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LEVERAGE ACROSS FIRMS, BANKS, AND COUNTRIES

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ABSTRACT

We present new stylized facts on bank and firm leverage for 2000-2009 using extensive internationally comparable micro level data from several countries. The main result is that there was very little buildup in leverage for the average non-financial firm and commercial bank before the crisis, but the picture was quite different for large commercial banks in the United States and for investment banks worldwide. We document the following patterns: a) there was an increase in leverage ratios of investment banks and financial firms during the early 2000s; b) there was no visible increase for commercial banks and non-financial firms; c) off balance-sheet items constitute a big fraction of assets, especially for large commercial banks in the United States; d) the leverage ratio is procyclical for investment banks and for large commercial banks in the United States; e) banks in emerging markets with tighter bank regulation and stronger investor protection experienced significantly less deleveraging during the crisis. These results show that excessive risk taking before the crisis was not easily detectable because the risk involved the quality rather than the amount of assets.

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1 Introduction

The 2007–2009 global crisis started in the financial sector and quickly turned into a global recession with an unprecedented decline in output, employment, and trade. The lessons from previous emerging market crises indicate that banks' and firms' financing conditions are key mechanisms turning financial crises into recessions. Higher cost of external financing and declining collateral values force firms to lower leverage by lowering investment leading to lower output (Kiyotaki and Moore (1997)). Changes in leverage over the business cycle is, therefore, a potentially important amplification mechanism propagating the initial adverse shock to the real economy (Bernanke and Gertler (1995)). Many commentators have argued that the lending boom of the early 2000s, which fueled the sub-prime crises, caused firms and banks to increase their leverage to unprecedented levels. When the boom turned into a bust, following the banks' contraction of credit, a sharp de-leveraging accompanied the largest global financial meltdown since the Great Depression.

To this date, no empirical evidence has been brought to bear on the determinants of leverage before and after the crisis in the framework of an international comparative study, although many recent theory papers aim at understanding the endogenous leverage process (Farhi and Tirole (2010); Fostel and Geanakoplos (2008); Brunnermeier and Pedersen (2009)).[1] This is the task we undertake in this paper by studying leverage patterns across firms, banks, and countries over time before and after the 2007–2009 crisis. Our main result is that excessive risk taking before the crisis was not easily detectable in aggregate data because pre-crisis increases in leverage was mainly limited to investment banks and brokers/dealers in developed countries. Large banks also took large risks although this mainly became clear after the crises started. These institutions grew their balance sheets aggressively by increasing debt and assets during asset booms—this pattern was prevalent in the United States and to a lesser extent in Europe. Banks in emerging markets behaved differently possibly due to tighter bank regulation and stronger investor protection. Using regression analysis, we show that banks in emerging markets had a tendency to grow leverage ratios less aggressively before the crisis and (with high statistical significance) were able to maintain their leverage ratios during the crisis.

The current global crisis underscores the importance of understanding patterns in leverage over time, across firms and banks, and whether these patterns differ across countries with different institutional and regulatory structures. In particular, we would like to know what type of banks

[1] Important early exceptions are the highly influential works of Adrian and Shin (2008, 2009, 2010) and Greenlaw, Hatzius, Kashyap, and Shin (2008). These papers focus solely on the United States.

and firms were highly leveraged in which countries in the run-up to crisis. We study these patterns by utilizing the most comprehensive and comparable firm-level and bank-level world-wide dataset, ORBIS from Bureau van Dijk Electronic Publishing (BvD), 2000–2009. Our data set covers listed, private, large, and small non-financial firms, financial firms as well as banks. There appears to be no previous work that investigates the determinants of firm and bank capital structure using time-varying, comprehensive, and comparable data from many countries. Hence, the novelty of our study comes from the fact that we are the first to investigate patterns of firm leverage together with patterns of bank-financing using a global micro-level data set over time.

Why is this important? Establishing leverage patterns across time and across countries using country level aggregate data may not give the full picture. Even for a single country there may be issues since aggregate data masks micro level patterns. For example, Adrian and Shin (2008, 2009, 2010) show that leverage patterns are countercyclical for the U.S. non-financial sector, as expected, but this is not the case when they focus on particular institutions within the financial sector, namely broker dealers. A rise in asset prices will mechanically increase the value of equity (banks' net worth) as a percentage of assets. Therefore, rising asset prices will lead to a lower leverage ratio, defined as the ratio of assets to equity. Conversely, in a downturn, asset prices would fall and the leverage ratio would increase. Adrian and Shin (2008, 2009, 2010) finds that such a pattern holds for the non-financial sector but not for investment banks, whose leverage rises during booms and falls during downturns; i.e., the leverage of investment banks is procyclical. This procyclicality amplifies the business cycle, potentially leading to systemic risk if asset prices do not properly reflect fundamental values ("bubbles"). Their findings show that these financial institutions actively manage their balance sheet and leverage during the booms and busts using collateralized borrowing and lending. He, Khang, and Krishnamurthy (2010) emphasize the shift in securitized assets within the financial sector by showing that while investment banks were decreasing their leverage by selling such assets during the deleveraging process of 2008–2009, commercial banks and government increased their leverage since these latter institutions acquired these assets.

The works by Adrian and Shin and He, Khang, and Krishnamurthy use mainly aggregate-sectoral data from the Flow of Funds of the Federal Reserve and can only investigate the difference between commercial banks and investment banks as an *aggregate* in the U.S. but not systematically bank-by-bank and not as banks from different countries.[2] It is very likely that these type of

[2]Adrian and Shin (2008, 2009, 2010) use data from SEC filings for five big investment banks in the U.S.: Lehman Brothers, Merill Lynch, Morgan Stanley, Bear Sterns, Goldman Sachs, and Citigroup, finding results similar to ours. He, Khang, and Krishnamurthy (2010) and Greenlaw, Hatzius, Kashyap, and Shin (2008) also use data from the

aggregate patterns are driven by the big banks. We think it is important to know how typical investment banks and typical commercial banks behave and whether the U.S. patterns are different from those of other countries. From a regulatory standpoint, the policy prescription will differ if aggregate patterns are driven by few big players rather than by a large number of small and mid-size banks.

We show that leverage is procylical for large commercial banks in the United States and to a lesser extent in Europe, where we define a "large" bank as a bank that has more then a billion dollars worth of assets at the beginning of our sample. These banks seem to have increased their leverage pre-crisis because they have comparative advantage in raising funds in short-term market (overnight repos and commercial paper) and they skirted capital requirements using off-balance sheet investment vehicles. They may be somewhat more stable than investment banks due to their ability to also obtain funds from deposits; nonetheless, excessive risk taking from huge banks, which are considered safe due to explicit deposit insurance and implicit insurance ("too-big-to-fail"), raises serious regulatory issues. Our paper's main contribution is to help us understand patterns of leverage before the crisis. Our results may have important policy implications especially with regards to regulatory reform.

The remainder of the article proceeds as follows. Section 2 reviews the theoretical and empirical literature on leverage. Section 3 lays out a simple theoretical framework for ease of interpreting the empirical results. Section 4 presents our data and discusses relevant issues. Section 5 presents the empirical patterns and regression results. Section 6 presents robustness analysis. Section 7 concludes.

2 Literature on Leverage

Since the celebrated paper of Modigliani and Miller (1958) there has been an outpouring of theoretical work on the underpinnings of the firm's capital structure but empirical work is only slowly catching up. Theoretical models pinpoint important departures from the Modigliani-Miller assumption which makes capital structure relevant for the value of firms. However, we still do not know the empirical relevance of many different theories. Specifically, we lack a good understanding of the determinants of capital structure of the private and public sector especially outside the United States because most of the empirical literature focuses on the United States using data from COM-

SEC on five big commercial banks in the United States: Bank of America, JP Morgan Chase, Citibank, Wachovia, and Wells Fargo and find similar results.

PUSTAT on large listed firms. This literature is mostly cross-sectional and hence cannot speak to the time-series dynamics in leverage patterns (see Frank and Goyal (2004) for an example).

The corporate finance literature studying U.S. non-financial listed firms shows that the most important cross-firm determinants of leverage are size, profitability, and tangibility (collateral). In a seminal paper, Rajan and Zingales (1995), using data from non-financial listed firms for the year 1991, find that these factors are also important for leverage in the G7 countries and differences in accounting practices across countries do not affect the leverage patterns for firms. They also find that European firms have higher levels of leverage on average than U.S. firms. Booth et al. (2001) study ten developing countries using a data set of large listed firms in a static setting and find that the factors important for leverage in developed countries (size, profitability, and tangibility) are also important for developing countries; however, at the same time there are significant country-level differences in mean levels of leverage. Lemmon, Roberts, and Zender (2006) undertake a dynamic analysis using data (COMPUSTAT and CRSP) from listed U.S. firms and conclude that more than 90 percent of the variation in leverage is captured by firm-fixed effects and the determinants identified by the previous cross-sectional literature—such as size, profitability and collateral—only account for 10 percent of the variation. This result implies that for listed non-financial firms the leverage is remarkably stable over time.

For financial firms and banks, we are only aware of the study by Gropp and Heider (2009) which applies the insights of the non-financial firm-level literature to banks. In theory, bank capital is determined by regulatory capital requirements and hence there should not be any cross-sectional variation in banks leverage ratios (although there can be time variation for a given bank) which partly explains why the empirical literature on bank leverage is sparse. Gropp and Heider (2009) show that there is large variation in banks capital ratios and investigate whether capital requirements are a first-order determinant of banks' capital structure. They undertake an analysis similar to that of Rajan and Zingales (1995) but using data that has both cross-bank and temporal variation from BANKSCOPE as does the present article. They focus on the top 100 large listed European and U.S. banks between 1991 and 2004. As in the U.S. non-financial firm-level study of Lemmon, Roberts, and Zender (2006), they find that the importance of determinants such as size, profitability and tangibility disappears once bank-fixed effects are accounted for. They also find that minimum capital requirements does not have a role in explaining banks' capital structure. This might be because banks optimize their capital structure like firms in a market based system based on prices and pressures from shareholders and debtors as modeled by Flannery (1994), Flannery and Sorescu (1996), Myers and Rajan (1998), Diamond and Rajan (2000), Flannery and Rangan

(2008) and Allen et al. (2009). Another important finding from the study of Gropp and Heider (2009) is that on the margin banks finance their balance sheet growth entirely from non-deposit liabilities.

As a result, the main conclusion of the empirical literature on the determinants of non-financial firms' and banks' leverage so far is that patterns are pretty stable over time and determined by similar cross-bank and cross-firm determinants in different countries, though there exist significant country differences. The empirical results of Adrian and Shin (2008, 2009) and Greenlaw, Hatzius, Kashyap, and Shin (2008) regarding the procylical nature of leverage suggest that the largest banks manage their capital structures based on internal value at risk and not based on regulatory constraints.

The recent theoretical literature on endogenous leverage builds upon financial frictions theories. Financial intermediaries face frictions in raising funds and when these frictions worsen they sell their assets at fire-sale prices and reduce liquidity provision. These models go back to the influential work of Shleifer and Vishny (1992). These leverage-constraint models, for example Geanakoplos and Fostel (2008), Adrian and Shin (2010), and Brunnermeier and Pedersen (2009), focus on the amount of debt financing of intermediaries which face a leverage constraint. In such models, the asset demand (and the demand for risky assets) of the intermediary will be affected and tighter constraints will lead to deleveraging. The next section details a simple representation of such a setup.

3 Leverage of Investment Banks: The Adrian-Shin Model

This section outlines the framework of Adrian and Shin (2010) for understanding changes in asset valuations and leverage. Suppose a household buys a house worth 100 dollars and finances this investment by taking a mortgage of 90 dollars. The difference between these two sums is household's equity, which here equals 10 dollars. In balance sheet diagram form:

Assets	Liabilities
House, 100	Equity, 10
	Mortgage, 90

Leverage is defined as the inverse of the equity ratio; that is, the ratio of total assets to equity,

hence in this example leverage is 10. Now, what happens to leverage when asset values fluctuate? If we define A as the market value of assets and E as the market value of equity, leverage is given by:

$$L = \frac{A}{E} = \frac{A}{A - D} \tag{1}$$

If the market value of debt stays constant asset price changes increase equity one-to-one and leverage is inversely related to assets. When the price of a household's house goes up, net worth increases, and the households leverage goes down.[3] For example, if the price of the house goes up to 101 dollars, equity goes up by one dollar and leverage falls to 9.18, simply shown as:

Assets	Liabilities
House, 101	Equity, 11
	Mortgage, 90

Thus the prediction of a standard theory, where leverage is not actively managed, is a negative relation between balance sheet (asset) growth and leverage growth. Given asset growth, equity reacts and leverage adjusts.

Financial intermediaries, such as banks, can behave very differently by engaging in active balance sheet management. For example, if the intermediary targets a constant leverage it will react to changes in net worth by adjusting debt. If balance sheets are not marked to market—as is typically in the case for commercial banks—then leverage is measured as total book assets to book equity and financial intermediaries can react to an increase in asset prices by increasing their debt in order to maintain a constant leverage in terms market value. In this case, the relationship between balance sheet leverage growth and the balance sheet size (asset growth) can be positive. This implies that leverage can be procylical: high during booms and low during busts.[4]

Why might this be the case? Financial intermediaries strive to maintain a constant (maximal) risk exposure while maximizing earnings through high leverage. A commonly used concept is VaR (Value at Risk) which is an estimate of a financial institution's worst case loss.[5] Let us denote

[3]This pattern is borne out in the flow of funds data for the household sector as shown by Adrian and Shin (2010).

[4]This pattern is borne out in the flow of funds data for the financial sector, specifically broker-dealers, as shown by Adrian and Shin (2010).

[5]VaR is usually defined with respect to a confidence level of, say, 99%. Then VaR would be defined such that the probability that losses on the asset portfolio exceed the value VaR is less than 1%.

Value at Risk per dollar of assets held by a bank by V. If the banks wants to maintain the total VaR; i.e., $V \times A$ to be equal to capital, E, then we have $E = V \times A$ and leverage is:

$$L = \frac{A}{E} = \frac{1}{V} \tag{2}$$

If this sketch provides a good approximation to the behavior of (investment) banks procylical leverage is directly related to countercylical VaR. Leverage is high during boom times since during these times, risks are low. Leverage is low during contractions since risks are high due to increased volatility of asset prices.

Let us go back to our previous example but now illustrate the balance sheet of a bank with the same diagram:

Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Let us assume this bank actively manages its balance sheet to keep the leverage level constant at 10. If the price of securities increase by 1% to 101, leverage falls to 9.18 and if the bank targets a constant leverage of 10, it must increase its debt; i.e.,

$$A/E = (101 + D)/11 = 10$$

Thus, an increase in price of securities of 1 dollar brings an additional debt of 9 dollars. Leverage is now 10 and the new balance sheet looks like:

Assets	Liabilities
Securities, 110	Equity, 11
	Debt, 99

This type of active balance sheet management makes the demand for assets procylical and amplifies the financial cycle. When the demand for assets is high, this puts pressure on their price which in turn increases prices and induces banks to take on more debt, increasing the size of the

balance sheet. The mechanism works reverse in downturns, through the selling off of assets, possibly at fire-sale prices.

This type of behavior goes against the standard theory where assets come first and equity and debt adjust. Here, equity becomes sticky and assets grow by taking on more debt, and debt goes down by selling of assets. This way of thinking is different from the traditional interpretation where adjustment works via equity. According to this VaR model, leverage is explained by risk. Below we provide evidence that indeed growth of assets and growth of leverage is positively linked for investment banks and large banks, and that time dynamics in our leverage measures for these banks in the U.S. follows the VIX volatility index.

4 Data and Descriptive Statistics

4.1 Data

We use a unique data set composed of firm- and bank-level observations from the ORBIS database provided by Bureau van Dijk Electronic Publishing (BvD), between 2000–2009. This database is an umbrella product that covers the other well-known databases from the same company such as AMADEUS (only Europe firms), ZEPHYR (worldwide mergers), BANKSCOPE (worldwide banks) and OSIRIS (worldwide listed firms). The time coverage of each firm/bank is a subset of the sample period, leading to an unbalanced panel.[6]

The database comes in two modules: Financials, which provides financial information—both balance-sheet and off-balance sheet items—and Ownership/Corporate tree, which provides information on foreign and domestic owners of each firm and all the subsidiaries and many establishments. In our original data set, we have 60,000 publicly quoted companies worldwide (OSIRIS), 30,000+ banks (BANKSCOPE) worldwide, 29 million European companies from 46 countries (AMADEUS), 18+ million U.S. and Canadian companies, 5+ million South and Central American companies, 6+ million companies in the Far East and Central Asia (mainly in Japan, Korea, China), and 790,000 African and Middle Eastern companies (ORBIS).

We will only use banks/financial firms and large non-financial firms in this study since the small non-financial firms have no role in this crisis. In fact, we document that even large non-financial firms were not important for the crisis and the whole action in pre-crisis leverage patterns comes from banks and financial firms. Nevertheless, we investigate non-financial firms because Welch

[6]We use ZEPHYR data to control for all firm mergers and acquisitions that happened during our sample.

