11

Bank Off-balance-sheet Leverage: Some Lessons from the Financial Crisis

Nikolaos I. Papanikolaou

University of Luxembourg

Leverage is one of the main underlying features of banks' balance sheets. Traditionally, leverage arises directly through the use of deposited funds or other balance-sheet items, such as bonds and credit lines, as a supplementary tool of banks' equity capital in financing fresh loans and investments. However, leverage can also be traced off the balance sheet of banking organisations. More specifically, in the years before the outbreak of the late 2000s crisis, banking firms took advantage of financial engineering that allowed them to transfer a large part of their leverage off their balance sheets.

This chapter will examine how modern banking and the related off-balance-sheet leverage activities have affected the individual soundness of US banks, as well as the systemic health of the US banking industry, both before and after the onset of the 2007–08 financial crisis. To help achieve this, we will capture off-balance-sheet leverage with different, yet complementary, measures, and also empirically assess the impact of these measures on the overall risk-taking behaviour of US banks and on systemic risk. The details of the empirical analysis can be found in a complementary study (Papanikolaou and Wolff, 2013), which more technically oriented readers can explore.[1]

OFF-BALANCE-SHEET LEVERAGE

In the years running up to the crisis – that is, from the late 1990s onwards – banks were capable of transferring a part of their leverage

and the accompanying risk off their balance sheets, mainly through their engagement in securitisation activities and over-the-counter (OTC) derivatives trading. Both those undertakings were strongly linked to what became known as "regulatory arbitrage". This sort of arbitrage concerned the response of banks to the restrictions imposed on their operations by Basel I and II and, especially, those imposed on banks' equity capital. More concretely, regulatory arbitrage was the game that took place for more than two decades between commercial banking firms and the regulatory authorities in advanced market economies, where the former were innovating and developing new financial instruments to help elude the scrutiny of supervisors and increase their returns, while the latter were tightening the rules in order to avoid excessive risk taking and safeguard the stability of the financial system.

Securitisation was mainly achieved through the setting up of asset-backed commercial paper (ABCP) conduits and structured investment vehicles (SIVs) where banks could transfer significant portions of their assets. More specifically, a large amount of bank assets was transferred to the above-mentioned investment pools, whereas, at the same time, the sponsoring banks were providing these pools with liquidity and credit enhancements in order to ensure funding liquidity for them. These enhancements – widely known as backstops – could attract a low charge under the Basel agreements and were funded mostly by short-term, securitised debt and only by very little equity capital, or any other long-term investments. In so doing, the sponsoring institutions were able to free up capital and, at the same time, federal assets in the so-called shadow banking system.[2] This permitted banks to originate new assets and, more generally, to finance their activities without having to issue new equity capital.[3] As a result, conduits and SIVs contained a significant degree of bank leverage and risk in an implicit form that was achieved through the structuring of the financial instruments *per se*. Nonetheless, under the aforementioned business scheme of funding (which had come to be known as the "originate-to-distribute model"), investors in conduits and SIVs would return the assets back to the originating banks once they suffered a loss; indeed, banks were legally obliged to take bad assets back on their books. That is to say, asset risk was still burdening the sponsoring institutions.

Derivative products, on the other hand, evolved as part of the

effort to better manage investment risks among international market participants. Specifically, derivatives trading facilitated capital flows worldwide by unbundling, and then more efficiently reallocating, the various sources of risk that were associated with traditional banking products such as bank loans, bonds and securities. Hence, the financial innovation of introducing derivatives to capital markets allowed the rather traditional arrangements of risk to be redesigned in order to meet the desired risk profiles of the issuers and holders of these instruments. Put differently, through the use of derivatives, a part of risk could be taken away from those investors who were not willing to carry it and moved towards those who were more willing and (probably) more able to bear it.

