Karlsruher Institut für Technologie

Fakultät für Wirtschaftswissenschaften
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Bachelor Thesis in Macroeconomics

„Study on us commercial banks“

Winter semester 2019/20

Not yet defined

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Contents

1 Introduction

Explorative journey through historical financial filings of us commercial banks. Analysis under close consideration of economic business cycles.

Different perspectives:

- banking sector as whole (Aggregated)
- Banks categories

Analysis timeseries and cross section
Long term trend analysis vs short term business cycles analysed
Some questions approached:

- How did the balance sheets of commercial banks evolve over time?
- To what extent are balance sheet positions pro-cyclical, with regards to crisis and trough definitions by the NBER ?
- Are there relationships between different balance sheet positions on an aggregate level?
- How did the commercial bank landscape change over time in regards to asset size?
- How did the balance sheets of commercial banks of different sizes evolve over time?
- To what extent is leverage pro-cyclical ?
- Are there differences in leverage behaviour between different banks categorized by asset size?

2 Main part

2.1 Data

- Data from $http://pages.stern.nyu.edu/\ pschnabl/data/data_callreport.htm$ (Originally from FIEC031 Reports and 041); Schneider adjusted for variables change and so on
- Timeframe: 1976Q1-2013Q4, data per year and quarter for each individual bank. The timeseries xaxis is coherent throughout all graphs. Every tick on the xaxis is one quarter. The tick with the year label marks quarter 1.

We take our crisis data from the official documentation of the National Bureau of Economic Research(NBER)

One can also differentiate between a so called "banking" (originated in the banking sector) vs "market" (originated from outside banking sector) crisis as in Berger and Bouwman (2013). The assumption here is that banking crisis could be reflected stronger in the data.
The crisis will be marked on the graphs as gray zones.
Crisis data: https://www.nber.org/cycles.html
Crisis:

- 1980Q1-1980Q3 early 1980s recession (market crisis)
- 1981Q3-1982Q4 early 1980s recession (market crisis)
- 1990Q3-1991Q2 credit crunch (banking crisis)
- 2001Q2-2001Q4 dotcom bubble (market crisis)
- 2007Q4-2009Q3 financial crisis (banking crisis)

Other important structural events to consider:

- Gramm-Leach-Bliley in 1999
- Reigle-Neil in 1994 - the law removed several obstacles to banks opening branches in other states and provided a uniform set of rules regarding banking in each state.
- FDICIA in 1991 - FIDC responsibility to rescue banks with least-costly method.
- Basel 1 in 1988, Basel 2 in 2004, Basel 3 in 2010
- Wide-spread adoption of financial innovations (interest rate derivatives, asset securitization, adjustable rate mortgages)

Additional adjustments of data:

- Negative equity removed as those banks are bankrupt
- Investment banks becoming commercial banks in 2009 removed
- Bank mergers removed by growth of assets above 40%
- For risk analysis: commercial banks aggregated to bhcs
- Values are in thousands

2.2 Methods

- No inflation adjustment: We are only interested in the actual priced value of the banks assets and not the quantity of the assets. Meaning for instance the banks could hold ten assets in 2000 with a value of 100$ and ten assets in 2013 with a value of 150$ caused by a rise the overall price level. Although there was not welfare increase as the quantity did not increase, the value the banks hold still increased.
- Tranformations: Log, to account for relative changes and enable comparisons over time.
- Timeseries analysis:
- Detrending with HP Filter (Parameter: 1600)
- (Deseasonalize with X11 procedure)
- Correlation/Autocorrelation
- 2-tailed p-value on correlation with significance levels: ***: <0.01 **: <0.05 *: <0.1

2.3 General look at balance sheet fillings

The following section will guide us through the distribution of financial components held by the us commercial banks sector as a whole. We will see what types and amounts of financial instruments banks are holding and how these positions evolved over time.

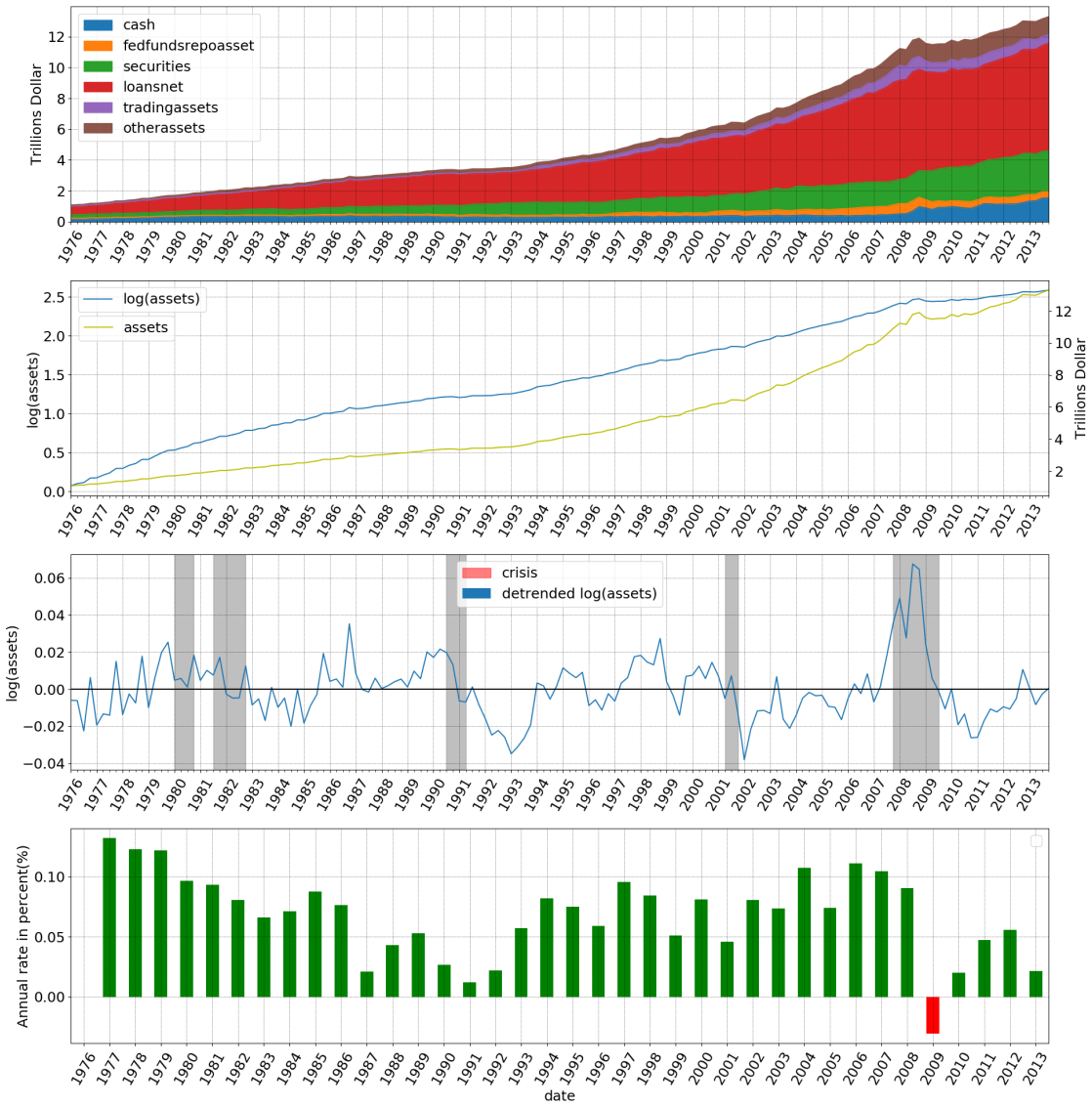
2.3.1 Assets & Liabilities

The typical positions a commercial bank is holding on its balance sheet are:

Assets	Liabilities
Cash	Equity
Fed funds sold and securities purchased under agreements to resell (fedfundsrepoassets)	Fed funds bought and securities sold under agreements to repurchase
Securities: - Treasury - Mortgage-backed Security - Other	Deposits: - short - other
Loans net[1]	
Trading assets:	Trading liabilities
- net interest rate derivatives - net other fixed income - net other trading	
Other assets[2]	Other liabilities

Every position beside the trading assets are hold "not for trading purposes". Meaning for instance the securities position and loans position are not held for trading. Figure 1 gives a general overview how the total assets held by all banks per year and quarter evolved over time. The value of assets rose from below 2 trillion to above 13 trillions dollars of assets. In comparison, the GDP of US in 2013 was 16.78 trillions. We can see a period of flatness/low growth from year 1990-1993, a drop in 2002 and 2008/Q2. While the absolute values give us some indications of where anomalies occur, we will perform time-series analysis by decomposing the logarithmised data in trend, cyclical components. As seen within Figure 1, the value of assets has a clear trend with no indication of existing seasonality over the given timeframe. The second graph within Figure 1 compares the development of assets transformed by natural logarithm to the absolute values. Both are drawn within their own vertical axis. While the growth of absolute assets is more exponential over time, the logarithm of assets grows more linear. The linear trend tells us that the relative growth rate stays constant over time. In the third part of Figure 1 we can see the de-trended part of the asset timeseries. Here we can see variations that significantly differ from the trend. As mentioned in the data section the gray areas show crisis periods. The alignment of crisis periods with us banks total assets variations is limited. We can see that the impact of the early 1980s recession did not lead to more volatility than other normal periods. The dotcom bubble in 2001 lead to a downward variation of us commercial banks assets away from the trend. In regards to the financial crisis in 2008 we see a huge positive variation with a rapid drop back to the trend. Assuming we have set the most fitting filtering parameters for the HP-Filter, it is interesting to see that the assets did not fall significantly below the trend. The loss was rather caused by an overheated market falling back to normal.

