

Student: Guillaume Despaigne

Tutor: Evren Ors

The determinants of US regional banks failures during the subprime crisis

HEC Paris

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Student: Guillaume Despaigne

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Abstract: The aim of this thesis is to determine and analyze the causes of US regional bank failures during the subprime crisis. In order to get a better understanding of the crisis and its impact on US banks, we first present the evolutions that have radically changed the US banking landscape over the past few decades and lead to the worst banking and economic crisis since the Great Depression. We then perform a mean difference analysis to compare the characteristics of failed banks and safe banks, which did not fail. We find significant differences on most of our variables and can clearly identify a profile of failed banks. We build a dynamic logistic model to assess the determinants of bank failures during the crisis. Despite the rise of new financial technologies and of a universal banking business model strongly connected to financial markets, which mostly impacted the largest banks, our findings show that failed small banks have been the victims of a credit bubble linked to real estate.

1) Introduction

The subprime crisis, which has been widely considered as the worst banking and economic crisis since the Great Depression in the 1930s, has created the opportunity to revive the analysis of bank failures and develop new failure prediction models. Indeed, recent research on bank failures is based on past periods: the 1980s and the beginning of the 1990s for Cole and Wu (2009), from the mid-1980s to the mid-1990s for Wheelock and Wilson (2000), the first part of the 1990s for Curry Elmel and Fissel (2004). Most of the failure prediction models built are thus based on the bankruptcies which occurred at the time of the Savings and Loans crisis or in the couple of year after. To our knowledge, the only study that looked at bank failures after the end of the long deregulation process opened at the end of the 1970s, is King, Nuxoll and Yeager (2006). They find that the dramatic regulatory financial and technological changes which have happened in the banking system have modified causes of bank failures, based on the comparison of failed banks over 1984-1994 and 1995-2003. They also underline that despite the development of new dynamic statistic models, the research into bank financial distress and failures has slowed.

Even though the number of failures remains high after a peak in 2009, which shows that bank failures caused by the subprime crisis are not over, we think it is time to look at the determinants of the failure of US banks which have already failed.

We decided to perform a classical mean difference test on several variable to determine whether failed banks have been differing from safe banks and consequently determine meaningful inputs to a dynamic logistic model very similar to the one first introduced by Shumway (2001) for corporate failure prediction, which has then been tested by Cole and Wu (2009) for bank failure prediction. However, contrary to them we do not include macro-economic data which is an interesting possibility offered by dynamic models. Moreover we rely exclusively on bank accounting data, as using market data would have dramatically reduced our bank sample¹. Both Shumway (2001) and Cole and Wu (2009) develop mathematical arguments proving the superiority of dynamic logistic models using data panels on logit or probit, one-period models which only rely on cross-sectional data. First, this comes from the fact that dynamic models use much more observations which improves the accuracy of estimates and coefficients. Second, dynamic models allow to capture how long a bank is at risk of failure, whereas this is not taken into account by one-period models which produces biased and inconsistent estimates.

As the crisis revealed the depth of the changes caused by deregulation, financial innovation and technological progress to the US banking and financial system, we devote the next section to a

¹ Curry, Elmer and Fissel (2004) report that at the end of 2008 only 400 banks were listed on a total number of banks close to 8,000.

description and analysis of the evolution of the US banking system based on a review of literature. The third section presents our data, the treatment we made and the variables we will use in the comparison of failed and safe banks. The fourth section presents the results of the comparison of failed and safe banks on 25 criteria and builds a profile of failed banks. The fifth section presents the results of our dynamic logistic regression and the extent to which it verifies our hypotheses on the determinants of bank failures during the crisis. Finally the sixth section concludes.

2) The evolution of the US banking system before the crisis

In a few decades, US banks experienced dramatic changes and transformations which were essentially fuelled by the combined impacts of deregulation and technological changes. This resulted among other things in the boom of financial markets and the development of securitization which led to the 2007-2008 credit bubble and the following crisis. In this section we describe the main evolutions of the US banking industry in order to better understand the nature of the banking industry in the 2000s and the causes of bank failures during the crisis. This will help us determine the variables which we will use to compare failed and non-failed banks, as well as potential inputs to the dynamic logistic model.

a) Deregulation and its impact on US banks

i) A short history of deregulation

At the beginning of the 80s, the US banking industry was essentially made of small depository institutions which dominated real estate lending, consumer lending and small business lending. In their article on community banks, DeYoung and al. (2004) explain that the US banking industry had been shaped by the regulation of the 1920s and 1930s following the Great Depression. According to DeYoung and al. (2004), commercial banking was the largest intermediary in the US financial system with nearly 60% of intermediated assets when including thrifts and other depository institutions.

In this heavily regulated context, banks were protected from geographical competition by the McFadden Act of 1927 which prohibited interstate branching². There was only one loophole in the McFadden Act, which allowed cross-border banking through multibank holding companies. However, prior to the Banking Act of 1956 exploiting this loophole required state approval.

² However the Mc Fadden Act did not put the same constraints on wholesale banking. Commercial and industrial loans could be delivered on a national basis through local loan production offices, as long as these offices did not engage in deposit-taking.

Following the Banking Act of 1956, which closed the loophole on BHC acquisitions across states, and until 1978, the beginning of interstate banking deregulations at the state level, not a single state allowed one of its banks to be owned by a multibank holding company. In addition to intersate banking prohibition, most states limited to different degrees intrastate branching. Some states such as Illinois or Texas even prohibited any form of branching, imposing unit banking institutions.

The Glass-Steagall Act of 1933 shielded banks from product competition with other financial services providers. Commercial banks were strictly forbidden to engage in investment banking, insurance or brokerage. In addition to that, thrifts and credit unions were not allowed to issue commercial and industrial loans, limiting them to compete with commercial banks only on services to households.

Banks were also protected to some extent from pricing competition as Regulation Q limited competition on interest rate paid on all deposits except negotiable certificates of deposit (CDs) above \$100,000, by imposing ceiling rates.

In the context of high inflation and increasing interest rates at the end of the 1970s, the 90-day Treasury Bill rate exceeded by far the ceiling imposed by regulation Q, provoking a large outflow of deposits from the traditional banking system to other non-bank financial institutions such as the newly created money market mutual funds, which allowed their owners the ability to write checks.

The beginning of a 20-year deregulation process thus coincides with a period of difficulties for the US banking system due to the rise of disintermediation and the competition on deposits from non-bank institutions. The development of technological innovation also put pressure on the weakest players. Calomiris (2000), in the introduction of its book *U.S. bank deregulation in historical perspective*, underlines the fact that these deep changes were well received by banking scholars, whose research had shown the inefficiency and sometimes harm that geographic and product competition regulation imposed on bank customers.

The table below summarizes the main steps of the federal deregulation process which culminated in 1999 with the Gramm-Leach-Bliley Act, also know as the Financial Services Modernization Act, definitively repealing the Glass-Steagall Act of 1933.

Table 1 : Evolution of the U.S. Banking Regulation at the Federal Level

1975-1994 Removal of restrictions on intrastate branching

Maine was the first state to dismantle restrictions on intrastate branching in 1975. It was followed by New-York and New-Jersey in 1976 and 1977. The removal of intrastate

branching allowed statewide consolidation of the banking industry. Several scholars looked at the effect of such deregulation on economic growth and have found mixed results. However, it is certain that such deregulation helped to build a stronger banking system³.

1978-1994 Removal of restrictions on interstate branching

Maine again was the first state to allow bank holding companies from other states to acquire Maine banks in 1978, as long as reciprocity existed with the state of the acquiring banks. Restrictions began being effectively dismantled only in 1982 when New-York state passed a similar law, and when Massachusetts passed regional reciprocity limited to New-England states. Before the end of the decade, most states (but six of them) participated to one or several regional pacts.

1982 Garn-St. Germain Depository Institutions Act

The original purpose of the Act was to deregulate the thrift industry by allowing them to issue commercial loans and thus to compete directly with commercial banks. The act also removed regulation Q which had caused a massive outflow of deposits from thrifts and commercial banks to money market mutual funds. The act also permitted banks and thrifts to create money market deposits accounts to compete directly with money market funds. The Bank Holding Company Act of 1956 was amended to allow bank holding companies to acquire failed banks and thrifts in any state, regardless of state law.

1987 Authorisation by the Federal Reserve to create Section 20 subsidiaries

In compliance with the powers granted by the Bank Holding Company Act of 1956 and the 1970 Amendments to the Act, the Federal Reserve allowed banks to form investment banking subsidiaries. These newly formed affiliates were permitted to underwrite municipal revenue bonds, mortgage and asset-backed securities (Tier 1 powers). The revenues generated by the Section 20 subsidiaries should not exceed 5% of total revenues, in order to respect the restrictions imposed by the Section 20 of the Banking Act of 1933.

1989 Extension of Section 20 subsidiaries permitted activities

The Federal Reserve granted additional authorizations to selected group of banks to underwrite corporate securities. This privilege was then increase and extended to other banks. The revenue limit was raised to 10%.

1989 Financial Institutions Reform, Recovery and Enforcement Act (FIRREA)

The Act came as a response to the Savings & Loans crisis. It allowed bank holding companies to acquire thrifts, required agencies to issue CRA (Community Reinvestment

³ In *US bank deregulation in historical perspective*, Calomiris presents the compared average return on assets and return on equity for Illinois, a unit branching state and North Carolina, where statewide branching was allowed. We see that return on assets and return on equity are much higher and more stable in North Carolina.

Act) ratings publicly. To compensate for the costs generated by the CRA, FHLB (Federal Home Loan Banks) membership was opened to commercial banks. Previously it had only been available to thrifts and insurance companies. This boosted FHLB membership from 3,000 at the end of 1990 to 7,000 in 1999, and today almost two thirds of commercial banks are FHLB members. Advances from FHLB constitute an easy source of non-risk priced funding. It is used by almost one third of commercial banks. Stojanovic, Vaughan and Yeager (2008) proved that risky banks have a higher probability to rely on these advances than safer ones. Freddie Mac and Fannie Mae are also given additional responsibility to support mortgages for riskier borrowers (e.g. low-income families).

1994 Reigle-Neal Interstate Banking and Branching Efficiency Act

The Act repealed the McFadden Act of 1927 and permitted both interstate branching and acquisitions among bank holding companies. It completed the process of deregulation of geographic restrictions.

1996 Extension of Section 20 subsidiaries permitted activities

The Federal Reserve removed the firewalls that were keeping investment and commercial banking departments from working together, based on the experience of less regulated foreign underwriting affiliates allowed by the Edge Act of 1919. This resulted in increased synergies between commercial banking and investment banking activities stemming from lowered information costs. The revenue limit is raised to 25% of total revenues, enabling more banks to develop an investment banking business.

1999 Gramm-Leach-Bliley Act (GLBA) or Financial Services Modernization Act (FSMA)

This Act symbolized the final step of the deregulation process by repealing the Glass-Steagall Act of 1933, opening the way to the formation of giant financial services conglomerates and the establishment of American universal banks. Among other things, the Glass-Steagall Act prevented any bank from having more than 30% of the deposits in any state, and 10% nationwide. Besides bank holding companies, the GLBA creates financial holding companies, allowed to engage in commercial banking, insurance, securities underwriting, asset management, brokerage services and merchant banking. The revenue limit for Section 20 subsidiaries is raised to 45%.

ii) Towards a more concentrated industry

The end of geographic restrictions on commercial banking activities, through intrastate and interstate deregulation, resulted in several waves of mergers and acquisitions. Jeon and Miller (2007) demonstrate using a regression analysis that intrastate and interstate deregulations have a positive impact on the number of mergers per bank. Between 1988 and of 1997, the number of

US banks decreased by almost 30%⁴. On a longer period of time, from 1980 to 2001, the number of community banks (i.e. banks with total assets lower than \$1 billion) nearly halved, declining from 14,078 to 7,631. This drop, explained by mergers between community banks, is all the more impressive as during the same time interval 4,336 de novo banks were created. Assets held by community banks fell from 34% to 16% of total industry assets (DeYoung et al. (2004)). Even though most mergers occurred between community and small banks, some of them eventually lead to the creation of banking giants such as Citigroup, Bank of America or JP Morgan Chase. This dramatically increased assets concentration in the industry with the share of top 10 banks going from 20% to 34% between 1988 and 1997, and the share of top 50 banks going from 51% to 66% over the same period.

Not only did deregulation encourage bank mergers, it also fostered the creation of new commercial banks. Keeton (2000) and Seelig and Critchfield (2003) suggest that mergers caused the apparition of new banks. De Young (2003) finds these newly formed banks experienced lower failure rates over their first few years of existence, but after a while the failure rate increased significantly and then converged with the industry failure rate. This has also been verified by Jeon and Miller (2007).

The trend towards a more concentrated banking system has had several major consequences. First, geographic deregulation engendered a two-tier commercial banking system with a small number of national and super-regional banks holding most of banking assets and an overwhelming majority of small and community banks forming a fraction of the banking industry. The size factor is extremely important as strong growth and creation of large banks through mega-mergers has gone hand in hand with the apparition of a new business model exploiting the scale economies that are not accessible to smaller players. Overtime these very large banks expanded into new and more sophisticated products and activities, while small and community banks kept a traditional role of intermediation (i.e. collecting deposits and making loans) and limited themselves in most cases to traditional financial products. Concerning lending, large banks have developed standardized products based on hard quantifiable information and credit-scoring, while small and community banks keep offering more customized products by maintaining relationship lending, especially for small business loans for which soft non-quantifiable information may be more relevant than hard quantitative data.

Second, the concentration of commercial banking assets among large institutions at the national level did not have a significant effect on local market concentration. Indeed, Berger and Mester (2003) report that the average Herfindal index of local deposit market concentration across stays more or less the same through the 1990s. Thus bank mergers were more likely to be of the out-of-

⁴ Meyer (1998)

market type in order to increase geographical coverage. As a consequence, Berger and Mester (2003) show that market concentration did not have a negative price impact on customers, as the intensity of competition at a local level did not change much. Moreover, the creation of new banks in states experiencing mergers counter-balanced, at least partially, the concentration at a local level. Third, mergers between banks in the 1980s and 1990s have had a rather negative impact on productivity whereas mergers are generally associated with stable or improved cost efficiency. This negative impact has been more pronounced for merged banks than for the banking sector as a whole. However, according to Berger and Mester (2003), this deterioration of cost productivity has been more than offset by revenue synergies and improved revenue productivity, as the profit productivity increased significantly more for merged banks than for the banking sector in general. A first explanation for this could be that merged banks are on average larger than non-merged banks and were able to benefit more from product deregulation. A second complementary explanation could be that mergers allowed banks to benefit from risk diversification. An enlarged geographical scope could have moved up the efficient frontier and allowed banks to improve their return on assets while keeping their level of risk constant. The existing literature provides support for this explanation (Berger (1998), and Akhavein et al. (1997)).

iii) The emergence of universal banks in the US

Product deregulation has encouraged commercial banks to enter new activities: first investment banking with the creation of Section 20 subsidiaries, and then brokerage, insurance underwriting or merchant banking with the repeal of the Glass-Steagall Act. These new opportunities actually benefitted the most to a small number of already large commercial banks which had the strength and resources to enter these new businesses. Mamun, Hassan and Maroney (2005) find that the announcement of the GLBA resulted in significant higher abnormal share price returns for the largest banks. Moreover, even among large banks there was a significant higher return for banks which had a Section 20 subsidiary before the GLBA than for those which had not.

Developing new activities and expanding product mix was the key to achieve what has been called economies of scope. Calomiris (2000)⁵ underlines that contrary to economies of scale that are based on costs, economies of scope do not occur in the production process, but are rather based on revenue synergies and arise in the context of client-relationship management. Indeed, the idea is to develop customer-led growth by offering additional products to existing customers. For example a lending relationship with a large company gives the opportunity to offer additional services such as derivatives products, hedging, advisory services or even debt and equity underwriting services. This generates information scope economies in so far as information and

⁵ in *US banking deregulation in historical perspective*, chapter 6: Universal banking, “American style”

monitoring costs incurred in the framework of lending relationship can be spread on more products. Moreover information can also be re-used across the different product lines in order to better assess client-specific risks and improve the risk-return profile of the bank's activities. The existence of scope economies based on relationship increased the competition for gaining new customers. It thus has become widespread to offer underpriced corporate loans in order to attract new customers (Calomiris (2000)). The measure of profitability is consequently no more assessed on an individual transaction basis, but on a relationship basis by evaluating the resources devoted to a client against the revenues that the same client generates in the form of interest payments and fees for the bank.

The best illustration of the existence of scope economies based on information-sharing and informational advantage comes from the entry of commercial banks into the security underwriting business through section 20 subsidiaries in the 1990s. Pappaiouannou (2008) shows that commercial banks entered the underwriting business successfully. Their performance is particularly strong in debt underwriting and Yankee underwriting where they captured on average 58% and 60% respectively of the market over 2001-2004 versus only 19% and 15% respectively over 1990-1996. Their market share in equity and in municipal bonds underwriting also surged from 5% and 12% respectively over 1990-1996 to 40% and 36% respectively over 2001-2004. This gain in market share was mostly at the expense of independent investment banks. The top-6 bulge bracket investment banks also experienced a decline in market share over the 1990s and early 2000s except for equity offerings where they reinforced their positions overtime. Even though commercial banks had an information advantage due to their lending relationships with securities issuers this did not translate into significantly higher market share gain for high information content securities, for which the price discovery process is more complex. However, they were able to charge lower gross spread on debt underwritings according to Rotten and Mullineaux (2002), and the underpricing was reduced even more for non-investment grade bonds, which accredits the informational advantage of commercial banks resulting from scope economies. Concerning the equity underwriting market, Pappaiouannou (2008) findings also suggest that small-sized first-time issuers for whom information asymmetry is greater tend to favour commercial banks with which they have lending relationships, rather than investment banks. More generally a bank with a lending relationship with an issuer is more likely to underwrite debt or equity issues (Barath et al. (2007)).

The product diversification had a dramatic impact on the banking industry as a whole, even though banks from different sizes have been impacted to different degrees. Berger and Mester (2003) found that a larger product scope of commercial banks translated into both a worsening of cost productivity and an improvement of profit productivity from 1991 to 1997. This means that

banks were able to expand into more sophisticated products and services that generated higher profits despite bearing higher costs. The situation is contrasted between smaller and larger banks: banks in the larger quartile have experienced much higher profit productivity gains than banks in the smaller quartile. This demonstrates that scope economies have been more accessible to larger banks. Asaftei (2006) studied the return on assets (ROA) of banks by size categories (megabanks (top 1%), large banks (2%-5%), community banks (6% to 40%), micro-banks (41% to 100%)): he found that megabanks and large banks have a higher and increasing ROA over 2000-2005, while community and micro-banks have a lower and decreasing ROA. He explains this by a decline in net interest margin (NIM) for all bank categories, but which had a stronger negative effect on the smallest banks. All bank categories benefit from a positive contribution of the non interest margin (NNIM) on the ROA, but megabanks benefit the most thanks to both a positive price effect and quantity effect on the NNIM. On the contrary, other bank categories experience a negative quantity effect on the NNIM more than offset by a positive price effect. It should also be noted that large banks have on average a much larger NNIM of 2.6% versus 0.3% for small banks. Asaftei (2006) also finds that megabanks benefitted the most from an improved product and resource mix which more than compensated a negative productivity effect. Even though the negative impact of productivity was much smaller on ROA for the small and micro-banks, it was not counterbalanced by a high enough activity effect⁶, which was penalized by a negative effect of resource mix on ROA despite an improved product mix. In conclusion, Asaftei (2006) underlines that larger banks are better at substituting towards the most profitable product mix: the quantity expansion of lending compensates lower interest margins and non-interest revenues are increasing thanks to fees coming from new traditional products (such as off-balance sheet products and securitization) and from non-traditional products (such as investment banking, brokerage and insurance). Smaller banks benefitted less from the GBLA and cross-selling opportunities, as their scale prevented most of them to engage in investment banking or securitization, even though a large number has been cross-selling insurance products or charged additional fees for the servicing of traditional products such as loans sold to securitized pools.

b) Technological changes

Deregulation of the US banking industry had such a dramatic impact because it has been paralleled with a technological revolution which has given commercial banks the means to fully exploit both new geographical and product expansion opportunities.