(2007) show that only 10 out of the most leveraged 30 firms in S&P 500 typically are financial firms. Table 1 shows the number of bank-year and firm-year observations used.

For banks and financial firms we use a benchmark world sample, whereas for non-financial firms we only focus on Europe and the United States. The reasons for this focus for non-financial firms is twofold: First, this crisis was mainly about the financial sector. Second, for banks we have representative universal coverage and we want to compare dynamic patterns in bank leverage before and after the crisis across developed countries and emerging markets with different regulatory and institutional structures. However, for non-financial firms we do not have a representative sample and the coverage across countries varies widely. We focus on "large" firms (defined as firms with more than 150 employees) from the countries with best quality data and coverage and these countries are European countries and the United States which have better reporting requirements for accounting data. In Europe and the United States all large firms (listed or not) have to file with official registries. Given this requirement our European coverage is very good but the U.S. coverage suffers from the fact that many firms in the United States do not report assets given that most of them only provide consolidated statements.[7]

We use two types of samples for both banks and firms: permanent and non-permanent. The non-permanent sample is used in the regression analysis and in the investigation of cross-sectional patterns. We made sure the non-permanent sample does not suffer from survivorship bias by assembling our panel data from individual cross-sections using historical, archived releases of the database. This is important since the BvD erases the banks in BANKSCOPE from all previous years if the bank does not exist anymore in the current year. They apply a similar practice to firms in AMADEUS and in ORBIS where they keep a firm for 5 years after it disappears and then erase it from all years. Hence, the data has to be downloaded disk by disk for every year and not from the latest disk for all the previous years.

The permanent sample is used for time series figures. We have to use a permanent sample here otherwise we would not know if the changes we see in the dynamic leverage patterns are due to entry and exit of banks and firms. The trade-off is that these permanent samples will suffer from survivorship bias. Permanent samples are defined as firms and banks being there throughout the period of 2000–2009 and have non-missing asset data—a similar choice was made by Lemmon, Roberts, and Zender (2006).

[7]In addition to this issue, the BvD has a relatively thin coverage for the United States before 2007 even for consolidated accounts.

In the context of leverage, our bank data from BANKSCOPE is used by Gropp and Heider (2009). In the context of the bank competition literature, it is used by Berger, Klapper, and Turk-Ariss (2008) and Claessens and Laeven (2004). Our firm data is used by many authors in different contexts. Arellano and Bai (2010) use AMADEUS (European firms only) to study the relationship between leverage and financial development for one year (2004) but do not analyze dynamic properties of leverage. Coricelli et al. (2009) use AMADEUS data for 9 CEE countries in the pre-crisis period of 1996–2005 to study the relation between growth and leverage. ORBIS data, where we get the U.S. firms, is identical to the well-known Dun and Bradstreet dataset which is extensively used in the context of the United States. For example, Black and Strahan (2002) use this data to study entrepreneurial activity in the United States and Acemoglu, Johnson, and Mitton (2009) and Alfaro and Charlton (2010) use it for the cross-country study of concentration and vertical integration and vertical and horizontal FDI patterns, respectively. The firm level data also used in two other studies involving two of the authors of this article, namely, Kalemli-Ozcan, Sørensen and Volosovych (2010) and Fons-Rosen, Kalemli-Ozcan, Sørensen, Volosovych, Villegas-Sanchez (2011) who study the relationship between growth, volatility, and financial integration and productivity spillovers, respectively.

Our bank and firm data are suitable for international comparisons because the BvD harmonizes the data but also because our dynamic analysis either compares banks over time within a single country or banks over time within many countries using bank and country-time fixed effects which control for permanent differences between banks or countries and for global common factors. For our purpose, it is important to undertake a dynamic analysis, rather than a cross-sectional analysis which doesn't allow for fixed effects, because fixed effects will absorb all country- and time-level differences that are common to all banks and firms in a country such as differences in accounting practices, balance sheet representation, and domestic regulatory adjustments. For example, international financial reporting standards result in higher total asset amounts than U.S. generally accepted accounting principles because netting conditions are stricter under international standards.

In their cross-sectional analysis, Rajan and Zingales (1995) investigate three major differences in accounting practices to see if these make a difference in their international comparative study of leverage patterns in G7 countries. One of these differences stem from the fact that some countries require the reporting of consolidated balance sheets and while other countries do not, though many firms report consolidated balance sheets together with unconsolidated. Rajan and Zingales (1995) show that this does not make a difference to their results. In our case, fixed effects will absorb

these difference but nevertheless for non-investment (commercial) banks and non-financial firms we use only unconsolidated accounts to avoid double counting and improve comparability across different countries.[8] For investment banks, we use consolidated accounts because they only report these. Adding consolidated statements (holding companies) for commercial banks does not alter our results.

Regulatory requirements might also apply differently to different accounts. For example, in the United States minimum capital requirements apply both to individual banks and to consolidated banks, whereas in other countries this may be different. Investment banks and their subsidiaries are not subject to regulatory requirements in the United States and are regulated by the Securities and Exchange Commission while they other countries often have different regulatory systems. Again, any non-time varying bank-level changes will be absorbed by our fixed effects.

Another difference between countries can be due to assets and liabilities being valued at book value (historical) or at market value (current). As long as different countries follow different practices but all banks and firms do the same then these differences will be absorbed by our fixed effects. If different banks and different firms in different countries choose different practices that change over time then we cannot account for this (if constant over time, bank and firm fixed effects will control for these difference). Therefore, we stick to book value overall as reported in balance sheets if we have the choice between the two as in the case of listed firms and banks. For private firms and banks (which is the big fraction of our data) we have book value only.

At the country level, we use two sets of variables to proxy institutional regulatory structure. The first set of variables are from the World Bank's Doing Business Data Set, such as indices for the protection of Shareholder Rights and Investor Rights (taking values between 1 and 10 where a higher value means more protection). We use 2003-2006 values of the variables to capture the situation before the crisis. The second set of variables are from the Bank Regulation Data Set of Barth, Caprio, and Levine (2007). This data set comes in two survey waves, an initial one in 2003 and a later one in 2010. We use the 2003 values of the following variables: Real Estate Restrictiveness, which is an index that measures the extent to which banks may engage in real estate investment, development and management. The index takes a value between 1 and 4 where a value of 1 indicates no restriction and a value of 4 means these activities cannot be conducted. Overall Restrictiveness is a similarly defined index for real estate insurance and securities activities, where banks may engage in underwriting, brokering and dealing in securities, insurance and all aspects

[8] Assets may still be not measured right for each individual bank even we use unconsolidated accounts for each bank given the global nature of many banks.

of mutual fund industry. This index varies between 3 and 12 since it is the sum of three different indices and a higher number means more restrictiveness. Required Audit indicates whether or not there is a compulsory external audit of the bank by a certified auditor. If this takes a value of 1, it means there is a required audit, otherwise the variable takes a value of zero. Supervision Index indicates the efficiency of supervision and takes a value of 1 if there are multiple independent supervisors for banks and zero otherwise. Monitoring Index indicates the efficiency of monitoring and takes a value of 1 if top ten banks in the country are all rated by International Rating Agencies, if off-balance sheet items are disclosed to public, if banks must disclose risk management procedures to the public and if subordinated debt is required as part of regulatory capital. This index is zero otherwise.

4.2 Descriptive Statistics

For most of this article the leverage ratio is measured as the ratio of assets to equity (shareholder funds). This measure is equivalent to the measure 1−equity/assets as used by Gropp and Heider (2009).[9] We use this measure as our benchmark measure both for non-financial firms and banks. We also use for robustness the ratio of tier 1 capital (sum of capital and reserves minus intangible assets) to adjusted assets, ratio of total liabilities to total assets, ratio of total debt to total assets and ratio of total debt to equity. (Not reported in the present version of the article.) All these measures give similar results so we focus on the assets to equity ratio as leverage measure.

The leverage ratio (assets/equity) does not include off-balance sheet exposure. One of the key characteristic of this crisis is that, in the pre-crisis period banks funded a growing amount of long-term assets with short-term liabilities through the use of off-balance sheet vehicles, exposing themselves to credit and liquidity risk by providing credit facilities and guarantees to these vehicles. Many have argued that this was the main amplification mechanism (see Brunnermeier, 2009 and Adrian and Shin, 2009). In addition, banks held structured credit instruments on their own balance sheet, increasing their maturity mismatch of the balance sheet and their funding liquidity risk. Therefore, we also investigate patterns in the ratio of off-balance sheet items (guarantees and committed credit lines) to assets since a loan guarantee involves a future contingent commitment even it does not show up on the balance sheet. Banks report these data together with balance sheet as a separate memo line called off-balance sheet items where they report guarantees, com-

[9] Gropp and Heider use this measure because it includes all debt and non-debt liabilities of banks such as deposits while other standard measures of leverage are less suitable for banks.

mitted credit lines, and other exposure to securitization. Only very few banks report the last item. Investment banks do not report any of these items.

In our regressions, we use explanatory variables that are standard in the corporate finance literature such as size (proxied by log assets), profitability (proxied by net income/assets), and tangibility (proxied by total earnings assets/assets). We further investigate the role of foreign ownership, especially because the previous literature has overlooked potential effects of foreign ownership on leverage. We divide countries into different groups and compare listed versus non-listed firms/banks, big versus small firms/banks, and investment banks versus commercial banks.

As mentioned above, Table 1 shows the number of bank-year and firm-year observations by country, where for firms we focus only on large firms from European countries and from the United States to have more comparable samples. Large firms are firms with assets above 28 million USD and more than 150 employees. We have over 1.5 million observations for these firms. We have over 200,000 bank observations from 60+ countries. Table 2 presents the number of observations by bank type and account type. Most of our banks report unconsolidated accounts, commercial, and not listed. Similar picture emerges from firm level data where most of our firms are non-financial.

Table 3 presents descriptive statistics, averages across bank and time. The leverage ratio can be as high as 46 with a mean of 12 and the maximum amount of off-balance sheet items is 65 percent of assets with a mean of 10 percent. Table 3 also shows descriptive statistics by type of bank. Investment banks have slightly higher leverage, on average. "Sponsor" banks and large commercial banks have the highest leverage on average, around 22 and 17 respectively. "Sponsor banks" refer to banks which have created off-balance sheet investment vehicles. These are mostly large commercial banks. The names of the sponsor banks are from Acharya, Schnabl and Suarez (2010). There are 70 conduit sponsor banks in their data set and we have located 62 of these in our data. 31 of these banks are European, 23 are American, 4 are Australian, 3 are Japanese, and 1 bank is Canadian. Only 3 out of 62 are investment banks. Non-sponsor banks statistics are similar to the statistics of all banks.

5 Empirical Patterns

5.1 Aggregate Picture

In order to interpret our results for leverage, we start by plotting the development of bank assets and equity since 2000. In the Flow of Funds compiled by the U.S. Federal Reserve System, assets

of commercial banks, savings institutions, and credit unions increase from about 6 trillions dollars to over 12 trillion dollars in 2008 followed by a decline of several hundred billion since 2008—see Panel A. Investment banks ("brokers and dealers" in the Flow of Funds) saw a tremendous growth in assets from 2000 to 2008 followed by a steep reversal of over half a trillion dollars. Investment banks held large amounts of assets tied to sub-prime loans. These travails of the U.S. investment banking sector and the culmination in the default of Lehman Brothers, has been extensively documented in many places (see for example Duffie (2010) and Krishnamurthy (2001) and other papers in the *Journal of Economic Perspective*'s symposium on the financial crisis in the Winter 2010 issue).

Panel B of Figure 1 displays U.S. aggregated assets from the our bank-level data. "Aggregated," when results are based on bank by bank data, simply means the sum of assets (or equity) over all the banks in the sample. Compared to the Flow of Funds data, our aggregated data overstates assets because banks' claims on each other are not netted out and may display slightly lower growth as our data are deflated by the Consumer Price Index while the Flow of Funds data are nominal. Nonetheless, the patterns in our aggregated data are similar to the patterns in the Flow of Funds data for both investment banks and non-investment banks. Using our data, we are able to break down the patterns for large banks, large banks excluding investment banks and small banks. Panel C shows aggregated assets of European banks from our data.[10] Assets grew marginally from 2000 till 2004 followed by a sharp acceleration to more than 20 trillion dollars in 2008 followed by an astounding drop of about 3 trillion dollars from 2008 to 2009.

Figure 2 displays U.S. Flow of Funds equity and aggregated equity from our micro data in Panels A and B, respectively. U.S. investment bank equity grew sharply from 2004 to 2006 followed by a sharp drop in 2008 (the exact timing being slightly different between the quarterly Flow of Funds data and the annual aggregated data and a sharper decline in aggregated data given the log scale). For large banks (excluding investment banks) there has been a steady increase. For European banks aggregated equity, see Figure 2 Panel C, increased rapidly from about 600 billion dollars in 2004 to about 800 billion in 2007 followed by a slight drop in 2008 and a steep recovery in 2009.

Figure 3 compares aggregate U.S. leverage, calculated as assets over equity, from the Flow of Funds to aggregated leverage (aggregated assets divided by aggregated equity) compiled from our micro data. The U.S. patterns from the Flow of Funds accounts in Panel A are very similar to those of the aggregated data in Panel B which display aggregated assets divided by aggregated equity.

[10] European sample includes all European countries. Results with banks only from the EU are similar.

In 2004, SEC deregulated the minimum capital requirements for investment banks, freeing leverage ratios from regulatory constraints. A run-up in leverage of investment banks ("brokers and dealers" in the Flow of Funds) from 2004 to 2008 is evident in both panels although the Flow of Funds data, being quarterly, exhibits sharper peaks and valleys. The collapse in leverage of investment banks after 2008 is also clearly evident in both panels. This is (mechanically) explained by the sharp decline in assets combined with equity rebounding in 2009. Leverage ratio of commercial banks was quite stable from 2000 until 2008 when a steep decline occurred. This is explained by the small decline in assets and the steeper increase in equity seen in the previous figures. In the light of the VaR model we discussed above, it is not surprising that the pattern in leverage is similar to the pattern in the VIX risk measure, as shown in Appendix Figure.

Figure 4 "zooms in" on non-investment banks whose lines seemed flat due to the scale of Figure 3 and compares to European data. The Flow of Funds leverage ratio for non-investment banks can now be seen clearly to be quite stable between 12 and 14 until the middle of 2008 when the leverage ratio started dropping till near 9 in late 2009. A similar pattern is revealed in Panel B using aggregated data and it appears that this decline in leverage was concentrated in the group of large banks.[11] Large banks grew faster from 2004 to 2008 but because small banks kept growing after 2008 the difference in assets and hence the leverage ratio is now smaller. For Europe, aggregated leverage was quite stable apart from a slight decline after the 2001 dot-com crises until a steep run-up from 2006 to 2008 followed by a sharp fall-back in 2009—clearly caused by the decline in assets observed in Figure 1. In Europe we do not observe a separate category of investment banks since banking is universal.

The sub-prime crisis first came to the surface on July 31, 2007 with the default of two Bear Stearn hedge funds followed by BNP Paribas halting withdrawals from three investment funds. A large number of banks had created off-balance sheet conduits which mainly invested in asset-backed securities in order to reduce capital requirements. However, most conduits were still fully or partially guaranteed by their sponsoring banks which also provided committed lines of credit (see, Acharya, Schnabl and Suarez (2010) for more details on this). We have measures of guarantees and committed credit lines and we display the aggregated amounts relative to assets for all banks and separately for large banks in Figure 5. Investment banks do not report these items. The total amount of guarantees and credit lines were almost as large as total assets from 2000 till 2007—more precisely 85 percent—for large banks and lower at 70 percent for all banks. From 2007 till 2009

[11] These figures include investment banks for large and all banks to be able to compare the magnitudes to European banks.

there was a sharp reversal with the aggregate amount dropping to less than 50 percent of assets when banks were getting out these commitments in the wake of the interbank lending freeze. Large banks and smaller banks witnessed a narrowing gap. Panel B shows similar patterns for Europe in terms of timing, though less pronounced in scale; guarantees and committed credit lines are only as high as 20 percent of assets. This might be also due the differences in regulation where banks in Spain do not issue guarantees to off-balance sheet entities. The reason for this is the fact that before the crisis only one country, Spain, had imposed similar capital charges for assets on- or off-balance sheet and therefore Spanish banks did not sponsor conduits.

This article does not focus on guarantees and credit lines but it is obvious that banks carry a large amount of risk that is not visible from conventional leverage ratios. Ex post, major U.S. banks were subject to increasing risk from guaranteeing enormous pools of assets of declining quality; however, the pattern of Figure 5 does not indicate increased risk taking before 2007—only the collapse after the start of the crises reveals the risk taken. We will return to this theme again during our regression analysis but it is already clear that outside of investment banks neither leverage nor guarantees and committed credit lines relative to assets (or equity) signalled excessive risk taking over time in the run-up to the crisis. It appears that the increasing risk exposure of commercial banks in 2004–2007 were hidden in the deteriorating quality of the asset pool.