Figure 1: Asset side

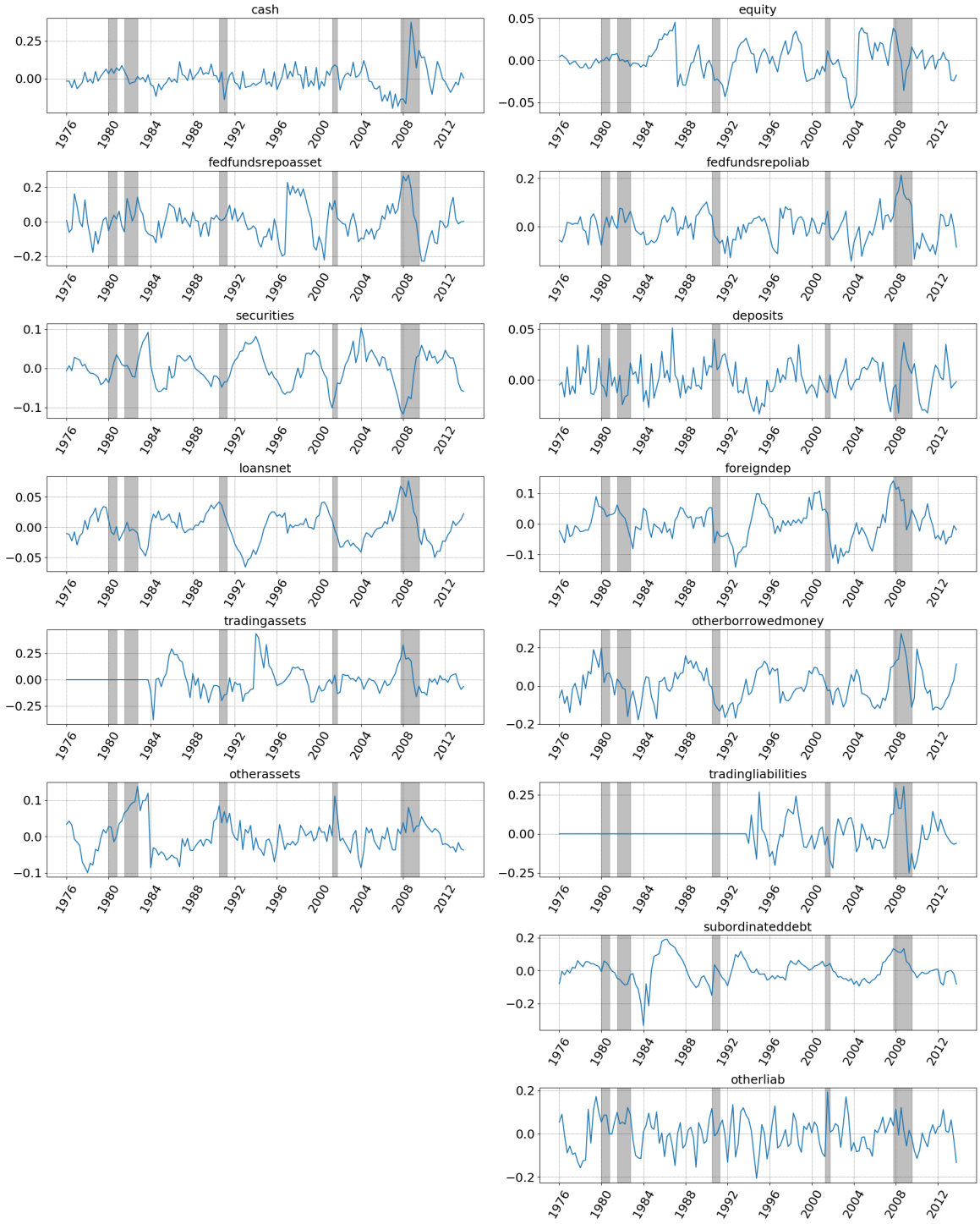


Diving into more detailed analysis of the balance sheet positions, Figure 2 gives us the detrended development of each individual position for both the asset side(left column) and liabilities side(right column) of a balance sheet. As a complement Figure 9 shows the share of each position in relation to the total assets. The cash position shows a clear spike in 2008, but beside then, the movements show no clear sign of irregularity. With the background of the 2008 crisis it makes sense that banks liquidated some of their assets to increase cash. The rise in cash comes along with a significant fall in securities. Figure 9 further supports our thesis that securities are sold to raise cash. Here we can see that while the share of securities fell until 2008, the share of cash rose. The liability "other borrowed money" also gets to its highest point in 2008, indicating anomalies in a bank financing in crisis. Trading assets follow the same behaviour as total assets in crisis 2008, but its variation in crisis periods do not significantly differ to other periods. We know from 9 that the share of trading assets continuously rose over time. In addition, we can observe a spike of trading assets in the period from 1992-1996. Equity has its lowest downward variation in 2004. We will see more of equities behaviour in the leverage section, when we analyse it in regards to total assets. Another interesting observation is that some positions show larger fluctuations in more recent times. The volatility of fedfundsrepoasset increased from 1996 onwards and of foreign deposits from 1992 onwards. We also see a contradictory relationship between loans and securities. When securities fall, loans rise and vice versa. Figure 3 confirms this relationship with a negative correlation coefficient of $r = -0.73$ and high significance according to the p-value. The scatter plot in Figure 6 illustrates this negative relationship. The two asset categories could be seen as substitutes to each other. With a substantial part of securities being mortage backed securities, this relationship does not come as a surprise. There is a small positive relationship between fedfundsrepoassets and trading assets. This could indicate that banks lending out excess federal funds or purchasing repurchase agreements are in such a healthy position to be able to increase trading assets as well. The scatterplot of this relationship in Figure 6 confirms a possible positive linear relationship. A similar positive relationship can be seen between fedfundsrepoassets and loans. However, the scatterplot in Figure 6 does not support a clear relationship. Quite surprising is the slightly negative correlation between domestic deposits and foreign deposits of $r = -0.34$. In addition, there is a positive correlation of $r = 0.37$ between equity and trading assets, indicating that increases in equity leads to increases in trading.[3] Another observation is the strong positive relationship between loans and foreign deposits of $r = 0.59$. (Foreign deposits are deposits made in foreign offices. It is not clear why there is such strong relationship here.) Further elaborating on 9, we can see that on the asset side, loans are the main target of investment for

[3]It is important to note that the mere assumption of a correlation between the two sides of a balance sheet contradicts the Modigliani-Miller-Theorem. The Theorem states the independence of assets by the financing capital structure

commercial banks. Throughout the 37-year time-frame the share of loans always stayed between $50 - 60\%$. The banks started with a share at 55% until it rose to just above 60% from 1985 onwards. The credit crunch crisis in 1991 caused a fall of the share back to 55%. This fall continued until 1995. From then on, the share of loans rose back to 60% until 2008, where it started to fell again. It fell to an all-time low in 2013 with a share of just above 50%. With the confirmed negative correlation between securities and loans, this came along with a rise in securities. The development of the cash share is also interesting. Cash continuously fell from a share of just below 20% to a share of below 5%. Here the crisis 2008 also marked a turning point with share rising back to above 10% again. On the liability side, as one would expect, we have deposits as a dominating source of funding for commercial banks. The share started in 1976 with 70% and fell until 2008 to an all time low of just above 50%. From there it went back to roughly 65%. This decrease in deposits, especially until 2008, must obviously come along with the increases of other types of finance. There is a significant increase of other borrowed money, peaking in 2008. Other borrowed money consists of Federal Home Loan Bank advances (FHLB) and other borrowings not clearly defined. After the crisis in 2008 there was a rapid decreases of other borrowings. FHLB advances are mainly used in funding low mortgages for low income households, which explains the alignment with the housing crisis in 2008. Lastly Figure 9 shows a general increase in the share of equity commercial banks hold from just above 5% to above 10%.

Figure 2: Detrended asset positions(left column) Detrended liability positions(right column) [a]



[a]Data is aggregated in the cross section over all banks, transformed with natural logarithm and detrended with HP-Filter. See details in the data section. Trading assets and liabilities have missing data in the beginning of the time period.

Figure 3: Correlation assets[a]

	cash	fedfundsrepoasset	securities	loansnet	tradingassets	otherassets
cash	1.0***	-0.07	0.06	-0.01	-0.08	0.1
fedfundsrepoasset	-0.07	1.0***	-0.34***	0.23***	0.34***	0.15*
securities	0.06	-0.34***	1.0***	-0.73***	-0.12	-0.01
loansnet	-0.01	0.23***	-0.73***	1.0***	0.11	-0.06
tradingassets	-0.08	0.34***	-0.12	0.11	1.0***	-0.12
otherassets	0.1	0.15*	-0.01	-0.06	-0.12	1.0***

[a]Pearsons correlation coefficient based on the detrended data used in Figure 2.

Figure 4: Correlation liabilities[a]

	equity	fedfundsrepoliab	deposits	foreigndep	otherborrowedmoney	tradingliabilities	subordinateddebt	otherliab
equity	1.0***	0.17**	-0.02	0.04	-0.06	0.12	0.27***	0.07
fedfundsrepoliab	0.17**	1.0***	0.06	0.34***	0.23***	0.34***	0.2**	-0.25***
deposits	-0.02	0.06	1.0***	-0.34***	-0.23***	0.04	0.11	-0.12
foreigndep	0.04	0.34***	-0.34***	1.0***	0.59***	0.16**	0.13	-0.03
otherborrowedmoney	-0.06	0.23***	-0.23***	0.59***	1.0***	0.08	0.15*	-0.04
tradingliabilities	0.12	0.34***	0.04	0.16**	0.08	1.0***	0.18**	0.02
subordinateddebt	0.27***	0.2**	0.11	0.13	0.15*	0.18**	1.0***	0.04
otherliab	0.07	-0.25***	-0.12	-0.03	-0.04	0.02	0.04	1.0***

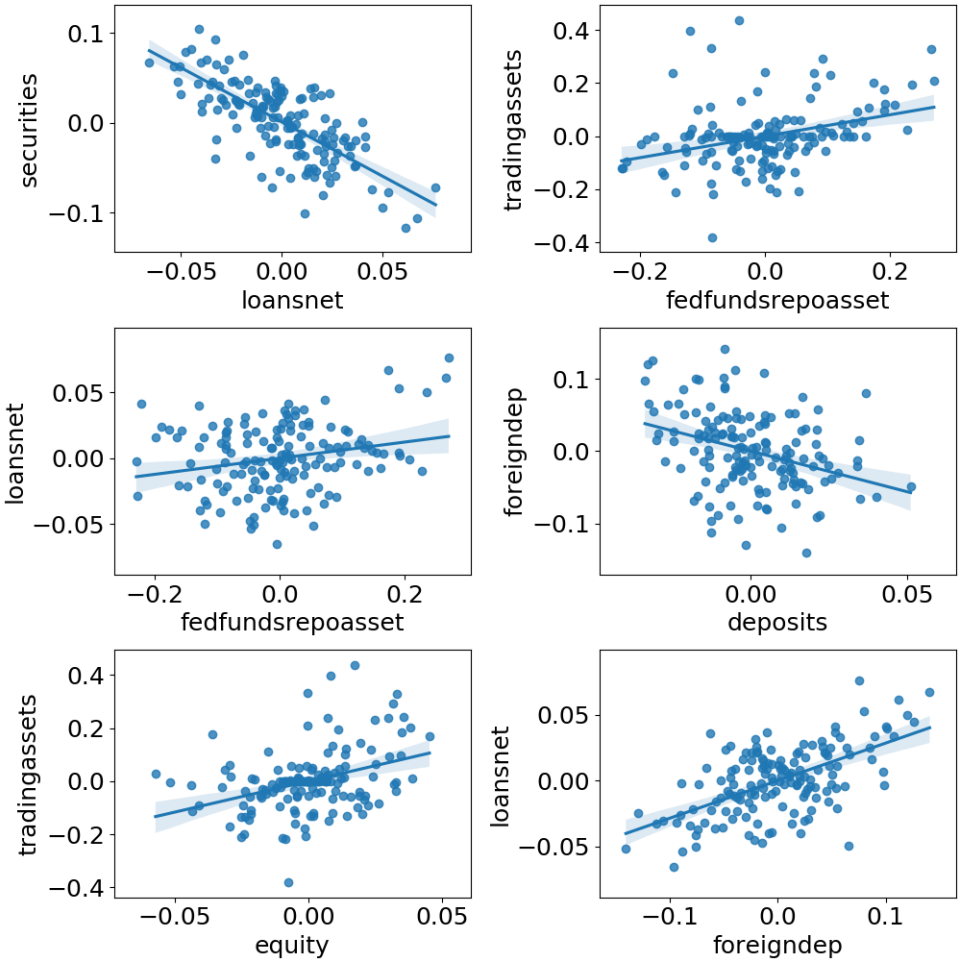
[a]Pearsons correlation coefficient based on the detrended data used in Figure 2.

Figure 5: Correlation assets with liabilities[a]

	equity	fedfundsrepoliab	deposits	foreigndep	otherborrowedmoney	tradingliabilities	subordinateddebt	otherliab
cash	-0.25***	0.1	0.38***	0.04	0.28***	-0.03	0.03	-0.18**
fedfundsrepoasset	0.21***	0.46***	0.32***	0.03	-0.12	0.48***	0.3***	0.13
securities	-0.06	-0.15*	0.08	-0.38***	-0.33***	-0.16**	-0.18**	-0.2**
loansnet	0.06	0.38***	0.17**	0.59***	0.54***	0.15*	0.21**	0.07
tradingassets	0.37***	0.33***	-0.09	0.23***	0.14*	0.49***	0.35***	-0.03
otherassets	0.02	0.1	-0.01	0.12	-0.07	0.04	-0.18**	0.29***

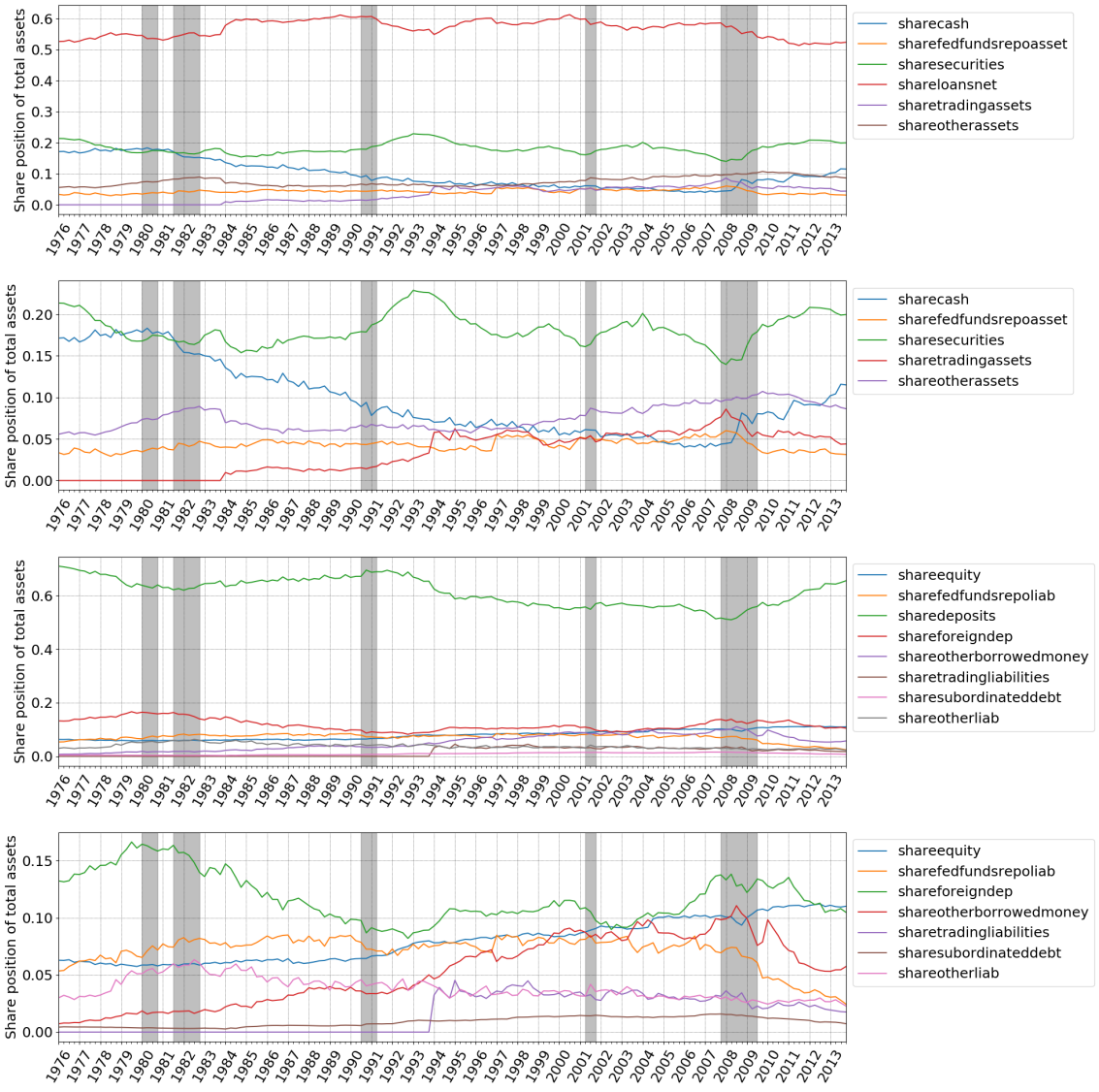
[a]Pearsons correlation coefficient based on the detrended data used in Figure 2.