⁶ decomposed into product mix, resource mix and scale effect

i) Technological changes in the banking industry: an historical perspective

Technological changes which impacted the commercial banking industry can be divided into two categories: financial innovations such as credit scoring or new products such as derivatives and asset-backed securities, and information technology-related changes such as the development of internet-banking, ATMs, electronic means of payment (credit and debit cards). However most of the financial innovations of the three last decades have been made possible because of the progress of compilation and computation technologies. They made possible the development of new products, risk-management tools and regulatory frameworks (Basle I, Basle II) because they made technically possible to perform heavy calculations and run complex statistical models and they lowered both information processing time and information processing costs. The ratio of computers and software to value added reveals that banking is the most IT-intensive industry in the United States.

A first decisive innovation was the apparition of the automated-teller machine (ATM) in the 1960s and 1970s. Initially banks thought that ATMs would be substitutes for human tellers. However, data from the FDIC and Bank Network News annual Data Book reported by DeYoung et al. (2004) show that both the number of ATMs and of bank branches has been increasing overtime. It suggests that ATMs and branches with employees have complemented rather than cannibalized each other.

The 1980s saw the development of additional major financial and technical innovations. The computers increased information processing capacities as well as the reduced cost and time of information transfer were instrumental in the apparition and the development of new financial markets such as options, futures, swaps on interest rates, stock indexes and other financial assets. At the same time they allowed existing financial markets to function more efficiently thanks to the development of electronic platforms to match orders on existing exchanges. Moreover, new technology was a key factor in the development of securitization and asset-backed securities, even though deregulation played an important role too. Indeed, the development of information technology made easier the computation and dissemination of information concerning the performance and the operation of the asset pools. We will look more in details at the consequences of the boom of securitization in the next subsection.

Technology has also had a dramatic impact on consumer and small-business lending. Introduced for the first time in the 1950s, credit scoring has spread from consumer and real estate loans in the 1980s to small business lending in the 1990s. While it has been used by most banks for consumer loans and mortgages, credit scoring has also been used mostly by large banks for small business lending, whereas small banks rather tend to emphasize soft (non-quantifiable) information and relationship lending. According to the Federal Reserve's 1996 Senior Loan

Officer Survey, credit scoring is primarily used in approving loans applications. Moreover, 80% of banks using credit scoring use it as a marketing tool, in order to determine from whom to solicit loan applications, and only 20% of banks using it set loan terms based on the scoring results. DeYoung and al. (2004) indicate that credit scoring and new technology may have resulted in increased lending, as banks are now accepting higher-risk borrowers, which were previously rejected. Credit scoring also had for consequence to lower underwriting costs as it is less expensive than human due diligence, even though it is unclear whether it is more effective at predicting default. The intensive use of credit scoring was necessarily accompanied by the development of private databases and information exchanges: they are intermediaries through which banks and other lenders share data on the creditworthiness of applicants. These exchanges aggregate data from various sources, e.g. banks, public records, trade creditor, and provide credit reports and/or credit scores to financial institutions. Such databases provide useful information; indeed, Jappelli and Pagano (1999) found that lending is higher and default rates lower in countries where lenders use information exchanges.

Another extraordinary evolution has been the changes which have affected the payment system. The 1990s have witnessed a switch from paper-based payments – i.e. cash and checks – to electronic payments – i.e. debit and credit cards. Gerdes and Walton (2002) reports that the number of checks paid in the United States fell from 49.5 billions in 1995 to 42.5 billions in 2000, this means an overall decrease by 14.2% or a 3% decline on average per year. In the meantime, credit card payments surged from 10.4 billion to 15.0 billion (an overall 44.2% increase or 7.3% constant annual growth rate (CAGR)), and debit card payments exploded from 1.4 billions to 8.3 billions (an overall 592.8% increase or 35.6% CAGR). Humphrey (2002) found that between 1990 and 2000 cash share and check share in personal spending fell respectively from 25.7% to 16.3% and from 61.8% to 56%. During the same period, credit and debit card share surged respectively from 12.2% to 21.2% and from 0.4% to 6.5%. Increased use of electronic payment resulted in a strong increase of the use of automated clearing houses (ACH). The volume handled by the Fed's ACH quadrupled from 915 million in 1990 to 3.8 billion in 2000. The rise of electronic payment may have two main explanations: increased volume and improved technology have considerably lowered unit costs – Fed data on ACH show a fall of 83% in real unit costs over 1990-2000, increasing use of electronic payments reflects the increased possibility to use such means of payments (growing network of merchants/ businesses accepting credit cards) and the growing number of debit and credit card among the population – most Americans now have several credit cards, thanks to the marketing efforts of the credit card industry (lifestyle cards, personality cards, etc.).

Progress in both financial and information technology have given banks new means to manage their risks and interest rate exposures. This was made possible by the development of increasingly sophisticated risk-models thanks to the rise in computing capacity, and new financial products such as derivatives that offer the possibility to implement complex and targeted risk management policies. In the 1990s, banks began to use new tools based on Value-at-Risk (VaR). Moreover the Basle Capital Accord adopted by the largest banks in the late 1990s and early 2000s went one step further in increasing the link between regulatory capital requirements and credit or asset risk. To comply with this new regulatory framework, banks have been continuing to develop their risk management models to estimate their exposures, default rates, loss given default, etc.

Internet also revolutionized front-office technologies and banking was no exception. The most widespread strategy has become the click-and-mortar, which combines a website with an existing network of branches and ATMs. Indeed, there were very few internet-only independent players and most of them have failed or shut their operations. Internet-only subsidiaries of large banks have also been reconverted to participate in a click-and-mortar strategy. We can distinguish between two types of websites: informational ones and transactional ones. According to Berger (2003), 37.3% of national banks have a transactional website and an additional 27.7% have only an informational website in 2002. The adoption rate of transactional website is very much linked to the bank size, with 100% of banks with more than 10 billions in total assets having one in 2000 and only 20% of banks with 100 million or less in total having one. However the adoption rate has been rapidly increasing. Even though Internet remains a marginal channel in the distribution of banking product and services it has been gaining share against other channels and helped reduce costs as well as problems associated with geography and distance.

ii) Technological change impact on bank concentration

Technological change has favoured bank concentration through mergers and acquisitions for several reasons. First, new technologies and financial products have created strong potential economies of scale. Deregulation coupled with technological innovation may have allowed the largest commercial banks to create new services and products which bear significant economies of scale: it is true for example for Internet-banking, ATMs, call-centers. Concerning wholesale and investment banking, larger banks have developed technology driven businesses where a large scale is a decisive advantage: derivatives, securitization and other off-balance sheet activities. At the same time new technology applied to existing products and services also generated higher potential economies of scale: it is true for electronic payment or credit scoring which has replaced relationship and soft information at larger banks because these methods bear high diseconomies of scale. The importance of size is shown by the fact that larger banks have always been the first to

adopt new technologies or new products. Indeed, even though these products are actually accessible to smaller banks it is at a higher marginal cost which makes them less attractive and may explain a later adoption. According to Berger (2003), larger banks thanks to their more sophisticated risk-management tools are likely to optimize capital use and invest more in high-risk high-expected returns assets. The development of IT systems within banks improved performance monitoring, allowing managers to better monitor their staff and to reduce agency costs within the organization by providing better aligned incentives.

In addition to scale economies, technological progress has also decreased diseconomies related to distance and to a large geographical scope. Geographic proximity has indeed no effect on the cost or revenues associated with new services such as internet banking, or derivatives in contrast to small business lending based on relationship and other services based on soft information. New technologies have also reduced distance-related diseconomies for traditional products and services, mostly by reducing costs associated with distance for example credit scoring does not require any local knowledge or geographic proximity. Finally, Berger and DeYoung (2002) show in their study of technological progress and geographic expansion based on MBHCs that technological progress during the period 1985-1998 has allowed banks senior managers to exercise more control over their non-lead affiliates. This translated into an improved control over costs and revenues. The impact of distance agency costs has also been reduced.

Second, technological changes may have decreased the riskiness and enhanced the attractiveness of mergers and acquisitions. Technological change may encourage consolidation because it could help banks engaged in M&A to reduce profit X-inefficiencies⁷ by spreading new products and best practices through consolidation (e.g. improved risk management, sharing a transactional website). M&As also spread new technologies applied to traditional products such as small business credit scoring. Besides, technological change has allowed banks to better identify and assess targets that are good candidates for X-efficiency improvement through the implementation of new technology. The existence of internal IT system and computer-based risk management tools may also help to speed up the integration process and to reduce the time during which new managers are unaware of developing problems. Empirical studies on U.S. banks during the 1990s found that mergers generated no improvement in cost X-efficiency, whereas they found profit efficiency improvement, but this could be linked to improved diversification of risk and a shift in the assets portfolio from securities to loans. Berger and Mester (2003) found that banks that recently merged

⁷“X-efficiency is the effectiveness with which a given set of inputs is used to produce an output. If a firm is producing the maximum output it can, given the resources it employs, such as labor and machinery, and the best technology available, it is said to be technically-efficient.” Wikipedia, X-efficiency

were responsible for much of the findings of profit efficiency improvement and cost efficiency worsening during the 1990s.

iii) Technological change impact on bank productivity, profitability and product diversification

Linking technological progress to bank productivity is difficult because technological change cannot be easily quantified and must rather be inferred from changes in productivity ratios overtime. Another problem comes from the fact that productivity is not influenced exclusively by technological change but also by the effectiveness with which technology is used. Then, it is difficult to account for the effects of technological change as it can impact banks in ways that are not captured by traditional productivity measures. If we look at credit scoring, it not only lowers underwriting unit costs, thus generating cost X-efficiency, but it may also help to improve the risk-return of the loan portfolio by keeping the default rate constant while increasing the interest earned. This second improvement is usually not captured by traditional productivity measures. Studies suggest that improvement in service and product quality may also not be taken into account either because they result in price increases and are thus accounted for as inflation, or because of competitive pressure their profits are passed away to customers.

The strong increase in ATMs number, the use of computers and other new technologies has allowed bank branches employees to focus on higher value-added activities and led to an increased efficiency measured by an increase on average of operating income per branch while the number of full-time employee equivalent (FTE) per branch has been reduced by 10% between 1985 and 2000. Even though the investment in an ATM network at little or no charge to customers may have been considered as deteriorating productivity during the 1980s, in fact it improved productivity over the long run.

At the bank level, Berger and Mester (2003) found a worsening of cost productivity of 12.5% annually more than compensated by revenue increases since profit productivity improved between 13.7% and 18.5% annually over a period of time from 1991 to 1997. The main cause of the increasing profit productivity is a change in the product mix of commercial banks which occurred thanks to the combination of both deregulation and technological change.

Despite the worsening of cost productivity, Asaftei's findings suggest that from 2000 to 2005 large banks became more efficient, i.e. the gap between the best-practice banks and the rest of the banks decreased. On the contrary, small banks have experienced an increase in the gap between the best-practice banks and the rest of the group. It highlights a growing heterogeneity among small institutions. Even though some small banks were able to keep up with the fast pace of technological progress, most of them are not able to implement the most recent technologies,

either because they do not have the financial means to support the required investments or because they do not expect to reap profits from the implementation of new technologies.

c) Securitization and disintermediation

i) The rise of securitization

First invented in the 1960s thanks to the development of information technology and the Ginnie Mae passthrough⁸, securitization exploded in the 1980s with the conjunction of several factors: i) the improvement in technology which has allowed to compute and disseminate information more rapidly, ii) regulatory changes which permitted commercial banks to get involved in asset-backed securities through section 20 subsidiaries, change in loan sales accounting rule introduced by the FHLBB in 1981, power and responsibilities granted to Fannie Mae and Freddie Mac through the FIRREA in 1989.

Securitization is a generic word which encompasses very diverse situations. It generally consists in the creation of liquid trading securities from a pool of illiquid non-traded assets, where the payoff features of the securities significantly differ from those of the assets (let it be in terms of seniority, maturity...). In order to do so, banks set up a special purpose vehicle (SPV) to which they sell assets with different characteristics (asset class, riskiness, maturity, interest rate...). To finance this acquisition, the SPV sell securities with different risk levels, interest rates and payoff characteristics to outside investors. In some cases the sponsoring bank retains a junior stake (called equity) in the SPV financing structure. In some cases the sale of the asset pool can be considered as a true sale, which implies that the risks associated to the asset pools have been effectively transferred to the SPV investors. In other cases, such as conduits (pool of assets financed by short-term commercial paper) or credit card securitization, the bank retains most of the risk associated with the asset despite their sale to outside investors.

The growth in asset-backed securities has been tremendous since the 1970s with more and more asset classes being securitized: mortgages, credit cards receivable, auto loans, commercial and industrial loans... From the 1970s to 2001, securitization went from several hundred billion dollars to more than 4,500 billion, an amount close to total banking assets which represented 5,700 billion as of the end of 2001. According to Uzun and Webb (2007), who identified 112 banks involved in securitization from 2001 to 2005, the most securitized asset class is mortgages with an average principal balance per securitizing bank of \$3.9 billion, closely followed by credit card

⁸ Ginnie Mae was set up in 1968 to promote home ownership. It guarantees MBS which are pooling residential real estate loans insured by other government agencies, including the Federal Housing Administration (FHA), the Department of Veterans Affairs, the Department of Agriculture's Rural Development. The loans are originally issued by commercial banks and real estate lenders and then sold to Ginnie Mae guaranteed MBS pools.

receivables with \$3.5 billion, other consumer loans with \$0.17 billion, home equity lines of credit (HELOCs) with \$0.11 billion. They also found that very few banks were securitizing most or all asset classes. On the contrary most of them were securitizing only one or a few asset classes.

Unlike other innovations developed by commercial banks, securitization has been supported by government intervention through two government sponsored enterprises: Fannie Mae and Freddie Mac. Backed by an implicit government guarantee, these two institutions have played a key role in the residential mortgage market and the growth in mortgage-backed securities (MBS). According to DeYoung et al., citing Passmore et al., Fannie Mae and Freddie Mac have sold to investors \$1,200 billion of MBS and are holding on their balance sheet another \$1,000 billion.

Uzun and Webb tried to determine the characteristics of banks engaged in securitization and the drivers of securitization by designing a logit model taking into account a sample of 112 banks engaged in securitization and 112 banks not engaged in securitization. The sample of non-securitizing bank has been designed to match each securitizing bank with the non-securitizing bank which has the closest asset size. They found that securitizing banks are larger than non-securitizing banks (five times larger on average based on their matched sample). However they found no significant difference in total risk-based capital ratio or in tier 1 leverage ratio. In one of their model, they also found that growth in total assets is a significant factor.

Asset size matters most because, like many other financial innovations, securitization benefit from strong scale economies, especially in the set up of conduits and asset pools where costs are rather fixed and not influenced by size (specific IT infrastructure, specialized teams, costs associated with legal and regulatory matters...). Even though community banks have not been able to develop their own securitization business they have used it as an important tool to geographically diversify their locally-concentrated loan portfolios, by purchasing MBS and financing it with loan sales to investment banks or SPV set up by larger banks engaged in securitization or by decreasing their exposure to traditional securities such as government bonds.

ii) The impact of securitization on the banking system and banks' business model

Securitization has had a profound impact on the banking system and is doubtlessly at the origin of the so-called "subprime crisis", referring to the mortgages contracted by high-risk borrowers with low income, bad credit history, high loan-to-value and payment-to-income ratios.

The most visible consequence of securitization has been a boom in credit, especially household credit. This has materialized by the rise in residential real estate mortgages. According to Heilpern et al. (2009), the stock of outstanding residential real estate mortgages reached \$11 trillion at the end of 2007, of which an estimated \$2 trillion were subprime and another \$1.1 trillion were f home equity lines of credit (HELOCs). A HELOC is usually some sort of revolving or fixed credit in

which the equity stake you have in your home serves as collateral. The rise in real estate prices during the 2000s which had been fuelled by the credit boom and low interest rates triggered a re-leveraging of US households which were able to accumulate more debts thanks to the increasing valuation of their homes. Contrary to residential real estate gross fixed capital formation (GFCF) which tracks more or less the evolution of GDP over 1963-2007, except during the early 1990s during which GFCF was below GDP growth, the residential real estate mortgage stock shows a decorrelation from GDP from the early 1980s on. While GDP grew at a CAGR of 5.3% between 1983 and 2007, the stock of residential real estate mortgages increased at a CAGR of 9%. The decoupling between physical assets evolution and financial assets evolution has been called financialization. The decoupling between mortgages and GDP coincides with the development of securitization on a large scale.

The rise in US house price, initially fuelled by a credit boom, itself driven by securitization, pushed banks to enlarge their product scope (e.g. adjustable-rate mortgage, Pick a Payment mortgage) to attract subprime borrowers. Banks and non-bank mortgage underwriters were all the more eager to extend credit to these risky applicants as the demand for such loans in the secondary market was high. In their study of the role of securitization in the expansion of subprime credit, Nadauld and Sherlund (2009) found based on a cross-section of 2,786 zip codes in 2005 that the change in market share between 2003 and 2005 five “Consolidated supervised entities”⁹(CSEs) banks was significant and positively related to the number of subprime loan sold to the secondary market. They also found that the higher is the proportion of subprime loan sold, the higher is the proportion of subprime loans on total loans.

Securitization did not only drive the expansion of the mortgage market, it has also been instrumental to the growth of credit cards which represent around 90% of consumer credit. According to Calomiris and Mason (2004), the average annual growth rate of consumer credit was over 12% between 1980 and 2002. After the crisis of the early 1990s, securitization helped revitalize the credit card industry which experienced growth of 18% in 1994 and 22% in 1995. At that time credit card represented 48.4% of the non-mortgage ABS market, and in 2001 it represented 28.2%¹⁰ Securitized credit cards made up about half of total consumer credit and 60% of credit cards receivables were securitized as of 2001, even though the vast majority of banks kept credit cards receivables on balance sheet. It reflects the fact that the largest commercial banks have engaged in securitization, whereas most small banks did not.

⁹ In response to a EU directive, the SEC proposed amendments on rules establishing regulatory capital requirements for the largest broker-dealers. These firms have become Consolidated Supervised Entities. The alternative rule is estimated to have reduced capital requirements by 30%-40%.