5.2 Median Leverage: Typical Bank and Firm

Aggregated (and Flow of Funds) patterns may be driven by a few megabanks, such as Bank of America, Citibank, and JP Morgan. Our micro data allows us to examine leverage of typical banks. We plot median leverage for banks over time in Figure 6. Panel A is visually dominated by investment banks which have pro-cyclical leverage ratios between 14 and 20. These medians are higher than those of commercial banks but much lower than the aggregate leverage ratios of investment banks—clearly, high leverage of investment banks is concentrated within the largest ones.

Panel B drops investment banks to better study the leverage ratio of the typical U.S. commercial bank. For the typical large bank, leverage has been steadily decreasing from around 12 to around 10.5 with temporary increases in 2004–2005 and 2008, while the median (overall) bank has had a stable leverage ratio between 10 and 10.5 from 2000 to 2009.[12] Panel C shows that the median European bank decreased leverage steadily from around 17.5 to 15 over our sample. The higher

[12]Bank leverage is much higher than typical firm leverage, displayed below, as found by Gropp and Heider (2009).

leverage in Europe may be due to various institutional features as studied by Rajan and Zingales (1995) who found higher leverage for European than for U.S. firms. In this paper, the focus is on temporal patterns in leverage and we notice that typical (median) banks have falling leverage ratios in both Europe and the United States with both countries displaying a temporary increase in 2008.

Figure 7 shows median levels of guarantees and committed credit lines to assets for large and for all banks. The median is much smaller than the aggregate ratio for large banks and much smaller again for all banks. This holds for both the United States and Europe implying that issuing of guarantees and committed credit lines was concentrated within the group of the largest banks. The patterns so far suggests that large banks were substantially more exposed to systemic risk than smaller banks.

5.3 Bank Leverage: Procylical or Countercyclical?

An increase in asset values will mechanically increase the value of both the numerator and denominator of the leverage ratio but the increase in equity will be proportionally larger and the leverage ratio will mechanically fall. Such a pattern is observed for households as pointed out by Adrian and Shin (2008, 2009). However, a firm or a bank may be able to use the increased equity as basis for further lending which will increase assets (and liabilities) relative to equity with the outcome that asset appreciation and leverage is no longer inversely related. Adrian and Shin (2008, 2009) demonstrate that non-financial corporations' asset growth and leverage is virtually uncorrelated using aggregate data from the U.S. Flow of Funds accounts.

A non-financial firm may face decreasing marginal profitability of investments; however, banks will often be able to invest in large liquid markets, such as mortgage-backed securities with non-decreasing marginal returns, while lending at a constant low rate through repurchase arrangements, commercial paper, or implicitly through cash management for hedge funds. If banks have target leverage ratios the net result will be that leverage does not increase with asset values but rather aggregate leverage and asset growth will be positively correlated over time. Adrian and Shin (2008, 2009) show this procylicality for U.S. investment banks 1963–2006. They show that for commercial banks the patterns is acylical, though Greenlaw, Hatzius, Kashyap, and Shin (2008) found a similar procylical pattern for 5 big commercial banks in the United States.

Figure 8 examines potential pro-cyclicality for U.S. investment banks, large commercial banks, and small commercial banks in Panels A, B, and C, respectively. The figure complements Adrian

and Shin (2008, 2009) and Greenlaw, Hatzius, Kashyap, and Shin (2008), plotting average growth of leverage against average growth of assets for the sample of all (investment, large, small) banks in our dataset. In these figures, all banks have equal weight and the interpretation is that the figures show whether banks typically display the Adrian-Shin pattern.[13] Because all banks have equal weights the patterns are not strongly affected by a few giant banks.

Panel A focusses on U.S. investment banks and the "Adrian-Shin pattern" is easily visible over the full sample period. Year 2008 is an outlier with large declines in assets and leverage but it pretty much lies on the line that one can easily fit using ordinary myopic eyeballs.[14] For large U.S. (non-investment) banks in Panel B, a similar pattern is visible, maybe with an even steeper slope although the observations for 2008 and 2009, which are above the other points, probably should be interpreted with caution: many observers, see for example, Greenlaw, Hatzius, Kashyap, and Shin (2008), interpret the increase in bank lending in 2008 as "forced lending" where borrowers—in particular—were drawing on pre-committed credit lines placed in the off-balance sheet vehicles. Certainly, the steep decline in assets, committed credit lines and guarantees that started in 2008 and accelerated in 2009 is consistent with banks needing time to unwind their obligations. Panel C shows a clear absence of pro-cyclical leverage for smaller banks.

For European banks, in Figure 9, we observe a slight tendency for leverage to be pro-cyclical for large banks, although with a much smaller slope than found for large U.S. banks. Smaller European banks display a surprisingly stable level of asset growth and no hint of pro-cyclical leverage is visible for this group of banks.

5.4 Non-Financial Firms

Mean values of leverage for large non-financial firms over time are plotted in Figure 10. Mean firm leverage for listed U.S. firms is very stable at around 2.3-2.4 while the leverage ratio is slightly larger for non-listed firms but still much lower than what we found for banks. This pattern is consistent with firms hoarding cash in 2009 (for example, Almeida, Campello, and Weisbach 2004 discuss how constrained firms may be more likely to conserve cash in a recession drawing on their bank lines of credit). For Europe, we see slightly higher leverage ratios, which may be due to differences in

[13]This is different from saying that the typical bank (usually interpreted as the median) displays the pattern. In the time series graphs, we plotted medians against time but it is not as meaningful to plot median leverage growth against median asset growth because the medians will belong to different banks.

[14]Note that in Adrian-Shin figures the 2008 point is on the top of the graph since they only use first quarter of 2008 where the crisis was still in its infancy. Our annual data reflects end of year accounts.

accounting rules, but the temporal patterns are similar to those of the United States with very little variation over time except that we find a weak but steady decline in leverage for all (mainly non-listed) firms. The great recession does not register at all for European non-financial firms.

Figure 11 examines potential pro-cyclicality of the leverage of non-financial firms. The U.S. data in Panel A show no inkling of pro-cyclicality and very little systematic growth. Leverage increased in 2008, likely due to loss of equity, but decreased as rapidly in 2009. European non-financial firms keep a constant amount of leverage over the sample, apart from the 2008 outlier which is similar to the United States.

5.5 Regression Analysis

From the previous section, it appears that leverage at the bank and firm level did not signal an impending recession. In the first version of this paper we performed regressions for non-financial firm leverage and confirmed the standard determinants of leverage, as identified in the corporate finance literature (reviewed above), but because nothing new came to the surface we turn to bank-level regressions in Table 4.

We estimate the relation

$$\text{Leverage}_{it} = \mu_i + \alpha * \text{size}_{it} + \gamma * \text{profit}_{it} + \delta * \text{collat}_{it} + \Sigma_t \beta_t \, D_t * X_{c(i)} \ ,$$

where the left-hand side is firm level leverage, μ_i is a firm level dummy ("fixed effect"), D_t is a set of time dummies (with 2000 left out to avoid collinearity), and $X_{c(i)}$ is one of the institutional/regulatory variables (we try several) for country c in which bank i is located.[15] We control for size (log assets), profitability, and collateral because these were found by Gropp and Heider (2009) to be predictors of bank leverage and excluding these variables might result in left-out variable bias.

The interpretation of the results out of this specification will be as follows: because the bank-level dummy captures any constant bank-level (and therefore also country-level) variables the interpretation of the other regressors is that they capture the change in leverage relative to bank-level averages while they are uninformative about permanent differences between banks (and countries). The objects of interest is the β_t coefficients which show whether countries with particular regulatory environments experience different temporal patterns in leverage.

[15] In the regression, we use the alternative equivalent leverage measure 1-equity/assets. The sign and significance of the estimated coefficients are similar to what we would find with assest/equity but the measure used here is between 0 and 1 which allows for easier interpretation of the coefficients.

The results of Table 4 are interesting. In columns (1)-(3), we run the exact regressions in Gropp and Heider (2009) and confirm their findings that size has a positive impact on leverage (with t-values around 40!), collateral have a positive significant impact (t-values around 10), while profitability has a negative impact (with t-values around 10).[16] These are the variables typically found to be significant with similar signs for non-financial firms and Gropp and Heider found that banks are not different.[17] Column (2) focuses on the banks that are large and listed on stock exchange (similar sample as Gropp and Heider) and column (3) uses lagged values, as it is typical in the literature, and obtains a weaker fit. Lagged assets may not be relevant during the crisis due to rapid changes in asset values and hence in the rest of the columns we use current values of controls—-assets and leverage are obviously determined simultaneously, but the focus here is on comparison across countries.

The temporal patterns are revealing: In columns (4) to (10) the time-dummy interaction terms are in general not significant for 2001 to 2007 (meaning these years are similar to 2000) except for the "required audit variable" and "monitoring variable" for which 2000 (left-out) leverage is higher than 2001–2007 (in the countries where these variables are higher, meaning stricter regulation). More interesting is the highly significant very robust pattern that more restrictive regulation is associated with a relatively higher leverage in 2008. We interpret this in the light of of the time series patterns observed in the figures. Banks with high leverage and, in particular, highly risky assets displayed strongly declining leverage in 2008 when assets were written down. As discussed previously, standard leverage measures did not flag that the assets on many banks' balance sheets were questionable, this only became apparent in assets value losses in 2008—the moment of truth! If a restrictive regulatory environment helped banks stay on the straight and narrow path in terms of asset quality, this should therefore also be visible only in 2008 and so it is. The positive coefficient associated with strict regulation imply that countries with strict regulation suffered lower asset losses which we interpret to mean that banks in those countries on average held higher quality assets and/or avoided risk exposure through guarantees to off-balance sheet entities with questionable assets. The coefficient to, say, overall restrictiveness of 0.003 implies that a change of 10 in overall restrictiveness (moving from least to most restrictive) leads to a change in the leverage ratio of 0.03. If the initial leverage ratio was 0.9 and the new leverage ratio is 0.93 that implies a change in assets over equity from 9 to 13.3 (=0.93/0.07)—a rather substantial increase in leverage. The implications is that leverage (or more precisely the underlying problems in asset quality) and,

[16] We experimented with different definitions of these variables and other controls, but the results are very robust.

[17] Gropp and Heider find that their results are not robust to inclusion of bank-fixed effects but we find very high significance even if such fixed effects are included here. This might be due to our bigger sample.

therefore, the vulnerability of the real economy is significantly impacted by regulatory constraint.

Table 5 considers the relation of assets and equity separately to the restrictiveness variable. We see that assets and equity increased more (or, in 2008, declined less) in the tighter regulation countries relative to other countries. These results are consistent with the result in Table 4 that tighter regulation countries deleveraged less, a result we interpret as these countries' banks holding less risky assets.

Figure 12 illustrates the results of Table 4 and Table 5 visually by plotting the growth of aggregate leverage from 2007–2008 against overall restrictiveness of regulation in 2003. While this does not exactly correspond to the regressions (since other variables are not controlled for) it illustrates the positive slope is driven by emerging markets such as Mexico, Brazil, and Turkey, which had stricter regulation and less declines in assets and leverage relative to developed countries (the bottom corner of the figure) such as the U.K. and Ireland in 2008. The United States, Germany and France are outliers.

6 Robustness and Other Issues

6.1 Other Determinants of Leverage: Banks and Firms

We have performed extensive robustness analysis, where we do not report all for space considerations. We have data on the ownership structure of the banks. Calculating "foreign ownership" of the banks as $\ln(1+FO)$ where FO represents percent voting stakes owned by foreigners, we obtain similar results. Foreign ownership itself enters negative and significantly. We have also used risk weighted assets based on Basel II requirements instead of total assets obtaining similar results.

What about the role of cash holdings? Figures 13 and 14 display median and aggregate cash holdings of European and U.S. banks. For Europe, the picture is one of steadily increasing cash holdings, roughly mirroring the increase in assets. For the United States, the picture is similar before the crisis although cash holdings increased a little slower than aggregate assets. However; overall, these data would not have signalled an increase in risk taking before the crisis. The U.S. data displays a highly pronounced spike in 2009. This reflects the breakdown of interbank lending during the crisis when banks did not lend to other banks which might be in danger of failure. The banks, therefore, held the assets on their books, wherefore the spike in cash, and the Federal Reserve lent directly to banks needing short-term financing. In order to limit any potential inflationary impact of the large reserves the Federal Reserve, for the first time in its history, began paying interest on

reserves in October 2008. In effect, the Federal Reserve acts as an intermediary between banks with excess funds and banks wishing to lend. This mechanism is explained in detail in Keister and McAndrews (2009).

We have also performed firm level regressions for non-financial firms. The standard determinants of leverage such as size, collateral and profitability all have the expected signs but there was no visible increase or decrease in leverage of the non-financial firms before and/or after the crisis as we have shown before graphically. We have checked whether this can be explained by firms cash holdings but those holdings also do not show an significant time variation. These results are available upon request.

6.2 The Role of Conduits

Acharya, Schnabl, and Suarez (2010) show that commercial banks set up conduits to securitize assets—specifically Asset Backed Commercial Paper (ABCP)—without transferring risk to outside investors. These conduits were designed to avoid capital charges and commercial banks facing more stringent capital requirements were more likely to set up conduits with guarantees implying that risk was not transferred outside of the banking system.

Conduits are independent shell companies sponsored by large financial institutions. Acharya, Schnabl, and Suarez (2010) use a hand-collected dataset on the universe of conduits from January 2001 to December 2008 and their sponsors. They show that almost all conduits have credit guarantees by large financial institutions. We do not have their conduit data nor we do have some of these conduits in our data but we do have the sponsors. The data on guarantees and committed credit lines we have shown before include the credit guarantees to conduits because these are explicit commitments of the sponsor banks. Acharya, Schnabl, and Suarez (2010) report that investors in conduits only lost 1.7 percent of their investments in ABCP since the guarantees were called and the assets were liquidated and/or absorbed by the sponsoring bank. Figure 5 is consistent with this fact. Thus, it is clear that the deleveraging process is closely linked to these conduits and their sponsor banks.

Did banks with conduits have different leverage? Very few of the conduit sponsor banks are investment banks (3 out of 62 sponsors in our data) and almost all the sponsor banks are large commercial banks. We do not have the actual conduits in our dataset but, in order to investigate if sponsor banks had different leverage on their balance sheets, we plot Figures 1–7 dropping all conduit sponsor banks from our permanent sample. All these figures are identical to our previous

figures and hence not reported to save space. They are available upon request.

6.3 The Role of Mergers and Government

During the crisis, a lot of mergers took place such as Bank of America's takeover of Merrill Lynch as of January 2009, JP Morgan's takeover of Bear Stearns in 2008. We do not control for these which took place mid to end of 2008/beginning of 2009. It is most likely the case that the merger will not cause an immediate increase in the assets of the commercial bank. But over time as the securities held by the acquired banks are transferred, we should see a slow rise in the assets of the commercial bank. Thus, this is an important issue if we want to trace changes in leverage and assets throughout the end of 2010 since Bank of America's and JP Morgan's assets might increase as a result of the acquisitions. The same issue might also effect the acquired banks but He, Khang, and Krishnamurthy (2010) notes that they do not observe any change in Merrill Lynch's asset holdings in the first quarter of 2009. Other investment banks were not acquired but ceased to be investment banks and converted into bank holding companies, in particular Goldman Sachs and Morgan Stanley. As noted by He, Khang, and Krishnamurthy (2010) even after being converted into holding company status, the commercial banking operations represent a very small fraction of the business of these investment banks.

He, Khang, and Krishnamurthy (2010) argue that there has been a shift in the distribution of risky assets during 2008-2009, where the assets sold by the investment banks are bought out by commercial banks and the government. They use aggregate flow of funds data and their results are likely driven by big banks, which they also confirm by using data on the largest banks from SEC filings and call reports.

The government played a very active role in recapitalizing banks. He, Khang, and Krishnamurthy (2010) suggest that the preferred stock owned by the government must be subtracted from equity in calculating "true leverage." They find, using FDIC-data, that such a correction raises the leverage of the top 19 commercial banks in the United States from 10.0 to 14.4 in the first quarter of 2009. There is also the the issue of recording the assets at book value. He, Khang, and Krishnamurthy (2010) argue that "true leverage" may have been as high as 30 if assets were marked to market. While He, Khang, and Krishnamurthy (2010) were able to roughly impute the fall in the value of banks' asset during the peak of the crises for the commercial banking sector as a whole and for some major banks, it is not an easy task to do systematically bank-by-bank over our sample and hence we do not perform such an exercise. We also do not perform an adjustment on

the government owned stock since we argue that if the purpose of measuring leverage is to gauge the riskiness of banks, surely government owned preferred equity helps buffer the risk. We report asset and equity holdings and leverage of big investment and commercial banks from the United States and Europe in Table 6. Our numbers match He, Khang, and Krishnamurthy (2010) for investment banks. For commercial banks, we have a slight increase in 2008 but not as high as found by He, Khang, and Krishnamurthy (2010) since we do not adjust for government owned equity.