Figure 6: Scatterplot for selected positions[a]



[a]Linear regression based on the detrended data used in Figure 2.

Figure 7: Share of balance sheet positions [a]



[a]The second/fourth graph is a focus of the first/third, just without loans/deposits position.

Figure 8: Autocorrelation - Asset side [a]

	lag	assets	cash	fedfundsrepoasset	securities	loansnet	tradingassets	otherassets
0	0	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1	1	0.668482	0.543616	0.678344	0.857966	0.874169	0.670577	0.686616
2	2	0.549088	0.385644	0.441868	0.663799	0.750934	0.462435	0.564927
3	3	0.383607	0.185667	0.262141	0.481113	0.582572	0.290667	0.429074
4	4	0.364207	0.276731	0.141942	0.259817	0.426244	0.183740	0.414830
5	5	0.094690	0.003499	-0.063425	0.026585	0.225113	-0.058170	0.243093
6	6	0.023946	0.023056	-0.208787	-0.153482	0.071170	-0.161202	0.167211
7	7	-0.114478	-0.179763	-0.294161	-0.288772	-0.092589	-0.247924	0.069033
8	8	-0.103289	-0.096091	-0.311070	-0.350237	-0.192288	-0.221654	-0.017683

[a]

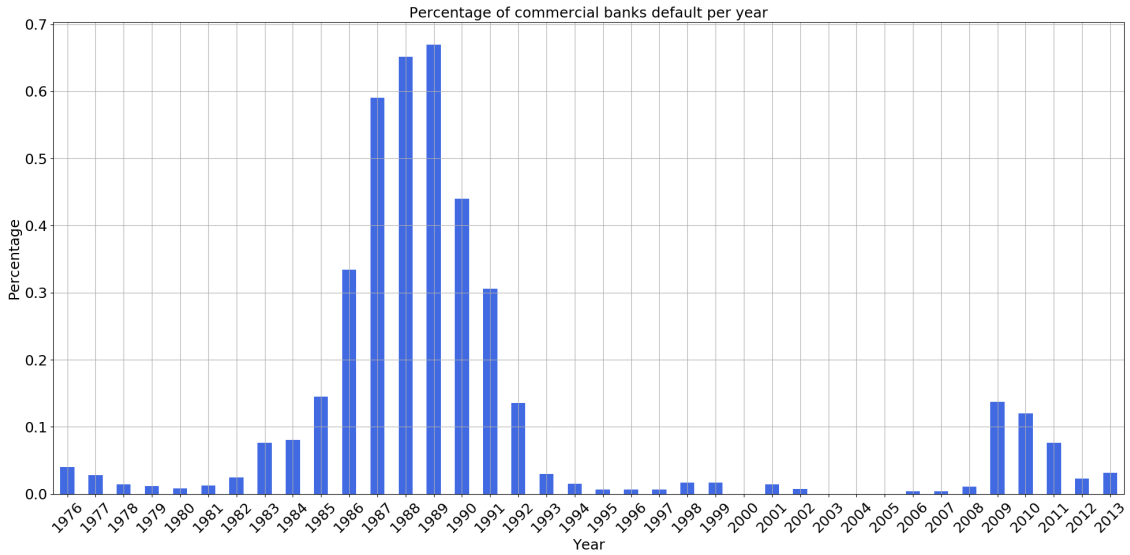
Figure 9: Autocorrelation - Liabilities side [a]

lag	equity	fedfundsrepoliab	deposits	foreigndep	otherborrowedmoney	tradingliabilities	subordinateddebt	otherliab
0	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1	0.723293	0.628063	0.328080	0.798504	0.731746	0.529164	0.805696	0.368007
2	0.449616	0.404419	0.292106	0.661453	0.541543	0.243973	0.689890	0.012917
3	0.179874	0.211710	0.055729	0.463610	0.361965	0.147006	0.509253	0.078217
4	0.009426	0.183654	0.348144	0.329830	0.283648	-0.132563	0.336406	0.145914
5	-0.103217	0.005744	-0.196956	0.117763	0.173004	-0.291591	0.190992	-0.091779
6	-0.109206	-0.058821	-0.179869	0.001884	0.064673	-0.387505	0.081116	-0.295527
7	-0.155159	-0.182500	-0.321517	-0.124807	-0.095045	-0.427252	-0.068200	-0.089373
8	-0.143907	-0.143367	0.106174	-0.155675	-0.215672	-0.382195	-0.173296	0.008344

[a]

2.3.2 Defaults

Figure 10: Banks default



Graph description: The graph shows an estimation of how many banks have defaulted at a certain time (year,quarter). It is based on the negative equity recorded by banks. Hence, it is not exact and some banks might continue to exist in case of mergers or bailouts. Also sometimes banks are double counted, if a negative equity does not immediately result in bankruptcy.
Key Observations:

- main defaults in years 1986-1991 and 2009-2011
- long stable period from 1991-2008
- In 1990 there were many more smaller banks. Smaller banks might have a higher likelihood to fail. In 1990: 74% small banks, 2010: 35% small banks

To-Do: Bank Defaults within bank categories

2.4 Loans

Not finished, more coming
Graph description: It shows the share of loan types of total loans over time.

Key Observations:

- real estate loans has largest share

Figure 11: Loans

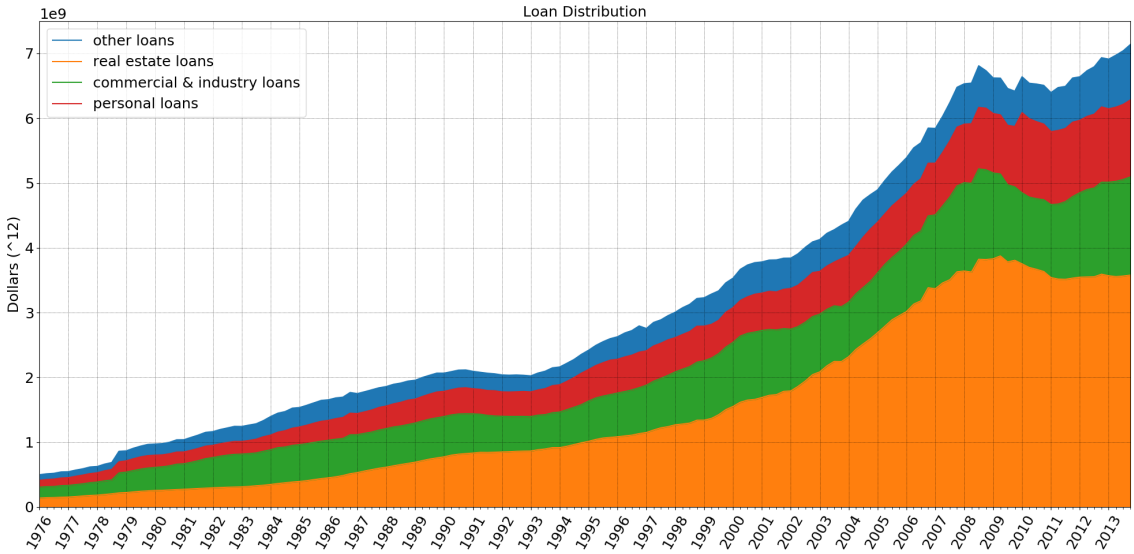


Figure 12: Loans by repricing maturity

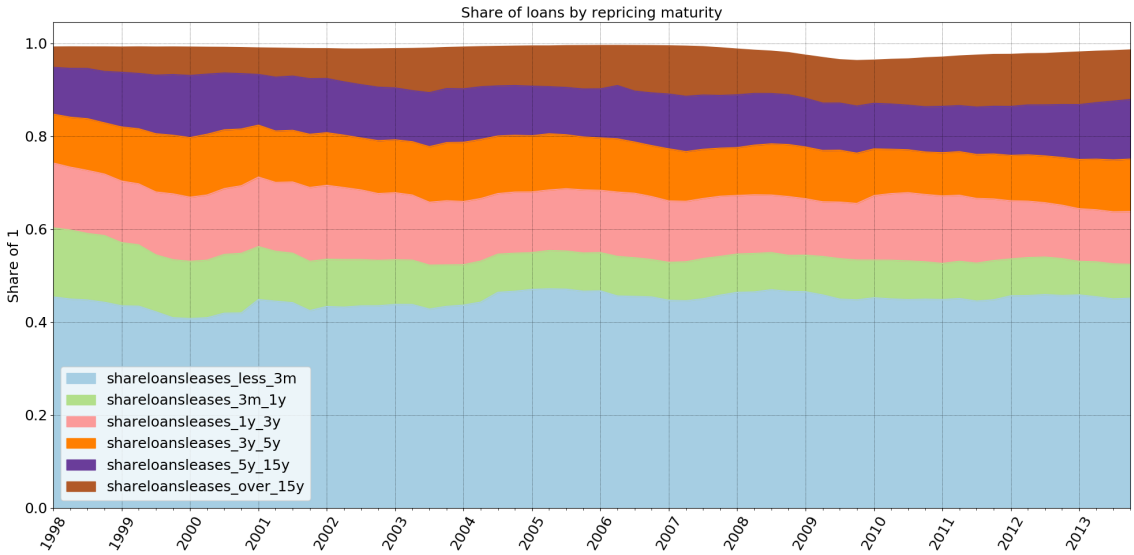
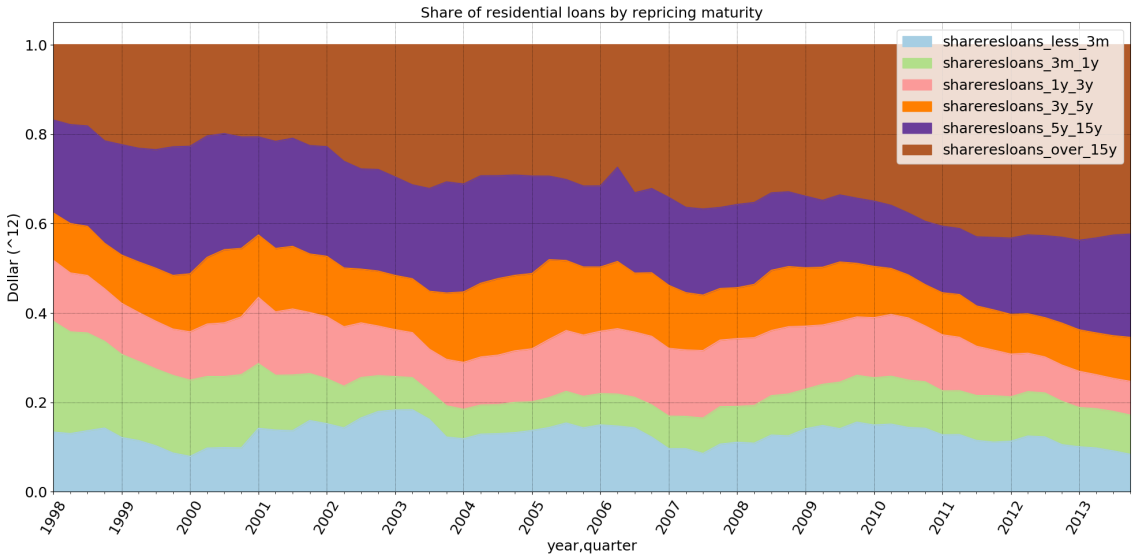


Figure 13: Residential Loans by repricing maturity



2.5 Distribution of asset sizes among banks - To Big to Fail

Following section tries to illustrate a problematic raised by recent economist commonly referred as the rise of "To Big to Fail" banks. Banks are considered as "to big to fail" when they are so large and interconnected with other banks that its individual risk impacts the systemic risk of a whole economy. The term first came into play with the failure and bailout of Continental Illinois National Bank and Trust Company in 1984. And indeed, over the last few centuries the number of banks on the US landscape fell significantly from 14419 banks in 1976 to 6035 banks in year 2013. While the mere reduction would not impose such a problem, the distribution of total assets developed more and more unequal. In 1976, the top 0.1% a total of 14 banks held 32.4% of all assets. In comparison, in 2013 the top 0.1% a total of 6 banks held 50% of all assets. Table 14 and Figure 15 show these numbers by looking at the assets distribution by banks percentiles. In addition, the unequal distribution of assets can also been seen in Figure 16 The curved lines show the Lorenz curve per year as referenced in the legend. The more curved the lines become, the more unequal is the distribution. The horizontal line represents perfect equality. Although in 1980 unequal distribution was high already, it increased even more. In year 2013, the top 5% held almost 90% of all assets. Figure 17 shows us the gini coefficient over time. Its range is from zero to one. A value of one means one bank owns everything, while a value of zero indicates perfect equality (10% of banks own 10% of assets, 50% of banks own 50% of assets and so on...). The higher the value, the higher the inequality in asset distribution. The trend supports our observation of rising inequality. An interesting observation here is the impact of crisis on the asset distribution. Crisis tend to reduce the inequality and act as redistribution. Assuming that assets values fall in times of crisis, the impact of crisis must be higher on larger banks. We will look into how different banks

size categories are impacted differently in section 2.6. The exact causes of the structural changes in the US banks landscape are not clear. However, geographic deregulation and other regulation reforms such as the repeal of the Glass-Steagall act in 1999 did support the increasing inequality. In addition, larger banks are more likely to be bailed out. This puts them in an easier position to finance themselves. The perverse consequence is a moral hazard. A bank that with high likelihood to be bailed out takes on to much risk (Farhi & Tirole, 2012) . The severe consequences of this are clear since the financial crisis in 2008. Authorities responded to this issue by setting additional capital requirements on larger banks.