¹⁰ Bond Market Association, 2003

Beyond a credit boom which benefitted mostly to households and the real estate market, securitization has triggered a shift from the traditional intermediated banking model in which banks originate and retain loans on their balance sheet, financing them mostly with equity capital and deposits, to a disintermediated and fragmented banking model deeply interconnected with financial markets, in which banks originate or purchase and then sell on and distribute loans, keeping few of them on balance sheet. Consequently, the high loan portfolio turnover permitted by securitization allows banks to lend more with the same amount of equity capital because most loans don't stay on the balance sheet. Banks tend to become an intermediary between borrowers and capital markets, generating fees and income through origination, sale and ABS structuring and underwriting. However, the reality is maybe more complex: studies such as Acharya, Suarez and Schnabl (2010) on conduits have shown that securitization does not always result in a "true sale" in so far as the risk associated with the assets are not passed away to outside investors but stay within the bank. Even though US GAAP does not impose on banks to consolidate conduits (whereas IFRS does), we can consider that the frontier between on and off-balance sheet may be in some instances more fictive than real. In a way, securitization can be seen as a non-traditional source of financing bank's assets by borrowing money on financial markets; this tends to mitigate the disintermediation view.

Another subject of interest is the advantages and disadvantages of securitization. At the light of the recent crisis, the supposed risk-diversification, increased transparency and stability of the banking system do not sound convincing. However, when looking carefully at the traditional banking model, we find that banks use deposits, which are by nature short-term resources which can be withdrawn at any time and exhibited a strong volatility in the 1970s and 1980s, to finance loans which are long-term commitments, hence creating an asset liability mismatch as well as a lack of visibility on resources that could be invested. When considering that households have been investing a decreasing part of their financial assets on checkable accounts and savings accounts from the 1970s until now (DeYoung et al. (2004)), securitization may have appeared to be a cheap, more reliable and longer-term source of funding than deposits. It also allowed banks to indirectly hold more assets without having to increase their regulatory capital.

Because it establishes a fragmented value chain with numerous intermediaries between the borrower and the final investor, securitization creates non-trivial agency problems and leaves room for arbitrage opportunities. Concerning agency problems, there is obviously an issue of asymmetric information between the loan originator and the final investor. Credit card securitization provides an insightful example of that. Outside investors can access to all the information on the credit history of the credit card holders pooled in the SPV through various public and private databases. The only piece of information they do not have, but which the

issuing bank knows is how the customer was attracted. Indeed, unobservable customer characteristics make them more or less likely to choose a scheme over another. It means that some offers may be more attractive to low or high default risk customers. This also explains why rating agency are more conservative when assessing new accounts compared to seasoned credit cards, for which the asymmetric information is less acute, because the market has learned about their at first unobservable characteristics overtime. Asymmetric information has been mitigated by several initiatives: i) the rating by rating agencies of the debt tranches issued by the asset pool, ii) the alignment of investors and issuing bank interest by the fact that issuing banks retain the most junior stake in the asset pool tranches, iii) the existence of implicit or explicit recourse and/or guarantees on the assets given by the issuing banks, which acts as a signal of the assets quality.

However these different mitigants to agency problems have been exploited by banks to engage in credit rating arbitrage and in regulatory arbitrage. If we first take a look at the ABS rating process, we find that rating agencies were often involved at the same time in helping banks and investment banks structure asset pools and “tranche” cashflows and in rating the very same ABS, which casts a doubt on rating agencies credibility because of the obvious conflict of interests. More interestingly, Nadauld and Sherlund (2009) explain that bank have an incentive to engage in rating arbitrage: it consists in buying the cheapest combination of loans to reach a given rating level (which reflects a higher credit quality than the pool intrinsic credit quality). This means buy marginally riskier loans which could still be eligible for a high-quality credit rating. Nadauld and Sherlund find that high past real estate price appreciation was significantly and positively related with the size of a deal AAA-tranche. They explain that banks engaged in credit rating arbitrage by purchasing or issuing loans of lower credit quality (riskier borrower, higher LTV, higher payment to income) in areas with high price appreciations which allowed them to minimize the purchasing price and maximize the selling price, as a deal rating has a direct impact on its cost of funds. Rating arbitrage made securitization very attractive and profitable, especially for investment banks, which explains why they were among the largest purchaser of subprime loans in areas with high price appreciations.

Second, the existence of implicit recourse especially on credit card securitization deals (Calomiris and Mason (2004)) and of explicit guarantees on conduits (securitized assets financed by short-term commercial paper) resulted in banks retaining most or all of the risks associated with the securitized assets. Consequently, banks were exposed to these assets as if they were on their balance sheet but without having to finance them with regulatory capital because they were considered as off-balance sheet for regulatory ratios computations. This helped banks to decrease their funding cost (because equity is more costly than debt) and made securitization profitable. Based on very simple calculations, Acharya, Schnabl and Suarez (2009) found that conduits would

not have been profitable if they had to be financed with a capital requirement of 8%. Thus, the consolidation of conduits for regulatory matters would have discouraged banks to set them up in the first place. Regulatory arbitrage is not limited to by-passing regulatory capital requirements by playing on the difference between on and off-balance sheet. Referring to Acharya and Schnabl (2009), Nadauld and Sherlund explain that between 2004 and 2007 the growth in risk-weighted assets was much lower than the growth in total assets, which means that banks have been investing in safer assets than those which they were holding during this period. When we know that banks kept as much as 30% of the AAA-rated tranche of all real estate related ABS and CDOs on their balance sheet, it is easy to understand that banks used securitization as a way to free-up additional regulatory capital, or let's say to take on more risk for an equal level of regulatory capital. This form of regulatory arbitrage is based on the rating arbitrage presented above to decrease regulatory capital requirements. Exposure to assets which would have required higher capital levels given their risk are actually held through the AAA-rated tranche of the ABS, which requires less regulatory capital. This regulatory arbitrage can be viewed as based on the use of asymmetric information by banks on the true riskiness of their assets against regulators.

d) The development of financial markets and derivatives

The limitations and restrictions imposed from early on on banks, limiting their size and scope and thus their ability to support and finance companies which have been getting larger over time, has fostered the development of broad and active capital markets which are a major source of financing for the economy. In his book *U.S. bank deregulation in historical perspective*, Calomiris (200) underlines that a key characteristic of the American universal banking model is the growing integration between commercial banks and financial markets. According to him, leveraging and using the comparative advantage of US financial markets will be one of the drivers of success for US commercial banks in the first decades of the twenty-first century. If it is true that US financial markets have been more developed and active than in other countries, they also experienced a tremendous growth thanks to technological changes which have allowed to reduce transaction costs, to compute data and disperse information instantly. Financial innovation reinforced and was reinforced by technological change. As a consequence, financial markets scope is increasing at a very high pace thanks to the creation of new products such as complex derivatives. The latest example is doubtlessly the extraordinary growth of credit derivatives and especially credit default swaps. The notional amount of credit default swaps stood at \$698 billion at the end of June 2001;

by the end of 2004 it had multiplied by 10, and grew to \$42,580 billion at the end of June 2007¹¹. Another interesting point in the history of capital markets is the rise of new categories of players with a strong influence. Since the 1980s we have witnessed the development of the hedge funds industry. Despite its small size in terms of assets under management, compared to the total size of assets managed worldwide, hedge funds represent a large part of the transactions on financial markets due to their very active strategies. Besides, the recent apparition of high frequency trading has had a meaningful impact on the capital markets, as it fuelled the overall increase in volumes. However, most commercial banks have limited activities linked to commercial markets. Going back to credit derivatives, Minton et al. (2008) found that between 1999 and 2005 only 23 out of 395 (i.e. 5.82%) bank holding companies with total assets greater than \$1 billion were using credit derivatives. The average notional amount held by these 23 banks was around \$240 billion. This very high number reflects the fact that, even though few banks have trading activities, those who do have a large exposure to financial markets.

The development of new products has given the opportunity to implement sophisticated risk-management practices using interest rate derivatives, exchange rate derivatives or credit derivatives in order to better control these risks. This has been done to a certain extent by the largest banks which benefit from scale efficiencies and have the human, technological and financial resources do so; but most small banks are unlikely to use derivatives or other sophisticated financial products in order to transfer some risks to other markets players. Moreover, Minton et al (2008) conclusion is that most of the exposure of banks to credit derivatives is related to dealing and trading activities rather than hedging credit risks.

3) Data and hypotheses on the failure of US regional banks

a) **Data**

The data are extracted from the quarterly Call Reports filed by all FDIC insured banks with the Federal Financial Institutions Examination Council (“FFIEC”), which collect them on behalf of several banking regulators (the Federal Deposit Insurance Corporation (FDIC), the Federal Reserve (Fed), and the Office of the Comptroller of the Currency (OCC))¹². The data are taken from the Call reports on a quarterly basis. They include income statement, balance sheet and off-balance sheet items for the period 2001-2009. The data on bank failures are disclosed by the FDIC on its website and provide the name, the certificate number and the closure date of individual banks.

¹¹ Statistics from the Bank of International Settlements (BIS), reported by Minton et al. (2008)

¹² Call Reports data are publicly available on the website of the Federal Reserve of Chicago

We observe 10,504 individual banks over the 2001-2009 period, of which 7,608 have data available over the entire time period. The other banks have either failed or been acquired or closed during the 2001-2009 time period. As only 189 banks have failed, most of the remaining 2,666 banks which have disappeared may have been acquired. This again emphasizes the increasing concentration of the industry developed in section 2. We have 302,027 bank-quarters observations in the panel data, representing on average 28,8 bank-quarters per bank over a period of 36 quarters. Our primary identifier for the banks in the database is the RSSD ID which is also the primary identifier of the Call Reports database. An entity has one and only one RSSD ID over its lifecycle, even though it may change its name or its bank charter number.

The list of failed banks, disclosed on the FDIC website, shows that 230 banks failed between 2001 and the end of the first quarter of 2010. For the purpose of this study, we consider that the so-called subprime crisis began on August 9, 2007, when BNP Paribas froze withdrawals from three funds and suspended net asset value calculations because the rising illiquidity of ABS on the market made them difficult to trade and to value fairly. As a consequence, all banks which failed after July 1, 2007 are included in our sample. We drop from the panel banks which have failed between 2001 and June 30, 2007. However, the number of failed banks represented in our panel is lower than the 208 banks which failed between Q3 2007 and Q1 2010 (Table 1). When we

Table 2: Bank failures in the US over time

	number of bank failures	number of failed banks missing in call reports	missing in %
2001	4	2	50.0%
2002	11	1	9.1%
2003	3	0	0.0%
2004	4	1	25.0%
2007 Q1	1	0	0.0%
2007 Q2	0	0	na
2007 Q3	1	1	100.0%
2007 Q4	1	0	0.0%
2008 Q1	2	0	0.0%
2008 Q2	2	0	0.0%
2008 Q3	9	3	33.3%
2008 Q4	12	2	16.7%
2009 Q1	21	1	4.8%
2009 Q2	24	4	16.7%
2009 Q3	50	8	16.0%
2009 Q4	45	8	17.8%
2010 Q1	41	4	9.8%
Total	231	35	15.2%

matched the list of failed banks with the Call Reports based on the RSSD ID, we found that 31

failed banks were not included in our data, which represents 14.8% of the banks which failed between Q3 2007 and Q1 2010. As a consequence, our model is based on the data available for the 140 banks which are in our database and which failed between Q3 2007 and Q4 2009. We add to these banks the 37 banks for which we have information and which failed in Q1 2010, only for our historical comparison.

The fact that some banks are missing comes as a surprise as all commercial banks are registered with the FDIC and have a legal obligation to fill the quarterly Call Reports. We find that 27 of the missing banks are Savings Banks, 3 are Savings & Loans Associations, which are both supervised by the OTC, and the last one is a National Bank supervised by the OCC. Washington Mutual, which was the U.S sixth largest bank and whose failure has been making the headlines in 2008, is included in the 27 Savings Banks.

These institutions are supervised by the Office of Thrift Supervision (OTS), which has its own financial reports (Thrift Financial Reports) disconnected from the Call Reports. This explains why a number of failed banks could not be found in our database.

When looking at the timing of bank failures, it is striking to observe that the number of failures has reached its peak until now over the last three quarters (Q3 2009, Q4 2009 and Q1 2010). We see that the bulk of the failures has happened after Lehman Brothers' bankruptcy in September 2008. This is unexpected given that i) the liquidity crisis has been partly resolved thanks to the massive injection of liquidities in the financial system by central banks and governments, which has eased the situation for most banks and provided them with cheap and abundant funding ii) the financial markets have been recovering after Q1 2008 and this despite the recent turbulences. Even more surprising, despite the shock created by the bankruptcy or near bankruptcy of large Wall Street firms and commercial banks (e.g. Washington Mutual and Wachovia), local and federal authorities have let banks fail, which may indicate that these failures had little impact on the strength of the financial system and did not increase systemic risks because these banks were much smaller and "too-small-to-save". Another reason which may explain this distribution of failures overtime is that most US banks are small-sized local institutions with a rather traditional lending business model. We think that even though the situation has improved on financial markets, banks with large loan portfolios are still facing a significant credit risk in the aftermath of the credit bubble and have to deal with high delinquency rates on their loans.

We now present the data that we have extracted from the Call Reports in order first to compare failed banks and safe banks on several key metrics to understand the potential differences between the two categories of banks and second to build a dynamic logistic model.

We selected data from the income statement, the balance sheet and off-balance sheets commitments linked to potential securitization activities either realized by the bank or by third-parties (Table2). The items are identified in the Call Reports by a series (4 letters) and a numeric or alpha-numeric code (4 figures). If we except the RSSD series which is used for identification and information about the bank (name, charter number.....), we have three series: RIAD which refers to income statement items, RCFD and RCON which are used for balance sheet and off-balance sheet items. The RIAD series are cumulative data over one year on a consolidated foreign and domestic basis. It means that the RIAD data reported for Q2 are for the 6 first months of the year, the data for Q3 are for the 9 first months of the year. We decumulate the RIAD series items in order to get proper quarterly data. RCFD data series are on a consolidated foreign and national basis whereas RCON data series are on a consolidated national basis only. Thus when the two data

Table 3: Items extracted from the Call Reports database

Series and item	Item name
RSSD9001	RSSD ID
RSSD9999	Reporting date
RSSD9010	Entity short name
RIAD4340	Reported net income /(loss)
RIAD4074	Net interest income
RIAD4093	Total non-interest expenses
RIADA220	Trading revenue
RIAD4079	Total non-interest income
RCFD2170	Total Assets
RCFD8274	Tier 1 capital allowable under the risk-based capital guidelines
RIAD3210	Total equity capital
RIAD4470	Cash dividends declared on preferred stocks
RIAD4460	Cash dividends declared on common stocks
RCFD1350	Federal funds sold and securities purchased under agreements to resell in domestic offices of the bank and of its edge and agreement subsidiaries, and in IBFS
RCFDB989	Securities purchased under agreement to resell
RCONB987	Federal funds sold in domestic offices
RCFD2800	Federal funds purchased and securities sold under agreements to repurchase
RCFDB995	Securities sold under agreement to repurchase
RCONB993	Federal funds purchased in domestic offices
RCFD2200	Total deposits
RCON2710	Amount of deposits accounts of more than \$100,000
RCON2343	Total brokered retail deposits issued in denominations of less than \$100,000
RCFD0010	Cash and balances due from depository institutions
RCFD2122	Total loans and leases net of unearned income
RCFD1766	Commercial & industrial loans
RCFD1975	Loans to individuals for household, family and other personal expenditures
RCFD1410	Loans secured by real estate
RCFD1590	Loans to finance agricultural production and other loans to farmers
RCFD2165	Lease financing receivables (net of unearned income)
RCON1480	Real estate loans secured by nonfarm nonresidential properties
RCON1420	Real estate loans secured by farmland
RCON1415	Construction and land development loans
RCON1430	Real estate loans secured by 1-4 family residential properties
RCON1460	Real estate loans secured by multi-family (5 or more) residential properties

Series and item	Item name
RCFD1754	Held to maturities securities, total (amortized cost)
RCFD1773	Available for sales securities, total (fair value)
RCFD3545	Trading assets, total
RCFD3548	Trading liabilities, total
RCFD8509	Fair value of held to maturity mortgage-backed securities (MBS), total
RCFD8511	Fair value of available for sale mortgage-backed securities (MBS), total
RCON3534	Trading assets, mortgage pass-through securities issued or guaranteed by FNMA, FHLMC, or GNMA
RCON3535	Trading assets, other mortgage-backed securities issued or guaranteed by FNMA, FHLMC, or GNMA (including CMOs, REMICs, and stripped-MBS)
RCON3536	Trading assets, all other mortgage-backed securities
RCFDB705	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, 1-4 family residential loans
RCFDB706	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, home equity lines
RCFDB707	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, credit card receivables
RCFDB708	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, auto loans
RCFDB709	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, other consumer loans
RCFDB710	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, commercial and industrial loans
RCFDB711	Outstanding principal balance of assets sold and securitized with recourse or other seller provided credit enhancements, all other loans
RCFDB790	Assets sold with recourse or other seller-provided credit enhancements and not securitized, 1-4 family residential loans
RCFDB791	Assets sold with recourse or other seller-provided credit enhancements and not securitized, home equity lines
RCFDB792	Assets sold with recourse or other seller-provided credit enhancements and not securitized, credit cards receivables
RCFDB793	Assets sold with recourse or other seller-provided credit enhancements and not securitized, auto loans
RCFDB794	Assets sold with recourse or other seller-provided credit enhancements and not securitized, other consumer loans
RCFDB795	Assets sold with recourse or other seller-provided credit enhancements and not securitized, commercial and industrial loans
RCFDB796	Assets sold with recourse or other seller-provided credit enhancements and not securitized, all other loans
RCFDB776	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: 1-4 family residential loans
RCFDB777	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: home equity lines of credit
RCFDB778	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: credit card receivables
RCFDB779	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: auto loans
RCFDB780	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: other consumer loans
RCFDB781	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: commercial and industrial loans
RCFDB782	Maximum amount of credit exposure arising from credit enhancements provided by the reporting bank to other institutions' securitization structures in the form of standby letters of credit, etc.: all other loans
RCFD1406	Total loans and lease financing receivables: past due 30-89 days and still accruing
RCFD1407	Total loans and lease financing receivables: past due 90 days or more and still accruing
RCFD1403	Total loans and leases finance receivables: non-accrual

series are available for the same item we prefer using the RCFD data series.

Some items such as deposits in denomination over \$100,000 or brokered deposits are only relevant within the US as the FDIC deposit insurance threshold of \$100,000 only applies in the US. This threshold was raised to \$250,000 on September 30, 2009. As a consequence, we have data on

deposits in denomination higher than \$100,000 only until the first quarter of 2006 included, and data on deposits higher than \$250,000 since then. We are forced to use the RCON data series for our detailed split of loans secured by real estate because the RCFD data series is available only since mid-2008. We keep the RCON data series during the whole period for consistency reasons. We add to the items list (Table 3) the reporting period for each item. It shows that MBS held either in securities or in trading have stopped being reported at the bank company level after Q1 2009. Moreover, our data on exposure to securitization vehicles through off-balance sheet commitments such as recourse or liquidity enhancement were reported only from Q2 2001 on.