While the risk-shifting function of derivatives can play the useful role of hedging and thereby facilitating capital flows, derivatives can – at the same time – create new risks for the health of banking institutions and the soundness of the financial system. The extensive use of derivative contracts is likely to lead to a lower degree of transparency between counterparties as well as between regulators and market investors, which could potentially harm the stability of the system. Furthermore, the embedded leverage in derivatives reduces the amount of capital that acts as a cushion to market turmoil, raises the risk of bank failure and heightens doubts about the soundness of the entire sector.

EMPIRICAL ANALYSIS: THE DATASET

The empirical analysis is based on a dataset that consists of 19 US banking holding companies (BHCs) – see Table 11.1. The sample institutions have been selected primarily on the basis of their systemic importance for the US economy and the degree of their off-balance-sheet exposure as documented in the bank derivatives reports of the Office of the Comptroller of the Currency (OCC) of the US Department of the Treasury.

The examined institutions are included in the top 50 BHCs' list of the National Information Center of the Federal Reserve System, and all belong to the category of systemically important financial institutions (SIFIs). This is to say, the US authorities would be reluctant to let any of them go bankrupt as this would have a shattering effect on the whole financial system. Indeed, not a single entity among those that failed from the beginning of the crisis in mid-2007 is included in

Table 11.1 Sample of banks

Bank name	Bank name
1. Bank of America Corp	11. Metlife Inc
2. BB&T Corp	12. Northern Trust Corp
3. Citigroup Inc	13. PNC Financial Services Group Inc
4. City National Corp	14. RBS Citizens Financial Group Inc
5. Comerica Inc	15. State Street Corp
6. Fifth Third Bankcorp	16. Suntrust Banks Inc
7. First Horizon National Corp	17. Unionbancal Corp
8. Huntington Bankshares Inc	18. US Bank Corp
9. JP Morgan Chase & Co	19. Zions Bankcorp
10. Keycorp	

our dataset. On the contrary, almost all our banks (except Metlife Inc, RBS Citizens Financial Group Inc, and Unionbancal Corp) have received huge financial assistance from the US government through the Troubled Asset Relief Program (TARP).[4] Apparently our sample banks provide the bulk of financing to the industry and households in the US and elsewhere – meaning that, if any of them were allowed to fail, this would inevitably cause serious systemic liquidity shortages in the economy.

It does not come as a surprise that the banks comprising our dataset have been engaged in non-traditional banking activities to a much greater extent than their smaller counterparts. Actually, academic banking literature (see, for example, Rime and Stiroh, 2003) has shown that large, systemic banks are very prone to so-called "universal activities" as compared to small- and mid-sized institutions, which are less diversified and resemble single-line businesses. Our sample banks have indeed been involved in a broad range of activities other than pure commercial banking activities such as loan granting and deposit taking. These activities were explicitly defined by the Gramm–Leach–Bliley Act of 1999 in the US and included – among several others – securities dealing and underwriting, insurance underwriting, financial and investment advisory services, merchant banking and issuing or selling securitised interests in bank-eligible assets.

We believe it is important to justify at this point why we have focused our analysis on the US banking sector and not on some other advanced banking market. First and foremost, the crisis originated in the US before spilling over into other economies around the globe.

Hence, by looking at the US banking industry, we are capable of better tracing some of the root causes of the financial turmoil. Second, differences in accounting regimes can lead to large variations in the off-balance-sheet leverage behaviour of banks, which lie at the centre of the present analysis. Evidently, Generally Accepted Accounting Principles (GAAP) allowed US commercial banks to treat their SIVs and ABCP conduits as being entirely off their balance sheets. In contrast, the International Financial Reporting Standards (IFRS) that European banking institutions follow are somewhat less tolerant toward off-balance-sheet business as they require banks to keep a record of these sort of items not off but on their balance sheets. Along the same lines, the use of IFRS results in significantly higher amounts of total assets and hence lower leverage ratios for the same or similar exposures than does the use of US GAAP. The reason for this is the netting of OTC derivatives, which is allowed under the former reporting systems. More concretely, the netting conditions are stricter under IFRS in that the gross replacement value of derivatives is generally shown on the balance sheet, even when positions are held under master netting agreements with the same counterparty.