Figure 14: Count of banks by percentiles

	Top 0.1%	01Share	Top 1%	1PercentShare	Top 10%	10PercentShare	Top 50%	50PercentShare	Total all banks
1976	14	0.324922	144	0.558099	1442	0.780650	7210	0.946214	14419
1980	14	0.340622	144	0.581818	1442	0.793497	7208	0.948957	14417
1984	14	0.288709	144	0.556493	1439	0.790446	7194	0.948429	14389
1988	13	0.240856	130	0.546860	1298	0.811423	6491	0.954550	12982
1992	11	0.228150	114	0.539679	1136	0.811301	5682	0.954310	11363
1996	9	0.273671	95	0.609738	946	0.850118	4732	0.964386	9464
2000	8	0.348473	83	0.701729	825	0.881838	4126	0.972520	8252
2004	8	0.452258	76	0.741929	757	0.891446	3784	0.975372	7567
2008	7	0.510510	70	0.794367	702	0.910356	3511	0.980069	7022
2012	6	0.506170	60	0.801828	604	0.916754	3018	0.980764	6035

Figure 15: Aggregate assets by percentiles

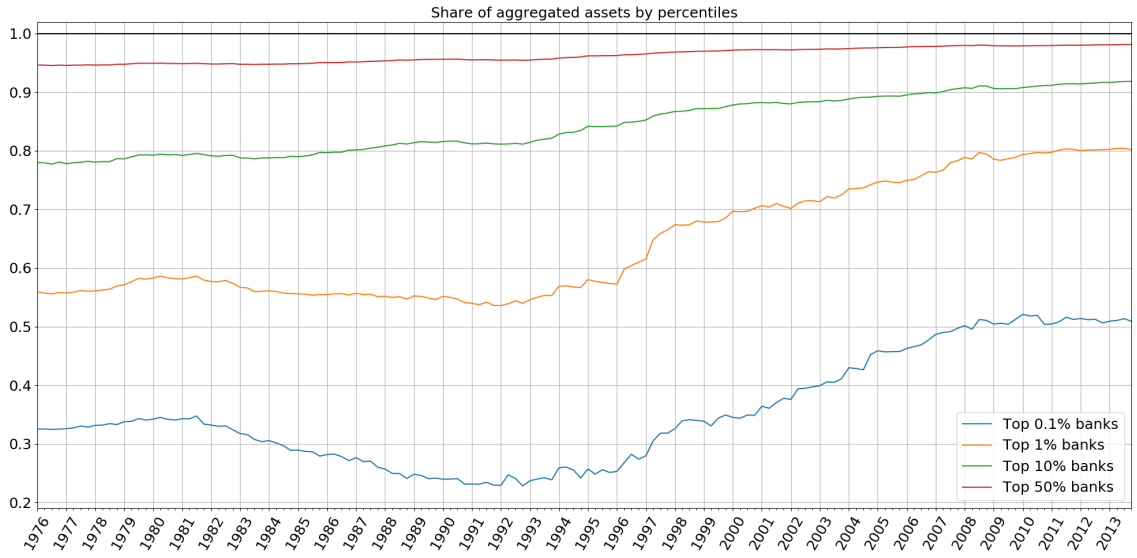
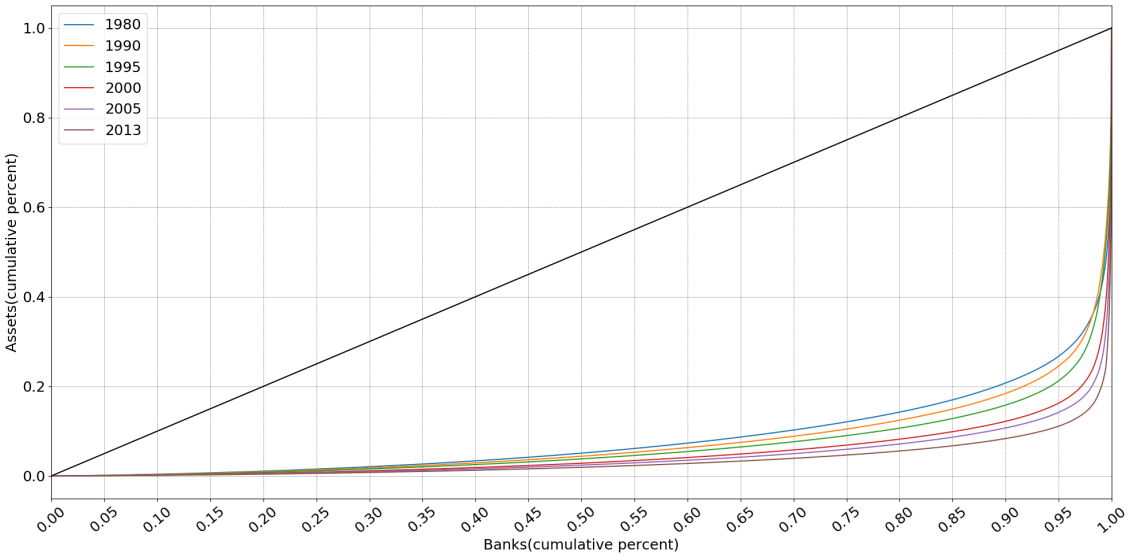
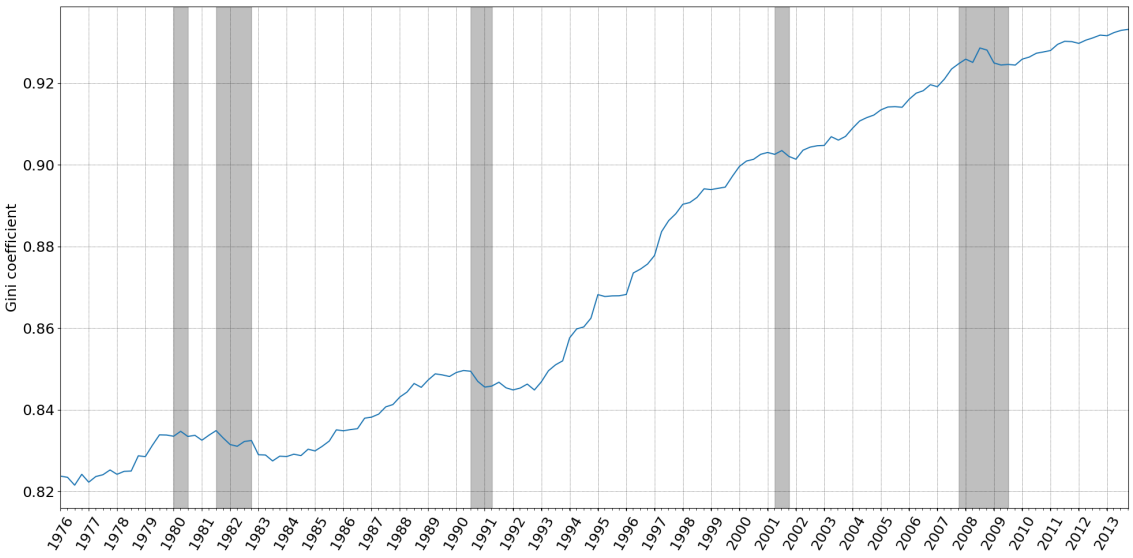


Figure 16: Lorenz Curve[a]



[a]Always Quarter 1

Figure 17: Gini coefficient[a]



[a]

2.6 Banks by asset size

In this section we allocate banks into different categories ranked by asset size to find differences in behaviours and impacts of business cycles on each category over time. We have four categories following the convention of the Federal Reserve Bulletin[4]:

- 10 largest banks
- large banks (those ranked 11 through 100)
- medium-sized banks (those ranked 101 through 1,000)
- small banks (those ranked 1,001 and higher)

To get an overview of what asset sizes each category covers figure 18 contains boxplots for each category and year. Within all categories we can see a consistent rise in asset sizes, with all banks per category benefiting. The ten largest banks start of with every banks asset size below than a quarter of a trillion assets in 1976. In 2013, the median asset size was 0.32 trillion with banks going up to an asset size of just under two trillion. Note, we have not combined commercial banks with their matching bank holding company. Bank Holding Companies have asset sizes beyond two trillion. For the top 10 banks, we can see a clear rise in heterogeneity over time regarding their asset sizes. The Interquartile Range (IQR) get to its largest size until the end of the time-frame. Large banks began with an asset size way below $0.25 * 10^1 1$ year 1976 and worked their way up with asset sizes up to $1.75 * 10^1 1$ dollar in year 2013. The heterogeneity of large banks regarding asset size also increased over time. Medium banks ranges between $0.25 - 8$ billion dollar assets per bank and small banks between $0.25 - 5$ hundred million dollars over our time-frame. As with the aggregate assets analysed below, the top two categories benefit more from the asset size increases. In comparison to the asset increases within the top 10, the typical small bank did not show any significant gains over time. The fact that the chosen categories do not show so many outliers strengthens our choice of categories. Only the small banks category has a decent amount of outliers with an asset size below the median.

Figure 19 shows us the development of aggregate assets by the defined banks categories over time. There a key points in time for each category that marked changes in their asset growth. From the start of our chosen timeframe (1976) until 1985 all the categories showed similar growth behaviour. Then, in year 1984, growth of the top 10 assets started to slow. Shortly after that, year 1985 marked a starting point of flat, low growth for the banks ranked $1000 - \infty$. These small banks did not recover from this low growth until the end of our chosen timeframe. An obvious reason for this could be the fact that the total number of banks also fell. Table 14 shows the year 1984 marked a starting point

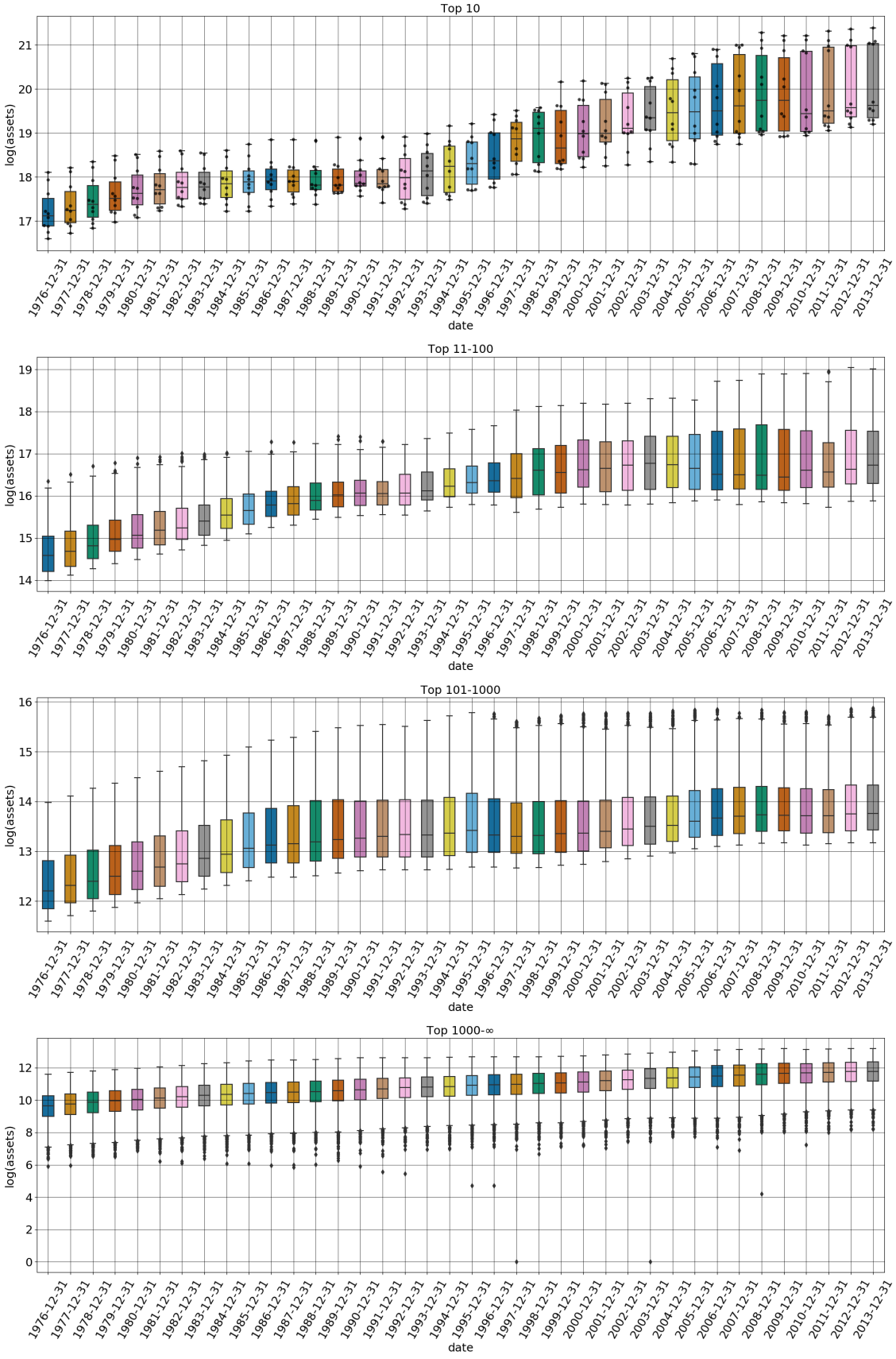
[4]https://www.federalreserve.gov/pubs/bulletin/2000/0600lead.pdf