After a quick check to assess the extent of missing data in the database, we find that 383 banks have no information over the total period for the four main items extracted from the income statement. We decide to drop these banks observations from the database. We list these banks in Appendix one (Table A1). From the name of these entities and investigations on a random sample it seems clear that they are branches or subsidiaries of large foreign banks and most of them should have a status of Agreement Corporation, which allow them to engage in international banking. Consequently these banks are out of the scope of this study. We also dropped 94 banks that have missing information on our first level of loan categories for all quarters. After a check, it appears that these institutions are mostly subsidiaries conducting the international banking activities of US banks or holding companies of international subsidiaries of US banks. We provide a complete list of these banks in Appendix 1 (Table A2).

b) Variables and hypotheses

We construct financial variables encompassing traditional bank failure variables that have been found to be statistically and economically significant on bank failure prediction¹³. To these we add specific variables to test our hypothesis in the context of bank failures during the current crisis (Table 4). We divide the variables into the following categories: profitability, scope and business model, asset allocation and asset quality, capital adequacy and liquidity. Given that all our variables are based on accounting ratios, we want to avoid the potential effects of outliers on our results. Consequently, we winsorize all our variables at the one-percent level in both tails of their distribution.

We measure bank profitability with three variables:

- the ratio of net income against the total assets (NET_INC), which is an after tax return on assets. A high profitability is likely to be associated with a low failure risk. We expect failed banks to be significantly less profitable than safe ones, at least a couple of quarters before

¹³ Cole and Wu (2009), Wheeloc and Wilson (2000), King, Nuxoll and Yeager (2006)

their failure. In the logistic regression we expect that the net income ratio will be negatively correlated with failure.

- the ratio of net interest margin against total assets (NET_INT_INC). This ratio is dependent both on the importance of interest earnings assets (mostly loans) on the assets side and of deposits and other funding sources on the liabilities side. We do not have clear expectations for failed banks on this ratio. On the one hand, they may rely more heavily on brokered deposits or alternative funding sources that will become costlier as bankruptcy nears and deteriorate their net interest margin. Rising default and non-performing loans will also hurt the net interest margin. On the other hand, they may hold riskier interest-yielding assets, which earn a higher interest rate, and they may also hold more interest-earning assets, which tends to increase the net interest margin on total assets.
- the ratio of non-interest expenses on total assets (EXPENSES). Banks with lower non-interest expense to total assets are likely to be better managed and more profitable. Failed banks should logically have a significantly higher ratio of non-interest expenses on total assets.

Our assessment of the bank's business model is based on:

- the ratio of non-interest income on total assets (FEE_INC). We expect failed banks to have been more aggressive in their business diversification strategies and to have tried to take advantages of the new opportunities arising from scope deregulation. As a consequence, we think that the ratio of non-interest income against the total will be positively correlated with failure in the logistic model and that failed banks have a higher non-interest income ratio than safe ones.
- the ratio of mortgage-backed securities (MBS) on total assets (MBS_ONBS). Very few banks engaged in securitization, but a larger proportion was exposed to it by holding MBS. We suppose i) that banks engaged in securitization retained some senior tranches of their special purpose vehicles (SPVs) on their balance sheet in addition to the equity tranche, ii) that small or regional banks bought MBS and sold some of their loans to geographically diversify their assets as their loan portfolio was locally concentrated. We think that the ratio of mortgage-backed securities is higher at failed banks than at safe ones, even though our opinion is that this will not be the strongest determinant of bank failures.
- the ratio of off-balance sheet exposure to ABS through recourse and other liquidity enhancements to securitization structure (ABS_OFFBS). We expect that most banks are not exposed to such credit risks and that this did not play a strong role in most bank failures. However it may be an indicator of a bank sophistication and riskiness.

Table 4: Variables used in the comparison and the dynamic logistic creation

Variable name	Details on the variable computation
net_int_inc	Net interest income / Total Assets: RIAD4074 / RCFD2170
fee_inc	Fee income / Total Assets: RIAD4079 / RCFD2170
expenses	Total non-interest expenses / Total Assets: RIAD4093 / RCFD2170
net_inc	Net Income / Total Assets: RIAD4340 / RCFD2170
cum_div	Dividend on last 4 quarters / Total Assets: $\Sigma(\text{RIAD4470} + \text{RIAD4460})$ / RCFD2170
cash	Cash / Total Assets: RCFD0010 / RCFD2170
securities	Investment securities / Total Assets: $(\text{RCFD1754} + \text{RCFD1773})$ / RCFD2170
lo	Total loans and leases net of unearned income / Total Assets: RCFD2122 / RCFD2170
other_lo	Other loans (incl. gvts, states...): $(\text{RCFD2122} - \text{RCFD1590} - \text{RCFD2165} - \text{RCFD1766} - \text{RCFD1975} - \text{RCFD1410})$ / RCFD2170
agri_lo	Agriculture & farmers loans / Total Assets: RCFD1590 / RCFD2170
receiv_lo	Lease financing receivables / Total Assets: RCFD2165 / RCFD2170
ci_lo	Commercial & Industrial loans / Total Assets: RCFD1766 / RCFD2170
cc_lo	Consumer credit (incl. credit cards) / Total Assets: RCFD1975 / RCFD2170
re_lo	Loans secured by real estate / Total loans: RCFD1410 / RCFD2170
com_re_lo	Commercial real-estate / Total Assets: RCON1480 / RCFD2170
res_re_lo	Residential real-estate / Total Assets: $(\text{RCON1430} + \text{RCON1460})$ / RCFD2170
farm_re_lo	Farmland real-estate / Total Assets: RCON1420 / RCFD2170
dvpt_re_lo	Development / Total Assets: RCON1415 / RCFD2170
mbs_onbs	Total on-balance sheet MBS: $(\text{RCFD8509} + \text{RCFD8511} + \text{RCON3534} + \text{RCON3535} + \text{RCON3536})$
abs_offbs	Off-balance sheet exposure to ABS: $(\text{RCFDB705} + \text{RCFDB706} + \text{RCFDB707} + \text{RCFDB708} + \text{RCFDB709} + \text{RCFDB710} + \text{RCFDB711} + \text{RCFDB790} + \text{RCFDB791} + \text{RCFDB792} + \text{RCFDB793} + \text{RCFDB794} + \text{RCFDB795} + \text{RCFDB796} + \text{RCFDB776} + \text{RCFDB777} + \text{RCFDB778} + \text{RCFDB779} + \text{RCFDB780} + \text{RCFDB781} + \text{RCFDB782})$ / RCFD2170
non_perf_lo	Total past due and non accruing: $(\text{RCFD1406} + \text{RCFD1407} + \text{RCFD1403})$ / RCFD2170
equity	Total Equity / Total Assets: RIAD3210 / RCFD 2170
core_dep	Core Deposits / Total Assets: $(\text{RCFD2200} - \text{RCON2710} - \text{RCON2343})$ / RCFD2170
non_core_dep	Non-core deposits / Total Assets: $(\text{RCON2710} + \text{RCON2343})$ / RCFD2170
dep	Total deposits / Total Assets : RCFD2200 / RCFD2170
ff_purchased	Federal funds purchased & securities sold under agreement to repurchase / Total Assets: RCFD2800 / RCFD2170
other_funding	Other funding / Total Assets: $(\text{RCFD2170} - \text{RIAD3210} - \text{RCFD2200} - \text{RCFD2800})$ / RCFD2170
ln_ta	Ln (Total Assets): $\ln(\text{RCFD2170})$
growth	$\exp(\ln(\text{Total Assets})_t - \ln(\text{Total Assets})_{t-1}) - 1$
lag2_growth	Total assets growth rate lagged by 2 quarters
lag4_growth	Total assets growth rate lagged by 4 quarters

We measure asset allocation and asset quality with several variables. We have a first level of asset allocation between total loans on total assets (LO) and securities on total assets (SECURITIES). We suppose that since the subprime crisis was a mortgage credit crisis, a larger loan ratio is a determinant of bank failure, even though this measure does not take into account loan quality. Given the amount outstanding of subprime loans, we think that they are widespread enough to have been developed by a large number of banks. Moreover, the extent of the credit bubble and of its burst may have impacted borrowers of all qualities. On the contrary, we assume that failed

banks have a lower security ratio and that this ratio is negatively correlated to failure. We then investigate more in details the link between some loan categories and failure:

- the ratio of commercial & industrial loans (CI_LO). This metric measures corporate lending which was not the main driver of the crisis despite the high leverage of some companies. We do not expect this ratio to be significantly different between failed and safe banks.
- the ratio of consumer credit (CC_LO). The large majority of consumer credit is made of credit card receivables. As American households are heavily indebted, we think that with the economic crisis following the burst of the credit and housing bubbles, consumer credit is likely to be a determinant of bank failures. Thus, failed banks should exhibit a significantly higher exposure to consumer credit than safe ones.
- the ratio of real estate loans (RE_LO). The current crisis has been driven by a housing bubble coupled to a massive rise in real estate mortgages. We think that bank which failed were holding large real estate loans portfolio. We expect failed banks to have a larger real estate loan ratio and that this ratio will be positively correlated to failure. In order to understand more in detail which type of real estate loans have been driving bank failures, we break down real estate loans into commercial real estate (COM_RE_LO), residential real estate (RES_RE_LO), real estate development (DVPT_RE_LO) and farmland (FARM_RE_LO). We assume that the category that is accounting for most of the role played by real estate loans is residential real estate, followed then by commercial real estate.

To measure asset quality we chose to regroup or three variables which are expected to be higher for failed banks and be positively correlated to failure:

- the ratio of non-performing loans: it is calculated as the sum of 30 days or more past due and non-accrual loans divided by total assets.

We measure capital adequacy based on two ratios:

- total equity capital divided by total assets (EQUITY). We think that a higher level of capital is a sign of good financial health because it gives the capacity to absorb large losses, it shows lower leverage and may also indicate in some cases that overtime the bank has been accumulating strong net earnings which were not entirely distributed in dividends. We expect failed banks to have falling capital ratios as they are heading towards bankruptcy.
- total dividends paid to shareholders over the last 4 quarters divided by total assets (CUM_DIV): we want to investigate whether banks which are paying higher dividends relative to total assets are more likely to fail or not. On the one side, banks distributing larger dividends to total assets may just be more profitable and this does not increase their

failure risk. On the other side, they accumulate less capital which serves as a cushion to go through rough times.

We measure liquidity based on several items from both the assets side and the liabilities side of the balance sheet:

- cash on total assets (CASH). It may seem contra-intuitive but if this variable is significantly different between failed banks and safe banks, we suppose that failed banks will try to accumulate the maximum level of cash in the last quarters preceding failure in order to avoid liquidity problems.
- total deposits on total assets (DEP). As deposits represent a stable and relatively cheap source of funding while the bank remains healthy, we think that a higher level of deposits is negatively correlated to failure. We think that failed banks faced liquidity problems because they had more aggressive funding structures prior to the crisis, which translated into a lower level of deposits to total assets. In order to refine our analysis we divide total deposits into core deposits (CORE_DEP) which are non-brokered deposits below the FDIC insurance threshold and non-core deposits (NON_CORE_DEP) which are going away in case of financial distress and which are made of brokered deposits and deposits above the FDIC insurance threshold.
- Federal funds purchased divided by total assets (FF_PURCHASED). Several studies have shown that this ratio is negatively correlated to failure and that the ratio of federal funds to total assets at failed banks is lower than at safe banks and is declining as bankruptcy approaches. This means that failed banks tend to rely more heavily on alternative, often higher priced funding sources, which refer as other funding.

The remaining variables which do not fit into any of the preceding categories are:

- the natural logarithm of total assets which is an indicator of bank size (LN_TA). We expect that failed banks will be on average smaller than safe ones, first because small banks have less sophisticated risk management and asset liability mismatch management practices, second because they hold less geographically diversified assets, especially loans, which makes them very dependent from the health of their local real estate market and economic area, third because smaller banks are generally less profitable which makes them more fragile and sensitive to external shocks.
- the growth rate of total assets over one year (GROWTH), the growth rate of total assets lagged by 2 quarter (LAG2_GROWTH), by 4 quarters (LAG4_GROWTH) and by 8 quarters (LAG8_GROWTH). We think that failed banks have been growing very fast in the years preceding their failure whereas safe banks had a much quieter growth rate. As failure nears, we think that growth of total assets may fall sharply and even become

negative. We use lagged growth rate because the consequences of rapid asset growth tend to materialize with a timing gap. We think that large growth rate may reflect aggressive commercial policies which resulted in servicing lower-credit household, by providing new traditional financial products such as pick a payment mortgages or adjustable rate mortgages. A high growth rate can also be the result of entry into new activities in which the bank had no prior knowledge or into new geographies in which the bank did not have any informational advantage. This results in some kind of “Winner’s curse”, where the less informed new-entrant gains market share to the detriment of customer quality, which can generate risk mispricing.

4) An empirical study of failed banks and comparison with safe banks

a) Methodology

We compare the average for two groups of banks for given historical quarters before and during the crisis to see the evolution of the mean of our variables for both types of banks through the crisis. The first group contains which failed between Q3 2007 and Q1 2010, the second one contains safe banks that did not fail. We test quarter by quarter whether the mean difference between the two groups is statistically significant. As the non-failing bank group contains some banks which have become financially fragile and which may fail in a near future, it is likely that we underestimate the difference between failed banks and non-failing ones. In addition, we compare the average value taken by the variables for the group of banks which failed between Q3 2007 and Q4 2009, on a time to failure basis, with the average value for all bank quarters, excluding the bank quarters of failing banks which are between the quarter to failure selected and failure.

b) Results

The comparison of banks which failed during the crisis and the banks that did not fail suggest that failed banks have very distinctive features which clearly differentiate them from safe banks. When looking first at our measures of profitability (Table 4), we find that failed banks went from having a higher net interest margin before the crisis of about 30 basis point to having a net interest margin 130 basis points lower than the one of safe banks. Between Q2 2006 and Q1 2009 the net interest margin of failed banks has been divided by two whereas the margin of safe banks has only dropped on average by 12%. We think that our hypotheses may explain well such an evolution. Failed banks are holding riskier assets yielding higher interests on the asset side, which explains their statistically significant higher net interest margin before the crisis or twelve quarters before failure. When the credit crisis appears and these banks get closer to failure, the increasing level of

Table 5: Univariate tests of equality of the means between failed and safe banks (1/6)

Variable	Quarter	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	t-statistic
net_int_inc	Q4 2006	174	4.06%	3.76%	-0.30%	(-4.36)***
	Q2 2007	177	3.93%	3.71%	-0.22%	(-3.23)***
	Q2 2008	172	2.80%	3.46%	0.66%	(10.57)***
	Q1 2009	136	2.09%	3.33%	1.24%	(17.47)***
net_inc	Q4 2006	174	0.61%	0.81%	0.21%	(1.97)**
	Q2 2007	177	0.52%	0.93%	0.41%	(3.95)***
	Q2 2008	172	-2.04%	0.60%	2.63%	(21.69)***
	Q1 2009	136	-3.73%	0.42%	4.15%	(31.30)***
expenses	Q4 2006	174	3.46%	3.43%	-0.03%	(-0.21)
	Q2 2007	177	3.42%	3.43%	0.00%	(0.02)
	Q2 2008	172	3.85%	3.38%	-0.46%	(-2.50)**
	Q1 2009	136	3.54%	3.29%	-0.25%	(-1.35)
fee_inc	Q4 2006	174	0.71%	0.88%	0.17%	(1.52)
	Q2 2007	177	0.80%	1.01%	0.21%	(1.40)
	Q2 2008	172	0.70%	0.96%	0.27%	(1.80)*
	Q1 2009	136	0.45%	0.91%	0.45%	(2.84)***
mbs_onbs	Q4 2006	174	3.67%	5.26%	1.59%	(2.77)***
	Q2 2007	177	3.80%	5.23%	1.43%	(2.52)**
	Q2 2008	172	5.58%	6.98%	1.40%	(2.05)**
	Q1 2009	136	5.99%	7.47%	1.48%	(1.86)*
abs_offbs	Q4 2006	174	0.42%	0.48%	0.06%	(0.33)
	Q2 2007	177	0.49%	0.51%	0.02%	(0.08)
	Q2 2008	172	0.61%	0.58%	-0.03%	(-0.16)
	Q1 2009	136	0.52%	0.64%	0.11%	(0.49)

Variable	Quarter to failure	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	(t-statistic)
net_int_inc	1	140	2.13%	3.71%	1.58%	(21.91)***
	4	140	3.13%	3.71%	0.58%	(8.11)***
	6	140	3.62%	3.71%	0.09%	(1.19)
	12	134	4.07%	3.71%	-0.36%	(-4.84)***
net_inc	1	140	-4.94%	0.81%	5.75%	(48.45)***
	4	140	-2.04%	0.81%	2.86%	(24.24)***
	6	140	0.05%	0.81%	0.76%	(6.45)***
	12	134	0.85%	0.81%	-0.03%	(-0.27)
expenses	1	140	3.96%	3.35%	-0.61%	(-3.40)***
	4	140	3.73%	3.35%	-0.38%	(-2.12)**
	6	140	3.39%	3.35%	-0.04%	(-0.23)
	12	134	3.34%	3.35%	0.01%	(0.06)
fee_inc	1	140	0.53%	0.97%	0.44%	(2.95)***
	4	140	0.60%	0.97%	0.37%	(2.46)**
	6	140	0.82%	0.97%	0.15%	(0.98)
	12	134	0.63%	0.97%	0.34%	(2.25)**
mbs_onbs	1	140	6.35%	6.35%	-0.01%	(-0.00)
	4	140	6.01%	6.35%	0.34%	(0.46)
	6	140	4.64%	6.35%	1.71%	(2.36)**
	12	134	4.31%	6.36%	2.05%	(2.76)***
abs_offbs	1	140	0.32%	0.42%	0.10%	(0.54)
	4	140	0.43%	0.42%	-0.01%	(-0.05)
	6	140	0.41%	0.42%	0.01%	(0.05)
	12	134	0.21%	0.42%	0.21%	(1.11)

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

2-sided t-test using different variances for the two sub-samples

non-performing interest-earning assets sharply deteriorates the net interest margin. Higher funding cost may also partly contribute to the net interest margin drop. The analysis of the return on assets exhibits a similar decreasing trend. 12 quarters before failure failed banks had a return on assets in line relative to safe banks. As failure nears it deteriorates and becomes hugely negative. This reflects the impact of the credit crisis on banks' P&L. It is interesting to see that at the top of the credit bubble at the end of 2006, failed banks were already having a significantly lower return on assets, which would indicate that early signs of weakness were there before the crisis burst. We also find that the ratio of non-interest expenses on total assets seems to be neither a key difference between failed and safe banks nor a determinant of failure. When looking at the historical quarterly comparison, we find no significant difference on the expenses ratio between the two banks categories. We can thus reject the idea that failed banks had larger costs, which was our original hypothesis. The increase of this ratio one year prior to failure may rather be a consequence of financial distress and of unanticipated slowing assets growth. To conclude on profitability measures, we see that three years before failure failed banks were on average equally or more profitable than safe banks. We can thus reject the idea that failed banks were already less profitable and weaker before the crisis. On the contrary, it seems that failed banks were strongly impacted by the crisis, doubtlessly because they were holding riskier assets which generated large losses when the crisis burst.

Business model variables reveal that failed banks have been more “followers” than “early-adopters”. In Q4 2006 they have both a significantly lower fee income relative to total assets and a significantly lower MBS to total asset ratio than safe banks. We observe a catch-up on the exposure to MBS that increases as failure gets closer and as time progresses. As a consequence, we think that the increasing relative MBS exposure, as failure approaches, is more likely to reflect an industry trend. However it could also be interpreted as a risk-shifting towards riskier assets as financial distress pushes the management to engage in riskier bets to try to avoid bankruptcy. Fee-income relative to total assets first increases and we see the beginning of a catch-up movement. However when we get closer to bankruptcy fee income relative to total assets falls significantly, widening the gap between failed and safe banks. Off balance sheet recourse and other commitments linked to securitization (*abs_offbs*) are very low for failed and safe banks. This variable has thus little interest and must not be the most appropriate measure of exposure to off-balance sheet securitized assets.

