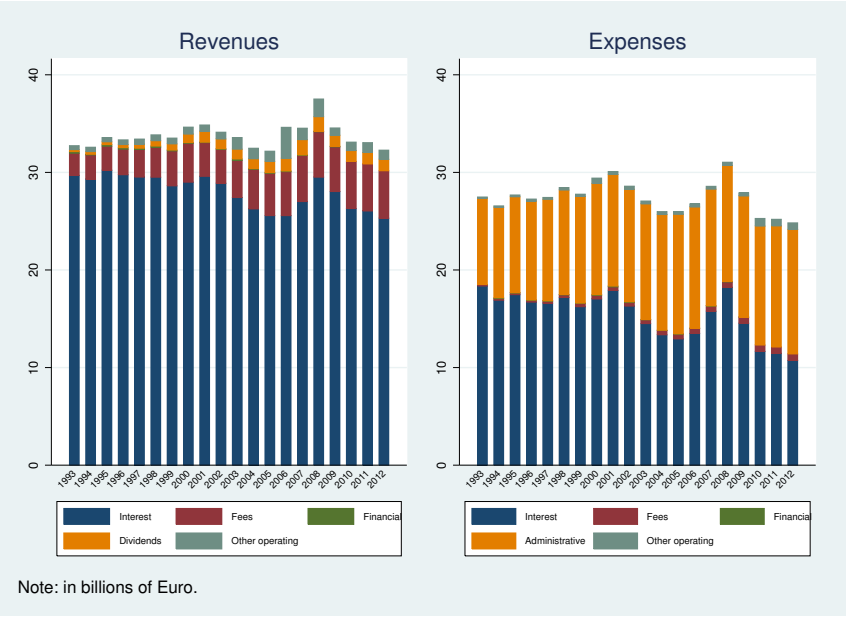
Note: in billions of Euro.

Figure A.24: Other revenues and expenses large cooperative banks



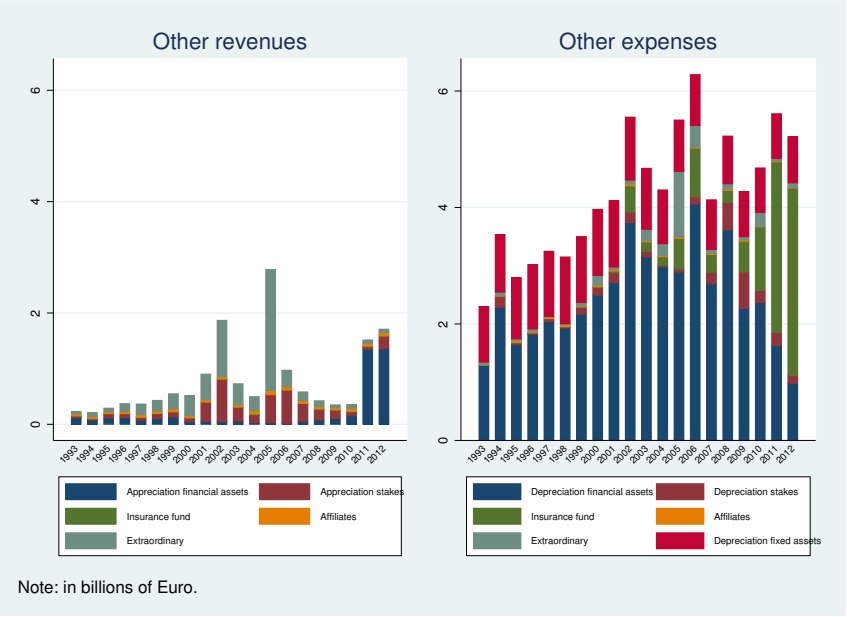
Note: in billions of Euro.

Figure A.25: Revenues and expenses regional cooperative banks



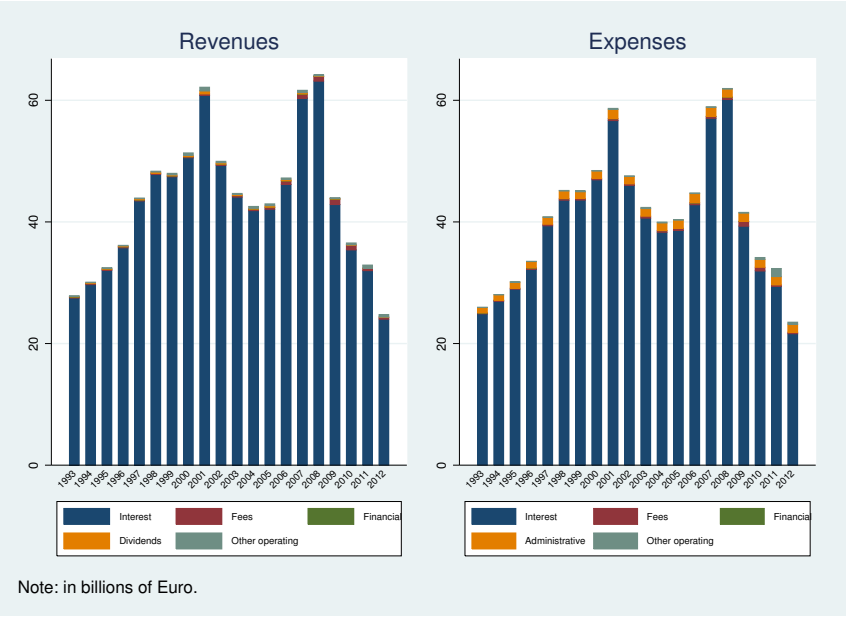
Note: in billions of Euro.

Figure A.26: Other revenues and expenses regional cooperative banks



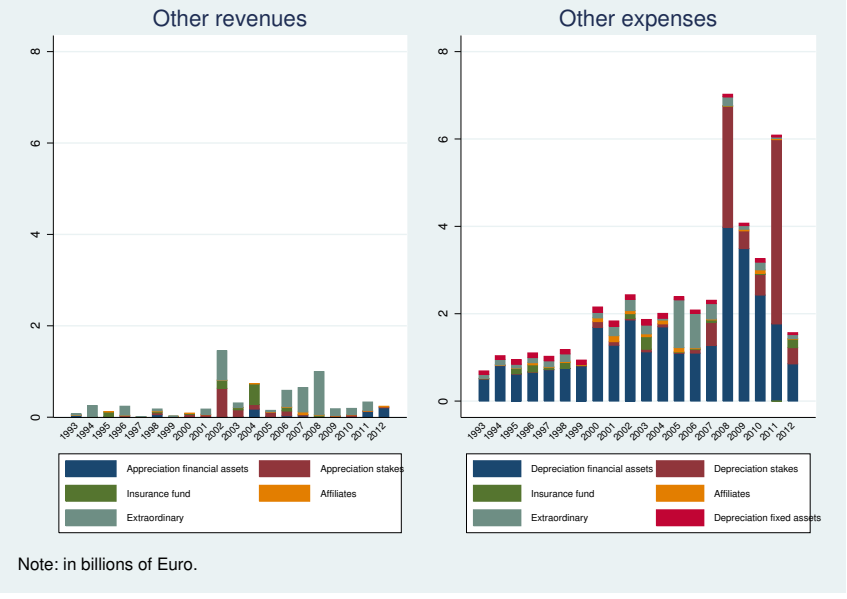
Note: in billions of Euro.

Figure A.27: Revenues and expenses mortgage banks



Note: in billions of Euro.

Figure A.28: Other revenues and expenses mortgage banks



Note: in billions of Euro.

A.3 Key performance indicators per banking group over time

This appendix shows the evolution of seven key performance indicators over time per banking group. All values are in percent. We depict the median of each KPI due to the presence of large outliers.