One final difference is that He, Khang, and Krishnamurthy (2010) focus on subsidiaries and, most likely unconsolidated statements, since they drop holding companies. (One has to use either consolidated or the non-consolidated statements in order to avoid double counting.) In our empirical analysis we also use unconsolidated accounts for non-investment (commercial) banks and for investment banks we use consolidated accounts throughout because these banks only report consolidated statements. For the purpose of Table 6, we use consolidated statements and holding companies for both commercial and investment banks in order to make a meaningful comparison between the two groups.

7 Conclusion

Traditional leverage ratios and off-balance sheet exposure relative to assets did not signal increasing risk taking by banks before the financial crises, with the exception of investment banks who aggressively increased leverage. On the whole, increasing risk before the crisis was associated with risky pools of assets although only few realized this at the time. When the crisis broke in 2008, the banks with large exposure to sub-prime assets suffered large declines in assets. Larger banks were the most exposed and it appears that the larger the banks the more risky on average. There was little relation between leverage and restrictiveness of regulation across countries before 2008 but the countries with stricter bank regulation and stronger protection of investor and shareholder rights were less affected by the crises implying that regulation may well have benefits even if these benefits are invisible until the economy faces a major stress event.

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A Data Appendix

A.1 Sample Construction

The micro-level data that we utilize in this paper provides not only the financial information on both balance-sheet and off-balance sheet items, but also the information on foreign and domestic owners of each firm/bank.

For banks, we have 3 sets of samples that give those information. They are created for U.S. banks, European banks and all banks, respectively. Each sample has two sets of sub-samples; permanent and non-permanent. The non-permanent samples are used in regression analysis and in the investigation of cross-sectional patterns. The permanent samples are used for time-series plots.

For firms, we have 2 sets of samples that contain very large and large industrial (both financial and nonfinancial) firms operating in U.S. and European countries. Similar to bank-level data, each sample has two sets of sub-samples, permanent and non-permanent.

A.2 Sample Selection Criteria

As we mentioned above, we have different samples for banks and firms. The structure of those samples differs in some aspects. Thus, different sample selection criteria are applied in each sample. The details on the structure of samples and the corresponding sample selection criteria are given in the below.

A.2.1 Bank Selection Criteria

The time period covered in bank-level samples that we downloaded via BANKSCOPE database is 1990-2010. However we exclude the first 6 years and the last year because of poor coverage. We apply the following sample selection criteria to obtain the samples that we use in our regression analysis:

- We drop central banks.
- We drop banks with faulty records such as inconsistent information on any generic variables such as date of establishment/type of company/template etc.
- We drop bank-year observations with negative values of assets/capital/reserves or deposits.

The final samples we obtained for U.S. and European banks have 13,964 banks with 194,802 observations and 14680 banks with 202,357 observations between 1996-2009, respectively.

In addition to above criteria, we first drop the banks that do not report Total Assets continuously between 2000-2009 and inactive banks to obtain the final samples that we use for creating time-series plots in this paper. The sample of European banks has 1123 banks with 11,230 observations while the sample of U.S. banks has 7334 banks with 73,340 observations—both for the period 2000-2009.

The time period covered in the world sample that contain the banks from all countries in the world is 1985-2009. However, we exclude the years before 1996 because of poor coverage. We apply the following sample selection criteria to this sample that we use in our regression analysis:

- We drop countries with less than 20 banks.
- We drop central banks.
- We drop banks with faulty records such as inconsistent information on any generic variables such as date of establishment/type of company/template etc.
- We drop bank-year observations with negative values of assets/capital/reserves or deposits.

The final sample has 32,158 banks with 229,610 observations between 1996-2009.

In addition to above criteria, we drop the banks that do not report Total Assets continuously between 2000-2008 to obtain the permanent sample. We exclude 2009 from that permanent sample because of poor coverage. Thus, very final sample has 9437 banks with 85,383 observations.

A.2.2 Firm Selection Criteria

The time period covered in firm-level samples that we downloaded via ORBIS and AMADEUS databases is 1996-2010, however we exclude the last year because of poor coverage. At the very first stage, we apply the following selection criteria and the resulting sample for U.S. firms consists of 236,734 firms with 585,632 observations and that for European firms have 343,819 firms with 2,273,360 observations.

- We drop firms with faulty records, which have inconsistent information on any generic variables such as date of establishment/type of company/template etc.

- We drop firm-year observations with negative values of all types of assets/capital/reserves and deposits.

The following sample selection criteria are applied to obtain the final samples that we use in our regression analysis:

- We drop firms if any of total assets, current liabilities and non-current liabilities is missing in all years between 1996-2009.
- We drop firms if any of total assets, employment, sales, operating revenue, current liabilities and non-current liabilities is negative.
- We drop firms whose total number of employees is lower than 10.
- We drop firms if Total Assets are less than 100,000 in PPP dollars.
- We drop firms if Sales are less than 1000 in PPP dollars.
- We drop firms if Operating Revenue are less than 1000 in PPP dollars.
- We drop firm-year observations at 0.1 and 0.99 percent of the tails of ratios employment/sales,sales/total assets, operating revenue/total assets and shareholders funds/total assets
- In the data that covers European firms, we drop countries having firms less than 100 at least 6 years between 1996-2009.
- We drop firm-year observations at 0.1 and 0.99 percent tails of all leverage measures we defined above.
- We drop firm-year observations at 0.1 and 0.99 percent tails for collateral variable defined as total fixed assets/total assets.
- We drop firm-year observations at 0.1 and 0.99 percent tails for all profitability measures defined above.

The resulting samples consist of 54,108 firms with 152,124 observations and 234,380 firms with 1,495,671 observations for U.S. firm-level sample and European firm-level sample, respectively.

Lastly, to obtain the samples that we use for creating time-series plots, we restrict the samples to the firms that report Total Assets continuously in the period starting by 2000. Thus, the sample

that contains European firms has 30,167 firms with 271,503 observations between 2000-2008. We exclude 2009 because of the poor coverage. And the sample that contains U.S. firms has 3053 firms with 18318 observations between 2004-2009. We exclude the years between 2000-2003 because of poor coverage.

A.3 Variable Definitions

The structure of the financial statements is not the same for banks and firms. Not only the coverage, but also the definition of the some variables differ, thus the construction of the variables of our main interest needs a careful and detailed work. The details are given in the below sections.

A.3.1 Bank-Level Variables

The variables we use to calculate bank-level measures are total assets, shareholders' funds, total debt, total liabilities, off balance-sheet items, net income, earning assets and adjusted assets.

Total Assets: Total book value of intangible, tangible and other fixed assets.

Shareholder's Funds: Book value of equity (issued share capital plus other shareholders fund)

Total Liabilities: Total book value of current and non-current liabilities.

Total Debt: Total book value of short term and long term debt.

Off-Balance Sheet Items: In financial statement of banks, the off-balance sheet volumes depend on three summary lines of acceptances, documentary credits and guarantees.

Guarantees : Total amount guaranteed by the bank.

Acceptances: reported off-balance-sheet: Total amounts the bank "accepts" to pay, usually under international trade finance arrangements where reported off balance sheet. These are usually reported on balance sheet (as a liability, often matched by a corresponding asset for a claim by the bank on the recipient of goods) under U.S. GAAP and IFRS.

Committed credit lines: Total committed and undrawn lines of credit extended by the bank.

Since the number of banks reporting acceptances is very limited, we used committed credit lines and guarantees to calculate total book value of off-balance sheet items.

Net income: Book value of profit/loss before deduction of Minority interests if any (Profit after taxation+ extraordinary and other profit). Following Heider and Gropp (2009), we used this

variable to proxy profitability of banks (ratio of total assets).

Earning Assets: Total book value of stock, bonds, CD and income from rental property, again following Gropp and Heider (2009), we used this variable to proxy collateral of banks (ratio of total assets).

Adjusted Assets: Book value of total assets excluding goodwill and intangibles.

A.3.2 Firm-Level Variables

The variables we use to calculate firm-level measures are total assets, shareholders' funds, total debt, total liabilities, EBITDA, PLBT.

Total Assets: Total book value of intangible, tangible and other fixed assets.

Shareholder's Funds: Book value of equity (issued share capital plus other shareholders fund)

Total Liabilities: Total book value of current (all current liabilities of the company such as Loans+ Creditors+ Other current liabilities) and non-current liabilities (all long term liabilities of the company such as Long term financial debt+other long term liabilities and provisions)

Total Debt: Total book value of short term and long term debt.

EBITDA: Total book value of Earnings before interest, tax, depreciation and amortization

PLBT: Profit (Loss) before tax: Operating profit+ financial profit.

A.4 Country-Level Data

In the analysis in which we utilize world bank data, we also use some country-level broad institution measures. They come from the ICRG, Doing Business databases and Bank Regulatory and Supervisory data.

This first dataset provides a quantitative measure for the protection of property rights. The measures on "Corruption" and "Law and Order" between 1996-2004 are selected for our purpose. The second one provides a quantitative measure of regulations for starting a business, dealing with construction permits, employing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business. The variables that we use are "Starting Business", "Getting Credit", "Protecting Investors" and "Enforcing Contracts". They provide the related information between 2004-2009. The last one provides information on bank regulations and supervisory practices for 107 countries. The database constitutes

of aggregate indexes that depend on responses to individual questions of the survey designed and implemented by Barth, Caprio, and Levine and funded by World Bank [18]. We use 2003 indices for the variables regarding "Bank Activity Regulation", "Mixing Banking / Commerce Regulation", "Competition Regulation", "Capital Regulation", "Official Supervisory Action", "Official Supervisory Experience and Structure", "Private Monitoring", "Deposit Insurance Scheme" and "Market Structure".

[18]For the details on the survey questions and data collection process, see Barth, Caprio, and Levine (2007). The data is also available at the following website: www.worldbank.org/research/interest/intrstweb.htm.

Table 1: Firms and Banks Across Countries, 2000–2009: Observations by Country

Country	Bank-Year	Firm-Year (Europe and U.S. Only)
ARGENTINA	1404	
AUSTRALIA	1384	
AUSTRIA	2996	5225
AZERBAIJAN	180	
BANGLADESH	412	
BELGIUM	1420	67385
BOSNIA	249	
BRAZIL	2248	
BULGARIA	333	11585
CANADA	963	
CHILE	547	
CHINA	993	
COLOMBIA	507	
COSTA RICA	861	
CROATIA	509	11277
CZECH REPUBLIC	449	37078
DENMARK	1812	23231
EGYPT	478	
EL SALVADOR	272	
ESTONIA	160	5847
FINLAND	350	32318
FRANCE	6809	182857
GEORGIA	125	
GERMANY	22981	104191
GHANA	337	
GREECE	472	
HONG KONG	1647	
HUNGARY	553	21703
ICELAND	262	2163
INDIA	1318	
INDONESIA	846	
IRELAND	914	13141
ISRAEL	332	
ITALY	9891	163632
JAPAN	10079	
KENYA	671	
KOREA REP. OF	810	
LATVIA	365	6399
LITHUANIA	198	6564
LUXEMBOURG	1617	2592
MALAYSIA	1514	
MEXICO	770	
NETHERLANDS	1345	29182
NEW ZEALAND	280	
NORWAY	1474	30479
PARAGUAY	230	
PERU	395	
PHILIPPINES	718	
POLAND	695	72030
PORTUGAL	765	34732
ROMANIA	366	16891
RUSSIA	5889	154729
SERBIA	345	19796
SINGAPORE	816	
SLOVAKIA	290	7989
SLOVENIA	337	4239
SOUTH AFRICA	980	
SPAIN	3069	133102
SWEDEN	1343	81489
SWITZERLAND	6104	4646
TAIWAN	1237	
THAILAND	661	
TURKEY	946	
UKRAINE	555	16099
UNITED KINGDOM	6533	183959
URUGUAY	464	
USA	112116	139026
VENEZUELA	619	
TOTAL	229610	1675576

Notes: Banks are defined broadly to include financial firms such as credit card companies, private equity firms, hedge funds, broker-dealers, specialized credit institutions, etc. Firms are large non-financial firms from Europe and the U.S.

Table 2: Firms and Banks Across Countries, 2000–2009: Observations by Type

BANKS

	World	Europe	U.S.
All	30056	14680	13964
Investment	975	402	138
Commercial	29081	14278	13826
Consolidated	6826	2612	3246
Unconsolidated	23201	10978	10606
Listed	3351	1164	1074
Unlisted	26705	13516	12890

FIRMS

	Europe	U.S.
All	227295	53666
Financial	1466	6632
Non-Financial	225829	47034
Consolidated	42451	16486
Unconsolidated	184844	37180
Listed	10476	8875
Unlisted	216819	44791

Notes: Consolidated and unconsolidated refers to the number of banks/firms with consolidated and unconsolidated statements, respectively. Listed indicates the number of banks/firms that are listed on a stock exchange. Financial firms are firms with Primary NACE Rev. 1.1 sector code i.e. J - Financial intermediation

Table 3: Descriptive Statistics: 2000–2009

Panel A: All Banks	N	Mean	Min	Max
Leverage Ratio	180518	12.399	1.267	46.343
Total Assets (billion USD)	180611	5.117	0.011	102.159
Adjusted Assets (billion USD)	141674	3.919	0.011	83.943
Equity (billion USD)	180562	0.345	0.002	6.386
Off Balance Sheet (ratio of Total Assets)	79573	0.007	0	11.577
Panel B: Investment Banks	N	Mean	Min	Max
Leverage Ratio	4101	13.566	1.267	46.343
Total Assets (billion USD)	4103	13.269	0.011	102.159
Adjusted Assets (billion USD)	1890	15.104	0.011	83.943
Equity (billion USD)	4103	0.807	0.002	6.386
Off Balance Sheet (ratio of Total Assets)	34	0.247	0	3.651
Panel C: Large Non-Investment Banks	N	Mean	Min	Max
Leverage Ratio	33704	17.379	1.267	46.343
Total Assets (billion USD)	33713	17.584	0.011	102.159
Adjusted Assets (billion USD)	20837	16.009	0.011	83.943
Equity (billion USD)	33707	1.151	0.002	6.386
Off Balance Sheet (ratio of Total Assets)	1601	0.09	0	11.577
Panel D: Sponsor Banks	N	Mean	Min	Max
Leverage Ratio	406	22.712	1.267	46.343
Total Assets (billion USD)	406	80.119	0.114	102.159
Adjusted Assets (billion USD)	368	69.499	0.113	83.943
Equity (billion USD)	406	4.95	0.002	6.386
Off Balance Sheet (ratio of Total Assets)	11	0.124	0	0.936
Panel E: Non- Sponsor Banks	N	Mean	Min	Max
Leverage Ratio	180112	12.375	1.267	46.343
Total Assets (billion USD)	180205	4.948	0.011	102.159
Adjusted Assets (billion USD)	141306	3.749	0.011	83.943
Equity (billion USD)	180156	0.335	0.002	6.386
Off Balance Sheet (ratio of Total Assets)	79562	0.006	0	11.577

Notes: Data is windsorized at 2 percent level. Bank statistics are based on broader world sample. In Panel A, the statistics are given for all banks. In Panel B, statistics of conduit sponsor banks are displayed. The names of the sponsor banks are from Acharya and Schnabl (2009). There are 70 conduit sponsor banks in their data set, where we have 62 of these on our data. 31 of these banks are European, 23 are U.S., 4 are Australian, 3 are Japanese and 1 bank is Canadian. In Panel C, the same statistics are given for the sample in which sponsor banks are excluded from the world bank sample of Panel A. Leverage Ratio is defined as the ratio of total assets to equity. Totals Assets are composed of tangible and intangible assets. Adjusted assets excludes good will and intangibles. Equity is measured as shareholder funds. Off Balance Sheet items are sum of guarantees and committed credit lines. We define large bank as a bank that has more then a billion dollars worth of assets at the beginning of our sample.All non-ratio items are in real dollars.