for a continuous fall in the number of banks. Category two and three, covering the banks ranked from $11-1000$, showed similar behaviour until 1992. From this point in time, the banks ranked $101-1000$ entered a period of low and negative growth, while the banks ranked from $11-100$ entered, together with the top 10 banks, a period of high growth. In the 1990s, a lot of regulation reforms occurred, aiding the growth of larger banks. These reforms are mentioned in section 2.1 and could have been key drivers for the growth of larger banks in the 1990s. The growth of banks ranked from $11-100$ then also fell back to low growth in year 2001. The top 10 banks assets, however, kept growing until the financial crisis in year 2008. We are also trying to see how closely the banks in the different categories resemble each other. Following section will look at how similar the business cycles of the banks are by looking at de-trended assets movements. In Figure 20 we can see de-trended assets values by each category over time. All bank categories were more or less affected by the crisis in 2008. For each category we see a spike, followed by a fall in assets. The top 10 banks were affected the most. However, they also have higher volatility overall and are less in numbers. Figure 20 also shows the standard deviation of assets per category. But they are not useful measure of comparison, since the amount of banks per category are different. In addition, table 21 shows the linear correlation between assets development over time for each category. As one might expect, all categories are positive correlated with the category just below themselves. However, there are significant differences when going beyond that. Category 1 (Top 10 banks) has a negative correlation with category 3 (Top $101-1000$) of -0.27 and no correlation with category 4 (Top 1000-rest). Although a negative correlation of -0.27 is not strong, it highlights the clear differences in business cycle timings. While the top 10 banks might go through a period of decreasing assets, the Top $101-1000$ might go through a period of increasing assets. An example of that can be seen in Figure 20 in year 1996. We are also considering the autocorrelation to take into account different timings. Significant asset changes of the top 10 might not have a immediate effect on the other categories in the same period, but perhaps one quarter later. We go up to ten quarters back to see possible impacts. The associated tables can be found in the Appendix (Figure 33). An interesting observation can be found for the correlation between category 1 and category 2 (lag 1) one period later. The correlation did rise from 0.4 to 0.43 with an one quarter lag. Indicating that large banks (cat 2) react slightly delayed to the decisions of the top 10 banks. The rest autocorrelations show no sign of anomalies.

To get an understanding how the balance sheets differ between the categories. Figure 22, 23 show the share of each position, as outlined in 2.3.1, for the assets as well as the liabilities. Loans continue to be the highest share on the asset side for all categories. Interestingly, all other categories beside the top 10 banks, show an increasing trend for share of loans. But the top 10 banks share of loans fell over our time-frame. We can also see only the top 10 are the only ones engaging in proper trading with a share of

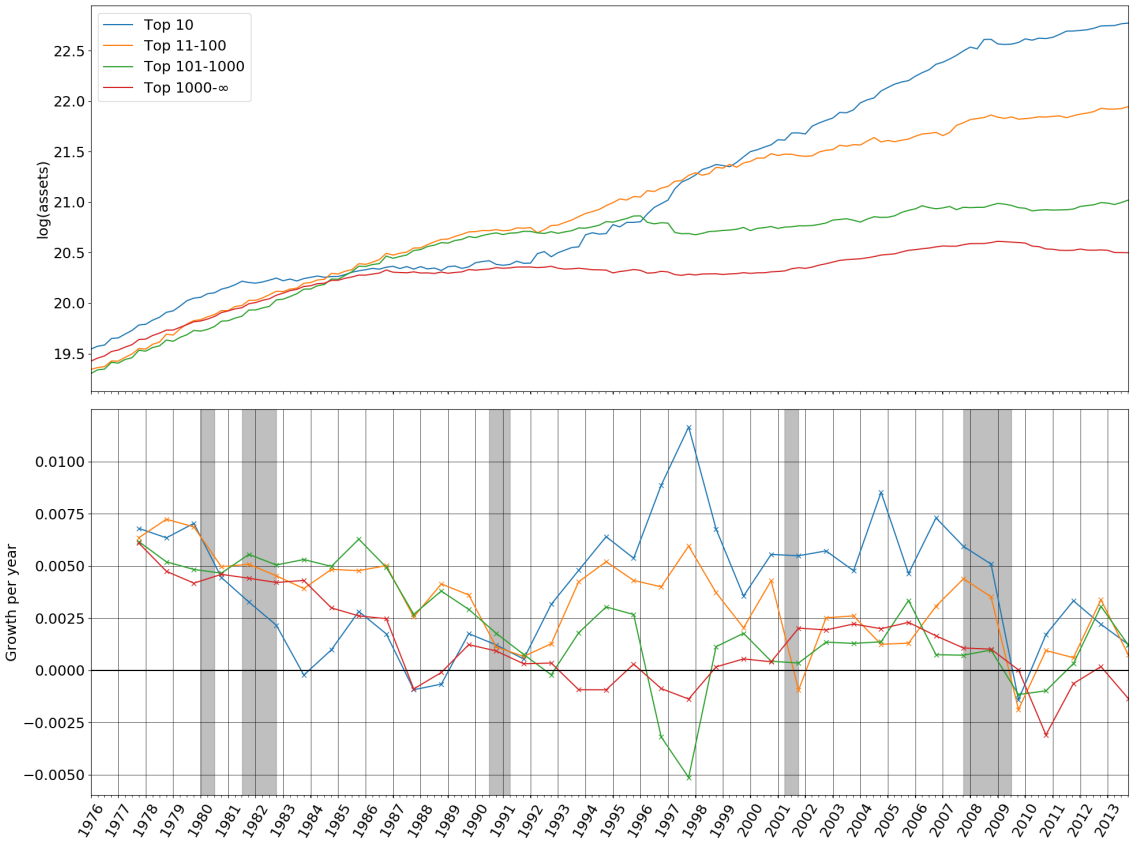
trading assets starting to rise significant in year 1994. For the liabilities, deposits are a main source of funding for all categories. However, the share of deposits varies between the categories. Larger banks tend to have a lower deposit share than medium and small banks. The share for the top 10 is between $60\% - 80\%$ and for the top 11-100 at 60% most of the time. But for medium banks the share is consistently at 80% and for small banks almost 90%. Hence, other forms of finance are relatively low for smaller banks. We can see the pattern that the larger the bank is, the more alternative ways of financing beside deposits are facilitated.

Figure 18: Boxplots for each category [a]



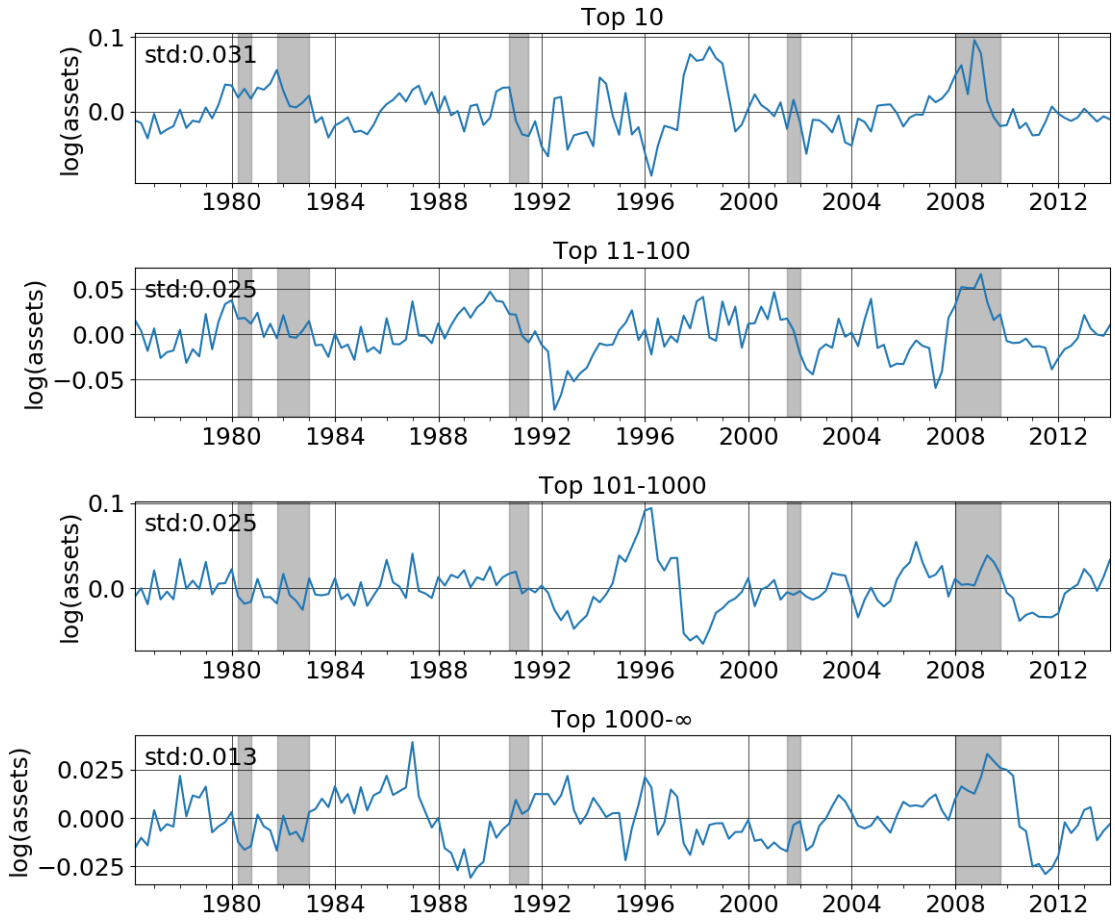
[a]The scientific "leX" notation on the vertical axis indicate the 10^x. All numbers are in thousands. Coloured boxes cover the mid 50% of asset sizes - IQR:25th Percentile to 75th Percentile. For the top 10, all individual datapoints are marked as dots. For the rest, only outliers are marked as dots. Outliers are marked above 1.5 times IQR.