Figure A.29: Key-performance indicators large commercials

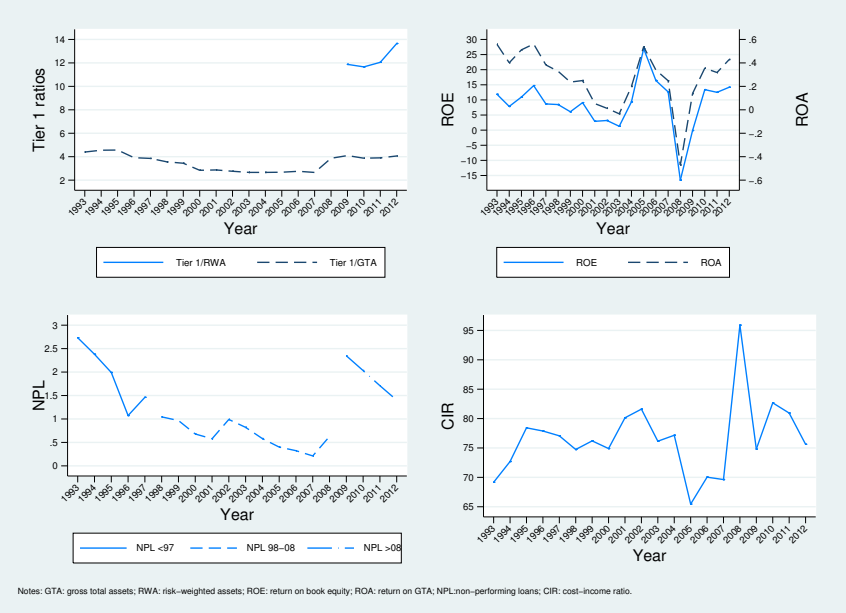
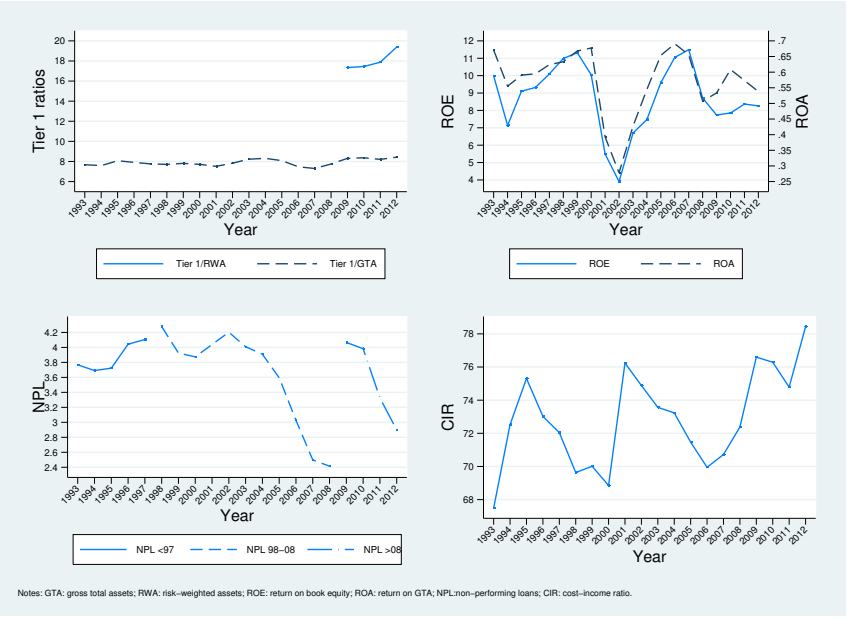
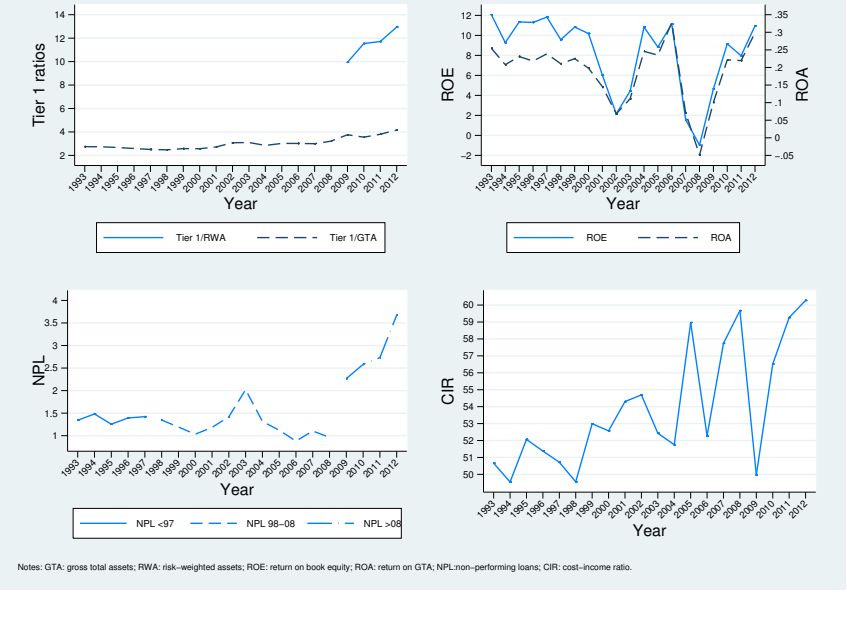


Figure A.30: Key-performance indicators regional commercials



Notes: GTA: gross total assets; RWA: risk–weighted assets; ROE: return on book equity; ROA: return on GTA; NPL:non–performing loans; CIR: cost–income ratio.

Figure A.31: Key-performance indicators large savings



Notes: GTA: gross total assets; RWA: risk–weighted assets; ROE: return on book equity; ROA: return on GTA; NPL:non–performing loans; CIR: cost–income ratio.