Asset allocation variables show strong differences between failed banks and banks that did not fail. At the highest level, we observe that whatever the period or the time to failure failed banks hold far less securities than safe ones, whereas their ratio of loans to total assets is significantly higher.

Table 6: Univariate tests of equality of the means between failed and safe banks (2/6)

Variable	Quarter	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	t-statistic
securities	Q4 2006	174	12.63%	21.16%	8.53%	(7.65)***
	Q2 2007	177	12.01%	20.84%	8.84%	(7.91)***
	Q2 2008	172	12.03%	20.17%	8.14%	(7.16)***
	Q1 2009	136	11.59%	19.95%	8.36%	(6.57)***
lo	Q4 2006	174	74.12%	64.68%	-9.43%	(-7.24)***
	Q2 2007	177	75.85%	64.85%	-11.00%	(-8.02)***
	Q2 2008	172	75.86%	65.67%	-10.19%	(-7.32)***
	Q1 2009	136	72.51%	64.82%	-7.69%	(-5.03)***
ci_lo	Q4 2006	174	10.06%	9.56%	-0.50%	(-0.93)
	Q2 2007	177	9.88%	9.60%	-0.27%	(-0.51)
	Q2 2008	172	9.80%	9.77%	-0.03%	(-0.04)
	Q1 2009	136	72.51%	9.52%	-62.99%	(-0.42)
cc_lo	Q4 2006	174	1.79%	4.79%	3.01%	(8.03)***
	Q2 2007	177	1.78%	4.64%	2.86%	(7.77)***
	Q2 2008	172	1.60%	4.35%	2.75%	(7.68)***
	Q1 2009	136	1.45%	4.05%	2.59%	(6.69)***
agri_lo	Q4 2006	174	1.11%	4.32%	3.21%	(5.56)***
	Q2 2007	177	1.08%	4.49%	3.41%	(5.74)***
	Q2 2008	172	0.93%	4.22%	3.29%	(5.80)***
	Q1 2009	136	0.76%	3.95%	3.19%	(5.26)***
re_lo	Q4 2006	174	60.19%	44.60%	-15.60%	(-10.95)***
	Q2 2007	177	62.06%	44.68%	-17.38%	(-12.02)***
	Q2 2008	172	62.52%	45.86%	-16.67%	(-11.22)***
	Q1 2009	136	59.88%	46.15%	-13.73%	(-8.40)***
com_re_lo	Q4 2006	174	19.26%	14.67%	-4.59%	(-5.57)***
	Q2 2007	177	19.50%	14.65%	-4.85%	(-5.94)***
	Q2 2008	172	20.21%	15.52%	-4.70%	(-5.44)***
	Q1 2009	136	21.62%	16.08%	-5.54%	(-5.63)***
res_re_lo	Q4 2006	174	15.47%	18.47%	3.00%	(3.03)***
	Q2 2007	177	14.95%	18.22%	3.26%	(3.31)***
	Q2 2008	172	15.11%	18.54%	3.43%	(3.46)***
	Q1 2009	136	16.53%	19.09%	2.56%	(2.30)**
dvpt_re_lo	Q4 2006	174	21.18%	7.29%	-13.89%	(-20.84)***
	Q2 2007	177	22.81%	7.57%	-15.24%	(-22.51)***
	Q2 2008	172	23.13%	7.58%	-15.54%	(-23.56)***
	Q1 2009	136	19.67%	6.71%	-12.96%	(-20.22)***
non_perf_lo	Q4 2006	174	1.76%	1.30%	-0.46%	(-4.48)***
	Q2 2007	177	2.41%	1.38%	-1.03%	(-9.31)***
	Q2 2008	172	5.80%	1.84%	-3.96%	(-27.94)***
	Q1 2009	136	7.99%	2.59%	-5.40%	(-27.35)***

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

2-sided t-test using different variances for the two sub-samples.

We see a slight decline in the ratios of securities to assets and loans to assets when we come closer to failure and when we go from Q4 2006 to Q1 2009. This decline is compensated by an increase

in cash balances. Given the importance of loans in the assets of failed banks, we also look at the split between different loan categories. Even though failed banks have a higher loan to assets ratio, the level of commercial and industrial loans to total assets is almost equal at failed banks and safe banks. The difference between the two types of banks is never statistically significant for this loan category. It is in line with our hypotheses. We did not report the results for loans financing receivables because this category is neither large at both types of banks nor a source of difference. The level of consumer credit relative to total assets is also statistically different for failed and safe banks. Contrary to our hypotheses, consumer credit is more developed at safe banks than at the banks that failed. The proportion of consumer credit is not changing much overtime for both types of banks. We also looked at agricultural loans as they are on average almost as important as consumer credit at safe banks. The situation is very similar to consumer credit. Failed institutions were significantly less exposed to agricultural loans relative to total assets than safe banks. As we expected, failed banks have a larger relative exposure to real estate loans, which is logical as the crisis was the consequence of a housing market and real estate credit bubble. Real estate loans represent on average a little more than 60% of total assets for failed banks, which is on average 50% higher than for safe banks which dedicate only 42% of their assets to real estate loans. As for all loan categories we do not observe a change in the proportion of real estate relative to total assets overtime or as bankruptcy gets closer. Given the importance of real estate loans for banks, we have a last level of detail for such loans. We looked at the three major categories of real estate loans: those financing residential properties, those financing commercial real estate, and those related to real estate development and construction. As research articles as well as newspapers have highlighted the role played by residential real estate and especially subprime mortgages in the crisis, we thought that failed banks would have held large residential real estate loan portfolios of lower credit quality. The reality proves to be quite different. The large exposure of failed banks to real estate is primarily driven by development and construction loans, which roughly represent 20% of total assets, a level on average four times higher than at safe banks. The second driver of the large exposure of failed banks to real estate is commercial properties mortgages. On average the proportion of commercial real estate loans is 50% higher at failed banks than that of safe banks. Contrary to our hypotheses, despite a larger exposure to real estate failed banks have a lower share of total assets invested in residential real estate loans than safe source of difference. The level of consumer credit relative to total assets is also statistically different for failed and safe banks. Contrary to our hypotheses, consumer credit is more developed at safe banks than at the banks that failed. The proportion of consumer credit is not changing much overtime for both types of banks. We also looked at agricultural loans as they are on average almost as important as consumer credit at safe banks. The situation is very similar to consumer credit. Failed banks were

Table 7: Univariate tests of equality of the means between failed and safe banks (3/6)

Variable	Quarter to failure	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	(t-statistic)
securities	1	140	11.37%	22.25%	10.88%	(8.60)***
	4	140	12.36%	22.26%	9.90%	(7.83)***
	6	140	12.71%	22.27%	9.57%	(7.57)***
	12	134	13.82%	22.30%	8.48%	(6.56)***
lo	1	140	72.55%	63.52%	-9.04%	(-6.22)***
	4	140	76.31%	63.50%	-12.81%	(-8.83)***
	6	140	76.85%	63.49%	-13.36%	(-9.20)***
	12	134	73.58%	63.46%	-10.12%	(-6.82)***
ci_lo	1	140	8.76%	9.60%	0.84%	(1.38)
	4	140	9.39%	9.60%	0.21%	(0.34)
	6	140	9.87%	9.60%	-0.27%	(-0.44)
	12	134	8.83%	9.60%	0.77%	(1.24)
cc_lo	1	140	1.49%	5.41%	3.92%	(8.68)***
	4	140	1.50%	5.42%	3.92%	(8.67)***
	6	140	1.51%	5.42%	3.91%	(8.65)***
	12	134	1.87%	5.43%	3.56%	(7.70)***
agri_lo	1	140	0.95%	4.39%	3.43%	(5.33)***
	4	140	0.92%	4.39%	3.48%	(5.40)***
	6	140	0.95%	4.39%	3.44%	(5.34)***
	12	134	0.97%	4.40%	3.44%	(5.21)***
re_lo	1	140	60.33%	42.67%	-17.66%	(-11.35)***
	4	140	63.46%	42.64%	-20.82%	(-13.39)***
	6	140	63.55%	42.62%	-20.93%	(-13.47)***
	12	134	61.08%	42.56%	-18.52%	(-11.67)***
com_re_lo	1	140	20.24%	14.05%	-6.18%	(-6.79)***
	4	140	19.72%	14.04%	-5.67%	(-6.23)***
	6	140	19.46%	14.04%	-5.42%	(-5.95)***
	12	134	20.65%	14.02%	-6.63%	(-7.13)***
res_re_lo	1	140	15.71%	18.87%	3.17%	(2.89)***
	4	140	15.37%	18.88%	3.51%	(3.20)***
	6	140	15.43%	18.88%	3.45%	(3.15)***
	12	134	16.86%	18.89%	2.03%	(1.82)*
dvpt_re_lo	1	140	20.91%	5.76%	-15.16%	(-24.18)***
	4	140	23.54%	5.73%	-17.81%	(-28.56)***
	6	140	23.78%	5.71%	-18.07%	(-29.08)***
	12	134	19.93%	5.67%	-14.27%	(-22.69)***
non_perf_lo	1	140	8.05%	1.62%	-6.43%	(-45.57)***
	4	140	5.34%	1.61%	-3.73%	(-26.59)***
	6	140	3.55%	1.61%	-1.94%	(-13.86)***
	12	134	1.38%	1.61%	0.23%	(1.58)

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

2-sided t-test using different variances for the two sub-samples.

significantly less exposed to agricultural loans relative to total assets compared to safe banks. As we expected, failed banks have a larger relative exposure to real estate loans, which is logical as the crisis was the consequence of a housing market and real estate credit bubble. Real estate loans

represent on average a little more than 60% of total assets for failed banks, which is on average 50% higher than for safe banks which dedicate only 42% of their assets to real estate loans. As for all loan categories we do not observe a change in the proportion of real estate relative to total assets overtime or as bankruptcy gets closer. Given the importance of real estate loans for banks, we have a last level of detail for such loans. We looked at the three major categories of real-estate loans: those financing residential properties, those financing commercial real estate, and those related to real estate development and construction. As research articles as well as newspapers have highlighted the role played by residential real estate and especially subprime mortgages in the crisis, we thought that failed banks would have had hold large residential real estate loan portfolios of lower credit quality. The reality proves to be quite different. The large exposure of failed banks to real estate is primarily driven by development and construction loans which roughly represent 20% of total assets, a level on average four times higher than at safe banks. The difference is statistically significant for all time periods. The split between the different categories of real estate loans remains also stable for failed banks as well as for safe ones.

Besides clearly diverging asset allocations, safe banks and failed ones differ on the quality of the assets held on their balance sheets. 4 quarters before their bankruptcy, the level of non-performing loans (30 days or more past due and non-accruing loans) reaches an impressive 5.3%, which represents roughly 7.5% of total loans. One quarter before bankruptcy the proportion of non-performing loans is even higher at 8.0%, i.e., representing on average more than 10% of total loans, which is extremely high. I think the rise of non-performing loans is clearly the driver of failure first because this partly generates the drop in net interest margin, second because provisions on bad loans further impact the net income. The historical quarter comparison is very instructive as it highlights the much sharper rise of non-performing loans at failed banks. In Q4 2006 the level of non-performing loans is already significantly higher at 1.76% at failed banks compared to 1.29% at safe ones. In Q1 2009, the level of non-performing loans has been multiplied by 4.5 times at failed banks at almost 8.0%, whereas it only more than doubled at safe banks and reaches 2.5%. In our view this points out the fact that failed banks have been holding riskier loans, which have performed relatively well until the real estate bubble exploded. Since the crisis has broken out they have witnessed a sharp rise in the level of their non-performing loans which has been the primary driver of their subsequent failure.

Our measure of capital adequacy show that even though failed banks had a slightly lower of equity capital in Q4 2006 or 12 quarters prior to failure, this difference was not statistically meaningful. Again, there were no obvious differences between failed and safe banks on this criterion before the crisis. Failed banks had not structurally weaker equity capital levels relative to total assets. Yet we observe a clear declining trend as time advances and as bankruptcy nears. We think that this

decline is explained first by the impact of declining profitability coupled to a still rapid asset growth 6 quarters before the failure occurs and then solely by the impact of net losses (table 4) when asset growth levels off. We also note that failed banks had a statistically significant more conservative dividend distribution policy when comparing dividends to total assets. We see two reasons for that, first as bankruptcy nears the degradation of net income relative to total assets makes failed banks able to distribute less dividends, second as failed banks have experienced strong asset growth (Table 9), they may have preferred to use net income generated to increase their equity and thus have enough regulatory capital to keep expanding their balance sheet without lowering too much their capital ratio.

Table 8: Univariate tests of equality of the means between failed and safe banks (4/6)

Variable	Quarter	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	t-statistic
equity	Q4 2006	174	11.91%	12.02%	0.11%	(0.18)
	Q2 2007	177	11.28%	12.69%	1.42%	(2.01)**
	Q2 2008	172	8.79%	12.42%	3.64%	(5.46)***
	Q1 2009	136	6.68%	11.85%	5.18%	(7.94)***
cum_div	Q4 2006	174	0.45%	0.59%	0.14%	(2.61)***
	Q2 2007	177	0.46%	0.59%	0.13%	(2.49)**
	Q2 2008	172	0.32%	0.57%	0.25%	(4.71)***
	Q1 2009	136	0.09%	0.45%	0.36%	(7.15)***
cash	Q4 2006	174	3.07%	4.46%	1.38%	(4.40)***
	Q2 2007	177	2.80%	4.22%	1.42%	(4.27)**
	Q2 2008	172	3.19%	4.80%	1.62%	(4.26)***
	Q1 2009	136	7.06%	6.52%	-0.54%	(-0.97)
dep	Q4 2006	174	79.25%	81.16%	1.91%	(2.18)**
	Q2 2007	177	80.61%	80.28%	-0.33%	(-0.32)
	Q2 2008	172	80.88%	79.27%	-1.62%	(-1.61)
	Q1 2009	136	86.23%	80.70%	-5.53%	(-5.40)***
non_core_dep	Q4 2006	174	41.65%	33.09%	-8.56%	(-8.18)***
	Q2 2007	177	41.54%	32.58%	-8.96%	(-8.49)***
	Q2 2008	172	42.36%	33.65%	-8.72%	(-8.23)***
	Q1 2009	136	43.98%	35.60%	-8.39%	(-6.90)***
ff_purchased	Q4 2006	174	1.80%	1.50%	-0.30%	(-1.22)
	Q2 2007	177	1.65%	1.52%	-0.13%	(-0.54)
	Q2 2008	172	1.91%	1.65%	-0.26%	(-1.04)
	Q1 2009	136	0.99%	1.23%	0.25%	(1.02)
other_funding	Q4 2006	174	6.11%	4.92%	-1.20%	(-2.69)***
	Q2 2007	177	5.68%	4.94%	-0.74%	(-1.63)*
	Q2 2008	172	8.00%	6.15%	-1.85%	(-3.61)***
	Q1 2009	136	6.91%	5.80%	-1.12%	(-2.06)**

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively

2-sided t-test using different variances for the two sub-samples.

Prior to the crisis, failed banks have had significantly lower cash relative to total assets. The results confirm our hypothesis that failed banks accumulate more cash as they head towards bankruptcy. Yet this accumulation happens very late when failure may seem unavoidable. We also observe

based on our historical quarter comparison that during the crisis all banks increased their level of cash to be prepared to face liquidity or financing issues. Prior to the crisis failed banks had a more aggressive financing structure characterized by a lower level of total deposits to total assets. When we look at the composition of these deposits we find that there are mostly made of more volatile non-core deposits which are brokered deposits (i.e., deposits above the pre-crisis FDIC insurance threshold of \$100,000). The level of non-core deposits is higher at failed banks, and contrary to what we could have expected it tends to increase relative to total assets as we approach bankruptcy whereas we would have expected a kind of bank-run, with massive withdrawals of uninsured deposits. Failed banks rely slightly more on federal funds, except when they are close to bankruptcy. The difference with safe banks is not significant for most periods. Failed banks also

Table 9: Univariate tests of equality of the means between failed and safe banks (5/6)

Variable	Quarter to failure	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	(t-statistic)
equity	1	140	6.55%	11.65%	5.10%	(8.26)***
	4	140	8.80%	11.65%	2.86%	(4.62)***
	6	140	10.16%	11.65%	1.49%	(2.41)**
	12	134	11.25%	11.65%	0.41%	(0.64)
cum_div	1	140	0.14%	0.54%	0.40%	(7.24)***
	4	140	0.41%	0.54%	0.14%	(2.44)**
	6	140	0.47%	0.54%	0.07%	(1.34)
	12	134	0.42%	0.54%	0.12%	(7.15)**
cash	1	140	6.59%	5.13%	-1.46%	(-3.57)***
	4	140	2.78%	5.13%	2.36%	(5.78)***
	6	140	2.16%	5.14%	2.97%	(7.28)***
	12	134	3.01%	5.14%	2.13%	(5.10)***
dep	1	140	85.61%	81.28%	-4.33%	(-4.36)***
	4	140	79.91%	81.28%	1.37%	(1.38)
	6	140	78.46%	81.28%	2.82%	(2.84)***
	12	134	79.17%	81.29%	2.12%	(2.08)**
non_core_dep	1	140	43.04%	30.23%	-12.81%	(-11.20)***
	4	140	41.67%	30.21%	-11.46%	(-10.03)***
	6	140	41.51%	30.20%	-11.31%	(-9.90)***
	12	134	41.00%	30.17%	-10.83%	(-9.28)***
ff_purchased	1	140	1.20%	1.58%	0.38%	(1.38)
	4	140	2.02%	1.58%	-0.44%	(-1.58)
	6	140	2.61%	1.58%	-1.03%	(-3.75)***
	12	134	1.94%	1.58%	-0.36%	(-1.29)
other_funding	1	140	7.55%	5.30%	-2.24%	(-4.29)***
	4	140	8.38%	5.30%	-3.08%	(-5.89)***
	6	140	7.60%	5.30%	-2.30%	(-4.40)***
	12	134	6.36%	5.29%	-1.07%	(-1.99)**

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

2-sided t-test using different variances for the two sub-samples.

rely more on alternative funding sources than safe ones, and this difference stays statistically significant when bankruptcy gets close, whereas we would have expected this alternative funding to dry up and disappear as financial distress increases. We do not have any information on FHLB advances, which may be included in this alternative funding sources, because this information is not publicly available. Several researchers pointed out the growing importance of FHLB advances as a funding source at small and community banks. For some banks, FHLB advances represented up to 20% of their total liabilities and were used to increase the volume of loans issued. With brokered deposits, FHLB advances are considered as non-risk priced non-core funding. Indeed interest rates paid either on deposits or on FHLB advances are only partially correlated to the riskiness of assets, which might have given failed banks the possibility to finance riskier assets without increasing their funding cost consistently with their risk-level.