Figure 19: Total assets by bank category [a]



[a]

Figure 20: De-trended assets by bank category [a]



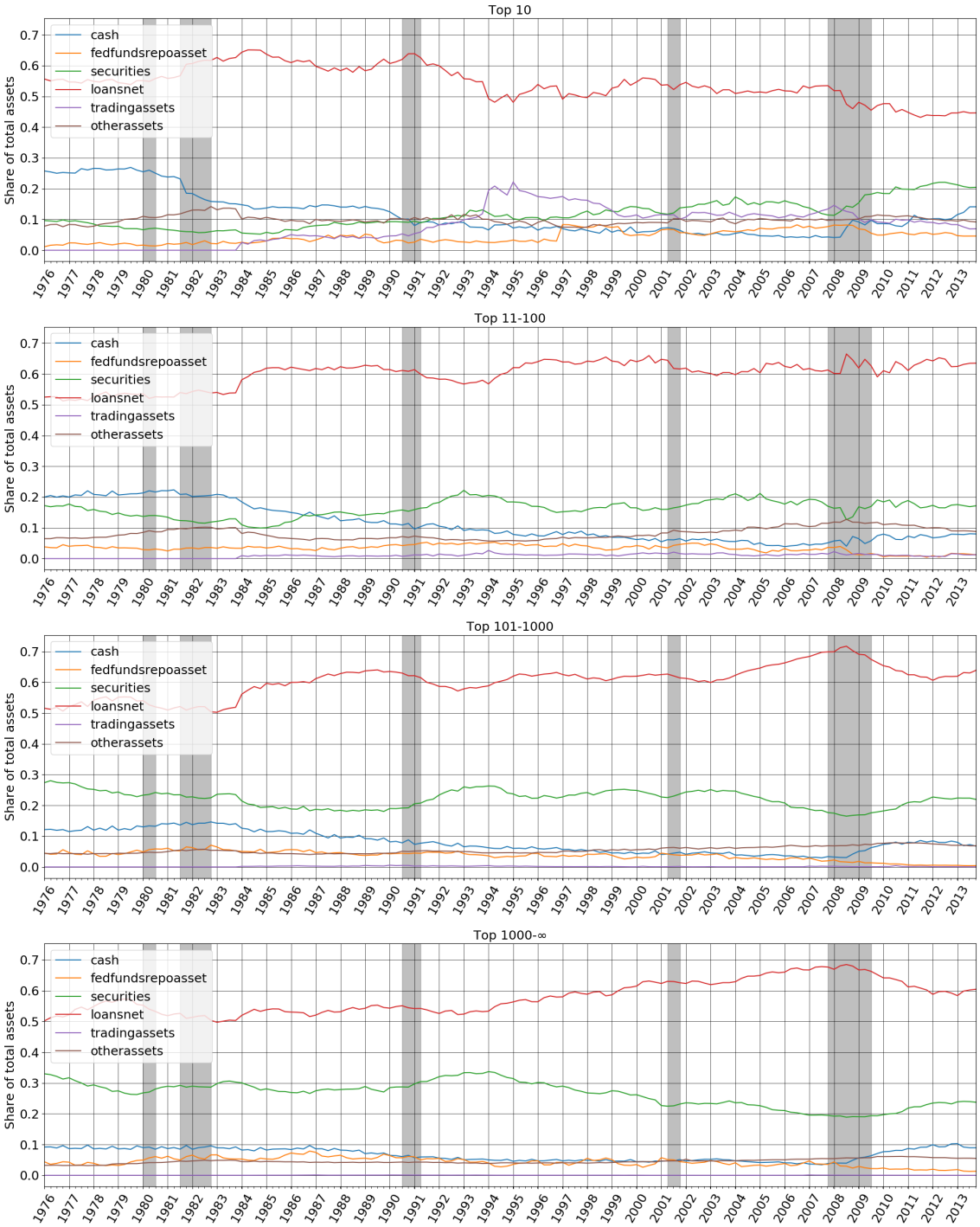
[a]

Figure 21: Correlation between assets of each category [a]

	cat1_assets	cat2_assets	cat3_assets	cat4_assets
cat1_assets	1.0***	0.41***	-0.27***	-0.07
cat2_assets	0.41***	1.0***	0.24***	-0.05
cat3_assets	-0.27***	0.24***	1.0***	0.41***
cat4_assets	-0.07	-0.05	0.41***	1.0***

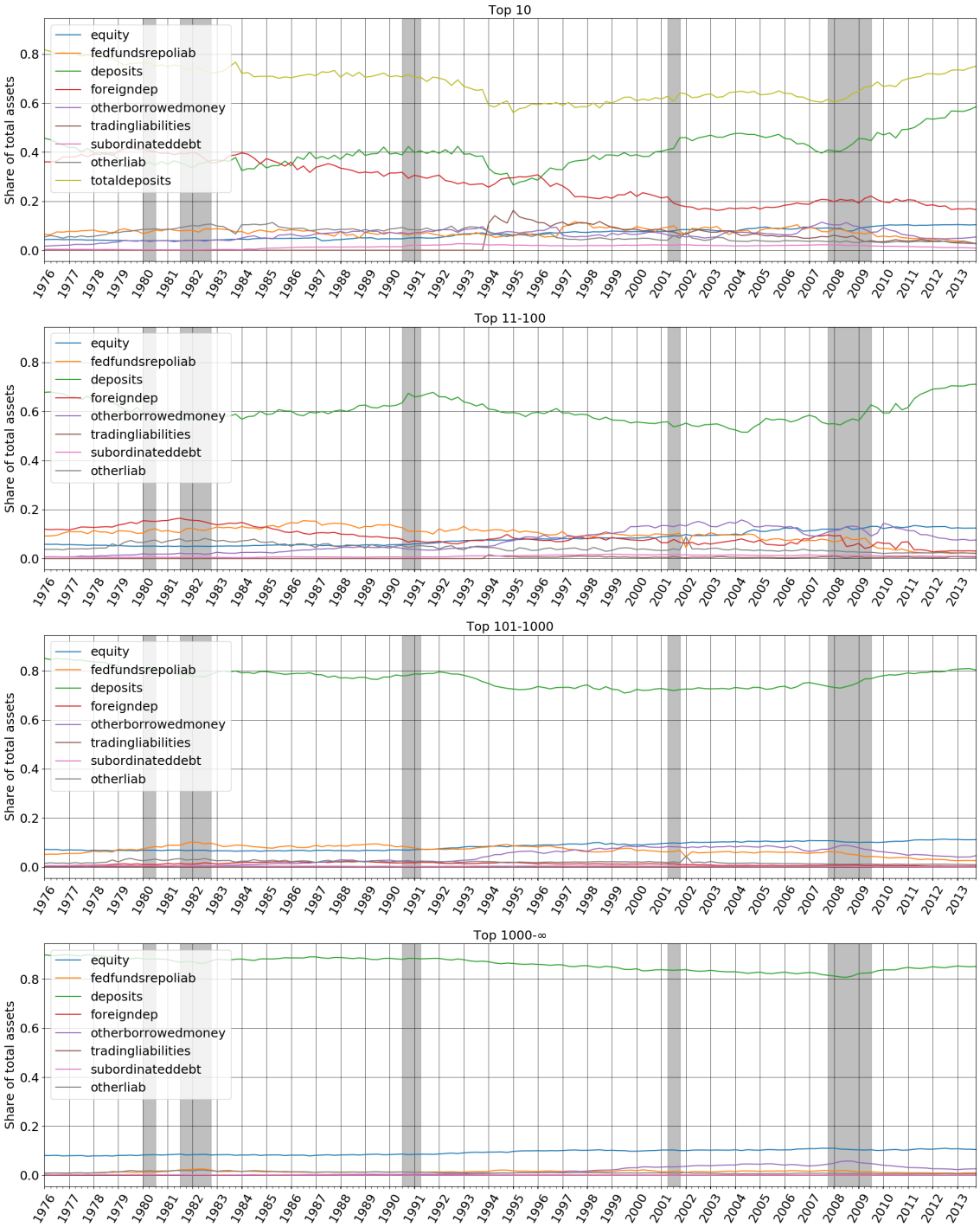
[a]Pearsons Correlation Coefficient

Figure 22: Share of total assets for each balance sheet account [a]



[a]

Figure 23: Share of total liabilities for each balance sheet account [a]



a

2.7 Leverage

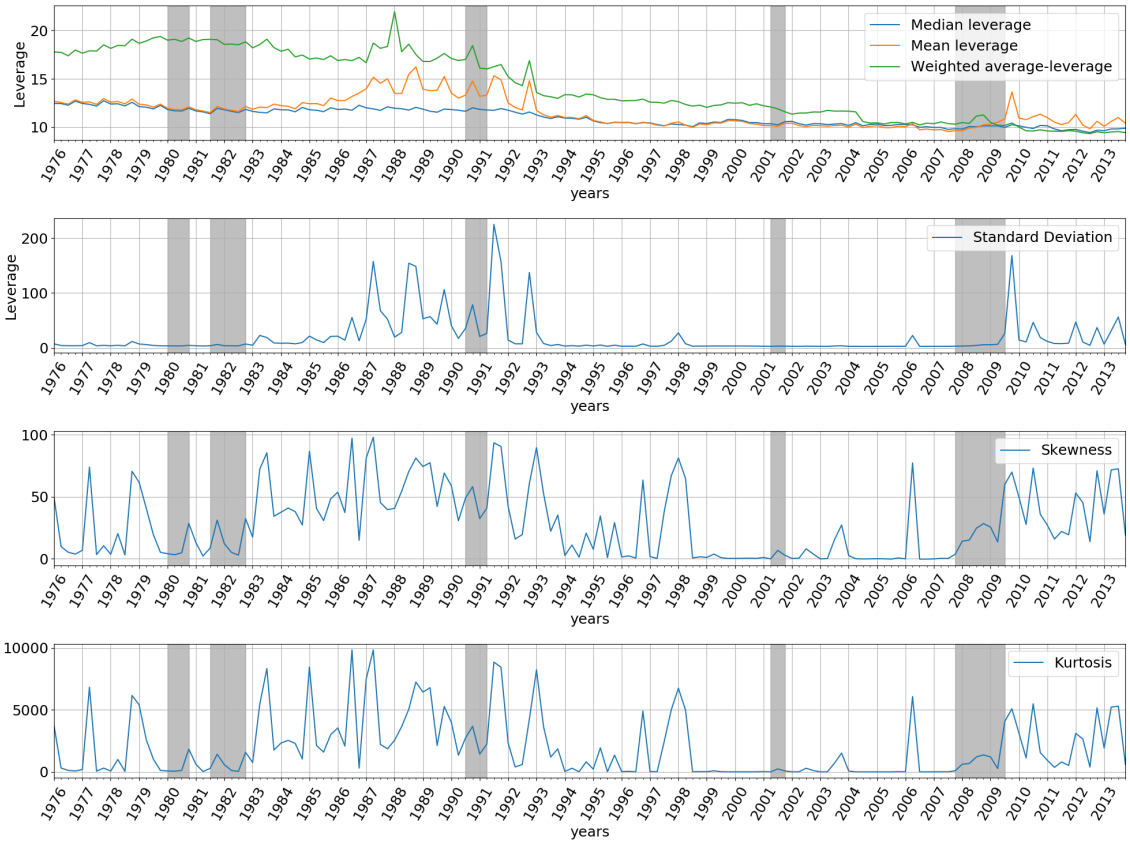
In this section we are going to take a look at the leverage of commercial banks. Leverage is a well known and often used concept for monitoring risk and health of financial institutions. While there are a few definitions of leverage, given the dataset we are working with, focus will be on accounting leverage: Total assets divided by total equity capital[5]. It is used by banks to improve their return on equity. As long as the interest on external capital does not exceed total capital ratio, raising external capital, thus increasing leverage, is beneficial for a bank. With this incentive in mind, it might not come as a surprise that when shareholder ask for a high return, increases in leverage follow. Since the buffer to cover losses in case investments turn bad is then reduced, increases in leverage can be seen as increases in risk. To account for policy makers setting capital requirements on banks on their highest organizational level, we aggregated all commercial banks to their belonging bank holding company. We are also removing all banks with negative equity from the dataset as they can be considered bankrupt.[6] We want to assess the leverage behaviour of still operating banks. For more information about bankrupted banks in the dataset see section 2.3.1. Figure 24 shows the mean, median and weighted-average leverage for each point in time. We can see the clear impact of high leverage banks on the average. Especially, in the periods around 1990 and 2008 where bankruptcy levels are high, there are major leverage increases in Figure 24 on the mean leverage. Looking at the median, gives us a clearer indication how leverage among healthy banks look. Hence, depending of what type of measure we choose (average, median...), we arrive at different observations. The only consistent information conveyed by all measures is a falling trend in leverage from year 1976 to 2013. More description coming...

To-Do: Correlations between cyclical leverage

[5]Tier 1 capital, according to Basel III.

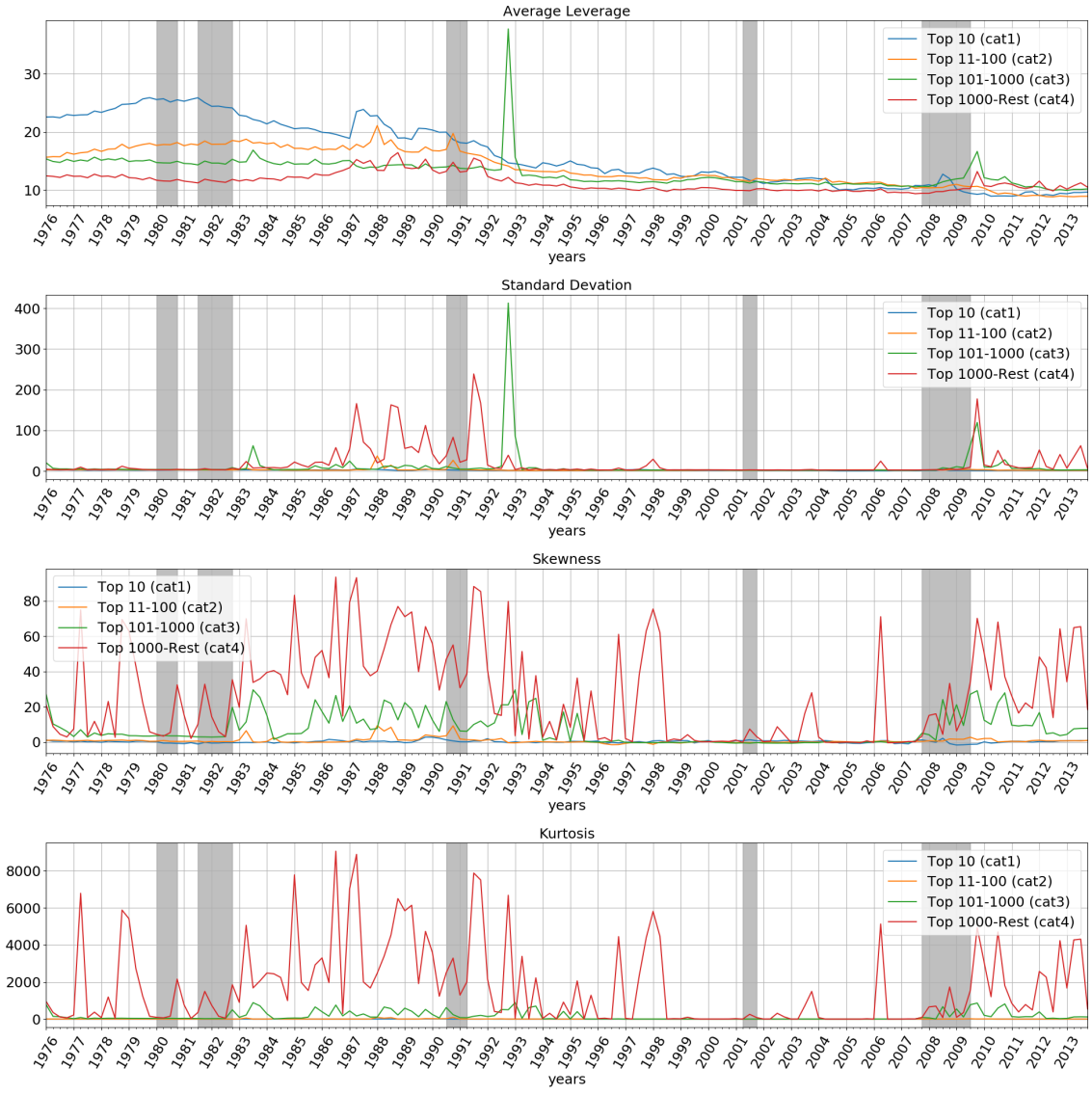
[6]Banks with negative equity, do not report financial information in the following periods. Only in the rare case of bailouts, they survive.