As an example, we can examine Deutsche Bank's balance sheet that is reported under both accounting principles. In 2009, the systemically important German bank reported an amount of total assets of €1.5 trillion under IFRS standards, where total assets were equal to €0.9 trillion if US GAAP had been applied. Given that the reported equity capital is (more or less) the same under both accounting principles, the on-balance-sheet leverage ratio for Deutsche Bank in 2009 was much higher in IFRS values. Of course, this has also been the case for every other accounting year.

From what we have seen above, GAAP provided US banks with more incentives to undertake a higher degree of intangible leverage compared to their European counterparts. Accordingly, our emphasis on US institutions allows us to develop more solid measures for their off-balance-sheet leverage activities and the corresponding leverage ratios, and then empirically test the effects of these activities on banks' soundness and on the system's health, which are the main issues examined in this chapter.

The data we employ in our empirical analysis are of quarterly frequency and cover the period Q1 2002 to Q3 2012. The whole data period is divided into two sub-periods: the earlier one (Q1 2002 to Q2

2007) includes the years before the outbreak of the crisis – ie, before August 2007 – when the difference between the interest rates on interbank loans and the short-term US government bills (the so-called TED spread) widened to 150–200 basis points relative to a historically stable range of 10–50 basis points.[5] The pre-crisis years were characterised by stable financial conditions and strong economic expansion. The second period extends from Q3 2007 to Q3 2012 and refers to the crisis period in which financial turbulence, uncertainty, and distress prevailed in the economy.

We do not observe the years prior to 2002 for the following reasons. First, the two international financial crises that erupted in East Asia and in Russia at the end of the 1990s, together with the Long-Term Capital Management (LTCM) crisis of 1998, had a destabilising impact on the US banking system. Second, no considerable regulatory or other similar reforms occurred in the US banking market from 2002 onwards, meaning that the operation of banks remained largely unaffected by exogenous factors throughout the examined period. In fact, the legislative activity in the US that largely influenced the functioning of the entire banking sector was the already mentioned Gramm–Leach–Bliley Act of 1999, which opened up the local market and allowed commercial and investment banks, securities firms and insurance companies to merge their activities. If any additional reforms had taken place in the banking regulatory environment after 2002, it would be very likely to have exerted an impact on the leverage decisions of banks and hence biased our results.[6]

EMPIRICAL ANALYSIS: THE MODEL

To empirically examine the impact of off-balance-sheet leverage on individual bank health and on systemic risk, we use the following pooled time series model:

$$Y_{iq} = \alpha_{iq} + \sum \beta_k \Delta lev_{iq,k} + \sum \gamma_m x_{iq,m} + \varepsilon_{iq}$$

where: $i = 1, 2 \ldots, N = 19$; q = Q1 2002, Q2 2002, …, Q3 2012
k = the number of leverage variables
m = the number of control variables

In this model: Y_{iq} stands for either individual bank risk, or systemic risk; the vector $\Delta lev_{iq,k}$ includes the average quarterly changes in the

different types of off-balance-sheet leverage business of banks; $x_{iq,m}$ represents the vector of bank-specific and macroeconomic control variables; ε_{iq} is the regression error term, whereas the vectors α, β and γ contain the parameters of interest to be estimated. The reason we include the off-balance-sheet leverage variables expressed in differences rather than levels is because we want to capture the effects of increasing and declining leverage trends on the dependent variables of our model.