Table 10: Univariate tests of equality of the means between failed and safe banks (6/6)

Variable	Quarter	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	t-statistic
ln_ta	Q4 2006	174	12.49	11.84	-0.65	(-6.24)***
	Q2 2007	177	12.55	11.83	-0.72	(-6.80)***
	Q2 2008	172	12.70	11.89	-0.81	(-7.64)***
	Q1 2009	136	12.63	11.96	-0.67	(-5.66)***
growth	Q4 2006	174	30.02%	11.20%	-18.82%	(-10.65)***
	Q2 2007	177	22.95%	11.23%	-11.72%	(-6.66)***
	Q2 2008	172	15.95%	12.24%	-3.71%	(-2.13)**
	Q1 2009	136	1.65%	11.37%	9.72%	(4.72)***

Variable	Quarter to failure	failed banks	Ratio for failed banks	Ratio for safe banks	Difference of means	(t-statistic)
ln_ta	1	140	12.66	11.76	-0.91	(-7.88)***
	4	140	12.70	11.76	-0.94	(-6.80)***
	6	140	12.66	11.75	-0.90	(-7.84)***
	12	134	12.41	11.75	-0.66	(-5.63)***
growth	1	140	0.30%	11.28%	10.99%	(5.99)***
	4	140	17.45%	11.28%	-6.17%	(-3.36)***
	6	140	20.74%	12.24%	-8.50%	(-5.13)***
	12	134	36.36%	11.22%	-25.15%	(-13.17)***
lag4_growth	1	140	20.95%	11.43%	-9.52%	(-5.21)***
	4	140	23.25%	11.41%	-11.83%	(-6.34)***
	6	140	29.93%	11.39%	-18.54%	(-9.80)***
	12	134	31.41%	11.32%	-20.09%	(-10.18)***

*, **, *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

2-sided t-test using different variances for the two sub-samples.

Our findings on failed banks size contradict our hypothesis that failed banks are on average smaller than safe banks. On the contrary they are significantly larger. The growth rate of total

assets for the last 4 quarters yields very interesting results. From an historical perspective, we see that failed banks went from very strong growth prior to the crisis with an impressive rate of 30% to almost no growth at the beginning of 2009. In the meantime the growth rate of safe banks total assets remained constant around 11% before and during the crisis. When we look at the growth rate from a time to failure perspective we observe the same pattern of fading growth which strongly fell in the last 4 quarters preceding bankruptcy. For all the quarters we selected the difference with safe banks is meaningful but has not always the same sign which could be a problem for the logistic regression. We also built growth variables lagged by 4 and 8 quarters that thus take significantly higher values for failed banks, even as we get closer to failure.

The comparison of failed and safe banks on the different variables is helpful to determine a profile of failed banks. Based on our results we find that failed banks were on average larger than US commercial banks and that this difference has been increasing before the crisis because failed banks experienced a much stronger asset growth, which then fell sharply when financial distress appeared. Prior to the crisis and a long time before their failure (12 quarters) failed banks did not distinguish themselves by any particular weakness: their profitability, capital ratios, or indicators of asset quality are very close to those of safe banks. Back in 2005 or 2006, banks that failed during the crisis were not very different from safe banks on these metrics. However the crisis strongly impacted profitability for failed banks which then caused a decline of capital ratios, an increase of non-interest expenses relative to total assets and a fall of their asset growth as they entered financial distress. These metrics that show the deterioration leading to failure, will prove very useful in failure prediction models, and have already been found significant in several studies. However they are more the symptoms than the underlying causes which lead banks to failure during the crisis. Our business model indicators do not bring very insightful results, showing that failed banks have not been at the forefront of business diversification or business model change as they hold less MBS and generate lower fee income relative to total assets than safe banks. In our view there are two major determinants of bank failure: the asset quality, reflected by the level of non-performing loans, and the asset mix, which unsurprisingly shows a higher proportion of loans, driven by a higher level of real estate related loans at failed banks. Other loan categories are either in line (commercial and industrial loans) with safe banks or less important (consumer credit and agricultural loans). What is more unexpected is that the higher relative exposure to real estate loans is driven by commercial real estate loans and construction and development loans whereas the proportion of residential real estate mortgages is significantly lower at failed banks. Given their asset mix we think that failed banks were structurally riskier as construction and development loans are risky despite a shorter maturity. In addition to that failed banks experienced very high

growth rates, which cannot be explained by the development of new businesses as both the asset mix and the revenue mix are staying relatively constant overtime. Consequently the growth comes from existing activities and especially lending. This strongly growing lending activity may be a hint of the riskier profile of failed banks. Indeed, a very strong growth in loans issuance can conduct to less careful applicant screening, to lowering credit standards, thus favouring lending volume over risk and quality. Moreover lending expansion into new geography or previously un-addressed riskier customer segments in which the bank did not have any informational advantage may have resulted in the bank attracting marginally riskier borrowers, which then increased the risks on the balance sheet. The fact that failed banks were holding riskier loans and were having borrowers of lower credit quality is reflected by the strong rise of the level of non-performing loans when the crisis starts. As a consequence, failed banks were much more severely hit by the crisis because of their riskier assets. Losses on their loan portfolios brought them progressively to financial distress and then to bankruptcy. Concerning the financing, failed banks have been exposed to higher liquidity risk because they relied more on non-core funding sources such as brokered deposits, alternative funding and to a lesser extent federal funds. This riskier financing structure may be a direct consequence of the strong growth of their total assets. Because it is difficult to increase rapidly core deposits or equity, fast growing banks favour non-core funding.

5) Developing a new bank failure prediction model

a) Methodology

We use a dynamic logistic regression using our data panel to assess the importance of our different variables in explaining bankruptcy. Shumway (2001) who was among the first to apply a dynamic model to corporate bankruptcy prediction develops a mathematical demonstration proving that one-period logit model are giving inconsistent variable coefficients and that they have a poor prediction ability compared to dynamic logistic regression. To our knowledge, dynamic models have been only applied to predict bank failures by Cole and Wu (2009), who demonstrate the superior in-sample as well as out of sample prediction accuracy of a dynamic logistic regression. Cole and Wu (2009) use data from Call Reports between 1980 and 1992, that they divide into two intervals 1980-1989 which is their sample period, and 1989-1992 which is used for the out of sample prediction. They compare the results of the logistic regression with the results of a probit model using the same variables. They find that a dynamic logistic regression yields much more accurate results than the one-period probit model. They also develop a second dynamic logistic regression model adding to the accounting variables from the Call Reports variables which are linked to economic data such as interest rate and GDP evolution, but they do not find that the

coefficients of these new variables based on economic data are not statistically different from zero and the second model does not improve the accuracy of the failure prediction.

Here we first build a model taking into account or most important variables without first detailing loans by categories. We build a second model where we drop the variables which we did have coefficients statistically different from zero. We then build a third model which replaces real estate loans by its different components.

b) Results

We find that our models are all globally statistically significant by performing a global Wald test. The results clearly show that banks with a lower net interest margin on total assets and a lower net income on total assets have a higher probability to fail. Banks that are less capitalized and hold a smaller proportion of securities have also higher failure likelihood. These results are not surprising and consistent with our findings based on the comparison of failed and safe banks. When looking at the drivers of failure, we find that a higher level of non-performing loans increases the most the failure probability, followed by a higher proportion of other funding and of non-core deposits. We find that the coefficient of non-core deposits is significant at a 5% level in model 1 and 2, but only at a 12.5% level in model 3. Even though the coefficients are a little different between model one and two, the conclusion remains the same. We find that the level of cash, which as expected negatively impacts the failure likelihood, is not statistically significant in our model. This is also true for federal funds purchased relative to total assets, for the bank size and the growth rate of total assets over 4 quarters, lagged by one year. The exposure to MBS is also not statistically

Table 11: Dynamic logistic regressions (1/2)

<u>Model 1:</u>			<u>Model 2:</u>		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
net_int_inc	-171.435	0.018	net_int_inc	-203.028	0.009
net_inc	-80.516	0.001	net_inc	-109.408	0.001
mbs_onbs	1.871	0.578	securities	-4.080	0.017
securities	-6.645	0.021	cc_lo	-9.229	0.177
lo	-4.187	0.029	ci_lo	-3.841	0.096
non_perf_lo	60.398	0.000	re_lo	-2.169	0.020
equity	-99.198	0.000	non_perf_lo	38.681	0.000
cash	-7.656	0.791	equity	-106.490	0.000
non_core_dep	2.866	0.003	non_core_dep	1.348	0.001
ff_purchased	0.482	0.915	other_funding	3.286	0.071
other_funding	4.407	0.070	growth	-1.997	0.947
ln_ta	0.055	0.676	intercept	1.885	0.776
lag4_growth	0.682	0.191			
intercept	-0.399	0.877			

Table 12: Dynamic logistic regressions (2/2)Model 3:

Variable	Coefficient	p-value
net_int_inc	-193.286	0.000
net_inc	-110.595	0.000
securities	-3.790	0.003
ci_lo	-3.900	0.021
com_re_lo	-1.284	0.168
res_re_lo	-3.170	0.010
dvpt_re_lo	-1.487	0.176
non_perf_lo	41.022	0.000
equity	-113.614	0.000
non_core_dep	0.878	0.125
other_funding	4.528	0.004
lag4_growth	0.428	0.236
intercept	1.761	0.158

significant but has a positive coefficient which means that a higher exposure to MBS could result in an increased probability of failure. This is unexpected given that on average failing banks are less exposed to MBS. We find that a higher level of loans to total assets decreases the probability of bankruptcy and that this coefficient is significantly different from zero. However the coefficient reveals that the marginal strength of the loan ratio is smaller than the strength of the securities ratio. It means that an additional 1% of total assets invested in

securities decreases more your probability of failure than an additional 1% invested in loans. It is interesting to note that none of the major investment assets categories (cash, securities and loans) increases the failure likelihood. We think this may be explained that there are no strong dynamic changes in asset allocation as failed banks get closer to bankruptcy. Thus the model cannot associate a specific asset allocation with failure because if we take a failed bank, the asset allocation per se which remains constant over time does not by itself explain why a bank fails at a certain point in time. The negative coefficient of the loan ratio can be explained by the fact that when bankruptcy gets closer failed banks tend to increase the share of cash tot the detriment of loans and securities (see Part 4). The direct cause of failure is the sharp drop of profitability, the rise of non-performing loans and the fall of equity to assets, which is well captured by our model.

To interpret the influence of the different asset classes on failure probability we consider the relative difference between them, as they are mutually exclusive alternatives: if you invest a larger proportion of your assets in one class, this means that you invest less in all other classes holding total assets constant. Assuming that the difference between the estimated coefficient is statistically significant, for model 1, we can say that a higher exposure to loans is increasing bankruptcy probability because shifting 1% of assets from securities to loan automatically increases the probability because the coefficient on the loan ratio is less negative than the coefficient on the securities ratio.

When looking at the breakdown of loans in Model 2 into several categories, we find that real estate decrease the least failure probability, followed by commercial and industrial loans and finally by consumer credit. However, the coefficient on consumer credit is not significantly different from 0, even at a 10%-level. If we compare the different loan categories with securities, we see that it

decreases more the failure probability to invest in securities rather in commercial and industrial loans and in real estate loans. In Model 3, we find that the asset classes which decrease the most failure likelihood is commercial and industrial loans, closely followed by securities and then by residential mortgages. The asset classes which decrease the least failure likelihood are commercial real estate loans and development and construction loans. These results are in line with what we could have expected based on the results of Part 4. Besides, we find that the coefficient for construction and development loans is not statistically different from zero.

We also find that both growth and growth lagged by one year are not significant in Model 1 and 3 and Model 2 respectively. We did not expect growth to be significant because it is first higher at failed banks when everything is still going well and then it drops suddenly in the last quarters before failure to almost zero. On the contrary we would have expected 4-quarter lagged growth to be more significant. It seems that we experience the same problem as with the asset allocation: lagged growth remains more or less flat with a slightly decreasing trend in the last quarters prior to bankruptcy which does not make it a well suited variable for our model.

In order to have coefficients on asset allocation variables which will be more intuitively interpretable, we created a dummy crisis variable equals to zero for all quarters before Q3 2007 and equals to one from Q3 2007 on. We then create the variables `re_lo_cr`, `com_re_lo_cr`,

Table 13: Dynamic logistic regressions with crisis-related variables

<u>Model 2b:</u>			<u>Model 3b:</u>		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
net_int_inc	-173.560	0.001	net_int_inc	-159.975	0.002
net_inc	-103.857	0.000	net_inc	-103.861	0.000
securities	-3.777	0.003	securities	-3.540	0.005
cc_lo	-6.227	0.156	ci_lo	-3.861	0.022
ci_lo	-3.699	0.030	com_re_lo	-143.368	0.204
re_lo	-8.089	0.001	com_re_lo_cr	141.583	0.209
re_lo_cr	5.829	0.011	res_re_lo	0.080	0.974
non_perf_lo	34.448	0.000	res_re_lo_cr	-3.680	0.130
equity	-106.632	0.000	dvpt_re_lo	13.381	0.186
non_core_dep	1.323	0.019	dvpt_re_lo_cr	-15.347	0.132
other_funding	2.788	0.006	non_perf_lo	37.191	0.000
growth	-2.031952	0.01	equity	-113.262	0.000
intercept	2.269126	0.067	non_core_dep	0.821	0.144
			other_funding	3.950	0.011
			lag4_growth	-2.815	0.589
			lag4_growth_cr	3.256	0.533
			intercept	2.339	0.059

`dvpt_re_lo_cr`, `res_re_lo_cr`, `lag4_growth_cr` which are equal to the multiplication of their original variable and of our dummy crisis variable. The idea behind these new variables is that as shown by

models 1, 2 and 3, exposure to real estate loans or any other class is not per se a determinant of failure because the asset allocation remains the same overtime at both failed and safe banks. This is the combination of asset allocation choices and of end of the real estate bubble which may have been a determinant of failure. We expect that our new variables will capture the combination of these two factors. We create models 2b and 3b based respectively on models 2 and 3 and to which we add the new combined variables whenever the original variable is used in the model. We find that if exposure to real estate loans is strongly decreasing failure likelihood prior to the crisis based on the coefficient of the variable `re_lo`, it changes much with the crisis. The coefficient on `re_lo_cr` is positive and significantly different from zero, which indicates that the exposure to real estate loans at the time of the crisis increases failure probability. We could test our combination on other asset variables to verify to what extent the combination of exposure to an asset class during the crisis increases failure probability. The results from model 3b are mixed. Even though they are not statistically different from zero at a high enough confidence level the coefficients on `com_re_lo` and `com_re_lo_cr` show that the combination of the crisis and of exposure to

Table 14: Measure of in-sample prediction accuracy

Decile	Model 1		Model 2		Model 2b	
	% of failed	cum. % of failed	% of failed	cum. % of failed	% of failed	cum. % of failed
1	94.3%	94.3%	93.6%	93.6%	96.4%	96.4%
2	3.6%	97.9%	2.1%	95.7%	1.4%	97.9%
3	0.7%	98.6%	2.1%	97.9%	0.7%	98.6%
4	0.7%	99.3%	0.7%	98.6%	0.7%	99.3%
5	0.7%	100.0%	1.4%	100.0%	0.0%	99.3%
6	0.0%	100.0%	0.0%	100.0%	0.7%	100.0%
7	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
8	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
9	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
10	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%

Decile	Model 3		Model 3b	
	% of failed	cum. % of failed	% of failed	cum. % of failed
1	96.4%	96.4%	96.4%	96.4%
2	1.4%	97.9%	1.4%	97.9%
3	0.7%	98.6%	0.7%	98.6%
4	0.0%	98.6%	0.0%	98.6%
5	1.4%	100.0%	1.4%	100.0%
6	0.0%	100.0%	0.0%	100.0%
7	0.0%	100.0%	0.0%	100.0%
8	0.0%	100.0%	0.0%	100.0%
9	0.0%	100.0%	0.0%	100.0%
10	0.0%	100.0%	0.0%	100.0%

commercial real estate strongly increases failure probability whereas exposure to commercial real estate in general decreases failure probability. The results for residential mortgages and construction and development loans are also not significant. The sign of the coefficients for *dvpt_re_lo* and *dvpt_re_lo_cr* do not make sense economically. Indeed they show that exposure to development and construction loans during the crisis lowers failure probability. The results are not statistically significant for lagged growth either. However, the sign of the coefficients shows that stronger lagged growth increases failure likelihood when the crisis burst. This is in line with our expectations.

As a matter of comparison we use the same criterion as Cole and Wu (2009) to check the accuracy of our models. For each model we rank in-sample predictions by decile and look at the percentage of failed banks within each predicted decile. The results are not very different from one model to another, and the prediction power of each model based on this criterion is very similar to the one of Cole and Wu (2009). If we want to have an idea of out-of sample prediction power, we find that on the 52 banks that failed between January 1, 2010 and April 23, 2010 51 are in the top decile for models 2, 2b, 3 and 3b in terms of likelihood of failure. The last bank is in decile 5, 4, 4 and 3 for model 2, 2b, 3 and 3b respectively.

We find that the logistic regression identifies well the direct determinants of bank failures and provides robust coefficient estimates as shown by its strong prediction power. From a more conceptual perspective, the models discussed above do not clearly identify the original cause of bank failures and do not help to quantify their relative importance. It is clear that banks failed because they have seen a sharp drop of their profitability which had for consequence to diminish their capital ratios. This seems to have been greatly driven by a deterioration of asset quality measured by the ratio of non-performing loans to total assets. We now want to check that the drop in profitability and the rise of non-performing loans is at least partly explained by the different asset allocation we have observed in Part 4 between failed and safe banks. Indeed we think that failed banks had riskier assets because the asset classes that they overweight relative to the safe banks benchmark are inherently riskier (e.g. construction and development loans) and because everything being equal they tend to end up with riskier borrowers, which in our view is partly linked to their rapid growth. In order to verify these hypotheses we perform two dynamic regressions on the non-performing loan ratio and the net interest income ratio to determine whether asset allocation and growth have a significant explanatory power.

Our regression on non-performing loans using both our original asset allocation variables and our “crisis effect” variables reveals that the main drivers of non-performing loans, when the

crisis breaks out, are the exposure to construction and development loans and to commercial real estate. Contrary to our hypotheses, the growth rate lagged by eight quarters is significant but a higher growth rate decreases the level of non-performing loans, whereas we expected that higher past growth would have been positively correlated to the level of non-performing loans. The R^2 , which indicates the part of the variance of the dependent variable explained by the regression, stands at 22.9%. It means that the bank strategic asset allocation explains 22.9% of the level of non-performing loans. The rest could be explained by more precise indicators of asset quality. The regression on net interest income, the profitability measure which is the most likely to be directly impacted by the asset mix and the level of non-performing loans, is statistically significant. As for

Table 15: Dynamic regressions

<u>Dynamic regression on non-performing loans</u>				<u>Dynamic regression on the net interest income</u>			
Variable	Coefficient	z-stat	p-value	Variable	Coefficient	z-stat	p-value
com_re_lo	1.21%	14.89	0.000	securities	0.23%	39.15	0.000
com_re_lo_cr	2.62%	49.35	0.000	com_re_lo	0.76%	89.31	0.000
res_re_lo	1.34%	17.79	0.000	com_re_lo_cr	-0.10%	-21.34	0.000
res_re_lo_cr	0.60%	17.21	0.000	res_re_lo	0.50%	62.11	0.000
dvpt_re_lo	-3.92%	-39.97	0.000	res_re_lo_cr	0.04%	13.15	0.000
dvpt_re_lo_cr	8.19%	95.93	0.000	dvpt_re_lo	1.10%	111.71	0.000
cc_lo	2.73%	16.15	0.000	dvpt_re_lo_cr	-0.54%	-68.96	0.000
ci_lo	0.43%	4.36	0.000	cc_lo	1.55%	93.38	0.000
agri_lo	1.37%	9.52	0.000	ci_lo	0.75%	75.15	0.000
lag8_growth_cr	-0.14%	-5.12	0.000	agri_lo	1.11%	74.18	0.000
intercept	0.90%	29.11	0.000	lag8_growth	-0.03%	-10.37	0.000
				non_perf_lo	-1.71%	-79.86	0.000
				intercept	0.44%	96.24	0.000

non-performing loans, the “crisis effect” variables for commercial real estate loans and construction and development loans have a negative impact on the net interest income. On the contrary, the crisis variable for residential mortgage has a very slightly positive coefficient which is yet significant. The increasing level of non-performing loans is also a strong explanatory variable to the fall of the net interest as bankruptcy approaches. The R^2 on this second regression is 26.1%. As a conclusion, the two regressions support our hypothesis that a bank asset mix has an effect on the failure likelihood as it has an impact on the asset quality (shown by our regression on the level of non-performing loans) and on the level of the net interest income (shown by our second regression on net interest income). Based on the regressions’ explanatory power we can also say that other factors, measuring more precisely asset risk and asset quality, are likely to explain the level of non-performing loans and the evolution of the net interest income.