Figure A.32: Key-performance indicators regional savings

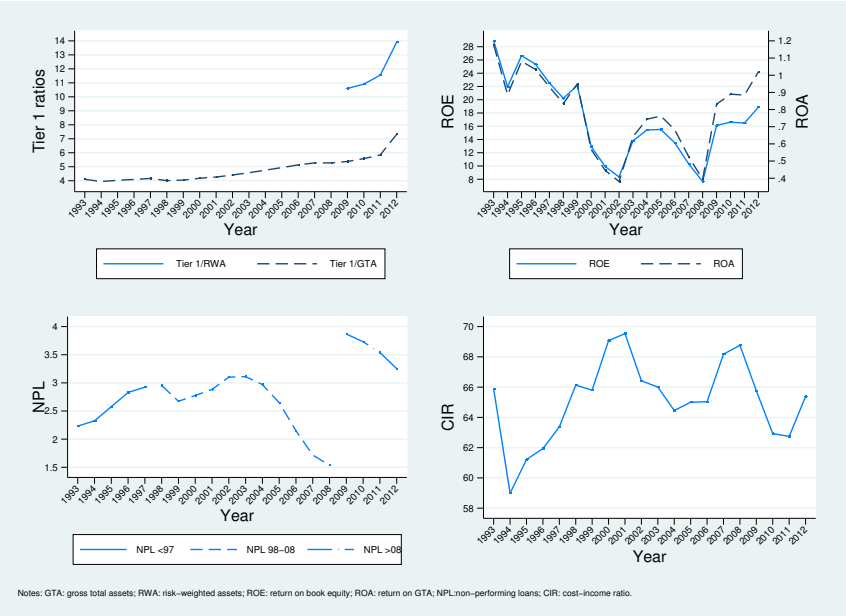


Figure A.33: Key-performance indicators large cooperatives

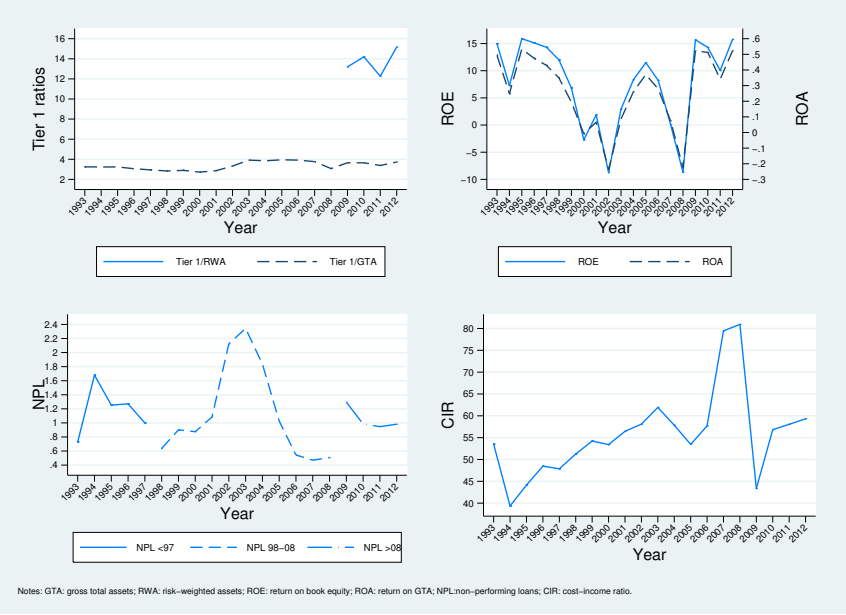


Figure A.34: Key-performance indicators regional cooperatives

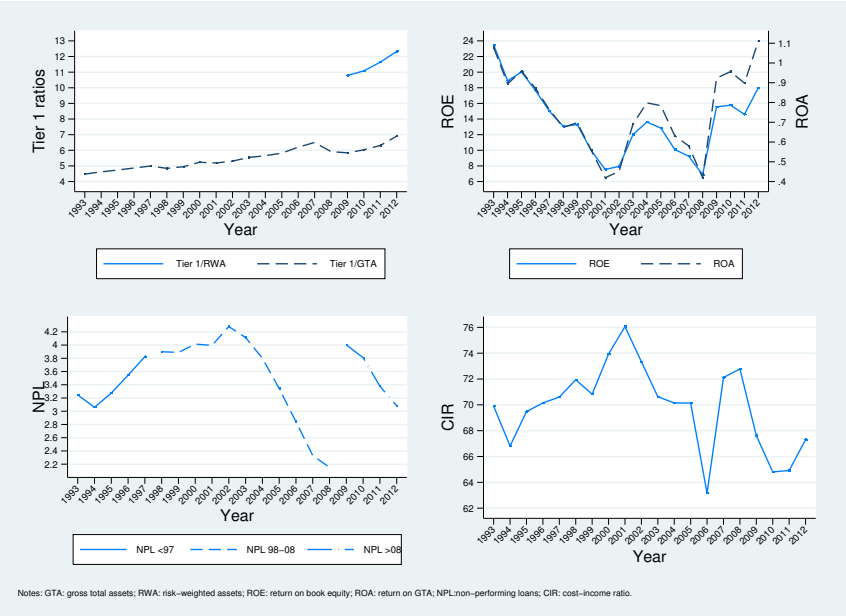
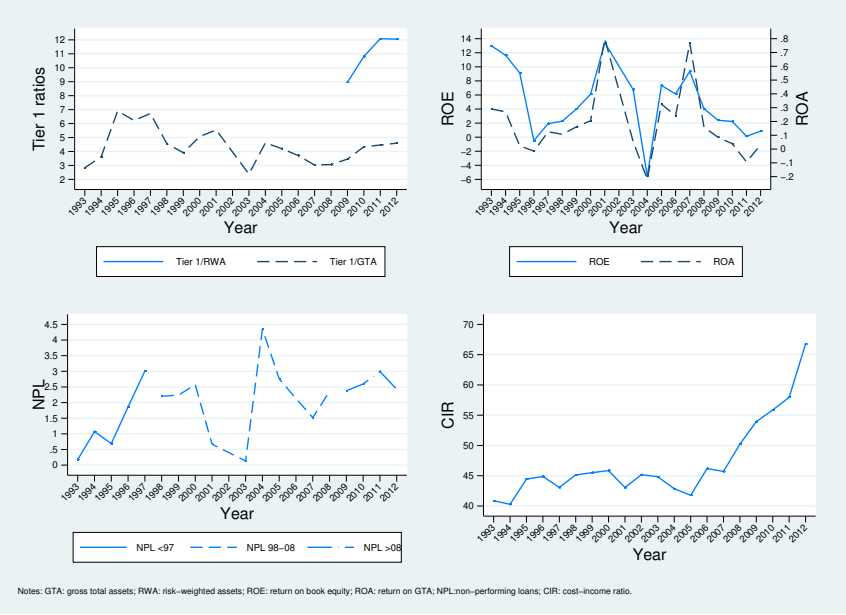


Figure A.35: Key-performance indicators mortgage banks



A.4 Lerner indices and components over time per banking group

This appendix shows for each banking group mean Lerner indices and associated marginal cost and average revenue components.