EMPIRICAL ANALYSIS: THE VARIABLES

In this section, we will describe the variables included in the regression analysis, which are reported in detail in Papanikolaou and Wolff (2013). Starting with the left-hand side variables of the model, we capture systemic risk by using the marginal expected shortfall (MES) as proposed by Acharya *et al* (2012). MES describes how the total risk exposure of an individual bank adds to the banking system's overall risk level. The intuition behind this measure of systemic risk is that a financial firm cannot continue its operation in case the value of its equity capital falls below some fraction of its outstanding liabilities. Such a capital shortage can be potentially harmful for the entire banking market and may, in turn, have repercussions throughout the financial and real sectors – depending on the systemic importance of the troubled institution. Accordingly, a banking firm is viewed as being systemically risky if it is likely to face a large capital shortfall just when the entire financial sector itself is under distress. In sum, MES provides us with the expected capital loss of a bank when the overall market declines by some specific amount over a given period of time. In practice, we first pick up the 5% worst days for an equally weighted portfolio of CDS returns on the 19 banks of our sample in every quarter of a year, and then compute the CDS returns for any given sample bank for these particular days.

MES relies upon two different, yet interrelated, measures of risk that are commonly used by managers to calculate the risk exposure of their firms: the expected shortfall (ES) and the value-at-risk (VaR). ES provides us with the anticipated loss of a financial institution conditional on the loss being larger than VaR, where VaR measures the potential loss in the value of a risky asset (or portfolio of assets) over a predetermined time period for a given confidence interval. In

fact, VaR is a widely used tool for volatility measurement that answers the question, "What is the largest amount of money that an individual, or an institution can lose in really bad times, or due to some extreme event of financial distress?" For instance, if the VaR on an asset is equal to €1 million at a one-week, 99% confidence level, there is a just a 1% chance that the value of the asset will drop more than €1 million over any other given week.

The other metric of risk we employ in our analysis is the total bank risk (TOTRISK). This measures the individual bank fragility and is calculated as the quarterly standard deviation of each sample bank's daily stock market returns. In particular, we first take the weekly (Friday-to-Friday) returns for each individual bank using its daily stock market prices obtained from Thomson Reuters Datastream. TOTRISK is then calculated as the empirical standard deviation of those returns. This is to say, TOTRISK captures the total volatility of equity prices for each individual bank. It incorporates credit risk, market risk and liquidity risk in a single measure.

The behaviour of the two risk variables of our model is presented in Figures 11.1 and 11.2. It is clear from Figure 11.1 that the average MES grows continuously over the entire data period. This implies that the massive deleveraging process which was triggered by the outbreak of the crisis in mid-to-late-2007, and which took place off the balance sheet of banks (as we will later discuss), did not interrupt the increasing course of systemic risk. On the other hand, TOTRISK is found to follow an increasing trend only before the crisis hit the financial system (see Figure 11.2). Deleveraging, in this case, benefited banks in terms of reducing their overall risk taking and improving their risk profile.

Turning to the right-hand-side variables of the regression model, we employ several different measures of banks' off-balance-sheet leverage that are complementary to each other. To develop these measures, we use data mainly from the FR Y-9C reports, filed quarterly by BHCs with the Federal Reserve. These reports contain consolidated balance-sheet and income statement data for US BHCs. We also collect data from the OCC's "Quarterly Reports on Bank Derivatives Activities".

We capture derivatives leverage by using the on-balance-sheet asset equivalent component of the exposure implied by the off-balance-sheet derivatives contracts. This measure is calculated by the