Figure 24: Median and Average leverage for all banks [a]



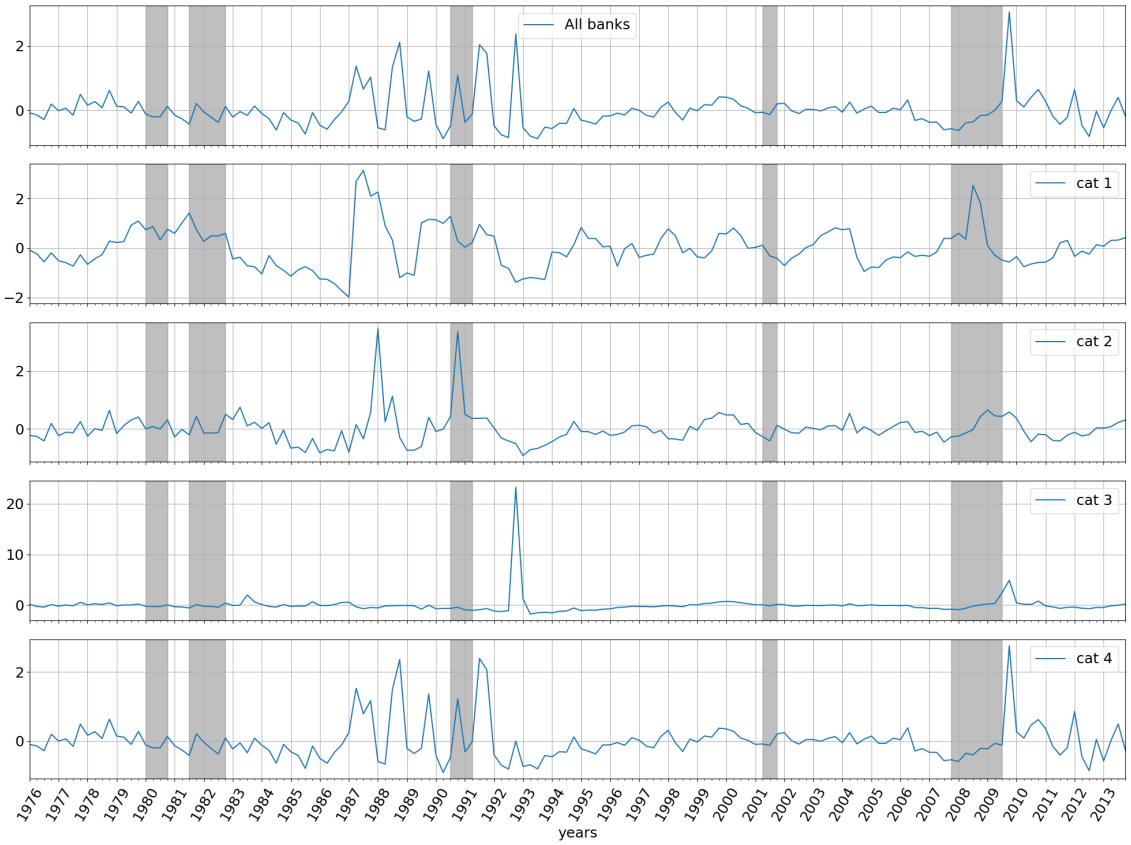
[a]The weighted-average leverage ratio is calculated by taking into account the asset size for each bank every point in time. Every leverage ratio for each individual bank is only accounted in the weighted-average by its share of assets compared to the total assets of all banks at that point of time.

Figure 25: Average leverage by category [a]



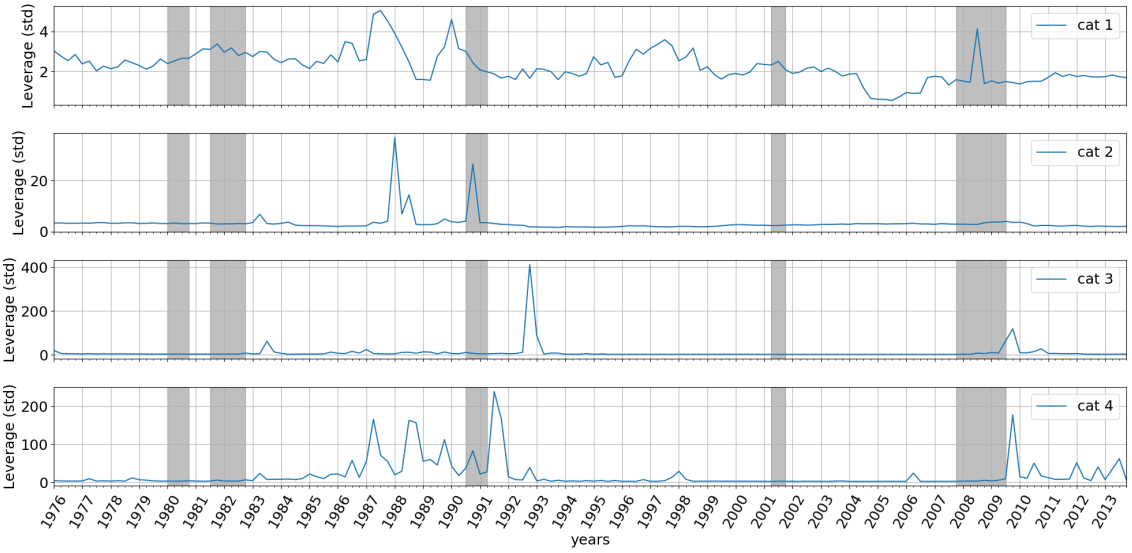
[a]

Figure 26: Cyclical average leverage by category [a]



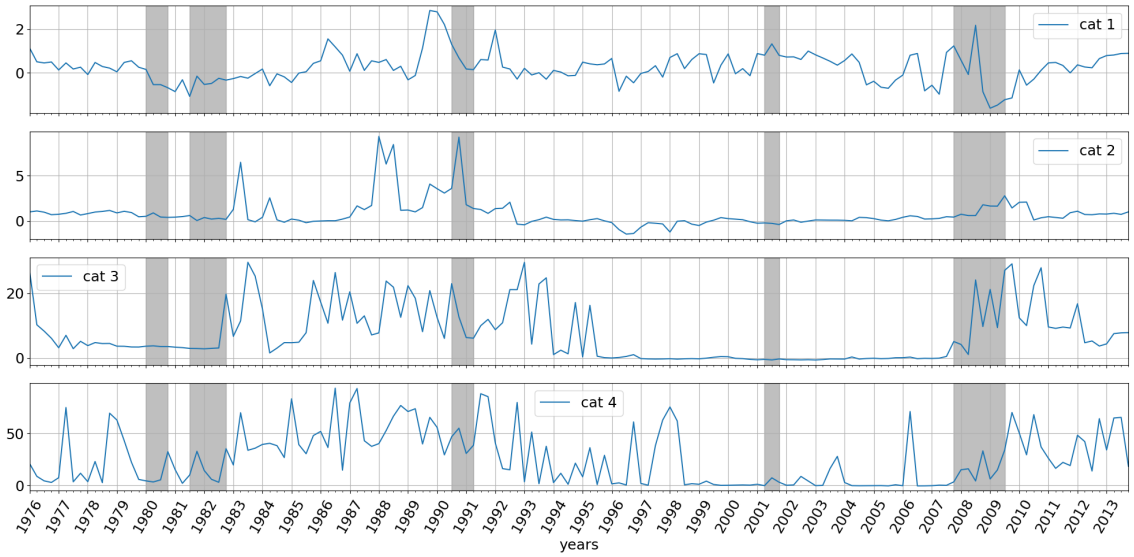
[a]Category 3 contains a banks with leverage over 10000 in year 1992Q4, which results in this exorbitant high spike.

Figure 27: Standard deviation of average leverage by category [a]



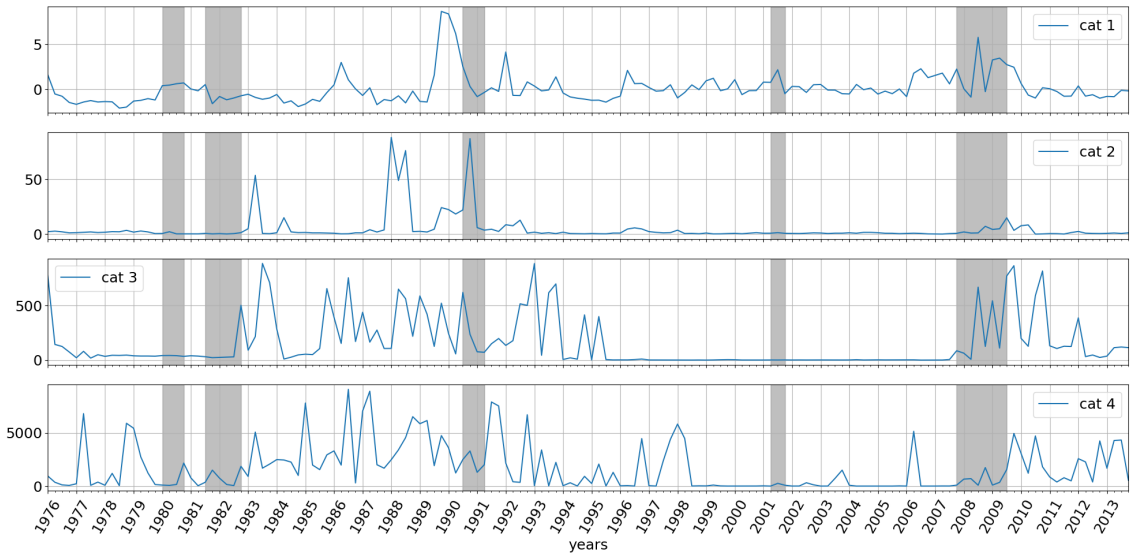
[a]Category 3 contains a banks with leverage over 10000 in year 1992Q4, which results in this exorbitant high spike.