Table 4: Bank Leverage: 2000–2009, World Sample

Dependent Variable:	Bank Leverage									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bank Sample	All	Listed	All	All	All	All	All	All	All	All
Regulatory/Institutional (R/I) Framework	NA	NA	NA	Investor Rights	Shareholder Rights	Required Audit	Supervision Index	Monitoring Index	Real Estate Restrictiveness	Overall Restrictiveness
Log Size	0.079***	0.075***	0.030***	0.076***	0.076***	0.075***	0.076***	0.074***	0.076***	0.075***
	(0.002)	(0.008)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Collateral	0.127***	0.475***	0.060***	0.124***	0.123***	0.130***	0.131***	0.177***	0.130***	0.132***
	(0.012)	(0.086)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)	(0.012)	(0.012)
Profitability	–0.446***	–0.082***	–0.313***	–0.413***	–0.415***	–0.387***	–0.388***	–0.291***	–0.391***	–0.392***
	(0.039)	(0.028)	(0.042)	(0.040)	(0.040)	(0.042)	(0.041)	(0.047)	(0.042)	(0.040)
2001× R/I Framework				0.001	0.001	–0.006***	0.001	–0.001	0.001***	0.001**
				(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
2002× R/I Framework				–0.001	–0.001	–0.011***	0.001	–0.001*	0.001	0.001
				(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
2003× R/I Framework				–0.001	–0.001	–0.011***	–0.001	–0.002***	–0.001	0.001
				(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
2004× R/I Framework				–0.001	–0.001	–0.007***	–0.002	–0.002***	–0.001	–0.001
				(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
2005× R/I Framework				–0.001	–0.001	–0.003	–0.001	–0.001	–0.001	0.001
				(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
2006× R/I Framework				–0.001	–0.001	0.004	–0.001	–0.001	–0.001	0.001
				(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
2007× R/I Framework				0.001	0.001	0.002	0.003	0.001	0.001	0.001
				(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
2008× R/I Framework				0.004***	0.003***	0.021***	0.009***	0.006***	0.004***	0.003***
				(0.001)	(0.000)	(0.006)	(0.002)	(0.001)	(0.001)	(0.001)
Bank dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year dummies	Yes	Yes	Yes	No	No	No	No	No	No	No
R^2	0.26	0.22	0.10	0.25	0.25	0.25	0.25	0.25	0.25	0.25
N	176116	19746	176116	176116	176116	176116	176116	176116	176116	176116

Notes: The table shows the results of a regression of bank leverage on bank size, profitability, collateral. Profitability calculated as Net Income Flow over Total Assets. Collateral calculated as Total Earnings Assets over Total Assets. Log Size is Logarithm of Total Assets in PPP Dollar units. Leverage is measured as 1 minus Equity over Total Assets. Standard errors are clustered at bank level and in parenthesis. All specifications include a full set of bank dummies. Column (1)-(3) include a full set of country and time dummies. Column (2) limits the sample to listed firms. Column (3) lags the controls Log Size, Collateral and Profitability one year. Column (4)-(10) include a country level variable that captures the regulatory and institutional framework (exact variable name is given in each column's heading), where this variable is interacted with time dummies. Note that these interacted effects controls for a full set of time dummies. 2000 is the omitted year.

Investor Rights is an index that shows the strength of investor rights protection. Higher number means higher protection. Shareholder Rights is a similarly defined index for shareholder rights protection. These variables come from World Bank Doing Business Data Set (2010). Real Estate Restrictiveness is an index that measures the extent to which banks may engage in real estate investment, development and management. The index takes a value between 1 and 4 where a value of 1 indicates no restriction and a value of 4 means these activities cannot be conducted. Overall Restrictiveness is a similarly defined index for real estate, insurance and securities activities, where banks may engage in underwriting, brokering and dealing in securities, insurance and all aspects of mutual fund industry. Again a higher number means more restrictiveness and this index varies between 1 and 12 since it is the sum of each component. Required Audit indicates whether or not there is a compulsory external audit by a certified auditor. If this takes a value of 1, it means there is a required audit, otherwise the variable takes a value of zero. Supervision Index indicates the efficiency of supervision and takes a value of 1 if there are multiple independent supervisors for banks and zero otherwise. Monitoring Index indicates the efficiency of monitoring and takes a value of 1 if top ten banks in the country are all rated by International Rating Agencies, if off-balance sheet items are disclosed to public, if banks must disclose risk management procedures to the public and if subordinated debt is required as part of regulatory capital. This index is zero otherwise. These variables are from Barth-Caprio-Levine (2010), Bank Regulation and Supervision Data Set. See table 1 for the countries in the World Sample.

Table 5: Bank Leverage: 2000–2009, World Sample

Dependent Variable:	Log Assets	Log Equity
	(1)	(2)
Regulatory/Institutional (R/I) Framework	Overall Restrictiveness	Overall Restrictiveness
2001× R/I Framework	0.027***	0.013***
	(0.002)	(0.002)
2002× R/I Framework	0.035***	0.017***
	(0.003)	(0.003)
2003× R/I Framework	0.042***	0.017***
	(0.003)	(0.003)
2004× R/I Framework	0.042***	0.014***
	(0.003)	(0.003)
2005× R/I Framework	0.042***	0.014***
	(0.004)	(0.004)
2006× R/I Framework	0.042***	0.014***
	(0.004)	(0.004)
2007× R/I Framework	0.040***	0.014***
	(0.004)	(0.004)
2008× R/I Framework	0.031***	0.019***
	(0.005)	(0.005)
Bank dummies	Yes	Yes
Year dummies	Yes	Yes
Country×Year dummies	No	No
R^2	0.17	0.15
	176116	176116

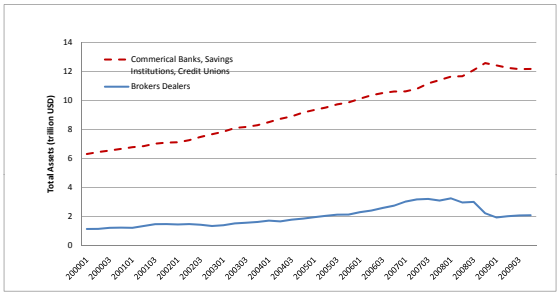
Table 6: Big Banks Leverage (in billion dollars)

	(2007)			(2008)		
	Assets	Equity	Leverage	Assets	Equity	Leverage
Bank of America	1616	138.3	11.7	1648.9	160.6	10.3
Bearn Stearns	372.4	11.1	33.5	N.A.	N.A.	N.A.
Citigroup	2060.5	112	18.4	1758.2	130.6	13.5
Goldman Sachs	1054.7	47.2	22.4	802.3	59.9	13.4
JP Morgan	1471.4	116.9	12.6	1972.8	152.4	12.9
Lehman Brothers	650.9	21.2	30.7	N.A.	N.A.	N.A.
Merrill Lynch	960.8	30.1	31.9	605.5	18.1	33.4
Morgan Stanley	984.7	29.5	33.4	597.6	46.1	13
Wells Fargo	542	45.1	12	1187.9	92.8	12.8
BNP Paribas	71.4	4.8	14.9	N.A.	N.A.	N.A.
Barclays	2073.8	54.1	38.3	3335.7	77	43.3
Deutsche Bank	2315.9	47.3	49	N.A.	N.A.	N.A.
Fortis Bank	331.3	27.3	12.1	N.A.	N.A.	N.A.
RBS	3211.1	154.5	20.8	3051.3	76.8	39.7
UBS	1.5	0.2	6.4	N.A.	N.A.	N.A.

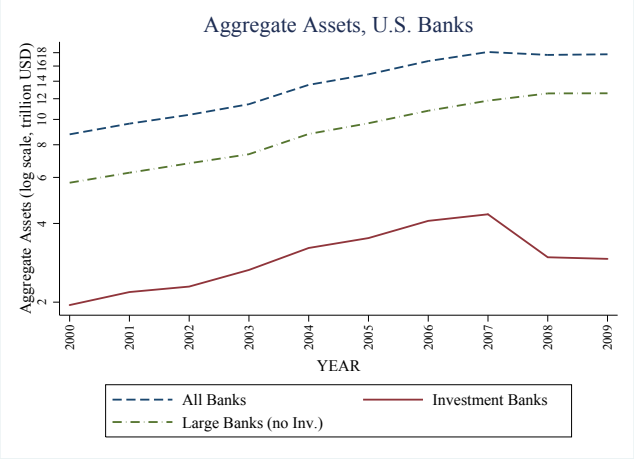
Notes: Data is windsorized at 2 percent level. Leverage Ratio is defined as the ratio of total assets to equity. Total Assets are composed of tangible and intangible assets. Equity is measured as shareholder funds. All non-ratio items are in real billion dollars.

Figure 1: Financial Sector Assets

Panel A: Flow of Funds Macro Data, Aggregate: U.S.



Panel B: Bankscope Micro Data, Aggregated: U.S.



Panel C: Bankscope Micro Data, Aggregated: Europe

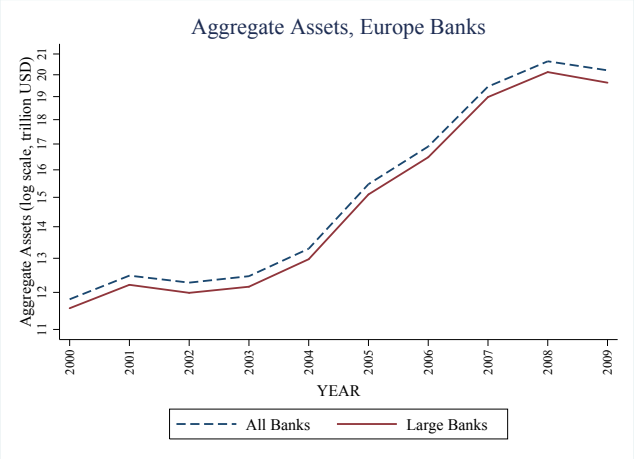
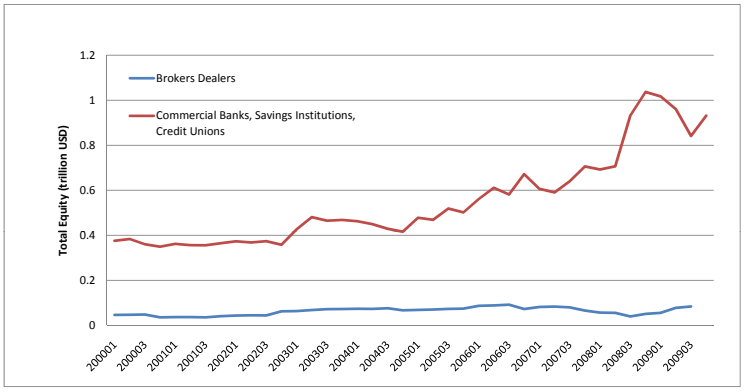
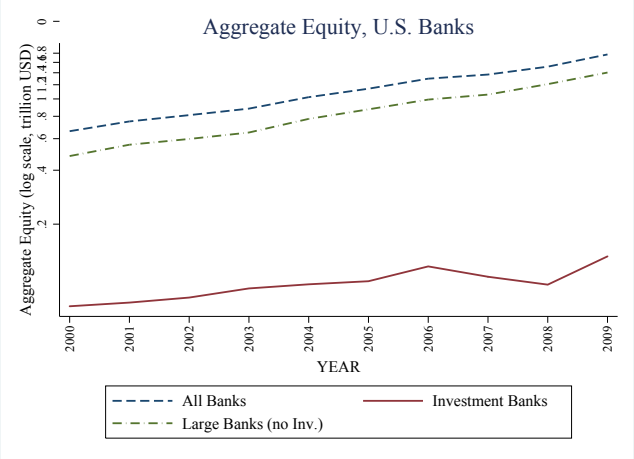


Figure 2: Financial Sector Equity

Panel A: Flow of Funds Macro Data, Aggregate: U.S.



Panel B: Bankscope Micro Data, Aggregated: U.S.



Panel C: Bankscope Micro Data, Aggregated: Europe

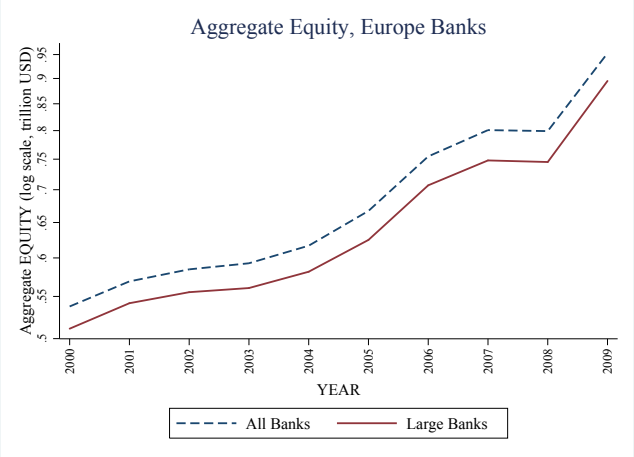
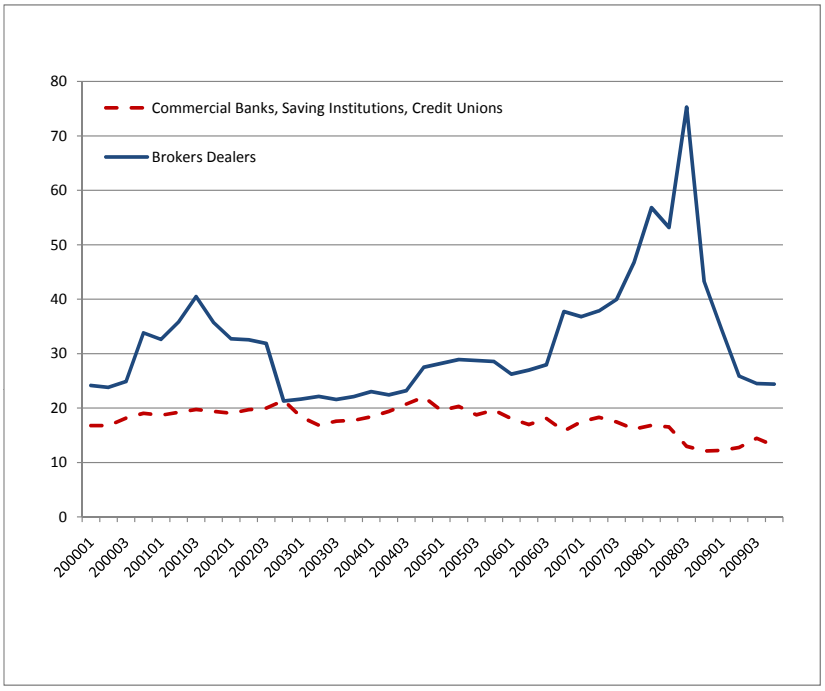


Figure 3: Financial Sector Leverage Ratio



Panel B: Bankscope Micro Data, Aggregated: U.S.

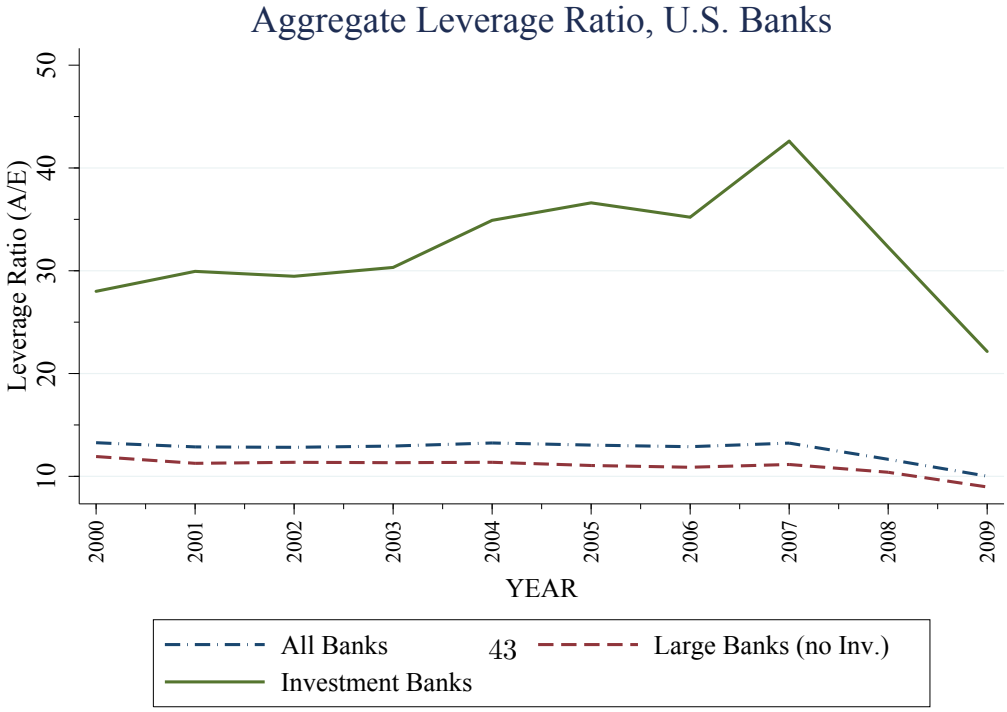
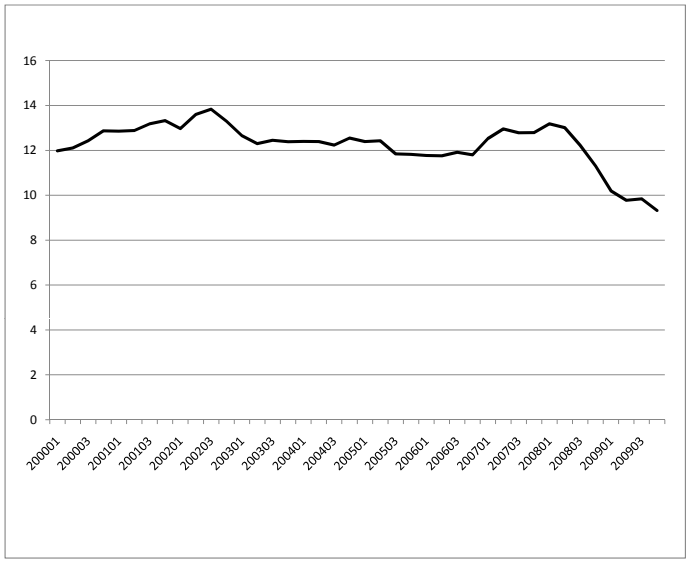
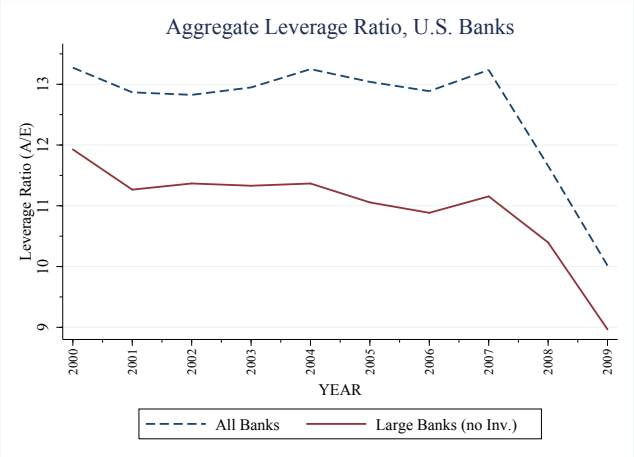


Figure 4: Financial Sector Leverage Ratio (Excluding Investment Banks)



Panel B: Bankscope Micro Data, Aggregated: U.S.