Figure 11.1 Average marginal expected shortfall

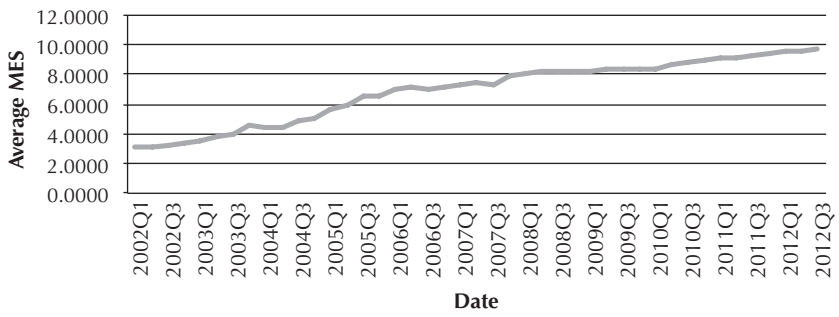
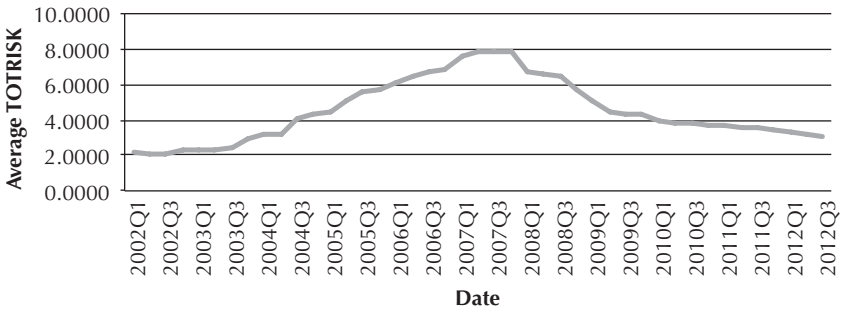


Figure 11.2 Average total risk



ratio of credit equivalent amount of OTC derivatives outstanding to Tier 1 and Tier 2 capital (DERLEV) and maps the off-balance-sheet derivatives positions onto their on-balance-sheet equivalents. The credit equivalent risk of a derivatives instrument essentially consists of two basic elements: the current exposure, which refers to the mark-to-market value of the instrument; and the potential exposure, which is a statistically determined potential loss arising from likely variations of the value of the instrument in its remaining life.

In addition to the derivatives activity of banks, we also measure asset securitisation through conduits and other special vehicles. As discussed earlier, financial engineering allowed banks to securitise loans and other assets and sell them to the secondary markets. The originating banks, however, retained the servicing rights to the bundle of securitised loans. We thus report the outstanding principal amount of loans and other assets sold and securitised with servicing

retained or with recourse or any other credit backstops provided divided by total assets (SECLEV) to capture the magnitude of banks' off-balance-sheet leverage due to asset securitisation activity.

Moreover, we employ a version of the off-balance-sheet leverage ratio (OBSLEV) proposed by the Bank for International Settlements (BCBS, 2009) in our model. The numerator of OBSLEV is given by the sum of commitments, direct credit substitutes, letters of credit and guarantees, acceptances and repos, where the denominator is the book equity capital. OBSLEV is very similar to the off-balance-sheet ratio used by the Bank of Canada. The main difference between the two ratios is the value of transaction- and trade-related contingencies that are both added in the numerator of the Canadian Bank's leverage ratio, but not in our ratio due to the lack of the relevant data.

Crucially, the derivatives contracts and securitised assets that are captured in DERLEV and SECLEV, respectively, are not considered in the OBSLEV ratio. This is to say, the three off-balance-sheet leverage variables that we include in our analysis have a complementary role to each other.

In Figures 11.3, 11.4 and 11.5, we can see that all kinds of off-balance-sheet leverage activities have been significantly increased during the pre-crisis period. In contrast, a rather sharp downward trend in all such sort of activities is reported in the crisis period. Apparently, the US SIFIs accumulated a high degree of leverage off their balance sheets during the economic upturn, whereas they largely reduced their off-balance-sheet holdings after the eruption of the crisis. For instance, the average SECLEV increased from 0.03 in