Figure A.36: Lerner index and components large commercial banks

Figure A.37: Lerner index and components regional commercial banks

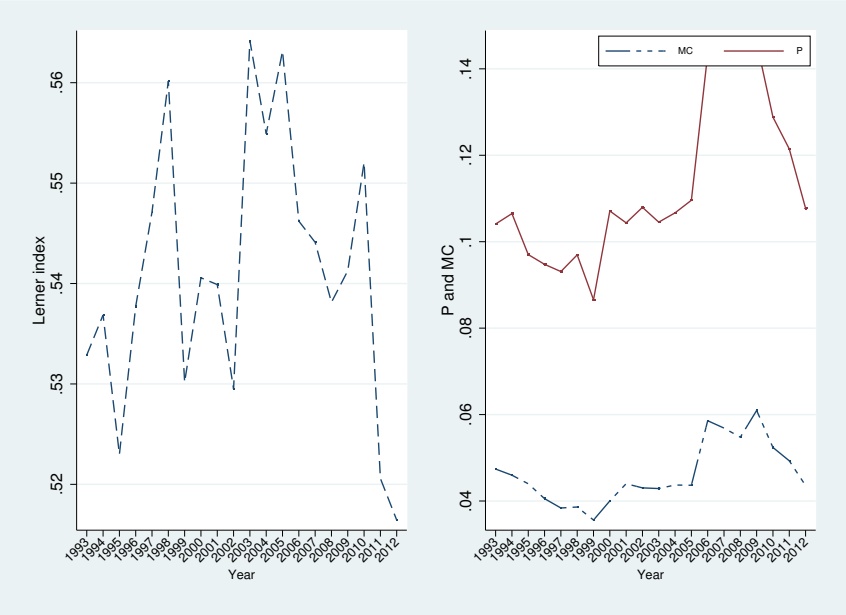


Figure A.38: Lerner index and components large savings banks

Figure A.39: Lerner index and components regional savings banks

Figure A.40: Lerner index and components large cooperative banks

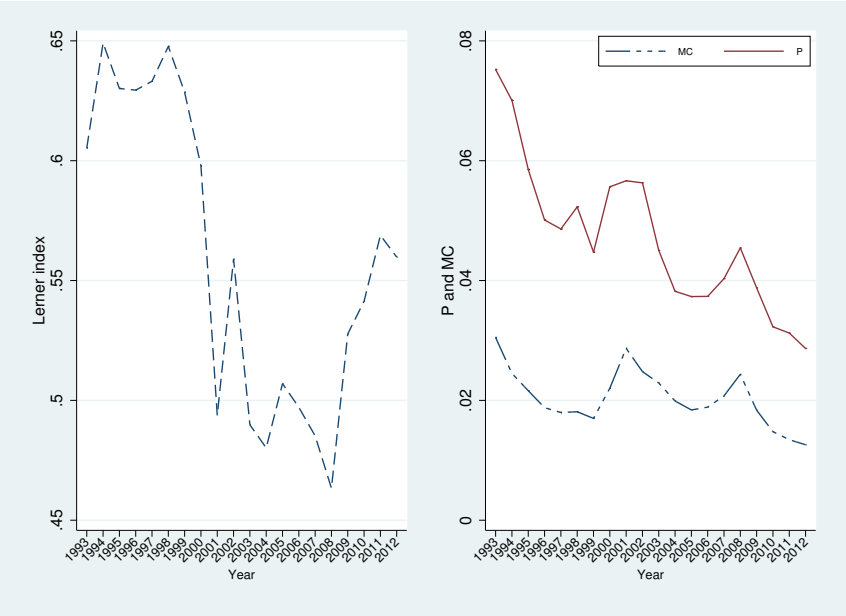


Figure A.41: Lerner index and components regional cooperative banks

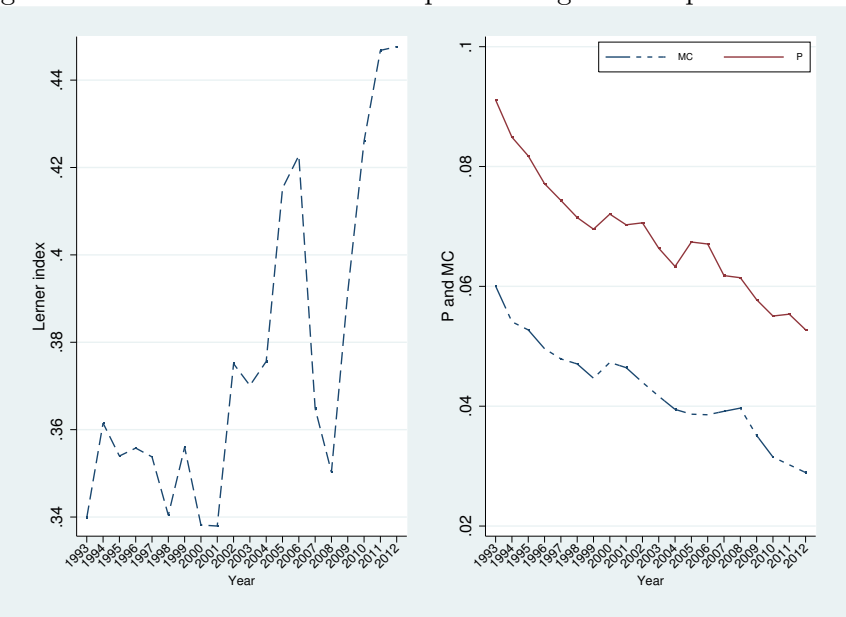


Figure A.42: Lerner index and components mortgage banks

A.5 Parameter estimates LCM stochastic cost frontier

Table A.1: Parameter estimates latent class stochastic cost frontier

Group	**1**		**2**		**3**		**4**	
	β	p-value	β	p-value	β	p-value	β	p-value
Constant	-1.326	0.000	-2.355	0.000	-2.915	1.000	-2.433	0.000
A1	0.111	0.000	0.023	0.000	0.125	0.000	0.091	0.000
A2	0.010	0.324	0.088	0.000	0.352	0.000	0.142	0.000
B1	0.094	0.000	0.074	0.000	0.001	0.593	0.135	0.000
B2	0.211	0.000	0.547	0.000	0.454	0.000	0.396	0.000
B3	0.099	0.000	0.211	0.000	0.079	0.000	0.282	0.000
B4	0.004	0.000	0.006	0.000	-0.054	0.000	0.021	0.000
C1	0.486	0.000	0.143	0.000	0.538	0.000	0.152	0.000
G1	0.005	0.018	-0.040	0.000	-0.006	0.003	-0.003	0.040
G2	-0.004	0.000	0.000	0.018	0.002	0.000	0.002	0.000
G11	-0.007	0.000	-0.001	0.000	0.003	0.000	-0.004	0.000
G12	-0.003	0.000	0.003	0.000	-0.004	0.000	-0.008	0.000
G13	-0.006	0.000	-0.003	0.000	-0.002	0.000	-0.009	0.000
G14	-0.003	0.000	0.000	0.469	0.000	0.053	-0.002	0.000
G21	0.012	0.000	0.002	0.000	-0.019	0.000	0.000	0.871
G22	0.022	0.000	0.009	0.000	-0.009	0.000	0.006	0.000
G31	0.023	0.000	0.002	0.000	0.002	0.000	0.020	0.000
Efficiency parameters								
σ	0.218	0.000	0.206	0.000	0.173	0.000	0.204	0.000
λ	0.096	0.800	2.662	0.000	0.000	1.000	1.489	0.000
Group determinants								
Intercept	2.027	0.000	0.635	0.020	1.284	0.000	– control group –	
Large banks	3.928	0.000	-4.818	0.000	1.230	0.165	– control group –	
Mortgage	-3.697	0.000	1.151	0.000	-1.729	0.000	– control group –	
Size	-0.151	0.032	-0.160	0.002	-0.100	0.139	– control group –	
East	1.848	0.000	-4.110	0.000	-8.495	0.000	– control group –	
Private	-2.322	0.000	2.786	0.000	1.321	0.000	– control group –	

Notes: Parameter estimates of a latent class stochastic cost frontier model. 3,912 banks and 48,839 bank-year observations between 1993 and 2012. The log-likelihood value is 25,852. Negative profit indicator included but not reported. Robust standard errors.

A.6 Description of covariates explaining Lerner indicators per banking group

Table A.2: Lerner determinants large commercials

Variable	Mean	Std. Dev.	Min.	Max.	N
MS_lag	38.001	29.447	7.741	96.743	87
PCM_lag	1.302	0.787	0.334	4.434	87
HHI_lag	0.318	0.266	0.092	0.936	87
CR3_lag	69.217	18.788	45.023	98.756	87
Branches	45.017	106.033	0.002	478.413	87
Diversity	14.973	16.369	6.303	97.128	87
Retail	18.155	18.827	0	66.264	87
Trade	8.553	14.282	0.256	66.357	87
Stock	1	0	1	1	91
Growth	1.313	2.663	-6.451	7.846	87
GDPcapita	11.007	0.257	10.526	11.281	82
Debt	2.794	1.221	1.345	5.438	87
Insovency	0.665	0.372	0	1.384	87
Restructuring	0.874	1.209	0	4	87
Distress	3.92	4.012	0	11	87
HGBReserves	0.253	0.437	0	1	87
Customerloans	39.995	14.083	3.504	65.823	87
Creditreserves	-0.196	0.288	-0.869	0.88	87
OBStoTA	6.204	3.531	0.306	13.965	87
roe	2.394	14.676	-55.304	36.881	87
liquid	5.921	2.116	1.397	11.232	87

Table A.3: Lerner determinants regional commercials

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
MS_lag	2.324	7.344	0	75.447	3004
PCM_lag	1.819	1.834	0.105	23.897	3004
HHI_lag	0.22	0.135	0.046	0.936	3004
CR3_lag	63.291	16.026	26.785	98.756	3004
Branches	17.979	74.457	0	2404.242	3004
Diversity	32.268	29.388	0	100	3004
Retail	9.777	16.652	0	100	2966
Trade	1.574	4.822	0	91.096	3004
Stock	0.535	0.499	0	1	3410
Growth	1.222	2.832	-11.757	25.459	3004
GDP per capita	10.768	0.417	9.489	11.354	2855
Debt	2.171	1.394	0.04	5.438	3004
Insolvency	0.571	0.422	0	3.415	3004
Restructuring	0.570	1.04	0	4	3004
Distress	2.966	3.653	0	11	3004
HGBReserves	0.179	0.384	0	1	3004
Customer loans	41.181	26.584	0	98.509	3004
Creditreserves	-0.448	1.758	-39.817	50.838	3004
OBStoTA	6.576	15.606	0	504.469	2784
roe	4.878	28.748	-837.822	404.69	3004
liquid	14.436	16.844	0	99.334	3004

Table A.4: Lerner determinants central savings

Variable	Mean	Std. Dev.	Min.	Max.	N
MS_lag	44.952	23.617	2.701	84.666	226
PCM_lag	0.481	0.26	0.105	1.642	226
HHI_lag	0.331	0.155	0.092	0.732	226
CR3_lag	75.333	13.827	45.023	98.177	226
Branches	0.493	0.915	0	4.62	226
Diversity	13.965	6.032	6.926	44.98	226
Retail	5.368	9.984	0	100	226
Trade	2.901	6.862	0.074	52.732	226
Stock	0.12	0.326	0	1	241
Growth	1.163	2.873	-6.783	13.693	226
GDP per capita	10.654	0.381	9.746	11.281	216
Debt	1.737	0.999	0.104	5.438	226
Insolvency	0.606	0.35	0	1.257	226
Restructuring	0.376	0.846	0	4	226
Distress	1.867	2.658	0	11	226
HGBReserves	0.451	0.499	0	1	226
Customer loans	37.423	10.083	11.824	65.887	226
Creditreserves	-0.156	0.18	-1.336	0.394	226
OBStoTA	4.405	3.092	0.007	16.158	226
roe	1.861	8.340	-70.335	9.244	226
liquid	2.78	1.672	0.005	10.857	226

Table A.5: Lerner determinants regional savings

Variable	Mean	Std. Dev.	Min.	Max.	N
MS_lag	10.447	11.388	0.012	89.95	9724
PCM_lag	2.755	0.645	0.706	8.926	9724
HHI_lag	0.174	0.133	0.046	0.936	9724
CR3_lag	54.941	17.574	23.946	98.756	9724
Branches	23.652	18.731	0	250.41	9724
Diversity	10.543	2.327	0	38.864	9724
Retail	50.687	9.763	0	74.311	9724
Trade	0.603	0.551	0.021	6.063	9724
Stock	0.006	0.077	0	1	10446
Growth	1.557	3.909	-23.037	31.913	9724
GDP per capita	10.075	0.319	9.120	11.281	9045
Debt	1.073	0.464	0	5.438	9724
Insolvency	0.752	0.42	0	1.606	9724
Restructuring	0.075	0.312	0	4	9724
Distress	0.247	0.654	0	11	9724
HGBReserves	0.083	0.275	0	1	9724
Customer loans	58.16	12.547	9.333	90.265	9724
Creditreserves	-0.422	0.492	-6.942	3.483	9724
OBStoTA	2.555	1.796	0.138	30.646	9724
roe	4.831	4.793	-273.625	69.289	9724
liquid	4.342	2.426	0.436	39.641	9724

Table A.6: Lerner determinants central cooperatives

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
MS_lag	7.117	2.426	1.814	12.565	51
PCM_lag	0.492	0.228	0.127	1.146	51
HHI_lag	0.224	0.115	0.092	0.484	51
CR3_lag	61.425	11.161	45.023	80.383	51
Branches	0.234	0.307	0.026	1.24	51
Diversity	11.199	3.656	7.552	29.562	51
Retail	2.031	13.993	0	100	51
Trade	2.867	6.666	0.104	29.489	51
Stock	0.782	0.417	0	1	55
Growth	1.089	2.86	-5.119	7.373	51
GDP per capita	11.08	0.138	10.777	11.281	48
Debt	2.549	1.604	0.104	5.438	51
Insolvency	0.535	0.338	0	1.174	51
Restructuring	0.725	1.15	0	4	51
Distress	3.804	3.832	0	11	51
HGBReserves	0.196	0.401	0	1	51
Customer loans	16.328	5.49	6.53	25.218	51
Creditreserves	-0.193	0.236	-0.868	0.424	51
OBStoTA	3.264	1.059	1.237	6.157	51
roe	4.815	2.399	0.295	13.723	51
liquid	3.104	1.315	1.077	6.646	51

Table A.7: Lerner determinants regional cooperatives

Variable	Mean	Std. Dev.	Min.	Max.	N
MS_lag	1.6	2.337	0.001	34.428	31345
PCM_lag	3.008	0.654	0.105	20.155	31345
HHI_lag	0.176	0.136	0.046	0.936	31345
CR3_lag	55.248	16.887	23.946	98.756	31345
Branches	47.075	45.46	0	649.289	31345
Diversity	15.529	11.141	0	100	31345
Retail	45.928	12.058	0	99.996	31345
Trade	0.645	0.934	0	89.846	31345
Stock	0.004	0.066	0	1	34146
Growth	1.607	3.66	-23.037	32.478	31345
GDP per capita	10.055	0.3	9.120	11.354	29764
Debt	0.991	0.458	0	5.438	31344
Insolvency	0.723	0.397	0	1.76	31345
Restructuring	0.097	0.353	0	4	31345
Distress	0.303	0.741	0	11	31345
HGBReserves	0.095	0.293	0	1	31345
Customer loans	58.22	11.91	4.318	94.872	31345
Creditreserves	-0.398	0.485	-29.124	8.984	31345
OBStoTA	2.774	2.601	0	70.033	31303
roe	5.411	3.663	-162.609	71.583	31345
liquid	6.806	3.98	0.024	60.795	31345