Figure 28: Skewness of average leverage by category [a]



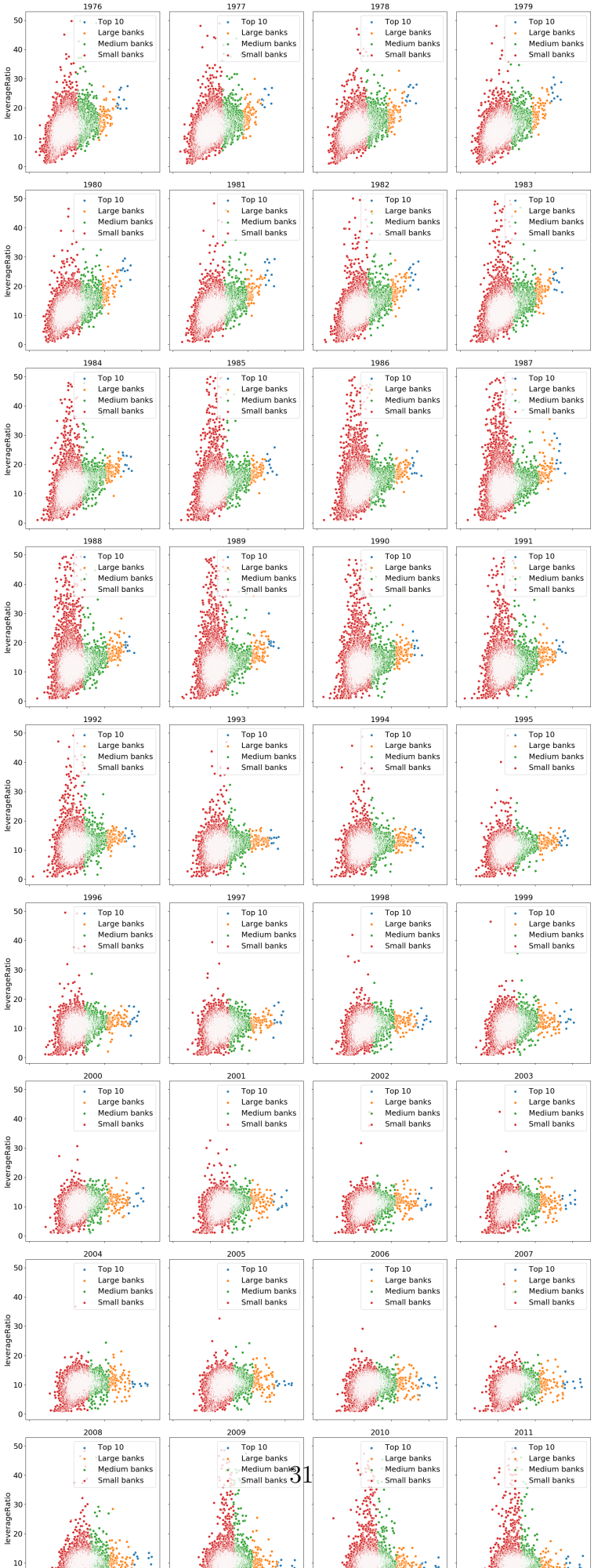
[a]

Figure 29: Kurtosis of average leverage by category [a]



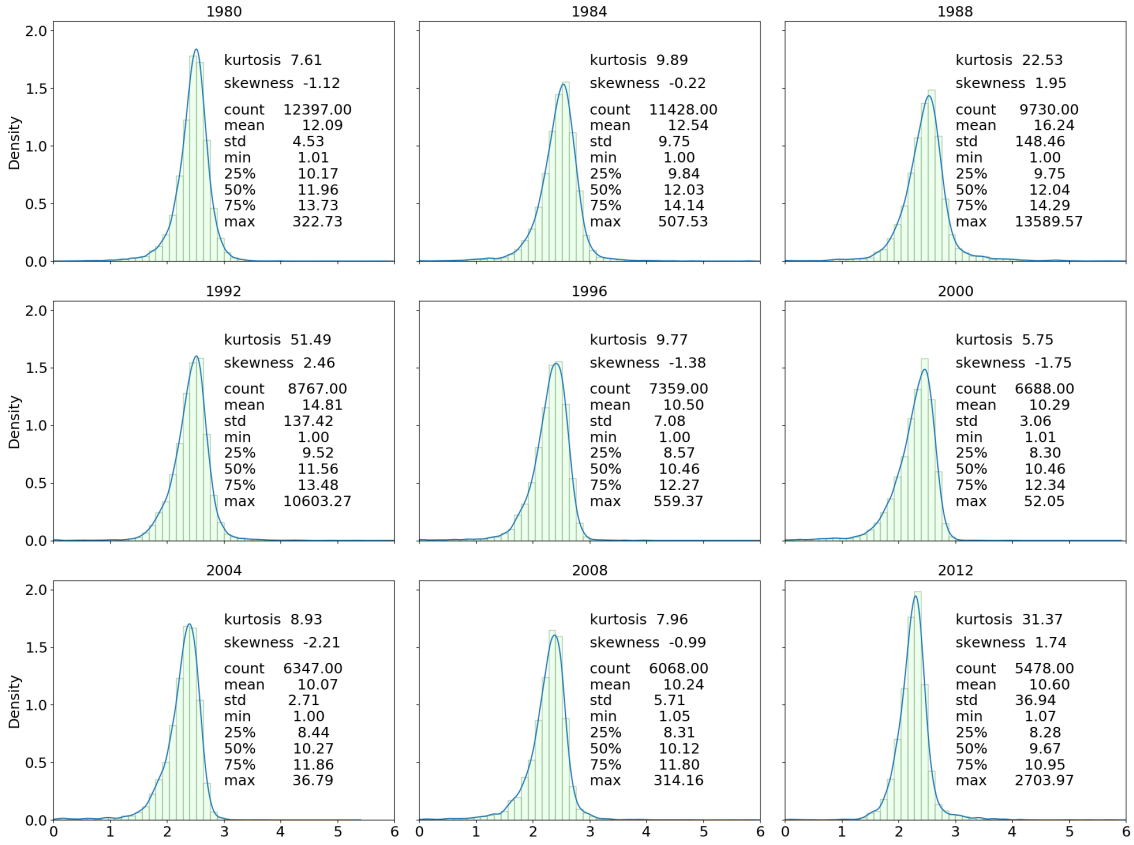
[a]

Figure 30: Assets vs Leverage [a]



2.8 Distribution of leverage

Figure 31: Distribution 1980-2013

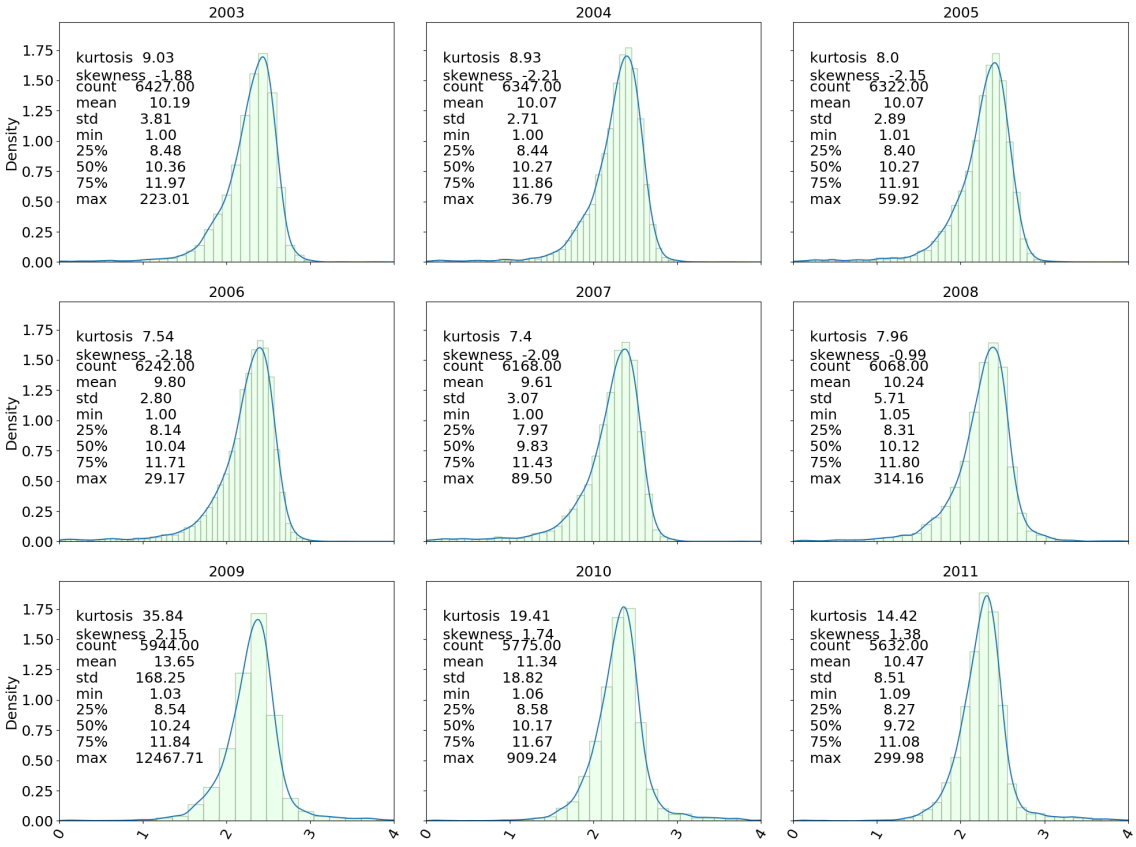


Graph description: Counts are normed to 1. Leverage is transformed with log10. Leverage ratios are always from quarter 4.

Key Observations:

- Log-normal distribution
- Large standard deviation in year 2010 with 18.82
- Less and higher bars in 2012 indicate higher homogeneity in 2013 compared to the years before.

Figure 32: Distribution in crisis 2003-2011



Graph description: Leverage ratios are always from quarter 4 and logarithmised.
Key Observations:

- Increasing homogenity over time.

3 Evaluation/Outlook

In general, this paper gives a broad overview over the us commercial bank landscape and key important factors that should be considered. The next steps would be to choose a specific focus/section and go into more detail. For instance, it would be interesting to find an optimal way to categorize us commercial banks. The literature seems to have found no coherent way of categorization. These categories would obviously be of key importance to us regulators.

Further points

- Shadow banking/investment banks not considered,significant part of trading assets still owned by non commercial bank
- Off balance sheet (off balance-sheet items constitute a big fraction of assets, especially for large commercial banks in the United States - Sebnem Kalemli-Ozcan, Bent Sorensen,Sevcan Yesiltas 2011)

- Valuations not realistic, book values...
- Applying more time-series models
- Applying of models such as Regression...
- Significant part of trading assets still owned by non commercial banks
- Correlation between assets and liabilities: Key part of Asset liability management for banks is maturity transformation. For correlation analysis, we should have differed between the different maturities of assets and liabilities. Correlations between positions of different maturity would have a more causal relationship. In addition, canonical correlation analysis could have been used to consider that balance sheet positions are jointly determined by the other positions. Also, the cyclical variation of shares instead of the cyclical variation of the log of absolutes values could have been used.
- Cyclical of share could have been analysed instead of absolute values (Some literature work with shares)
- Total assets represent the indicator which regulators and academics use most frequently for categorising. It measures the gross nominal volume of a bank's activities, but suffers from significant valuation problems, not only for derivatives, and it does not account for differences in individual bank business models or between financial systems.

4 Conclusion

A Appendix

Figure 33: Autocorrelations: Category 1-4 [a]

lag	cat1_assets+cat1_assets	cat1_assets+cat2_assets	cat1_assets+cat3_assets	cat1_assets+cat4_assets
0	1.0	0.41	-0.27	-0.069
1	0.66	0.34	-0.26	-0.088
2	0.44	0.27	-0.18	-0.032
3	0.36	0.18	-0.11	-0.007
4	0.26	0.079	-0.084	-0.029
5	0.055	-0.057	0.044	0.0053
6	-0.029	-0.14	0.2	0.12
7	-0.11	-0.19	0.32	0.18
8	-0.18	-0.17	0.36	0.14
9	-0.21	-0.11	0.36	0.12

lag	cat2_assets+cat1_assets	cat2_assets+cat2_assets	cat2_assets+cat3_assets	cat2_assets+cat4_assets
0	0.41	1.0	0.24	-0.046
1	0.43	0.63	0.11	-0.19
2	0.4	0.53	0.12	-0.14
3	0.33	0.32	0.075	-0.16
4	0.31	0.3	0.21	-0.016
5	0.25	0.071	0.084	-0.15
6	0.18	-0.00094	0.12	-0.089
7	0.074	-0.13	0.11	-0.063
8	0.019	-0.12	0.2	0.068
9	0.019	-0.3	0.04	-0.033

lag	cat3_assets+cat1_assets	cat3_assets+cat2_assets	cat3_assets+cat3_assets	cat3_assets+cat4_assets
0	-0.27	0.24	1.0	0.41
1	-0.14	0.12	0.68	0.14
2	-0.04	0.14	0.53	0.025
3	-0.026	0.047	0.35	-0.09
4	0.048	0.1	0.34	-0.0024
5	0.095	-0.076	-0.0006	-0.17
6	0.13	-0.11	-0.14	-0.19
7	0.061	-0.19	-0.31	-0.23
8	0.048	-0.22	-0.29	-0.083
9	-0.089	-0.43	-0.45	-0.11

lag	cat4_assets+cat1_assets	cat4_assets+cat2_assets	cat4_assets+cat3_assets	cat4_assets+cat4_assets
0	-0.069	-0.046	0.41	1.0
1	0.0062	-0.12	0.22	0.71
2	0.036	-0.054	0.2	0.55
3	-0.033	-0.083	0.16	0.39
4	-0.0073	0.019	0.25	0.42
5	0.035	-0.1	0.051	0.15
6	0.055	-0.067	0.0012	0.016
7	-0.043	-0.12	-0.057	-0.13
8	-0.11	-0.08	0.054	-0.063
9	-0.2	-0.22	-0.058	-0.22

Figure 34: Banks count by asset size [a]

	1980	1985	1990	1995	2000	2005	2010
(-0.001, 100000.0]	12717.0	11674.0	9145.0	6613.0	4810.0	3435.0	2313.0
(100000.0, 1000000.0]	1507.0	2287.0	2693.0	2843.0	3055.0	3562.0	3670.0
(1000000.0, 10000000.0]	174.0	287.0	325.0	342.0	307.0	381.0	413.0
(10000000.0, 10000000000.0]	18.0	27.0	49.0	75.0	80.0	80.0	83.0

[a]The left column is the asset interval size and the corresponding row the number of banks per year.