Figure 11.3 Average derivatives leverage

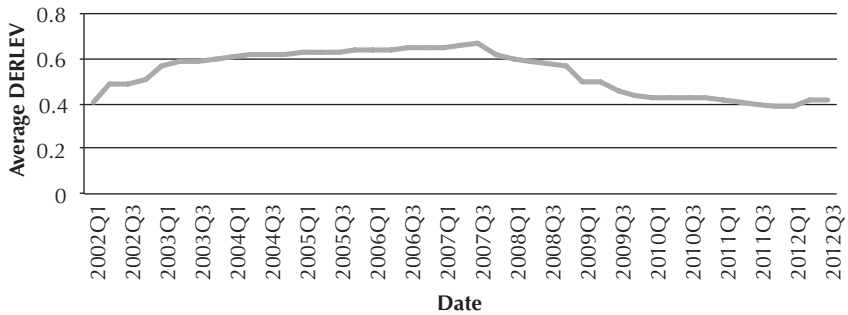


Figure 11.4 Average securitisation leverage

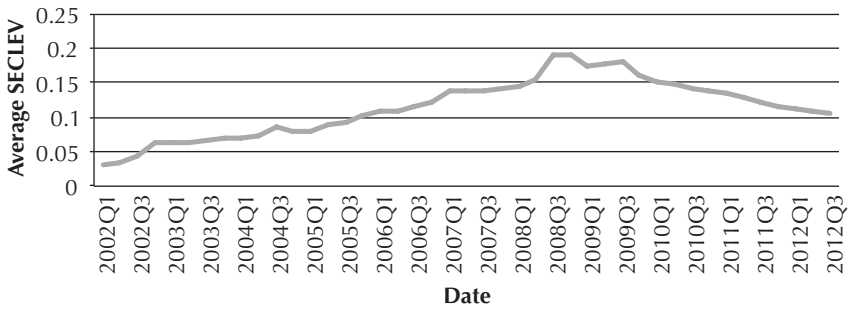
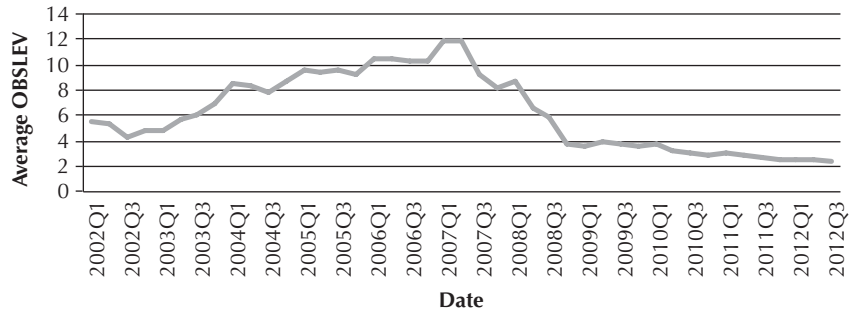


Figure 11.5 Average off-balance-sheet leverage ratio



Q1 2002 to more than 0.19 in Q4 2008; it was afterwards reduced to almost half, reaching the level of 0.10 in Q3 2012 (see Figure 11.4).

It is widely accepted that economic performance has a considerable effect on the demand and supply of banking services. More precisely, high levels of banking activity are generally related to favourable economic conditions. We thus employ the quarterly change in the US Consumer Price Index (INF) to control for variations in the level of prices, and the GDP output gap (GDP) to control for changes in economic growth. Inflation data are obtained from the Bureau of Labor Statistics of the US Department of Labor, whereas GDP data are taken from the Bureau of Economic Analysis of the US Department of Commerce.

Table 11.2 presents all the main variables that we use in the econometric analysis. The abbreviation of each variable and the source we use to collect the data are also reported.

PRE-CRISIS PERIOD FINDINGS

According to our empirical findings, and consistently with the descriptive charts presented earlier, the increase in the off-balance-sheet leverage activities of banks led to higher MES and higher TOTRISK in the years before the onset of the crisis. This can be explained as follows. Since the early 2000s, banks have responded to the augmented demand for credit instruments with higher yield by developing financial engineering techniques and creating modern types of products such as credit derivatives, credit default swaps, collateralised debt obligations and securitised loans. Although these developments may have come about as a result of wider financial advances aimed at improving the efficiency of the system, they also provided opportunities for increasing banks' off-balance-sheet leverage and for shifting risks among market participants in highly complicated ways. Most of the (then) new financial instruments were indeed opaque and masked the extent of leverage and interconnectedness of risk, which appeared to spill-over across a wide range of institutions and markets worldwide.