6) Conclusion

The subprime crisis has been the culminating point of a major evolution phase of the US banking industry which has been driven by a long deregulation movement, the rise of information technologies, and the implementation of new financial products. While major changes such as securitization are helpful to understand the credit and real estate bubbles and their subsequent bursts, or even Lehman Brothers or Bear Stearns bankruptcies, they seem to be less pertinent in explaining the determinants of US regional bank failures.

Failed US regional banks have been caught in a credit crisis. Based on our results, we think that the banks with both the riskiest loan categories allocation and the worst loan quality have failed.

We find that before the crisis failed banks were normal or difficult to distinguish from safe banks back in 2005 and 2006 based on capital ratios or profitability measures. It is true that they were exposed to a stronger liquidity risk. But we interpret their financing structure as the consequence of their stronger asset growth. The beginning of the crisis is linked to a progressive deterioration of their capital ratios, non-performing loans, and profitability measures. This deterioration tends to accelerate as bankruptcy gets closer. These symptoms, as we call them, are the direct explanation of bankruptcy, and are well captured by our dynamic logistic regression model. A profitability measure such the net income ratio, an asset quality measure such as the non-performing loan ratio or a liquidity measure such as the level of non-core deposits had already been found significant by Cole and Wu (2009) who examine bank failures between 1890 and 1995. The variables that measure the degradation of a bank situation and lead to bankruptcy are thus consistent over time and remain the same despite different environments. However these symptoms are often observable not very long before failure.

Moreover we try to determine the causes of bank failures, i.e. characteristics that were observable before the crisis and could have been an early-warning of bankruptcy risk. Our hypothesis is that failing banks asset-mix overweighted loans in general and real estate loans more specifically to the detriment of securities. This is not well captured by our first logistic regression models, and we added a “crisis” effect, simply simulated through a crisis variable, which partly confirms our hypotheses but do not prove statistically significant. We then performed dynamic regressions on the level on non-performing loans and net interest income that verifies that the asset allocation of failed banks is partly explaining the evolution of these two direct drivers of bankruptcy. Based on the results of our regression we can say that other elements explain the degradation of profitability and asset quality ratios over time. We think that more detailed asset

quality measures, maybe based on more subjective criteria could further explain why some banks failed when others did not.

We think that forward-looking dynamic models using macro-economic variables and simulating external shocks such as drop in real estate prices could be useful in the future to assess earlier banks with higher probability of failure when these shocks materialize.

Bibliography

- Acharya, V., Schnabl, P., Suarez, G., 2010. National Bureau of Economic Research, Inc, NBER Working Papers: 15730.
- Acharya, V., Schnabl, P., 2009. How Banks Played the Leverage Game, Chapter 2 in Restoring Financial Stability: How to Repair a Failed System, John Wiley and Sons, March 2009.
- Akhavein, J., Berger, A., Humphrey, D., 1997. The effects of megamergers on efficiency and prices: evidence from a bank profit function. *Rev. Ind. Organ.*, v. 12, pp. 95–139.
- Akhigbe, A., Whyte, A.M., 2001. The market's assessment of the Financial Services Modernization Act of 1999. *Financial Review*, v. 36, iss. 4, pp. 119-139.
- Al Mamun, A., Hassan, K., Lai, V.S., 2004. The impact of the Gramm-Leach-Bliley Act on the financial services industry. *Journal of Economics and Finance*, v. 28, iss. 3, pp. 333-47.
- Asaftei, G., 2008. The contribution of product mix versus efficiency and technical change in US banking. *Journal of Banking & Finance*, v. 32, iss. 11, pp. 2336-2345.
- Bharath, S., Dahiya, S., Saunders, A., Srinivasan, A., 2007. So what do I get? The bank's view of lending relationships. *Journal of Financial Economics*, v. 85, pp. 368 – 419.
- Berger, A., 2003. The economic effects of technological progress: evidence from the banking industry. *Journal of Money, Credit, and Banking*, v. 35, iss. 2, pp. 141-76.
- Berger, A., 1998. The efficiency effects of bank mergers and acquisition: A preliminary look at the 1990s data. In: Amihud, Y., Miller, G. (Eds.), *Bank Mergers & Acquisitions*. Kluwer Academic, Boston, pp. 79–111.
- Berger, A., Mester, L., 2003. Explaining the dramatic changes in performance of US banks: technological change, deregulation, and dynamic changes in competition. *Journal of Financial Intermediation*, January 2003, v. 12, iss. 1, pp. 57-95
- Berger, A., DeYoung, R., 2006. Technological progress and the geographic expansion of the banking industry. *Journal of Money, Credit, and Banking*, v. 38, iss. 6, pp. 1483-1513.
- Büyükkarabacak, B., Valev, T., 2010. The role of household and business credit in banking crises. *Journal of Banking & Finance*, v. 34, iss. 6, pp. 1247-1256.
- Campbell, J., Hilscher, J., Szilagyi, J., 2008. In search of distress risk. *Journal of Finance*, v. 63, iss. 6, pp. 2899-2939.
- Calomiris, C., 2000. *US bank deregulation in historical perspective*. Cambridge University Press
- Calomiris, C., Mason, J., 2004. Credit card securitization and regulatory arbitrage. *Journal of Financial Services Research*, August 2004, v. 26, iss. 1, pp. 5-27.
- Cole, R., Wu, Q., 2009. Predicting bank failures using a simple dynamic hazard model. CFR Seminar Series Library – 2009.

- Curry, J., Elmer, P., Fissel, G., 2005. Can the equity markets help predict bank failures? Federal Deposit Insurance Corporation. Working papers: 2004-03.
- Demirgüç-Kunt, A., Detragiache, E., Gupta, P., 2006. Inside the crisis: An empirical analysis of banking systems in distress. *Journal of International Money and Finance*, v. 25, iss. 5, pp. 702-718.
- Demyanyk, Y., Hasan, I., 2009. Financial crises and bank failures: a review of prediction models. Federal Reserve Bank of Cleveland, Working Paper: 0904.
- DeYoung, R., 2003. The failure of new entrants in commercial banking markets: a split-population duration analysis. *Review of Financial Economics* 12, pp. 7–33.
- DeYoung, R., Hunter, W., Udell, G., 2004. The past, present and probable future for community banks. *Journal of Financial Services Research*, v. 25, iss. 2-3, pp. 85-133.
- Gerdes, G., Walton II, J., 2002. The use of checks and other retail noncash payments in the United States. *Federal Reserve Bulletin*, 360-374.
- Heilpern, E., Haslam, C., Andersson, T., 2009. When it comes to the crunch: what are the drivers of the US banking crisis? *Accounting Forum*, v. 33, iss. 2, pp. 99-113.
- Humphrey, D., 2002. U.S. cash and card payments over 25 years. Florida State University working paper.
- Jappelli, T., Pagano, M., 1999. Information sharing, lending and defaults: cross-country evidence. Center for Studies in Economics and Finance Working Paper 22, University of Salerno.
- Jeon, Y., Miller, S., 2007. Births, deaths, and marriages in the US commercial banking industry. *Economic Inquiry*, April 2007, v. 45, iss. 2, pp. 325-41.
- Keeton, W., 2000. Are mergers responsible for the surge in new bank charters? *Economic Review*, Federal Reserve Bank of Kansas City, pp. 21-41.
- King, T., Nuxoll, D., Yeager, T., 2006. Are the causes of bank distress changing? Can researchers keep up? *Federal Reserve Bank of St. Louis Review*, v. 88, iss. 1, pp. 57-80.
- Meyer, L., 2008. Federal Reserve policy and transformation of the US banking system. *North American Journal of Economics and Finance*, v. 9, iss. 2, pp. 203-09.
- Minton, B., Stulz, R., Williamson, R., 2009. How much do banks use credit derivatives to hedge loans? *Journal of Financial Services Research*, v. 35, iss. 1, pp. 1-31
- Montgomerie, J., 2006. The financialization of the American credit card industry. *Competition and Change*, v. 10, iss. 3, pp. 301-19.
- Nadauld, T., Sherlund, S., 2009. The role of the securitization process in the expansion of subprime credit. US Federal Reserve Board's Finance & Economic Discussion Series. Working Papers, p1-53.

- Papaioannou, G., 2009. The market structure effects of commercial bank entry into underwriting: evidence from the league tables. *Journal of Financial Services Marketing*, v. 13, iss. 4, pp. 300-316.
- Rotten, I., Mullineaux, D., 2002. Debt underwriting by commercial bank-affiliated firms and investment banks: More evidence. *Journal of Banking and Finance*, v 26, pp. 689 – 718.
- Seelig, S., Critchfield, T., 2003. Merger activity as a determinant of de novo entry into urban banking markets. FDIC, working paper 2003-01.
- Shumway, T., 2001. Forecasting bankruptcy more accurately: a simple hazard model. *Journal of Business*, v. 74, iss. 1, pp. 101-24.
- Stojanovic, D., Vaughan, M., Yeager, T., 2008. Do Federal Home Loan Bank membership and advances increase bank risk-taking? *Journal of Banking & Finance*, Vol. 32 Issue 5, p680-698, 19p.
- Strahan, P., 2003. The real effects of U.S. banking deregulation. *Federal Reserve Bank of St. Louis Review*, v. 85, iss. 4, pp. 111-28.
- Uzun, H., Webb, E., 2007. Securitization and risk: empirical evidence on US banks. *The Journal of Risk Finance*, v. 8, iss. 1, pp. 11-23.
- Wheelock, D., Wilson, P., 1995. Why do banks disappear? The determinants of US bank failures and acquisitions. *Federal Reserve Bank of St. Louis, Working Papers*: 95-013.
- Yeager, T., Yeager, F.; Harshman, E., 2007. The Financial Services Modernization Act. *Journal of Economics and Business*, v. 59, iss. 4, pp. 313-39.

Appendix 1: individual banks dropped from the database based on missing information

Table A1: Banks dropped based on missing information on Income Statement variables

We dropped these banks because they had missing information for all the quarters of our sample period (2001-2009) on the following variables : RIAD4074, RIAD4340, RIAD4079, RIAD4093

rssd_id	Name	rssd_id	Name
1511	ROYAL BK OF SCOTLAND PLC NY BR	852302	LLOYDS TSB BK PLC NY BR
3403	ALLIED IRISH BKS NY BR	860400	BARCLAYS BK PLC NY BR
4512	CREDIT SUISSE FIRST BOST NY BR	875365	SUMITOMO BK SF BR
22039	SUMITOMO BK CHICAGO BR	887461	UNITED MIZRAHI BK LA BR
25012	ABN-AMRO BK NV NY BR	900100	BANCO DI NAPOLI SPA NY BR
29216	BANK AUSTRIA AG NY BR	905011	NATIONAL BK OF PAKISTAN NY BR
34014	STANDARD CHARTERED BK NY BR	908508	BANK OF CHINA NY BR
41218	NATIONAL AUSTRALIA BK NY BR	909000	BANK OF BARODA NY BR
41339	COMMERZBANK AKTIENGESE ATL AGY	910510	NORINCHUKIN BK NY BR
43164	BNP PARIBAS LA BR	916606	BANCA POPOLARE DI MILANO NY BR
44769	HANVIT BK LA AGY	916811	RABOBANK NEDERLAND NY BR
49465	KOREA EXCH BK LA AGY	919812	GULF INTL BK UK NY BR
54816	DOHA BK NY BR	920500	CREDIT AGRICOLE INDOSUEZ NY BR
54964	TOKAI BK LOS ANGELES AGY	922111	SOCIETE GENERALE NY BR
55318	DRESDNER BK AG NY BR	922812	STATE BK OF INDIA BROADWAY BR
55466	THAI FARMERS BK LA AGY	924919	SUMITOMO TR BKG NY BR
55617	NATIONAL WESTMINSTER BK NY BR	925813	UBS AG FIFTH AVE BR
57563	BANCO AGRICOLA SF AGY	926315	TOKAI BK NY BR
59811	PT BK CENTRAL ASIA NY BR	934413	BAYERISCHE HYPO VEREINS NY BR
63014	SANWA BK NY BR	953115	BANCO POPULAR ROCKEFEL CENT BR
64217	SHANGHAI CMRL BK NY BR	957908	BANCO DO ESTADO RIO GRAN NY BR
65812	SUMITOMO BK NY BR	958400	BANK OF EAST ASIA MIDTOWN BR
66716	T C ZIRAAT BANKASI NY BR	964616	UNITED BK AFRICA NY BR
67058	SOCIETE GENERALE DALLAS AGY	966012	WESTDEUTSCHE LANDESBANK NY BR
71439	FUJI BK CHICAGO BR	968726	NATIONAL BK OF PAKISTAN WA BR
86509	BANCO BRADESCO SA NY BR	969714	NATIONAL BK KUWAIT SAK NY BR
87001	BANCO ESPANOL CREDITO NY BR	972509	BNP PARIBAS NY BR
92331	SANWA BK CHICAGO BR	975863	BANK TOKYO-MITSUB PORTLAND BR
95716	STATE BK OF INDIA NY BR	978819	MELLON OVERSEAS INV CORP
96218	SHOKO CHUKIN BK NY BR	986010	PHILIPPINE NB NY BR
98865	ISRAEL DISCOUNT BEV HILLS AGY	992011	SVENSKA HANDELSBANKEN AB NY BR
104869	BANCO AGRICOLA LA AGY	994510	UNITED BK NY BR
107468	DRESDNER BK AG LA AGY	1009167	STANDARD CHARTERED BK LA BR
109565	FUJI BK LA AGY	1010462	BNP PARIBAS SF BR
110860	INDUSTRIAL BK OF JAPAN LA AGY	1013061	CHEKIANG FIRST BK SF AGY
111139	KOREA EXCH BK CHICAGO BR	1017265	LIU CHONG HING BK SF BR
112734	INDUSTRIAL BK JAPAN-CHICAGO BR	1089057	LASALLE TRADE SVC CORP
112819	DEUTSCHE BK AG NY BR	1157424	SKANDINAVISKA ENSKILDA NY BR
112967	BANK TOKYO-MITSUBISHI LA BR	1160170	SHINKIN CENTRAL BK NY BR
113311	DG BK DEUTSCHE GENOSSENS NY BR	1160189	BANCO MERCANTIL BANCO NY AGY
115566	PHILIPPINE CMRL INTL BK LA AGY	1160518	UBS AG MIAMI AGY
116068	STATE BK OF INDIA LA AGY	1163162	SUMITOMO BK LA BR
117663	UBS AG LA BR	1188101	GUNMA BANK NY BR
126030	SAKURA BK CHICAGO BR	1191633	SANWA BK LA BR

128137	NATIONAL BK PAKISTAN CHGO BR	1211401	BANCO ESPIRITO SANTO CMR NY BR
128212	DANSKE BK A/S NY BR	1212761	P T BK RAKYAT INDONESIA NY AGY
130103	ARAB BKG CORP NY BR	1217515	DEUTSCHE BK PRIVATE BKG INTL C
132200	BANCO REPUBLICA ORIENTAL NY BR	1217663	BANCO STANDARD CHARTER MIA AGY
134334	BANK HAPOALIM BM MIA BEACH AGY	1218334	NATIONAL BK OF CANADA LA AGY
135715	BANCO DE BOGOTA NY AGY	1218361	BANK OF CHINA LA BR
135902	BANCO DO BRASIL SA NY BR	1222957	DEN NORSE BK ASA NY BR
135939	BANCO DO ESTADO DE SAO MIA AGY	1256194	OHIO NAT CORP TRADE SVC
137812	BANCO DE CREDITO DEL NY BR	1357242	BANCA DI ROMA NY BR
138538	BANCO SANTANDER CENTRA MIA AGY	1358137	MASHREQBANK PSC NY BR
139030	BANQUE SUDAMERIS MIAMI AGY	1368604	BANCO LATINOAMERICANO NY AGY
139218	KBC BANK NV NY BR	1386907	JOYO BK NY BR
139610	ASAHI BK NY BR	1395374	CHIAO TUNG BK SAN JOSE BR
139919	BANCO MERCANTIL SAO PAUL NY BR	1415049	BANCO MERCANT CORAL GABLES AGY
140139	SOCIETE GENERALE CHICAGO BR	1415058	DG BK DEUTSCHE GENOSSE ATL AGY
140335	BARCLAYS BK PLC MIAMI AGY	1415955	CHANG HWA CMRL BK NY BR
141716	BANCO COMERCIAL PORTUG NY BR	1418107	OVERSEA-CHINESE BKG LA AGY
141930	DRESDNER BK LATEINAMER MIA AGY	1418125	IMPERIAL INTL BK
144315	P T BK NEGARA INDO PER NY AGY	1421497	SHIZUOKA BK NY AGY
144333	UBS AG CHICAGO BR	1436053	BANCO UNION CA MIAMI AGY
144539	BANCO COMERCIAL PORT MIA AGY	1437014	HUA NAN CMRL BK LA BR
146430	TOKAI BK CHICAGO BR	1437872	KBC BK NV ATLANTA AGY
149011	CHOHUNG BK NY BR	1437881	NATIONAL BK CANADA ATL AGY
158714	ROYAL BK OF CANADA NY BR	1438963	FIRST CMRL BK LA BR
175663	DAI-ICHI KANGYO BK LA AGY	1459294	RABOBANK NEDERLAND DALLAS AGY
176165	DEVELOPMENT BK SINGAPOR LA AGY	1476424	RIYAD BK HOUSTON AGY
178262	SAKURA BK LA AGY	1476433	TORONTO-DOMINION BK HOU AGY
180069	SOCIETE GENERALE LA BR	1488771	CHANG HWA CMRL BK LA BR
181664	UNITED OVERSEAS BK LA AGY	1492059	HUA NAN CMRL BK NY AGY
186753	UBS AG HOUSTON AGY	1492545	OGAKI KYORITSU BK NY BR
187255	BANK OF MONTREAL-HOUSTON AGY	1492826	BANK OF TAIWAN NY AGY
208619	BANK LEUMI LE-ISRAEL BM NY AGY	1751064	SHINHAN BK NY BR
209111	BANK OF MONTREAL NY BR	1751420	BANK OF EAST ASIA NY BR
209308	BANCO DE CHILE NY BR	1751626	FIRST CMRL BK NY AGY
212513	FUJI BK NY BR	1753684	DEXIA PUBLIC FINANCE BK NY AGY
213015	SANPAOLO IMI SPA NY BR	1820915	SAMPO BK PLC NY BR
213202	BANCA COMMERCIALE ITALIA NY BR	1820933	INDUSTRIAL BK OF KOREA NY BR
215112	OVERSEA-CHINES BKG CORP NY AGY	1831135	NORDDEUTSCHE LANDESBANK NY BR
216717	UNITED OVERSEAS BK NY AGY	1831368	BANK POLSKA KASA OPIEKI NY BR
217237	STATE BANK INDIA CHICAGO BR	1831920	BANCO SANTA CRUZ SA MIAMI AGY
221364	BANCA CMRL ITALIA LA AGY	1831984	BANK OF TOKYO-MITSUBIS ATL AGY
222932	BANCO COLPATRIA RED MU MIA AGY	1841497	TAIPEIBANK CO NY AGY
223434	BANCO BILBAO VIZCAYA MIA AGY	1852952	SWEDBANK FORENINGSSPARB NY BR
225531	CREDIT LYONNAIS MIAMI AGY	1858990	BANK OF EAST ASIA LA BR
226033	BNP PARIBAS MIAMI AGY	1861806	NISHI-NIPPON BK NY BR
227517	UNICREDITO ITALI NY BR	1861909	FARMERS BK CHINA SEATTLE BR
227638	ROYAL BK OF CANADA MIAMI AGY	1861918	PT BK BALI TBK LA AGY
228130	BANCO ATLANTICO SA MIAMI AGY	1861945	KRUNG THAI BK LA AGY
233116	ERSTE BK OESTERREICHISCH NY BR	1867723	MERITA BK PLC NY BR
237860	P T BK NIAGA LA AGY	1869352	SHANGHAI CMRL BK LA BR
244514	HABIB BK NY BR	1892592	CHUGOKU BK NY BR
245267	NANYANG CMRL BK SF BR	1896255	SAN-IN GODO BK NY BR
250515	LANDESBANK HESSEN-THURIN NY BR	1898781	BANK OF COMMUNICATIONS NY BR
253516	GULF INTL BK NY BR	1901793	UNION BK OF JAMAICA MIAMI AGY
260336	ABN-AMRO BK NV CHICAGO BR	1915820	BANCO AGRICOLA HUNTINGTON AGY