Panel C: Bankscope Micro Data, Aggregated: Europe

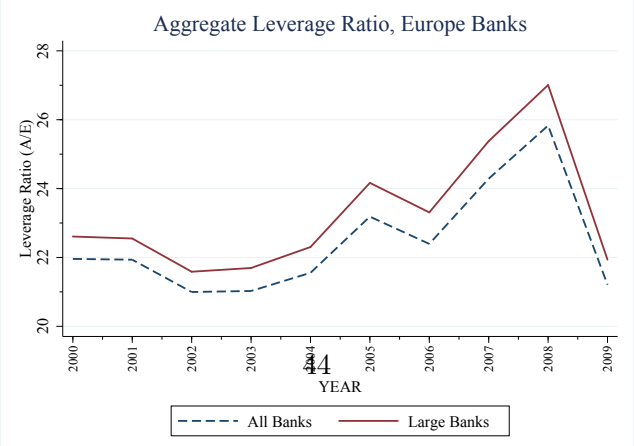
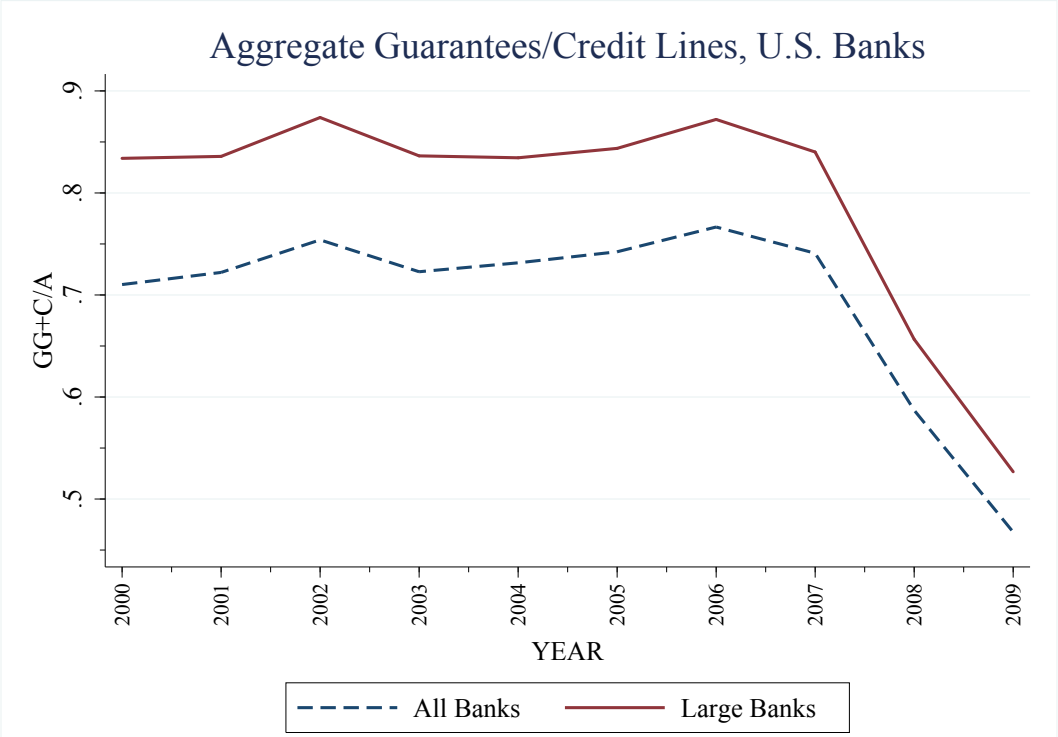


Figure 5: Financial Sector Off Balance Sheet Items Ratio: Aggregated

Panel A: Bankscope Micro Data, Aggregated: U.S.



Panel B: Bankscope Micro Data, Aggregated: Europe

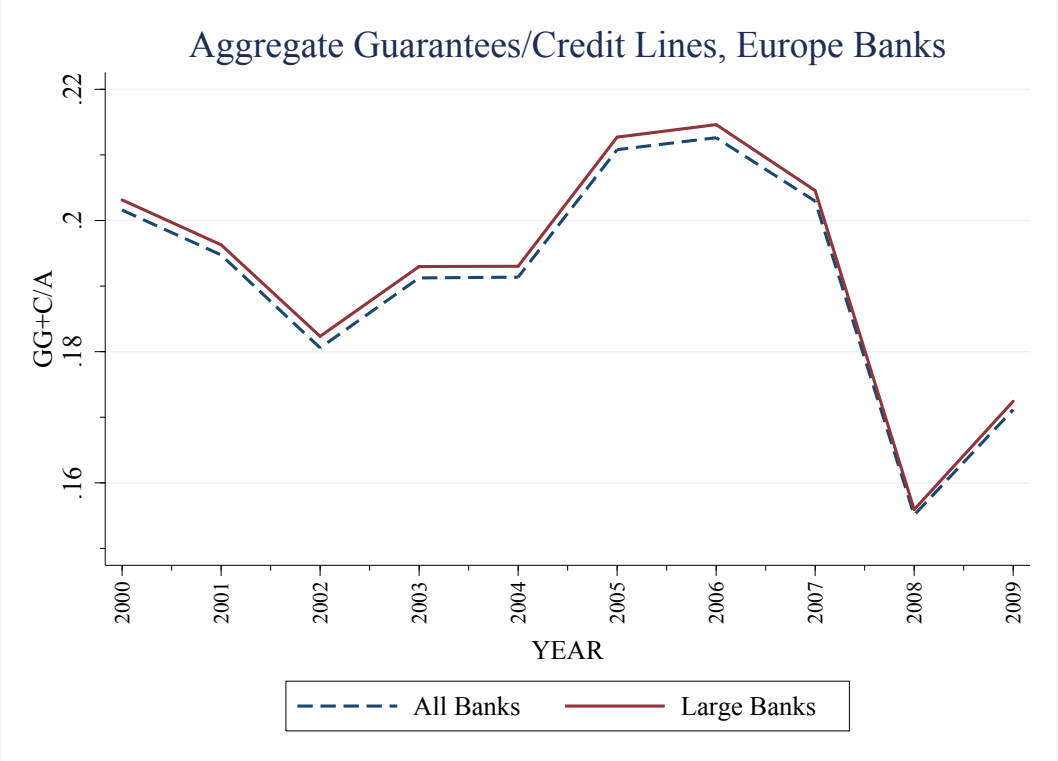
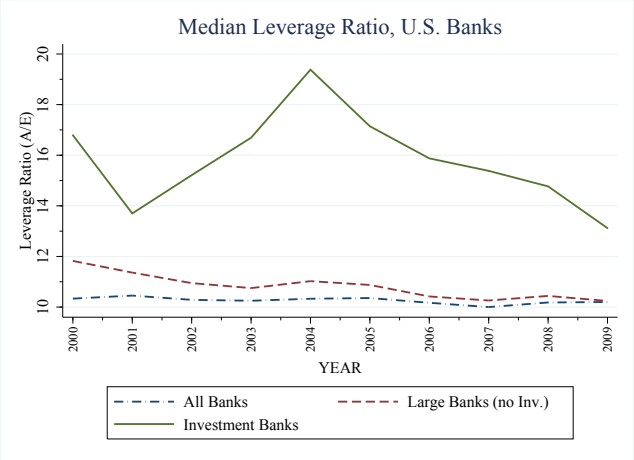
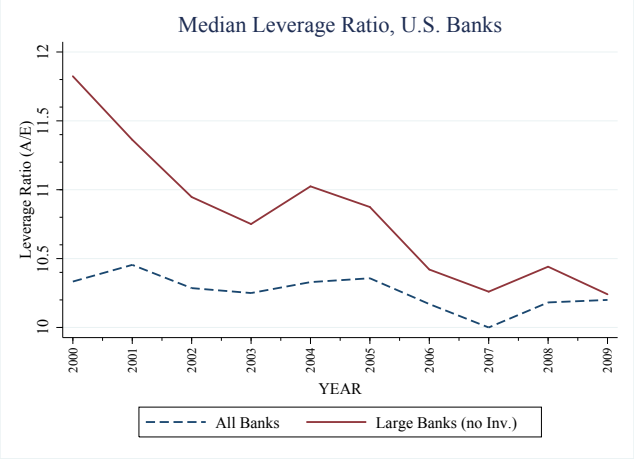


Figure 6: Financial Sector Leverage Ratio: Typical Bank

Panel A: Bankscope Micro Data, Median: U.S.



Panel B: Bankscope Micro Data, Median (excl. investment banks): U.S.



Panel C: Bankscope Micro Data, Median: Europe

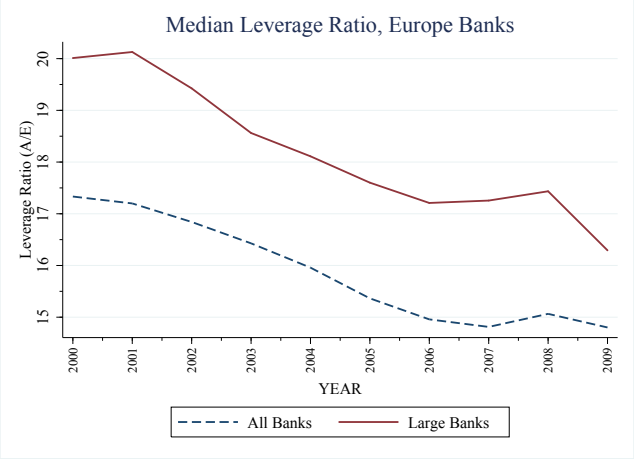
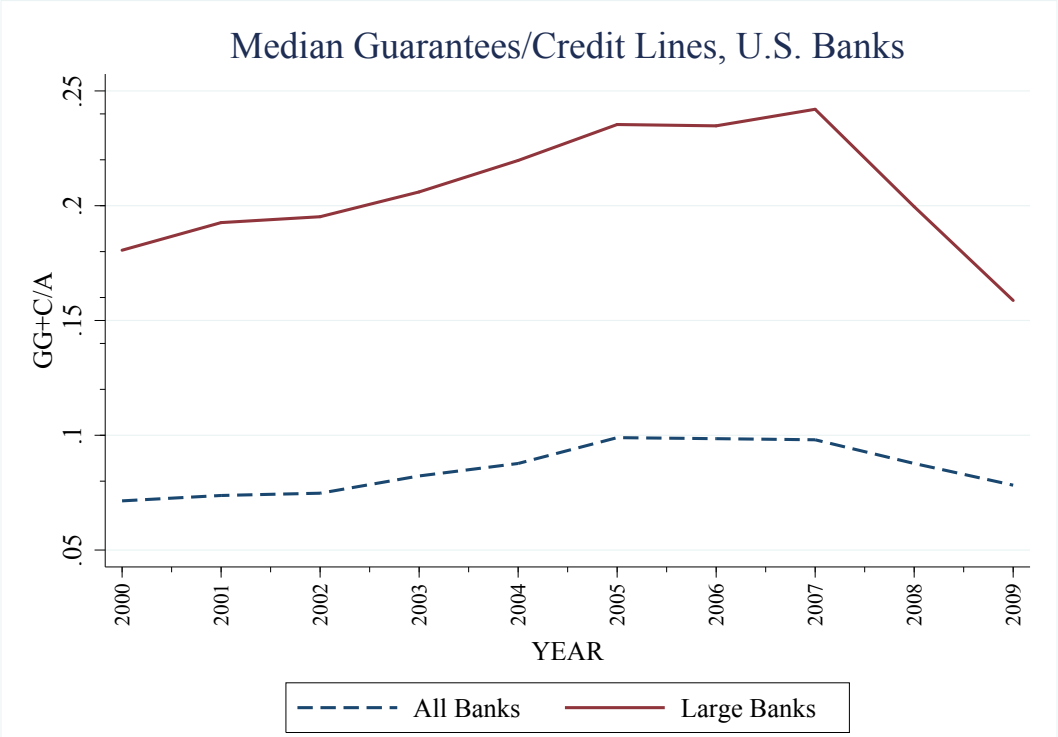


Figure 7: Financial Sector Off Balance Sheet Items Ratio: Typical Bank

Panel A: Bankscope Micro Data, Median: U.S.



Panel B: Bankscope Micro Data, Median: Europe

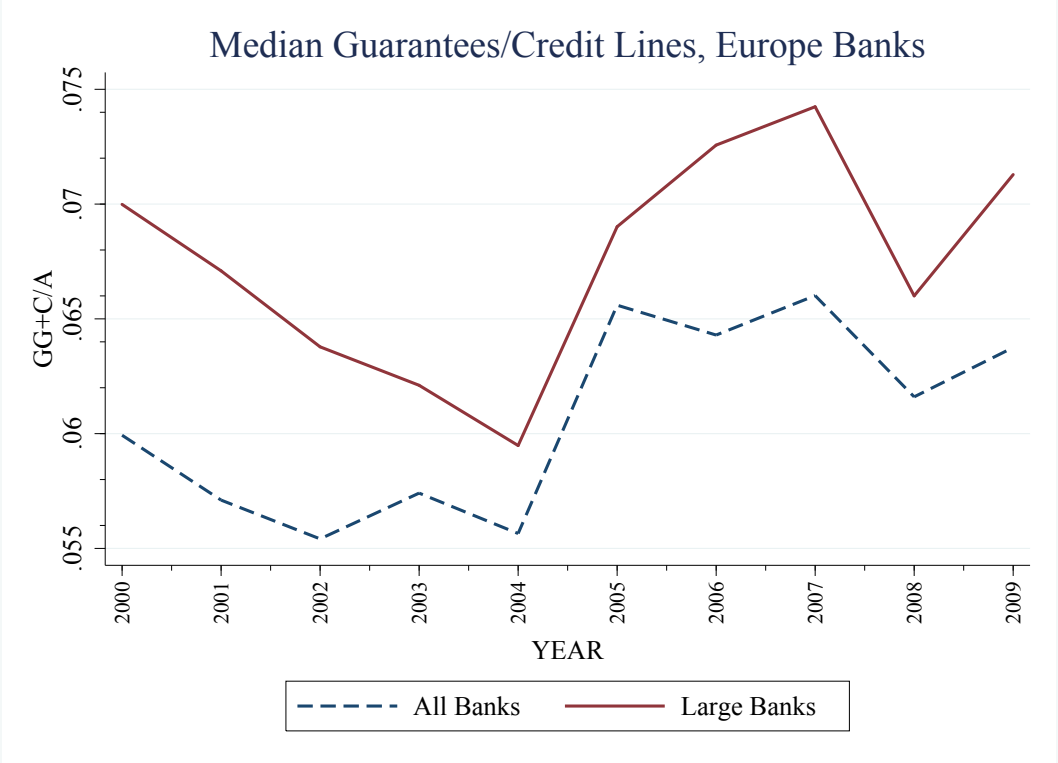
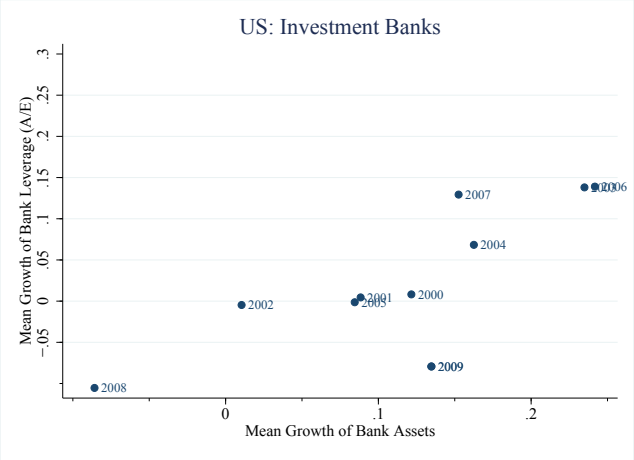
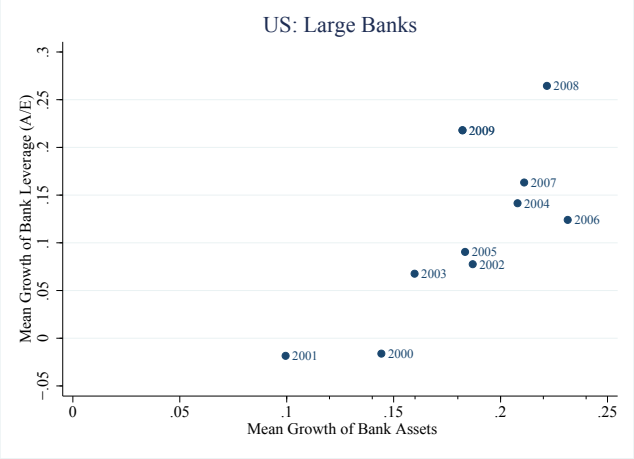


Figure 8: Financial Sector Procylical Leverage Ratio: U.S.