On the whole, the involvement of SIFIs in the off-balance-sheet leverage business during the pre-crisis period increased both individual bank risk and systemic risk, as revealed by the positive relationship we document between the leverage and the risk variables.

This is to say that the mixture of different off-balance-sheet leverage activities played a harmful role for both the health of individual banks and the stability of the entire system. The expansion of derivatives leverage associated with increased securitisation business as well as other off-balance-sheet activities weakened the health of individual banks, generating – at the same time – substantial instability in the system.

CRISIS PERIOD FINDINGS

The shrink of leverage, known as "reverse leverage" or "deleveraging", refers to the phenomenon in which financial intermediaries all attempt to shrink their balance sheets together by selling part of their assets or by reducing their debt with the aim of returning to a safe level of capital. However, deleveraging may also concern the off-balance-sheet exposure of banking organisations. Indeed, during the crisis period, the off-balance-sheet holdings of the US systemic

Table 11.2 Main variables and data sources

Variable	Abbreviation	Definition	Data source
Left-hand side variables			
Systemic risk	MES	First pick up the 5% worst days for an equally weighted portfolio of CDS returns on all sample banks in every quarter of a year, and then compute the CDS returns for each sample bank for these particular days	Bloomberg
Total bank risk	TOTRISK	The quarterly standard deviation of each bank's daily stock market returns	Thomson Reuters Datastream
Leverage variables			
Derivatives leverage	DERLEV	The ratio of credit equivalent amount of OTC derivatives outstanding to regulatory capital	OCCs Quarterly Reports on Bank Derivatives Activities & FR Y-9C Reports
Securitisation leverage	SECLEV	The amount of credit exposure arising from recourse or other seller-provided credit enhancements to SIVs and other conduits divided by total assets	FR Y-9C Reports
OBS leverage ratio	OBSLEV	The sum of commitments, direct credit substitutes, letters of credit and guarantees, acceptances and repos divided by total equity	FR Y-9C Reports
Macroeconomic environment			
Inflation rate	INF	The quarterly change in US Consumer Price Index (CPI)	US Department of Labor
Economic growth	GDP	GDP output gap	US Department of Commerce

banks were largely reduced (as was shown in the relevant summary statistics, see Figures 11.3, 11.4 and 11.5).

We find that the deleveraging process which occurred off the balance sheets of banks have worsened the systemic risk profile of the US banking system. This can be explained in the following way: shortly after the crisis erupted, US financial organisations sought to deleverage both their on- and off-balance-sheet positions, thus amplifying the already existing downward pressure on asset prices. As a result, the collateral values of assets held by banks deteriorated, making it difficult for them to raise fresh funds from the markets. Banks were therefore forced to further decrease their overall leverage exposure, thus encouraging the deleveraging spiral even further. This procyclical process was exacerbated by the large size and the systemic importance of the financial institutions that were engaged in all sorts of off-balance-sheet activities.

When a significant number of banks attempt to deleverage their positions with the aim of strengthening their leverage ratios, various destabilising factors can be set in motion. If, for instance, several systemic financial institutions sell part of their assets at the same time, the market prices of these assets will almost immediately fall, especially if the selling assets are of the same class (mortgage loans, housing assets, etc). Asset prices will then decline to the point where the sale proceeds will not retire enough debt to improve leverage ratios. In fact, ratios may actually deteriorate. Banks will, in turn, hold off selling as long as possible and the market will freeze up. As a consequence, a large volume of hard-to-value assets carried by highly leveraged institutions looms over the markets.