Table A.8: Lerner determinants mortgage banks

Variable	Mean	Std. Dev.	Min.	Max.	N
MS_lag	12.296	16.268	0.011	75.079	461
PCM_lag	0.435	0.283	0.105	1.595	461
HHI_lag	0.27	0.141	0.046	0.651	461
CR3_lag	70.062	15.955	28.257	94.06	461
Branches	1.091	2.488	0	30.522	461
Diversity	29.602	22.146	0	100	461
Retail	0.177	1.177	0	15.523	461
Trade	0.66	0.431	0.004	3.193	461
Stock	0.831	0.375	0	1	504
Growth	1.32	2.768	-9.466	19.092	461
GDP per capita	10.581	0.33	9.903	11.281	441
Debt	1.826	0.979	0.163	5.438	461
Insolvency	0.64	0.403	0	2.022	461
Restructuring	0.358	0.847	0	4	461
Distress	1.842	2.731	0	11	461
HGBReserves	0.108	0.311	0	1	461
Customer loans	66.368	18.72	9.381	98.942	461
Creditreserves	-0.103	0.218	-1.208	2.471	461
OBStoTA	0.703	1.438	0	14.767	412
roe	1.804	30.368	-451.789	50.394	461
liquid	0.378	1.026	0	7.532	461

Appendix B

Appendix Module IV

B.1 Domar weights

To collapse the firm-level decomposition at the industry level the three terms of Equation (3.3) are weighted. Aggregate output nets out intermediate deliveries:[1] $P_t^V V_t = \Sigma_t(w_{it}L_{it} + r_{it}K_{it})$, where V is value added and P^V is the price of value added. Hulten (1978) shows that aggregate output growth equals the appropriately weighted sum of firm output growth rates, $\Delta \ln V_t = \Sigma_t(v_{it}\Delta Y_{it})$, where:

$$v_{it} = \frac{1}{2}\left(\frac{P_{it}Y_{it}}{P_t^V V_t} + \frac{P_{it-1}Y_{it-1}}{P_t^V V_{t-1}}\right). \tag{B.1}$$

v_{it} represents the so-called Domar weight. It determines the contribution of each firm to aggregate output growth. Note that output includes intermediate inputs whereas aggregate value added excludes intermediate inputs. Thus, the sum of all Domar weights is typically greater than one. To link banking competition and output growth at the industry level, we use total industry value added from the EU KLEMS database. The weighted sum of firm output growth typically sums to less than industry output growth because we cover less than the whole industry but we know firm output growth contributions to total industry output growth.

[1] Gross domestic product (GDP) at the level of the economy or industry value added. We dismiss industry subscripts here for ease of exposition.

B.2 Production function data and results at the firm level

Table B.1: Descriptive statistics production function arguments 1993-2011

No	Industry description	Output (Y)		Capital (K)		Labor (L)		Intermediates (M)		N
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*
1	Agriculture	2,735	10,078	1,974	6,035	521	1,807	1,459	5,379	13,937
2	Mining and quarrying	68,187	415,109	29,188	186,217	22,176	185,847	18,768	108,526	2,903
3	Food and tobacco	79,243	293,702	10,748	26,955	8,248	21,388	45,591	126,751	13,794
4	Textiles and apparel	22,645	43,214	2,551	5,722	4,573	8,006	11,482	22,781	13,163
5	Wood and paper products	28,088	86,509	6,571	25,888	6,244	21,484	13,005	37,421	21,264
6	Coke and petroleum	1,570,000	4,130,000	70,042	162,594	35,317	72,178	727,751	2,280,000	401
7	Chemicals	173,127	858,721	33,242	155,534	37,684	193,693	85,031	446,548	7,525
8	Rubber and plastics	33,027	98,164	6,854	17,928	8,206	23,007	15,806	53,931	20,632
9	Metals	44,878	197,390	7,777	43,314	9,466	31,534	25,135	138,289	32,337
10	Electrical and optical	57,943	409,870	7,541	45,666	16,282	99,173	28,136	231,635	13,066
11	Machinery	84,545	819,967	8,668	64,904	21,581	228,096	43,243	404,887	32,984
12	Transport	674,710	4,660,000	84,043	564,565	117,157	761,726	435,804	3,130,000	5,502
13	Other	21,389	64,862	2,936	9,569	4,784	10,443	11,402	49,908	9,622
14	Utilities	352,710	1,060,000	169,430	361,133	33,011	85,154	231,643	896,830	3,979
15	Construction	19,353	88,963	2,007	9,342	5,172	21,939	4,879	18,213	25,324
16	Wholesale and retail other	24,046	152,379	1,618	9,277	1,925	5,426	18,867	124,055	42,219
17	Wholesale motor vehicles	47,580	259,645	2,116	11,394	3,088	12,779	39,316	233,458	101,442
18	Retail motor vehicles	34,858	335,358	2,367	18,566	4,544	40,139	24,399	257,204	37,379
19	Publishing	68,850	584,001	57,462	647,561	18,991	166,757	12,124	126,458	8,360
20	Telecommunications	2,250,000	6,310,000	2,250,000	8,860,000	724,432	2,220,000	100,683	243,470	243
21	Accommodation services	34,975	112,355	10,704	36,174	11,942	38,621	9,181	31,717	533
	TOTAL	58,856	690,193	10,109	256,521	9,677	133,423	35,356	437,908	406,609

Notes: The sample comprises 96,642 firms covered in the USTAN database of Deutsche Bundesbank. It comprises 519,230 firm-year observations pertaining to the years 1993–2011. USTAN industry codes based on the German WZ 2003 classification scheme are mapped to the EU KLEMS nomenclature (O'Mahony and Timmer, 2009). Output is measured as sales corresponding to position ap144 in the balance sheet reporting form Bilanzubersicht. Capital is measured as physical assets (position ap68). Labor is measured as the average number of employees per year (position ap34). All monetary values are measured in thousands of Euros and deflated with the gross value added price index per industry reported in the basic German file of the EU KLEMS database (see file 'ger_output_12i.xls' available at www.euklems.net). Prices for 2011 are extrapolated with the cumulative aggregate growth rate across the prices for the years 1991 until 2010. The base year is 2005. German currency is converted manually into Euros after 1998.

Table B.2: Production function estimates 1993-2011

Industry description	**Labor**		**Capital**		**Intermediates**		**N**
	β_L	*p-value*	β_K	*p-value*	β_M	*p-value*	
Agriculture	0.218***	(0.005)	0.000	(0.012)	0.330***	(0.020)	13,937
Mining and quarrying	0.430***	(0.020)	0.109***	(0.020)	0.223***	(0.026)	2,903
Food and tobacco	0.298***	(0.008)	-0.002	(0.009)	0.508***	(0.029)	13,794
Textiles and apparel	0.358***	(0.017)	0.006	(0.008)	0.426***	(0.038)	13,163
Wood and paper products	0.510***	(0.015)	0.016**	(0.006)	0.194***	(0.021)	21,264
Coke and petroleum	0.453***	(0.088)	0.120	(0.085)	0.494***	(0.083)	401
Chemicals	0.384***	(0.014)	0.010	(0.008)	0.537***	(0.033)	7,525
Rubber and plastics	0.378***	(0.008)	0.020***	(0.007)	0.426***	(0.023)	20,632
Metals	0.441***	(0.008)	0.041***	(0.004)	0.360***	(0.015)	32,337
Electrical and optical	0.428***	(0.009)	0.034***	(0.007)	0.425***	(0.017)	13,066
Machinery	0.464***	(0.009)	0.038***	(0.005)	0.364***	(0.017)	32,984
Transport	0.368***	(0.020)	0.016	(0.035)	0.479***	(0.042)	5,502
Other	0.368***	(0.011)	0.062***	(0.011)	0.397***	(0.029)	9,622
Utilities	0.185***	(0.031)	0.079*	(0.047)	0.213***	(0.068)	3,979
Construction	0.570***	(0.011)	0.041***	(0.007)	0.175***	(0.012)	25,324
Wholesale and retail other	0.185***	(0.006)	0.024***	(0.004)	0.563***	(0.033)	42,219
Wholesale motor vehicles	0.186***	(0.004)	0.029***	(0.002)	0.533***	(0.019)	101,442
Retail motor vehicles	0.245***	(0.008)	0.018***	(0.003)	0.596***	(0.025)	37,379
Publishing	0.677***	(0.032)	0.015	(0.016)	0.061***	(0.009)	8,360
Telecommunications	0.694***	(0.068)	0.067	(0.079)	0.072	(0.049)	243
Accomodation services	0.411***	(0.046)	-0.005	(0.024)	0.297***	(0.089)	533