Panel A: Bankscope Micro Data, Mean: U.S. Investment Banks



Panel B: Bankscope Micro Data, Mean: U.S. Large Banks (exc. inv.)



Panel C: Bankscope Micro Data, Mean: U.S. Small Banks

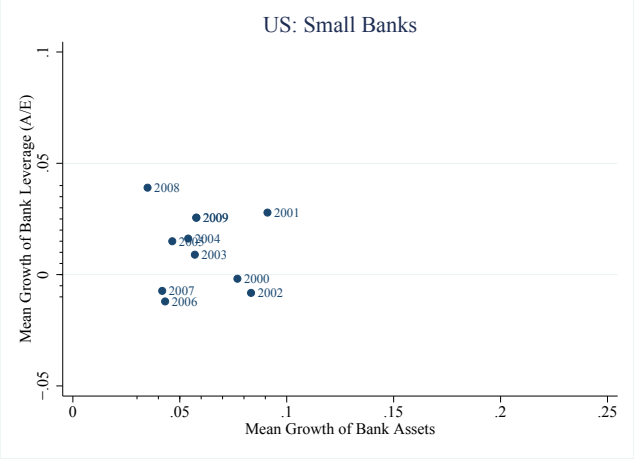
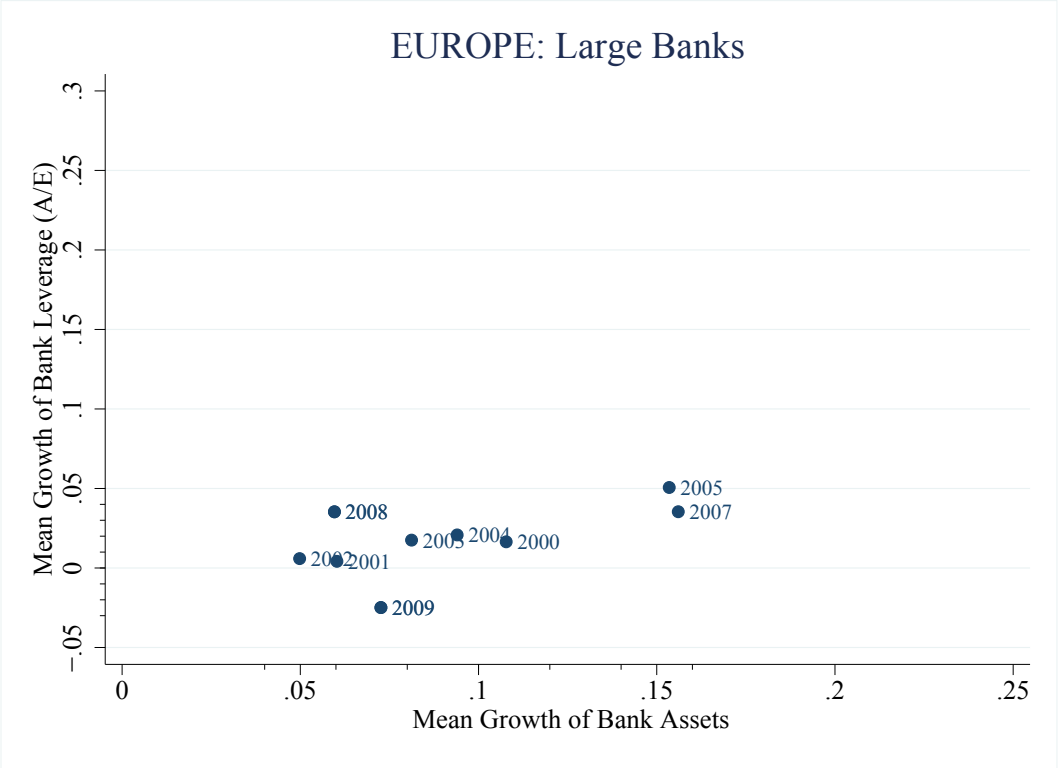


Figure 9: Financial Sector Procylical Leverage Ratio: Europe

Panel A: Bankscope Micro Data, Mean: Europe Large Banks



Panel B: Bankscope Micro Data, Mean: Europe Small Banks

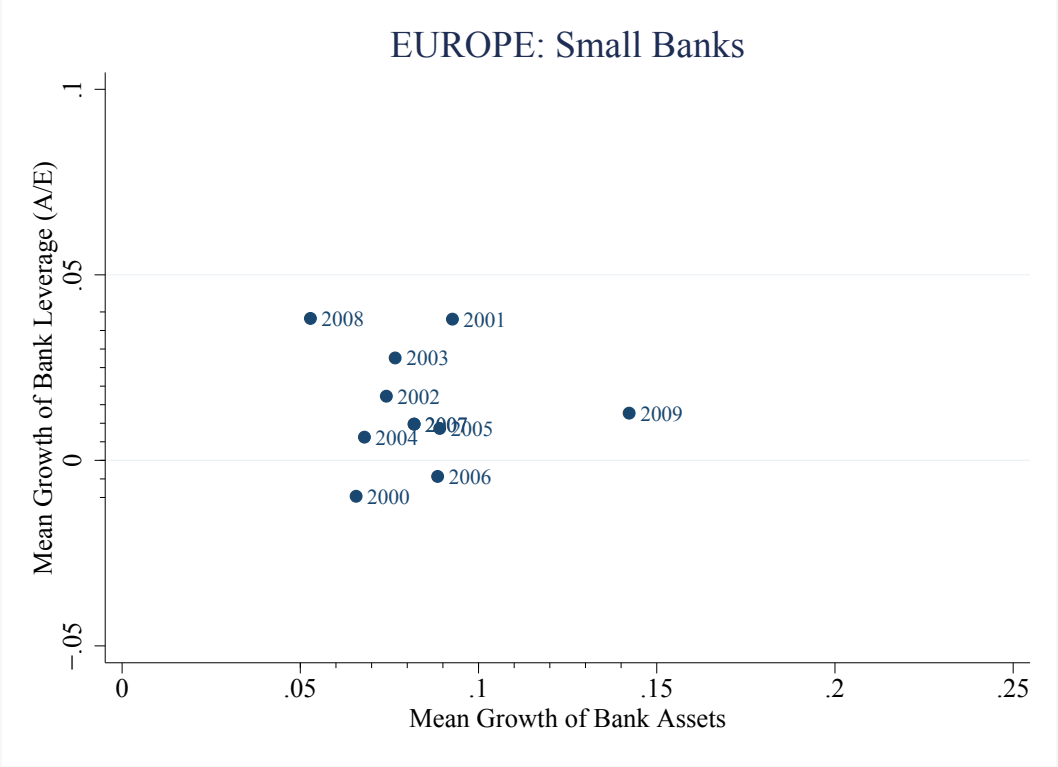
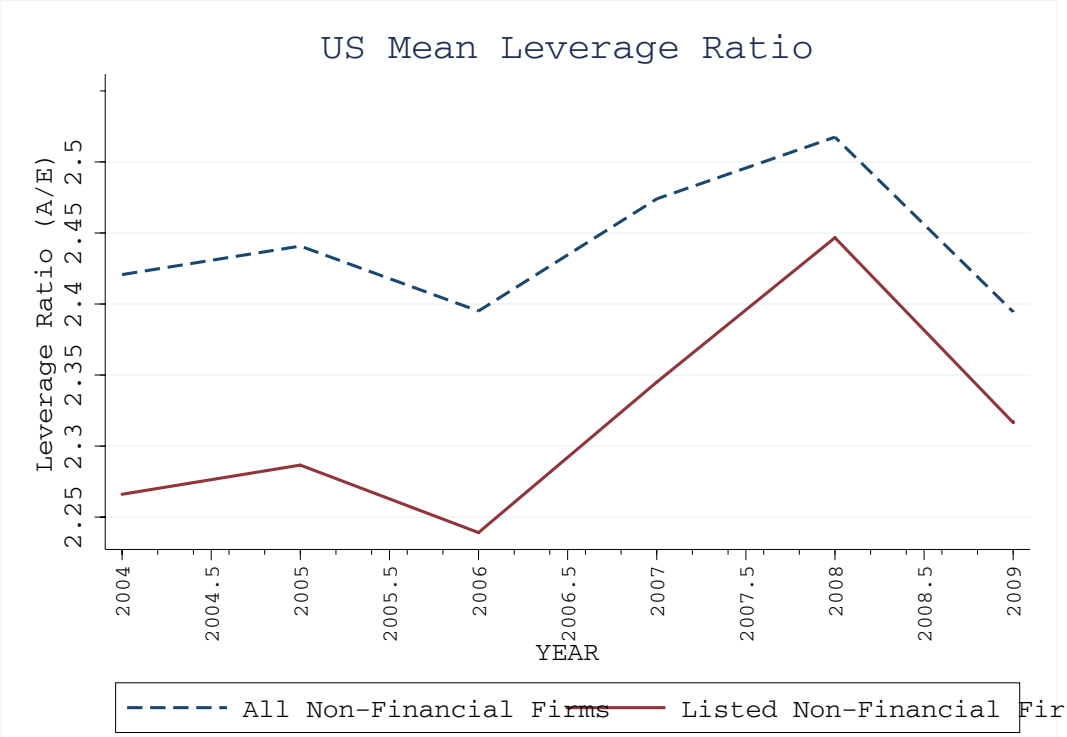


Figure 10: Non-Financial Sector Leverage Ratio

Panel A: ORBIS Micro Data, Mean: U.S.



Panel B: AMADEUS Micro Data, Mean: Europe

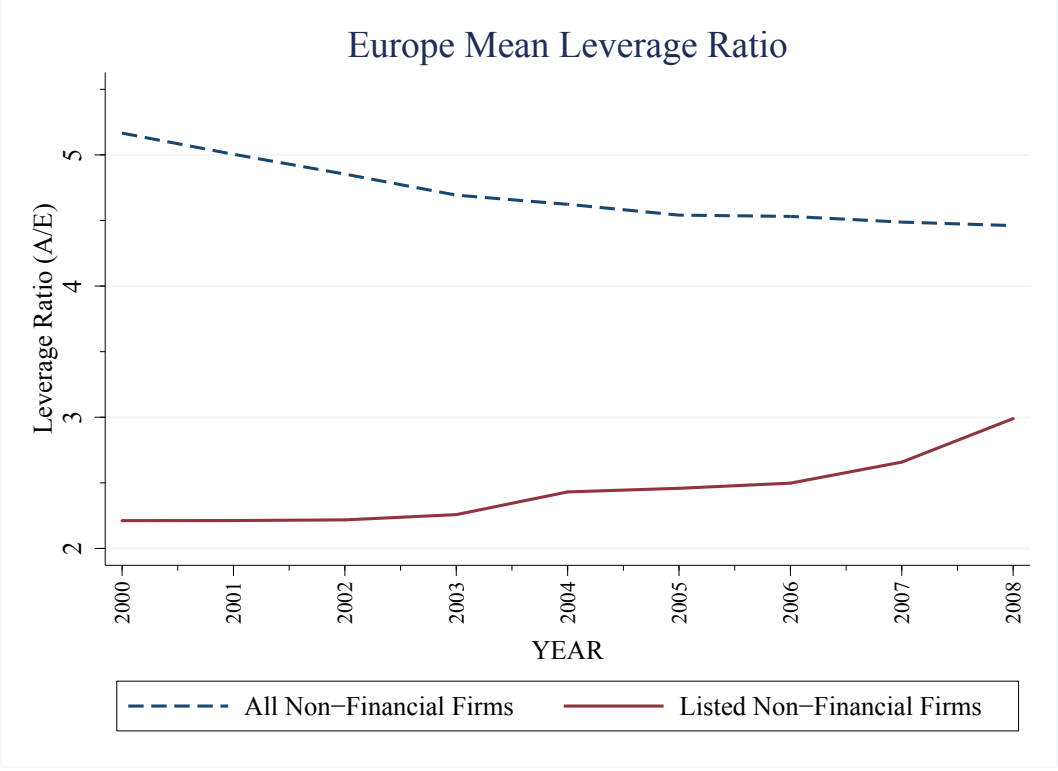
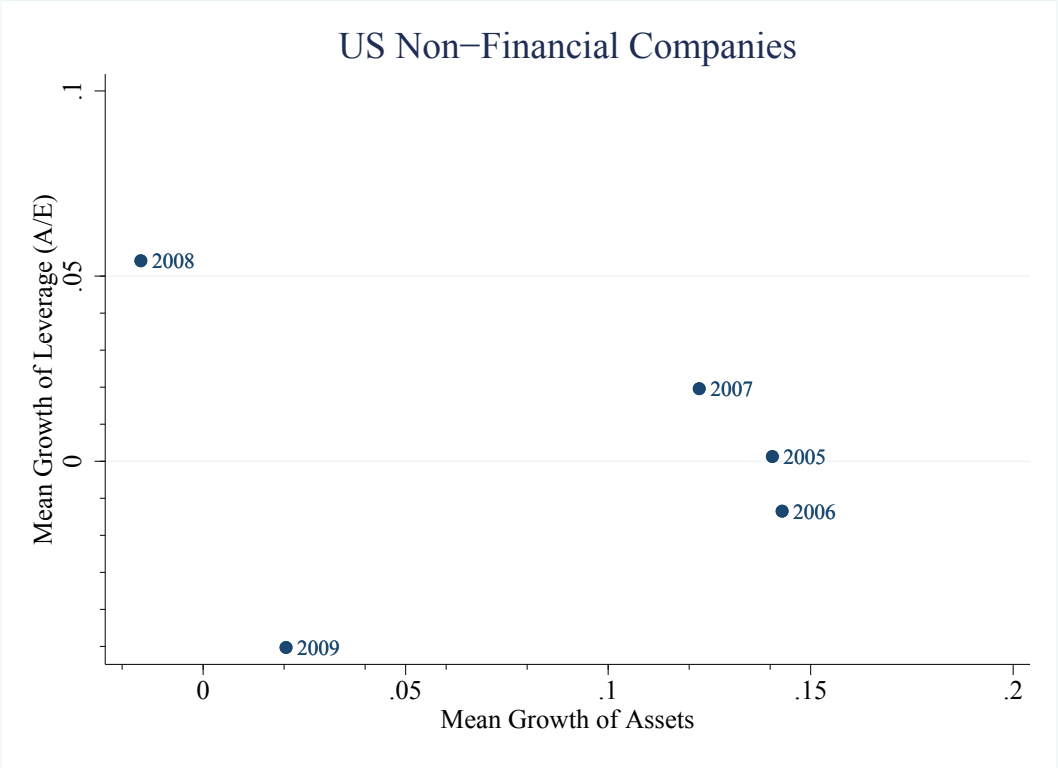


Figure 11: Non Financial Sector Procylical Leverage Ratio

Panel A: ORBIS Micro Data, Mean: U.S.