265818	KOREA EXCH BK NY BR	1921111	TURKIYE VAKIFLAR BK NY BR
288107	BANK OF NOVA SCOTIA BOSTON BR	1950308	POPULAR FINANCE
292711	MALAYAN BKG BERHAD NY BR	1984273	HOUSING CMRL BK NY BR
296362	BBVA BANCOMER SA LA AGY	1984312	LANDESBANK BADENWURT NY BR
297967	CANADIAN IMPERIAL BK LA AGY	1984602	KOOKMIN BK NY BR
298469	CREDIT LYONNAIS LA BR	1984796	KOREA DEVELOPMENT BK NY BR
302366	OVERSEAS UNION BK LA AGY	1987032	BANK OF NOVA SCOTIA HOU BR
304463	BANCA DI ROMA SPA SF AGY	1992483	BIL INTL HOLD
317810	MTSUBISHI TR & BKG CORP NY BR	1992858	CREDIT INDUS ET CMRL NY BR
318312	SAKURA BK NY BR	2012735	TAIPEIBANK CO LA BR
327239	BANK HAPOALIM BM CHICAGO BR	2012995	UNITED WORLD CHINESE BK LA AGY
328834	BNP PARIBAS CHICAGO BR	2023692	BANCO GALICIA Y BUENOS NY BR
332738	CANADIAN IMPERIAL BK CHGO BR	2023777	POPULAR LEASING & RENTAL
339531	COMMERZBANK AKT CHICAGO BR	2024402	BANCO DE SABADELL SA MIAMI AGY
348131	CREDIT LYONNAIS CHICAGO BR	2031679	CHIAO TUNG BK NY AGY
348917	BANCA MONTE DEI PASCHI NY BR	2045809	BANK OF TAIWAN LA BR
358019	KOREA EXCH BK BROADWAY BR	2051154	BANCO BILB VIZ ARG GUAYNABO BR
359034	BBVA BANCO GANADERO MIA AGY	2066121	TAIWAN BUS BK LA BR
362436	ISRAEL DISCOUNT BK MIAMI AGY	2138626	BANC OF AMER FSC HOLD
370169	ROYAL BK OF CANADA PORTLAND BR	2210287	BANCO DE CHILE MIAMI AGY
379210	BANCO IND DE VENEZUELA NY AGY	2235440	FIFTH THIRD INTL CO
380515	BBVA BANCOMER SA NY AGY	2281009	BANCO POPULAR PR CHICAGO AGY
382313	KRUNG THAI BK PUBLIC CO NY BR	2292135	BTM NORTH AMER INTL
383114	BNP PARIBAS EQUITABLE TOWER BR	2316518	KEY TRADE SVC CORP
383516	CITIC KA WAH NY BR	2356925	POPULAR MORTGAGE
398118	CHIBA BK NY BR	2361077	FARMERS BK OF CHINA LA BR
399638	BANCA DI ROMA CHICAGO BR	2403119	INDUSTRIAL & CMRL BK OF CHINA
419134	BANCO DEL PICHINCHA CA MIA AGY	2426828	VNB INTL SVC
423038	BANCO INTERNACIONAL DE MIA AGY	2430834	DEXIA BK BELGIUM NY BR
438818	BANCO BILBAO VIZCAYA ARG NY BR	2443973	BNP MEXICO HOLD
439310	BANCO ATLANTICO SA NY AGY	2500447	HUNTINGTON TRADE SVC
440615	BANCO ITAU SA NY BR	2516596	FIRST UNION OVERSEAS INV CORP
444819	BANK OF TOKYO-MITSUBISHI NY BR	2523295	HSBC BK CANADA SEATTLE BR
446934	BANCA COMMERC ITALIANA CHGO BR	2523316	HSBC BK CANADA PORTLAND BR
449515	METROPOLITAN B&TC NY BR	2527471	FIRST SCTY HONG KONG AGREEMENT
449560	SHIZUOKA BK LA BR	2534639	FIRSTAR TRADE SVC CORP
450810	TORONTO-DOMINION BK NY BR	2564319	SUNTRUST INTL BKG CO
451415	BANK AUSTRIA AG GREENWICH BR	2573898	MUNDER UK LLC
456531	ABN AMRO BK NV ATLANTA AGY	2599601	LEASETEC CORP INTL
471730	DRESDNER BK CHICAGO BR	2614009	LAND BK OF TAIWAN LA BR
480536	BANK LEUMI LE-ISRAEL MIA AGY	2618801	UBS AG CT BR
482633	BANCO DE LA NACION ARG MIA AGY	2631574	CREDIT AGRICOLE INDSZ CHGO BR
500715	BANCO SANTANDER CENTRAL NY BR	2696555	CHINATRUST COMMERCIAL BK NY BR
501217	BANCO ESTADO SAO PAULO NY AGY	2719294	CAJA DE AHORROS DE VAL MIA AGY
502812	BANCO TOTTA & ACORES SA NY AGY	2736255	CITY NAT INTL INS HOLD
507518	HANVIT BK NY AGY	2738213	BNP PARIBAS HOUSTON AGY
510910	OVERSEAS UNION BK NY AGY	2762571	BLACKROCK OVERSEAS INV CORP
511412	ROYAL BK OF CANADA LIB PL BR	2786755	FLEET CAP INTL
512017	COMMERCIAL BK OF KUWAIT NY BR	2809597	BANCO DE CREDITO E INV MIA AGY
514114	CREDIT LYONNAIS NY BR	2826062	BANK SINOPAC LA BR
518738	BANK OF NOVA SCOTIA ATL AGY	2851804	PNC CAP LEASING LLC
520076	BANK TOKYO-MITSUB SEATTLE BR	2856948	CLS BK INTL
522575	KOREA EXCH BK SEATTLE BR	2863786	CAIXA GERAL DE DEPOSITOS NY BR
525839	BANK OF MONTREAL CHICAGO BR	2905864	OLD KENT HONG KONG
534439	DAI-ICHI KANGYO BK CHICAGO BR	2912518	BANCA INTESA NY BR

538156	BANK TOKYO-MITSUBISHI HOU AGY	2921257	POPULAR INS
542733	BANCO DO BRASIL SA MIAMI AGY	2929703	CAHABA INTL
544867	PHILIPPINE NB HONOLULU AGY	2929851	E SUN CMRL BK LA BR
546937	STANDARD CHARTERED BK MIA AGY	2936587	IRWIN INTL CORP
547439	ATLANTIC SCTY BK MIAMI AGY	2972044	NATIONAL BK EGYPT NY BR
548669	BANK NOVA SCOTIA PORTLAND BR	2998334	STERLING TRADE SVCS
558109	CHRISTIANIA BK OG KREDIT NY BR	3006496	SOCIETE GENERALE GREENWICH AGY
560812	AUSTRALIA & NEW ZEALAND NY BR	3016141	BANCA SELLA SPA MIAMI AGY
563411	BANCO INTERNACIONAL SA NY AGY	3041385	ABBEY NAT TREASURY SVC CT BR
565518	BANGKOK BK PUBLIC CO NY BR	3043295	MONUMENT ST INTL FUNDING-I LLC
566560	BANCO NACIONAL MEXICO HOU AGY	3043307	MONUMENT ST INTL FUNDING-II LL
568117	CANADIAN IMPERIAL BK NY AGY	3045824	GOVERNOR&CO BK IR STAMFORD BR
569712	COMMONWEALTH BK OF AUS NY BR	3050369	NOVA EUROPEAN HOLD CO
571564	WING LUNG BK LA BR	3057470	BANCO DE BOGOTA SA MIAMI AGY
590501	BANK JULIUS BAER & CO NY BR	3068823	FLEET OVERSEAS CAP LLC
591003	BANK OF SCOTLAND NY BR	3068841	CITISTREET INTL LLC
592608	NATEXIS BANQUES POP NY BR	3072183	BANCO PASTOR SA MIAMI AGY
599401	BAYERISCHE LANDESBANK NY BR	3081091	STANDARD FED INTL LLC
602833	ABN AMRO BK NV MIAMI AGY	3083077	KRM HOLD
605432	BANCO IND DE VENEZUELA MIA AGY	3088979	SOUTHTRUST INTL
607539	LLOYDS TSB BK PLC MIAMI AGY	3098307	UNION PLANTERS HONG KONG INC
623511	BANCO PROVINCIA BUENOS NY AGY	3101551	CAJA DE AHORROS Y MONT MIA AGY
625618	BANCO NACIONAL MEXICO NY AGY	3108121	CAIXA DE AFORROS MIAMI AGY
627715	BANK OF NOVA SCOTIA NY AGY	3135631	BANCO DE CRE CORAL GABLES AGY
628217	SEOULBANK NY AGY	3141874	DEPFA BK PLC NY AGY
629812	WESTPAC BKG CORP NY BR	3142675	LANDESBANK SCHLESWIG NY BR
631619	INTERNATIONAL CMRL BK NY AGY	3151042	FORTIS BK SA/NV STAMFORD BR
632111	INDUSTRIAL BK OF JAPAN NY BR	3152094	FORTIS BK SA/NV NY BR
633716	SIAM CMRL BK PUBLIC CO NY AGY	3152656	EUROHYPO AG NY BR
633819	COMMERZBANK AG NY BR	3159262	CITIC KA WAH BK BROADWAY BR
634218	NATIONAL BK OF CANADA NY BR	3191963	BBVA BANCOMER SA HOUSTON AGY
636418	DAI-ICHI KANGYO BK NY BR	3201666	HBOS TREASURY SVC NY BR
647021	ABU DHABI INTL BK WA BR	3225091	BANCOLOMBIA SA MIAMI AGY
660637	BK TOKYO-MITSU CHICAGO BR	3234785	ZIONS BK INTL
660806	ARAB BK PLC NY BR	3271829	SVB GLOBAL FNCL
661139	NATIONAL BK OF CANADA-CHGO BR	3277148	NOVA CANADIAN HOLD CO
674102	BANCA NAZIONALE DEL LAVO NY BR	3296998	FIRSTBANK PR CORAL GABLES AG
675266	COMMERZBANK LA BR	3374841	BANCO DEL ESTADO D CHILE NY BR
683663	INTERNATIONAL CMRL BK CH LA BR	3385968	CARDINAL INTL LEASE LLC
707130	INTERNATIONAL CMRL BK CHGO BR	3395547	MBNA INTL INV CORP
708070	ALLIED BKG GUAM BR	3443523	CAJA DE AHORROS DE GAL MIA AGY
715676	BANK OF GUAM SAN FRANCISCO BR	3446467	UBS AG TAMPA BR
718976	HONGKONG & SHANGHAI GUAM AGY	3464809	DESJARDINS HALLANDALE BR
719478	METROPOLITAN B&TC GUAM BR	3465459	ROYAL BK OF CANADA DAL AGY
719870	FIRST CMRL BK GUAM BR	3470967	CAJA DE AHORROS DEL MIAMI AGY
720906	BANK MUAMALAT MALAYSIA NY BR	3597033	CALYON MIAMI AGY
727709	BANK OF INDIA NY BR	3598674	ROYAL BK OF CANADA HOU AGY
728658	FUJI BK HOUSTON AGY	3601097	FTN FNCL INV CORP
731667	BANK OF INDIA SF AGY	3628825	ROYAL BK OF SCOT GREENWICH BR
733764	BANK TOKYO-MITSUB SF BR	3712461	ICICI BK NY BR
734266	BANK OF NOVA SCOTIA SF AGY	3794711	ROYAL BK CAN THRE WRLD FNCL BR
744461	SANWA BK SF BR	3823246	CHINA MERCHANTS BK CO NY BR
746568	PHILIPPINE NB LA BR	3836620	BARCLAYS BK PLC LA AGY
747060	UBS AG SF BR	3848977	BANCO ESPIRITO SANTO NY BR
748665	SHANGHAI CMRL BK SF BR	3856066	TCF BANK INTL

776006	BANCO NACION ARGENTINA NY BR	3903308	INDUSTRIAL CMRL BK OF NY BR
779708	BANCA ANTONIANA POP VEN NY BR	3927591	CHINA CONSTRUCTION BK NY BR
788308	BANK HAPOALIM BM PLAZA BR	3930498	CORPBANCA NY BR
790105	BANK HAPOALIM BM NY BR	3939062	BANK OF NOVA SCOTIA MIAMI AGY
806864	CITIC KA WAH BK LA BR	3958223	RABOBANK NEDERLAND STL A
822211	BANK NOVA SCOTIA ST THOMAS BR		
839808	BANCO DI SICILIA SPA NY BR		
842107	CORP BANCA CA BANCO UNIV NY BR		

Table A2: Banks dropped based on missing information on loan categories variables

We dropped these banks because they had missing information for all the quarters of our sample period (2001-2009) on the following variables : RCFD1590, RCFD1975

rssd_id	Name	rssd_id	Name
24837	FIRST UNION INTL BKG CORP	1217515	DEUTSCHE BK PRIVATE BKG INTL C
96946	BANK ONE INTL CORP	1256194	OHIO NAT CORP TRADE SVC
169877	AMERICAN EXPRESS BK INTL	1418125	IMPERIAL INTL BK
302544	BANKAMERICA INTL INV CORP	1950308	POPULAR FINANCE
303046	COMERICA INTL CORP	1992483	BIL INTL HOLD
348104	STATE STREET INTL HOLDINGS	2023777	POPULAR LEASING & RENTAL
542939	BANKBOSTON INTL	2138626	BANC OF AMER FSC HOLD
545538	CITIBANK INTL	2235440	FIFTH THIRD INTL CO
560139	MORGAN GUARANTY INTL BK	2292135	BTM NORTH AMER INTL
569039	HSBC REPUBLIC INTL BK MIAMI	2316518	KEY TRADE SVC CORP
571939	BANCO DE BOGOTA INTL CORP	2356925	POPULAR MORTGAGE
591900	BOSTON OVERSEAS FNCL CORP	2426828	VNB INTL SVC
604725	PNC BK INTL	2443973	BNP MEXICO HOLD
634638	BANCO SANTAN CNTRL HISP INTL	2500447	HUNTINGTON TRADE SVC
636735	RIGGS INTL BKG CORP	2516596	FIRST UNION OVERSEAS INV CORP
642736	BANCO LATINO INTL	2527471	FIRST SCTY HONG KONG AGREEMENT
643519	BANKERS INTL CORP	2534639	FIRSTAR TRADE SVC CORP
645616	MORGAN GUARANTY INTL FNC CORP	2564319	SUNTRUST INTL BKG CO
647713	COUTTS USA INTL	2573898	MUNDER UK LLC
647731	PETRA INTL BKG CORP	2599601	LEASETEC CORP INTL
648215	FIRST FIDELITY INTL BK	2736255	CITY NAT INTL INS HOLD
657918	UNION BK OF CA INTL	2762571	BLACKROCK OVERSEAS INV CORP
680756	WELLS FARGO BK INTL	2786755	FLEET CAP INTL
695107	AMERICAN EXPRESS BK	2851804	PNC CAP LEASING LLC
719012	BANKERS CO OF NY	2856948	CLS BK INTL
720317	BNY INTL FINANCING CORP	2905864	OLD KENT HONG KONG
725013	MERRILL LYNCH INTL BK	2921257	POPULAR INS
727110	HARRIS BK INTL CORP	2929703	CAHABA INTL
729217	UNITED ST TC INTL CORP	2936587	IRWIN INTL CORP
753276	HSBC INTL FNCL CORP DE	2998334	STERLING TRADE SVCS
783871	BANKAMERICA INTL FNCL CORP	3043295	MONUMENT ST INTL FUNDING-I LLC
792211	CHASE BK INTL	3043307	MONUMENT ST INTL FUNDING-II LL
830319	CHASE MANHATTAN INTL	3050369	NOVA EUROPEAN HOLD CO
840242	BANK ONE INTL HOLD CORP	3068823	FLEET OVERSEAS CAP LLC
848912	BANK OF HAWAII INTL CORP NY	3068841	CITISTREET INTL LLC
849414	MARINE MIDLAND OVERSEAS CORP	3081091	STANDARD FED INTL LLC
858032	WACHOVIA INTL BKG CORP	3083077	KRM HOLD

876072	STANDARD CHARTERED OVERSEAS
877275	FUJI BK INTL
905310	STATE ST BK INTL
906915	CHASE MANHATTAN INTL FNC
909514	NORTHERN TR INTL BKG CORP
913418	BANCAFE INTL
919737	BANK OF AMER OVERSEAS CORP
938019	CITIBANK OVERSEAS INV CORP
978819	MELLON OVERSEAS INV CORP
1089057	LASALLE TRADE SVC CORP

3088979	SOUTHTRUST INTL
3098307	UNION PLANTERS HONG KONG INC
3234785	ZIONS BK INTL
3271829	SVB GLOBAL FNCL
3277148	NOVA CANADIAN HOLD CO
3385968	CARDINAL INTL LEASE LLC
3395547	MBNA INTL INV CORP
3601097	FTN FNCL INV CORP
3856066	TCF BANK INTL