Note: The sample comprises 96,642 firms covered in the USTAN database of Deutsche Bundesbank. It comprises 519,230 firm-year observations pertaining to the years 1993–2011. Variables defined as in Table B.1. All variables are in logarithms. Coefficient estimates based on the Wooldridge (2009) GMM estimation strategy of the Levinsohn and Petrin (2003) control function approach.Reported coefficients and standard errors (SE) for labor (β_L), capital (β_K) and material (β_M) resulting from employing the Wooldridge (2009) GMM estimation on Equation (3.2). N denotes the number of firm-year observations. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Table B.3: Descriptive statistics growth components at the firm level 1993-2011

Industry	**Mean annual growth rates**				**Mean Domar weights & factor shares**			
	Output (Y)	*Labor (L)*	*Capital (K)*	*Intermediates (M)*	*Domar*	*L share*	*K share*	*M share*
Agriculture	0.033	-0.001	0.036	0.025	0.002	0.151	0.263	0.587
Mining and quarrying	0.006	0.024	-0.001	0.006	0.008	0.311	0.394	0.295
Food and tobacco	0.032	0.019	0.019	0.031	0.003	0.196	0.229	0.575
Textiles and apparel	0.004	-0.003	-0.016	0.004	0.003	0.252	0.266	0.482
Wood and paper products	0.035	0.026	0.016	0.035	0.001	0.277	0.292	0.430
Coke and petroleum	0.064	-0.069	0.042	0.076	0.078	0.248	0.211	0.541
Chemicals	0.050	0.039	0.037	0.055	0.004	0.218	0.274	0.508
Rubber and plastics	0.042	0.037	0.023	0.047	0.002	0.261	0.284	0.455
Metals	0.056	0.031	0.030	0.064	0.001	0.352	0.240	0.408
Electrical and optical	0.056	0.063	0.029	0.064	0.003	0.291	0.280	0.428
Machinery	0.056	0.021	0.029	0.064	0.001	0.371	0.201	0.428
Transport	0.056	0.025	0.033	0.067	0.009	0.294	0.176	0.530
Other	0.018	0.005	-0.002	0.023	0.004	0.284	0.273	0.444
Utilities	0.041	-0.010	0.008	0.034	0.013	0.150	0.333	0.516
Construction	0.038	0.011	0.013	0.021	0.001	0.353	0.298	0.349
Wholesale and retail other	0.041	0.024	0.039	0.040	0.002	0.119	0.114	0.767
Wholesale motor vehicles	0.031	0.039	0.016	0.030	0.001	0.111	0.147	0.742
Retail motor vehicles	0.029	0.020	-0.008	0.028	0.001	0.181	0.177	0.641
Publishing	0.045	0.009	0.026	0.026	0.003	0.362	0.408	0.230
Telecommunications	0.111	0.147	0.073	0.107	0.080	0.266	0.586	0.148
Accomodation services	0.049	0.025	0.035	0.022	0.045	0.352	0.343	0.305
Total	0.038	0.026	0.019	0.038	0.002	0.220	0.212	0.568

Notes: The sample comprises 96,642 firms covered in the USTAN database of Deutsche Bundesbank. It comprises 519,230 firm-year observations pertaining to the years 1993–2011. USTAN industry codes based on the German WZ 2003 classification scheme are mapped to the EU KLEMS nomenclature (O'Mahony and Timmer, 2009). Output is measured as sales corresponding to position ap144 in the balance sheet reporting form Bilanzubersicht. Capital is measured as physical assets (position ap 68). Labor is measured as the average number of employees per year (position ap34). All montary values are measured in thousands of Euros and deflated with the gross value added price index per industry reported in the basic German file of the EU KLEMS database (see file 'ger_output_12i.xls' available at www.euklems.net). Prices for 2011 are extrapolated with the cumulative aggregate growth rate across the prices for the years 1991 until 2010. The base year is 2005. German currency is converted manually into Euros after 1998. Growth is measured as annually, i.e. year-on-year.

B.3 Descriptives statistics at the region-industry level

Table B.4: Descriptive statistics region-industry growth regressions 1994-2011

Industry	**Median growth components**				**Median ED**	**N**
	Output	*Input*	*Technology*	*Reallocation*		
Agriculture	0.010	0.007	0.007	-0.002	1.821	1,498
Mining and quarrying	0.002	0.001	0.001	0.000	2.723	997
Food and tobacco	0.024	0.020	0.007	-0.002	1.463	1,641
Textiles and apparel	0.004	0.000	0.001	0.001	-1.415	1,406
Wood and paper products	0.016	0.011	0.004	-0.001	-0.511	1,638
Coke and petroleum	0.010	0.010	0.001	-0.001	0.531	280
Chemicals	0.018	0.015	0.001	0.000	38.937	1,422
Rubber and plastics	0.030	0.029	0.004	-0.001	1.034	1,670
Metals	0.027	0.025	0.008	-0.004	3.700	1,668
Electrical and optical	0.026	0.026	-0.001	0.000	6.155	1,546
Machinery	0.030	0.022	0.012	-0.005	5.695	1,671
Transport	0.008	0.007	0.001	0.000	2.389	1,392
Other	0.019	0.013	0.005	0.000	11.085	1,412
Utilities	0.012	0.007	0.015	-0.004	0.244	1,323
Construction	0.009	0.003	0.008	-0.002	16.893	1,651
Wholesale and retail other	0.071	0.069	0.021	-0.017	-0.122	1,720
Wholesale motor vehicles	0.073	0.072	0.018	-0.017	2.347	1,728
Retail motor vehicles	0.009	0.009	0.002	0.000	0.940	1,707
Publishing	0.005	0.000	0.003	0.000	5.199	1,526
Telecommunications	0.001	0.001	0.000	0.001	4.399	173
Accomodation services	0.005	0.000	0.004	0.001	1.398	356
Total	0.017	0.013	0.005	-0.002	2.839	28,425

Notes: Medians for growth components aggregated per ROR and industry sector. ED denotes dependence on external finance calculated for US firms as in Rajan and Zingales (1998).

B.4 Other bank traits

Table B.5: Descriptive statistics of other bank traits

Variable	Mean	SD	Min	Max
Liquidity	6.683	2.020	2.476	17.312
Wholesale funding	2.952	2.184	0.000	16.840
Retail funding	44.642	8.096	13.681	63.718
Book equity to total assets	5.349	1.047	2.360	11.949
Capital support	3.497	7.705	0.000	76.275

Notes: 28,425 observations for up to 96 ROR in up to 21 industries between 1994 and 2011. Liquidity is measured as the share of cash, central bank assets, and short-term interbank assets to gross total assets. Wholesale funding is measured as securitized debt relative to gross total assets. Retail funding equals the share of fixed term customer deposits of total customer debt. Capital support depicts the ratio of the aggregated stock of capital preservation measures of banking pillar specific, cash and guarantees, to total equity of all banks per ROR.

B.5 Industry-region growth for different firm sizes

Table B.6: Aggregate industry growth per ROR for different firm size classes

Size	Micro	Small	Medium	Large
ED	0.001	0.002	0.010**	0.024
	(0.001)	(0.002)	(0.004)	(0.047)
LI	-0.002	0.000	-0.033	-0.303
	(0.005)	(0.009)	(0.020)	(0.225)
LI×ED	0.001	0.001	-0.002	0.051
	(0.004)	(0.005)	(0.010)	(0.099)
Spatial lag LI	0.011*	0.004	0.124***	0.516
	(0.006)	(0.013)	(0.032)	(0.330)
Spatial lag LI×ED	-0.003	-0.006**	-0.013**	-0.080
	(0.002)	(0.003)	(0.006)	(0.079)
Observations	15,000	21,591	21,620	16,497
R-squared	0.016	0.046	0.085	0.064
Industry-regions	1,580	1,679	1,615	1,353
5th	-0.004	-0.001	-0.031	-0.370
t-statistic	-0.999	-0.146	-1.152	-0.814
25th	-0.003	-0.001	-0.032	-0.351
t-statistic	-0.927	-0.091	-1.533	-1.333
50th	-0.003	0.000	-0.032	-0.329
t-statistic	-0.687	0.089	-1.417	-1.295
75th	-0.001	0.001	-0.034	-0.281
t-statistic	-0.227	-0.020	-1.561	-1.307
95th	0.001	0.003	-0.036	-0.200
t-statistic	0.065	0.160	-1.621	-1.253

The dependent variable is $\Delta \ln Y$. Subsamples aggregated separately for micro firms (€ ¡2 million sales), small firms (€ 2-10 million sales), medium size firms (€ 10-50 million sales), and large firms (€ ¿ 50 million sales). Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Table B.7: Factor growth per ROR for different firm size classes