Panel B: AMADEUS Micro Data, Mean: Europe

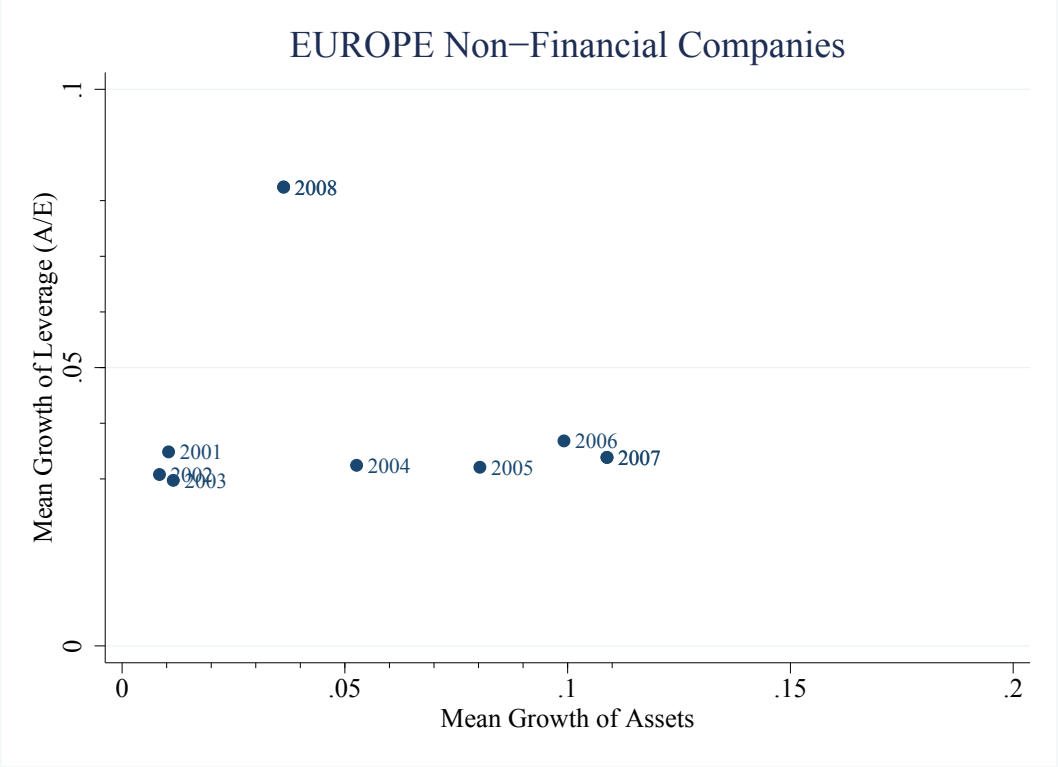
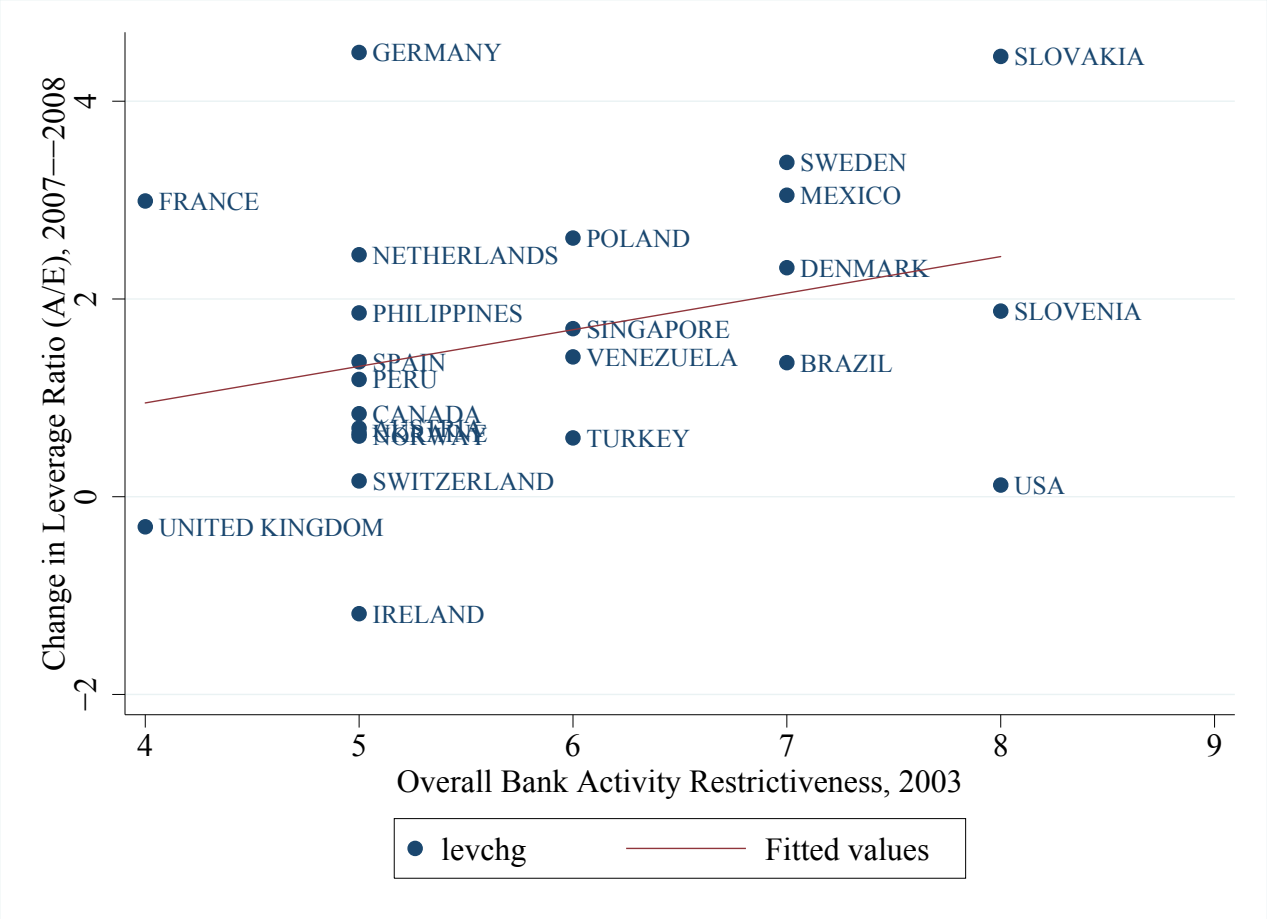


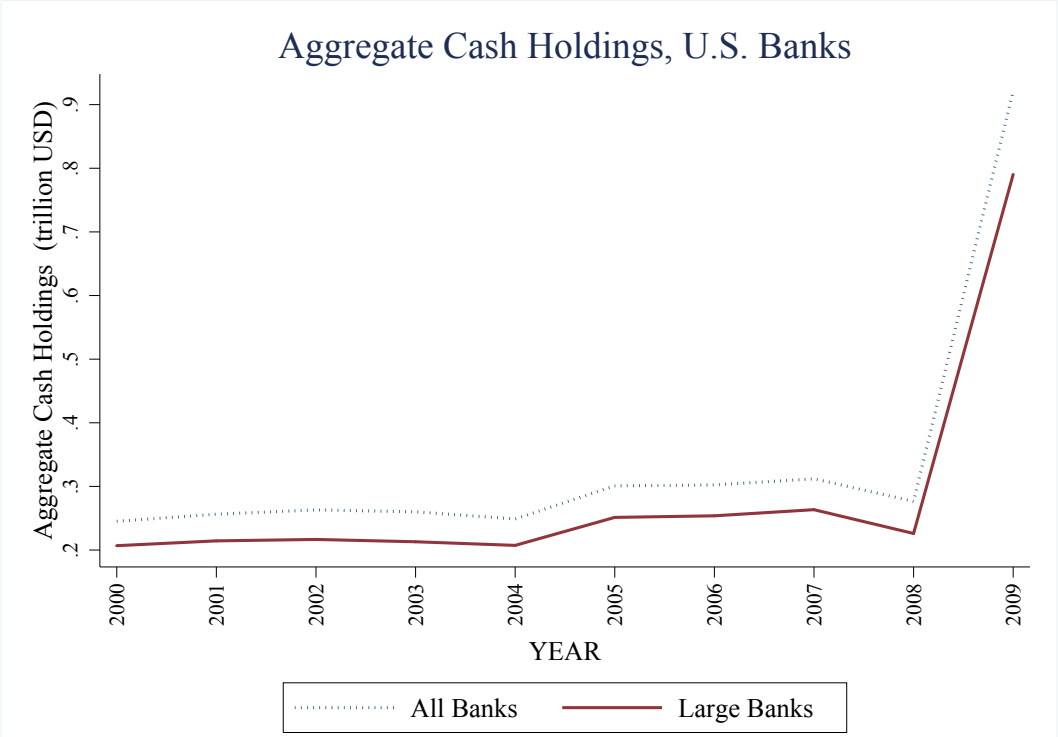
Figure 12: Regulation and Leverage Ratio



Notes: Growth in Aggregate Leverage Ratio is relative to other countries and other years. Overall Restrictiveness is an index for real estate, insurance and securities activities. The index takes a high value if banks are restricted from engaging in underwriting, brokering and dealing in securities, insurance and all aspects of the mutual fund industry. The index varies between 3 and 12.

Figure 13: Cash Holdings of U.S. Banks

Panel A: ORBIS Micro Data, Aggregate Cash Holdings, U.S. Banks



Panel B: ORBIS Micro Data, Median U.S. Bank Cash Holdings

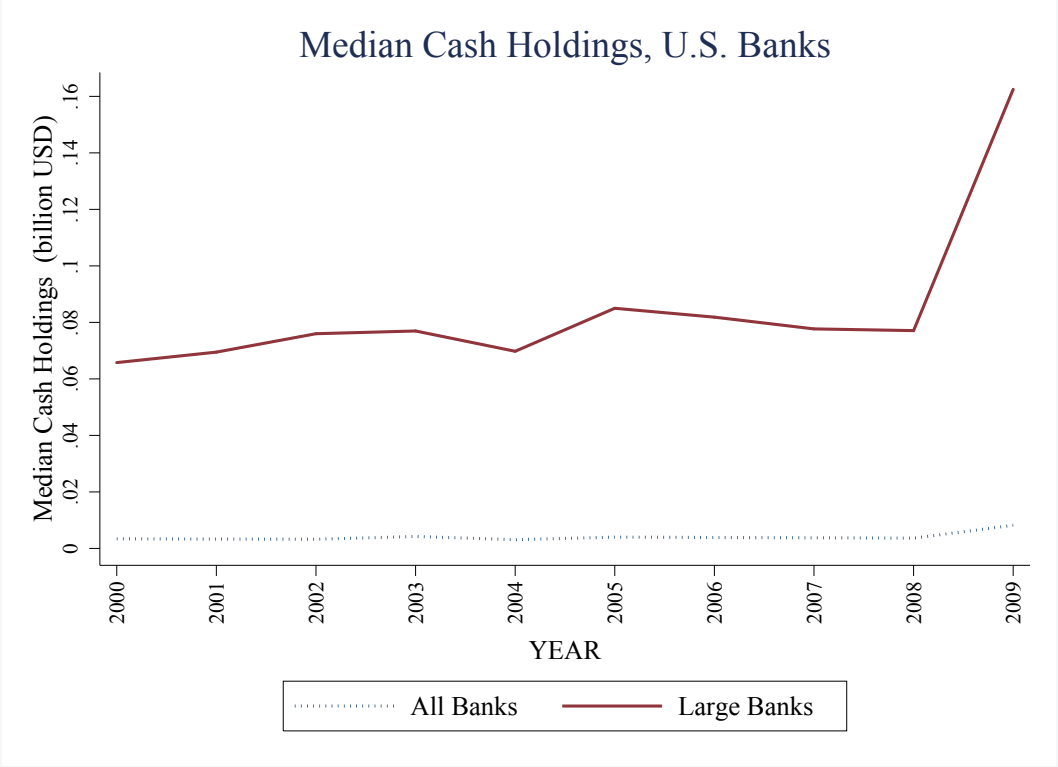
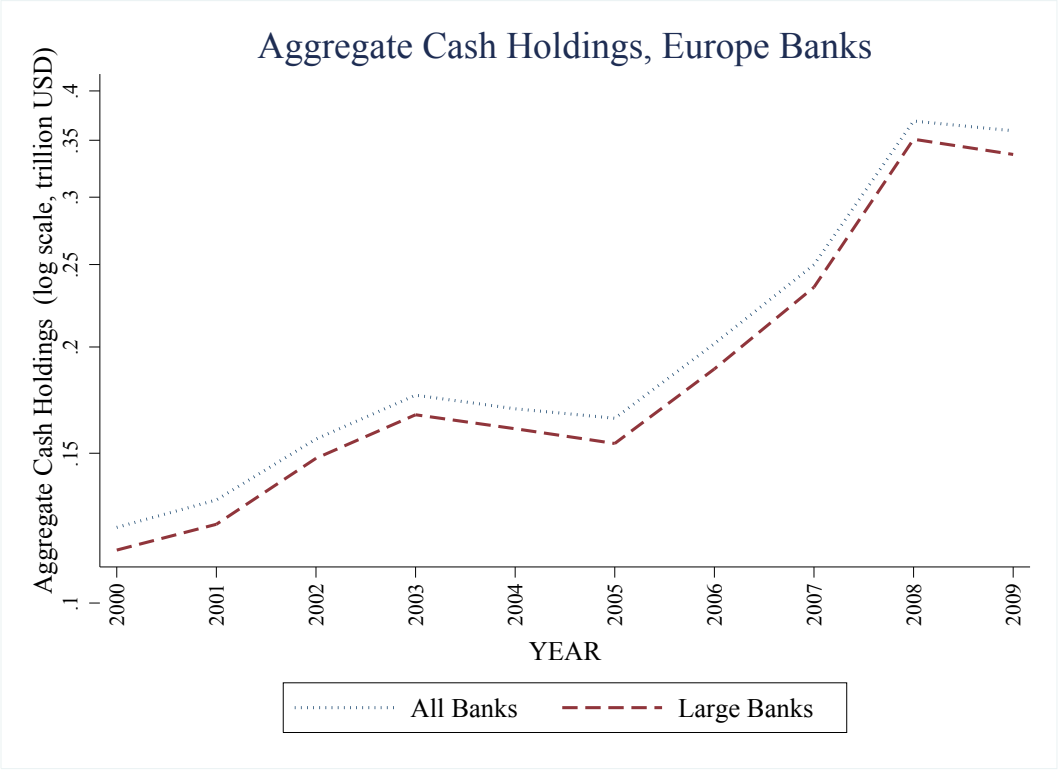
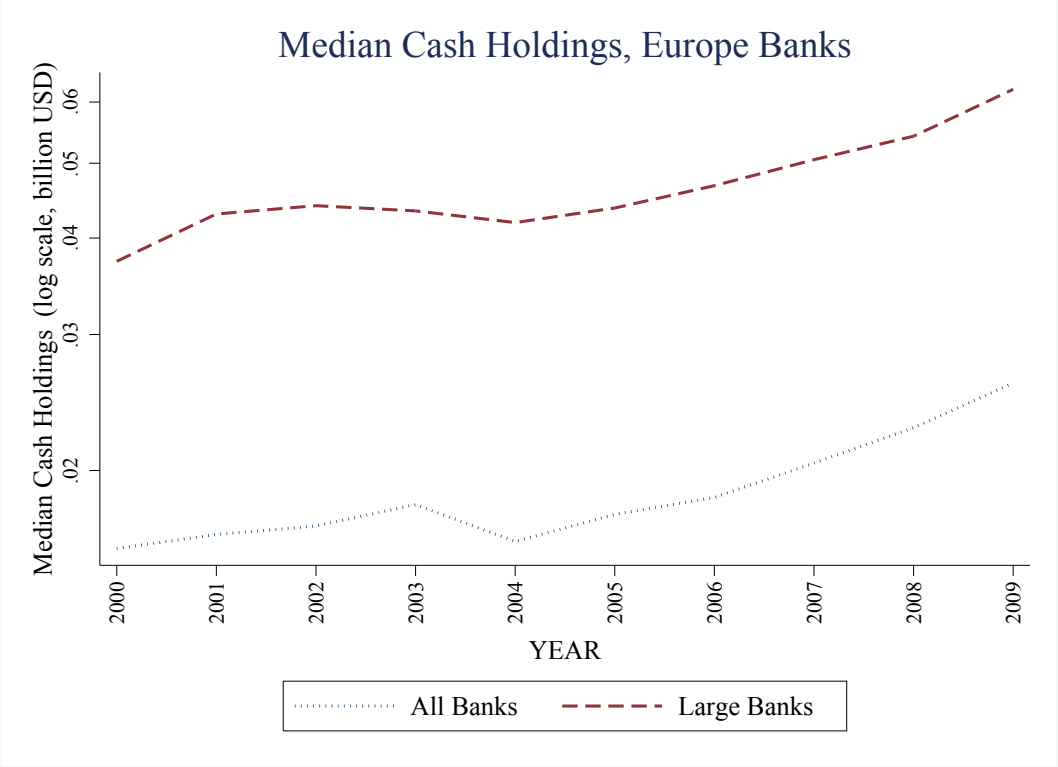


Figure 14: Cash Holdings of Europe Banks

Panel A: ORBIS Micro Data, Aggregate Cash Holdings, Europe Banks



Panel B: ORBIS Micro Data, Median European Bank Cash Holdings



Appendix Figure: Financial Sector Leverage and VIX