Size	Micro	Small	Medium	Large
ED	0.001	0.002	0.011**	0.007
	(0.001)	(0.002)	(0.004)	(0.051)
LI	-0.004	0.001	-0.019	-0.050
	(0.004)	(0.009)	(0.019)	(0.239)
LI×ED	-0.000	0.001	-0.003	0.182
	(0.003)	(0.005)	(0.010)	(0.178)
Spatial lag LI	0.007	-0.006	0.129***	0.185
	(0.006)	(0.012)	(0.031)	(0.332)
Spatial lag LI×ED	-0.001	-0.006**	-0.012**	-0.106
	(0.002)	(0.003)	(0.006)	(0.108)
Observations	15,000	21,591	21,620	16,497
R-squared	0.01	0.03	0.073	0.054
Industry-regions	1,580	1,679	1,615	1,353
5th	-0.004	-0.001	-0.015	-0.291
t-statistic	-0.455	-0.059	-1.023	-0.957
25th	-0.004	0.000	-0.016	-0.224
t-statistic	-0.864	-0.115	-0.817	0.099
50th	-0.004	0.000	-0.018	-0.144
t-statistic	-1.372	0.162	-0.873	-0.599
75th	-0.004	0.001	-0.021	0.026
t-statistic	-1.207	0.104	-0.708	-0.837
95th	-0.004	0.003	-0.026	0.314
t-statistic	-1.341	0.008	-0.930	0.677

The dependent variable is $\Delta \ln X$. Subsamples aggregated separately for micro firms (€ ¡2 million sales), small firms (€ 2-10 million sales), medium size firms (€ 10-50 million sales), and large firms (€ ¿ 50 million sales). Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Table B.8: Technical change per ROR for different firm size classes

Size	Micro	Small	Medium	Large
ED	0.001	0.000	0.004*	0.037*
	(0.001)	(0.001)	(0.002)	(0.023)
LI	0.002	0.001	-0.013	-0.016
	(0.003)	(0.005)	(0.010)	(0.125)
LI×ED	0.002	-0.002	-0.005	-0.074
	(0.002)	(0.003)	(0.005)	(0.092)
Spatial lag LI	0.011**	0.009	0.031*	0.229
	(0.005)	(0.008)	(0.018)	(0.181)
Spatial lag LI×ED	-0.002**	-0.001	-0.005*	-0.015
	(0.001)	(0.002)	(0.003)	(0.050)
Observations	15,000	21,591	21,620	16,497
R-squared	0.017	0.025	0.029	0.027
Industry-regions	1,580	1,679	1,615	1,353
5th	-0.001	0.003	-0.007	0.082
t-statistic	-0.346	-0.287	-1.376	0.524
25th	0.000	0.003	-0.008	0.055
t-statistic	0.873	0.735	-1.322	0.178
50th	0.001	0.002	-0.010	0.022
t-statistic	0.085	0.604	-0.991	0.396
75th	0.003	0.000	-0.014	-0.047
t-statistic	0.745	0.405	-0.764	-0.677
95th	0.007	-0.003	-0.022	-0.164
t-statistic	0.444	0.024	-0.570	-0.341

The dependent variable is $\Delta \ln A$. Subsamples aggregated separately for micro firms (€ ¡2 million sales), small firms (€ 2-10 million sales), medium size firms (€ 10-50 million sales), and large firms (€ ¿ 50 million sales). Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Table B.9: Reallocation per ROR for different firm size classes

Size	Micro	Small	Medium	Large
ED	-0.000	-0.001	-0.006*	-0.015
	(0.001)	(0.001)	(0.003)	(0.036)
LI	0.001	-0.006	-0.007	-0.090
	(0.003)	(0.006)	(0.014)	(0.142)
LI×ED	0.002	0.005	0.008	0.082
	(0.002)	(0.004)	(0.007)	(0.082)
Spatial lag LI	-0.008*	0.004	-0.030	-0.058
	(0.005)	(0.008)	(0.023)	(0.229)
Spatial lag LI×ED	-0.000	-0.001	0.003	-0.021
	(0.001)	(0.002)	(0.004)	(0.060)
Observations	15,000	21,591	21,620	16,497
R-squared	0.005	0.006	0.014	0.018
Industry-regions	1,580	1,679	1,615	1,353
5th	-0.002	-0.013	-0.018	-0.199
t-statistic	-0.660	-1.903*	-1.009	-0.996
25th	-0.001	-0.011	-0.015	-0.169
t-statistic	-0.411	-1.499	-0.764	-0.388
50th	0.000	-0.008	-0.011	-0.132
t-statistic	0.890	0.455	0.515	0.372
75th	0.002	-0.004	-0.004	-0.055
t-statistic	0.611	-0.557	-0.281	-1.060
95th	0.006	0.005	0.009	0.076
t-statistic	-0.014	-1.784*	-0.917	-0.869

The dependent variable is $\Delta \ln R$. Subsamples aggregated separately for micro firms (€ ¡2 million sales), small firms (€ 2-10 million sales), medium size firms (€ 10-50 million sales), and large firms (€ ¿ 50 million sales). Sample period between 1994 and 2011. Robust standard errors in parentheses. ***,**,* indicate significance at the 1%, 5%, and 10% level.

Bibliography

Aghion, P., T. Fally, and S. Scarpetta (2007). Credit constraints as a barrier to the entry and post-entry growth of firms. *Economic Policy 22*, 731–779.

Allen, F. and D. Gale (2004). Competition and Financial Stability. *Journal of Money, Credit, and Banking 36*(3), 433–480.

Anselin, L. (1988). *Spatial Econometrics: Methods and Models*. Dordrecht: Kluwer.

Ariss, R. T. (2010). On the implications of market power in banking: Evidence from developing countries. *Journal of Banking and Finance 34*, 765–775.

Ark, B. v., M. O'Mahony, and M. P. Timmer (2008). European growth: the end of convergence. *Journal of Economic Perspectives 22*, 25–44.

Bank for International Settlement (2013). *The Liquidity Coverage Ratio and liquidity risk monitoring tools*. Basel Committee on Banking Supervision Basel III.

Basu, S. and J. Fernald (2002). Aggregate productivity and aggregate technology. *European Economic Review 46*, 963–991.

Basu, S., L. Pascali, F. Schiantarelli, and L. Serven (2009). Productivity, welfare and reallocation: Theory and firm-level evidence. Working paper, NBER.

Beck, T. and A. Demirgüç-Kunt (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking and Finance 30*, 2931–2943.

Berger, A. N. and C. Bouwman (2009). Bank liquidity creation. *Review of Financial Studies 22*, 3779–3837.

Bikker, J., S. Shaffer, and L. Spierdijk (2012). Assessing competition with the Panzar-Rosse

model: The role of scale, costs, and equilibrium. *Review of Economics and Statistics 94*, 1025–1044.

Boone, J. (2008). A new way to measure competition. *The Economic Journal 118*, 1245–1261.

Boot, A. W. A. and L. Ratnovski (2013). Banking and trading. *mimeo*.

Boyd, J. H. and G. De Nicolo (2005). The theory of bank risk taking and competition revisited. *Journal of Finance 60*(3), 1329–1343.

Buch, C., C. T. Koch, and Koetter (2013). Do banks benefit from internationalization? Revisiting the market power-risk nexus. *Review of Finance 17*, 1401–1435.

Canales, R. and R. Nanda (2012). A darker side to decentralized banks: Market power and credit rationing in SME lending. *Journal of Financial Economics 105*, 353–366.

Carbó, S., D. Humphrey, J. Maudos, and P. Molyneux (2009). Cross-country comparisons of competition and pricing power in European banking. *Journal of International Money and Finance 28*, 115–135.

Cetorelli, N. (2004). Real effects of bank competition. *Journal of Money, Credit and Banking 36*, 544–558.

Cetorelli, N. and M. Gambera (2001). Banking market structure, financial dependence and growth: International evidence from industry data. *Journal of Finance 56*, 617–648.

Cetorelli, N. and P. Strahan (2006). Finance as a barrier to entry: Bank competition and industry structure in local US markets. *Journal of Finance 61*, 437–461.

Claessens, S. and L. Laeven (2004). What drives bank competition? Some international evidence. *Journal of Money, Credit and Banking 36*(3), 563–583.

Claessens, S. and L. Laeven (2005). Financial dependence, banking sector competition, and economic growth. *Journal of the European Economic Association 3*, 179–207.

Cowling, K. and M. Waterson (1976). Price cost margins and market structure. *Economica 43 (171)*, 267–274.

Dam, L. and M. Koetter (2012). Bank bailouts and moral hazard: Evidence from Germany. *Review of Financial Studies 25*, 2343–2380.

Degryse, H. and S. Ongena (2005). Distance, lending relationships, and competition. *Journal of Finance 60*, 231–266.

Delis, M. and E. Tsionas (2009). The joint estimation of bank-level market power and efficiency. *Journal of Banking and Finance 33*, 1842–1850.

Delis, M. D. (2012). Bank competition, financial reform, and institutions: The importance of being developed. *Journal of Development Economics 97*, 450–465.

Dell'Ariccia, G. and R. Marquez (2004). Information and bank credit allocation. *Journal of Financial Economics 72*, 185–214.

Demirgüç-Kunt, A. and V. Maksimovic (1998). Law, Finance, and Firm Growth. *Journal of Finance 53*, 2107–2137.

Demirgüç-Kunt, A. and V. Maksimovic (2002). Funding growth in bank-based and market-based financial systems: Evidence from firm level data. *Journal of Financial Economics 65*, 337–363.

Deutsche Bundesbank (2011). Effects of the act modernising accounting law on the bundesbank's statistics of the bank's profit and loss accounts. *Monthly Report September 63*, 38–46.

Deutsche Bundesbank (2012). Die Ertragslage der Deutschen Kreditinstitute im Jahr 2011. *Monthly Report September*, 13–47.

Deutsche Bundesbank (2013). Bankenstatistik. *Statistisches Beiheft 1 zum Monatsbericht Juli*.

Fernández de Guevara, J. and J. Maudos (2011). Banking competition, financial dependence and economic growth. *European Journal of Finance 17*, 739–764.

Greene, W. (2005). Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics 126*, 269–303.

Gropp, R., H. Hakenes, and I. Schnabel (2011). Competition, risk-shifting, and public bail-out policies. *Review of Financial Studies 24*, 2084–2120.

Guevara, J. F., J. Maudos, and F. Pérez (2005). Market power in European banking sectors. *Journal of Financial Services Research 27*, 109–137.

Hauswald, R. and R. Marquez (2003). Information technology and financial services competition. *Review of Financial Studies 16*, 921–948.

Hauswald, R. and R. Marquez (2004). Loan-portfolio quality and the diffusion of technological innovation. Working Paper 2004-02.

Hauswald, R. and R. Marquez (2006). Competition and strategic information acquisition in credit markets. *Review of Financial Studies 19*, 967–1000.

Hempell, H. S. (2004). Testing for competition among German banks. *Deutsche Bundesbank Discussion Paper Series 1* (04/02), 1–47.

Herrera, A. M., M. Kolar, and R. Minetti (2011). Credit reallocation. *Journal of Monetary Economics 58*, 551–563.

Hsieh, C. and P. Klenow (2009). Misallocation and manufacturing TFP in China and India. *Quarterly Journal of Economics 124*(4), 1403–1448.

Huang, R. (2008). The real effect of bank branching deregulation: Comparing contiguous counties across u.s. state borders. *Journal of Financial Economics 87*, 678 – 705.

Huang, R. and L. Ratnovski (2011). The dark side of bank wholesale funding. *Journal of Financial Intermediation 20*, 248–263.

Hulten, C. (1978). Growth accounting with intermediate inputs. *Review of Economic Studies 45*, 511–518.

IMF (2004). Germany's three-pillar banking system: Cross country perspective in Europe. *International Monetary Fund, Occasional Paper 223*.

IMF (2009). *Country Report No. 09/15 Germany: 2008 Article IV Consultation*. Washington.

IMF (2011). Germany: Technical note on banking sector structure. *IMF Country Report 370*.

Inklaar, R., M. Koetter, and F. Noth (2012). Who's afraid of big bad banks? Bank competition, SME, and industry growth. *Frankfurt School - Working Paper Series 197*.

Jondrow, J., C. A. K. Lovell, S. Van Materov, and P. Schmidt (1982, August). On the Es-

timation of Technical Inefficiency in the Stochastic Frontier Production Function Model. *Journal of Econometrics 19*(2-3), 233–238.

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *American Economic Review 80*, 1183–1200.

Kick, T. and M. Koetter (2007). Slippery slopes of stress: Ordered failure events in German banking. *Journal of Financial Stability 3*, 132–148.

Kick, T. and E. Prieto (2013). Bank risk taking and competition: Evidence from regional banking markets. *Bundesbank Discussion Paper 30*.

Koetter, M., J. W. B. Bos, F. Heid, J. W. Kolari, C. J. M. Kool, and D. Porath (2007). Accounting for distress when predicting bank mergers. *Journal of Banking and Finance 32*, 3200–3217.

Koetter, M., J. Kolari, and L. Spierdijk (2012). Enjoying the quiet life under deregulation? Evidence from adjusted Lerner indices for U.S. banks. *Review of Economics and Statistics 94*, 462–480.

Koetter, M., T. Nestmann, S. Stolz, and M. Wedow (2006). Still Overbanked and Unprofitable? Two Decades of German Banking. *Kredit und Kapital 39*(4), 1–15.

Koetter, M. and F. Noth (2013). It use, productivity, and market power in banking. *Journal of Financial Stability*, forthcoming.

Koetter, M. and T. Poghosyan (2009). The identification of technology regimes in banking: Implications for the market power-fragility nexus. *Journal of Banking and Finance 33*, 1413–1422.

Krahnen, J. P. and R. H. Schmidt (Eds.) (2004). *The German Financial System*. Oxford: Oxford University Press.

Kumbhakar, S. C. and C. A. K. Lovell (2000). *Stochastic Frontier Analysis*. Cambridge: Cambridge University Press.

Kutlu, L. and R. C. Sickles (2012). Estimation of market power in the presence of firm level inefficiencies. *Journal of Econometrics 168*, 141–155.

Leibenstein, H. (1966). Allocative Efficiency vs. X-Efficiency. *American Economic Review 56*, 392–415.

Lerner, A. (1934). The concept of monopoly and the measurement of monopoly power. *Review of Economic Studies 1*(3), 157–175.

Levinsohn, J. and A. Petrin (2003). Estimation of production functions using inputs to control for unobservables. *Review of Economic Studies 40*, 317–342.

Marquez, R. (2002). Competition, adverse selection, and information dispersion in the banking industry. *Review of Financial Studies 15*, 901–926.

Martinez-Miera, D. and J. Suarez (2012). A macroeconomic model of endogenous systemic risk taking. *CEPR Discussion Paper 9134*.

Maudos, J. and J. F. Guevara (2007). The cost of market power in banking: Social welfare loss vs. cost inefficiency. *Journal of Banking and Finance 31*, 2103–2135.

Ogura, Y. (2012). Lending competition and credit availability for new firms: Empirical study with the price cost margin in regional loan markets. *Journal of Banking and Finance 36*, 1822–1838.

O'Mahony, M. and M. Timmer (2009). Output, input and productivity measures at the industry level: the EU KLEMS database. *Economic Journal 119*, F374–F403.

Orea, L. and S. Kumbhakar (2004). Efficiency measurement using a latent class stochastic frontier model. *Empirical Economics 29*, 169–183.

Oshinsky, R. and V. Olin (2006). Troubled Banks: Why Don't They All Fail? *FDIC Banking Review 18*(1), 23–44.

Panzar, J. and J. Rosse (1982). Structure, conduct and comparative statistics. *Bell Laboratories Economic Discussion Paper*.

Panzar, J. and J. Rosse (1987). Testing for 'monopoly' equilibrium. *Journal of Industrial Economics 35*, 443–456.

Petersen, M. A. and R. G. Rajan (1995). The effect of credit market competition on lending relationships. *Quarterly Journal of Economics 110*(2), 407–443.

Petrin, A., T. White, and J. Reiter (2011). The impact of plant-level resource reallocations and technical progress on u.s. macroeconomic growth. *Review of Economic Dynamics 14*, 3–26.

Porath, D. (2006). Estimating probabilities of default for German savings banks and credit cooperatives. *Schmalenbach Business Review 58*, 214–233.

Rajan, R. and L. Zingales (1998). Financial Dependence and Growth. *American Economic Review 88*, 559–586.

Rajan, R. G. (1992). Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt. *Journal of Finance 47*, 1367–1400.

Repullo, R. and D. Martinez-Miera (2010). Does bank competition reduce the risk of bank failure? *Review of Financial Studies 23*, 3638–3664.

Schaeck, K. and M. Cihak (2013). Competition, efficiency, and stability in banking. *Financial Management*, forthcoming.

Shaffer, S. (2004). Patterns of competition in banking. *Journal of Economics and Business 56*, 287313.

Stiroh, K. J. (2004). Diversification in banking: Is noninterest income the answer? *Journal of Money, Credit and Banking 36*, 853–882.

Syverson, C. (2011). What determines productivity. *Journal of Economic Literature 49*, 326–365.

Wheelock, D. C. and P. W. Wilson (1995). Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency. *The Review of Economics and Statitistics 77*(4), 689–700.

Wheelock, D. C. and P. W. Wilson (2000). Why Do Banks Dissapear? The Determinants of U.S. Bank Failures and Acquisitions. *The Review of Economics and Statitistics 82*, 127–138.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Estimator and a Direct Test of Heteroskedasticity. *Econometrica 48*, 275–277.

Wooldridge, J. (2009). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics Letters 103*, 112–114.

Zarutskie, R. (2006). Evidence on the effects of bank competition on firm borrowing and investment. *Journal of Financial Economics 81*, 503–537.