Overall, any serious fall in asset prices, or any large losses in loans or securities, or any cut in cashflows, can exert reverse leverage effects on the system, and especially in a system that consists of highly leveraged institutions. Arguably, the deleveraging process puts additional downward pressure on the entire system, even although it might be beneficial for the health of banking organisations on an individual basis.

CONCLUDING REMARKS AND MANAGERIAL IMPLICATIONS

In this chapter, we have examined how modern banking that gave birth to the off-balance-sheet leverage activities affected the overall risk profile of US systemic banks as well as the level of systemic risk

before and after the financial crisis which erupted in mid-2007. We employed a very representative pooled time series dataset of US SIFIs that covered both the pre-crisis period as well as that after mid-2007, and modelled the relationship between bank soundness and systemic fragility with several complementary off-balance-sheet measures of bank leverage.

Our formal evidence reliably indicates that off-balance-sheet leverage largely contributes to both total bank risk and systemic risk, thus corroborating the findings that appear in the relevant academic literature (see, for example, Wu *et al*, 2011) as well as in the popular financial press. More concretely, we lend support to the view that, before the onset of the crisis, banks accumulated leverage both on and (especially) off their balance sheets. Indeed, banks were able to expand leverage in ways that were previously impossible: by largely relying on new financial products, they managed to extend the short-term funding of their medium- and long-term assets. This increased maturity mismatch and raised the probability of bank runs – and, in turn, the levels of individual bank risk and of systemic risk, thus forcing the system to either fail or consider large-scale bailouts.

Accordingly, in the pre-crisis era, the positive relationship that we document between the increasing off-balance-sheet leverage activities and risk shows that leverage was one of the main factors responsible for the fragility of the financial system. Nevertheless, a much more tangible threat to systemic stability was formed after the beginning of the crisis when banks started to dispose of the large number of bad assets they held either in their portfolio or out of it. The deleveraging process, which took place off the balance sheet of banks, is found to be beneficial for individual banks' health, but very harmful for the stability of the system.

The obtained empirical results indicate that bank managers need to closely monitor both the degree of risk taking of their institutions (by measuring TOTRISK, for example) and of systemic risk (using MES), and, at the same time, avoid putting such a heavy weight on the estimates of the earnings per share. Put more generally, it is crucial for managers to carefully look at different measures of bank performance from a microperspective view (profitability measures, risk measures, etc), while also paying special attention to the broader, macroprudential aspects of systemic stability.

In a similar vein, risk managers are expected to act more

prudently and keep an eye on the level of their off-balance-sheet leverage exposure, and also think of setting some specific internal limits to this sort of activities if needed. These kinds of limits should be complementary to the various microprudential and macroprudential restrictions imposed by bank regulators. The leverage ratio under Basel III, for instance, takes into account the off-balance-sheet items that will be – most likely – converted using a flat 100% credit conversion factor. Of course, for bank managers to act in a prudent manner, a risk-based remuneration framework needs to be established under Basel III to prevent them from excessive risk taking.

1 See Papanikolaou and Wolff (2013).
2 Shadow banking consisted of non-bank financial institutions such as hedge funds, insurance funds, investment funds, pension funds, SIVs and conduits (the most important ones). Some of these institutions, including SIVs and conduits, disappeared when the crisis erupted along with several markets where modern financial instruments were traded.
3 Banks were very keen on engaging in securitised activities not only because they could qualify for lower capital requirements, but also because securitisation had the additional advantage of generating fee income. Since fees did not have to be returned if securities suffered any losses, banks were furnished with an additional incentive to structure products and leverage their positions even further.
4 In late 2008, the US government enacted the Emergency Economic Stabilization Act (EESA), which authorised the Treasury Department to establish TARP and to spend up to US$700 billion in stabilising the financial system.
5 The acronym TED has been formed from T-bill in combination with ED, which is the ticker symbol for the Eurodollar futures contract.
6 It is well established in the banking literature that regulation strongly affects industry structure, and alters the behaviour of banks in terms of performance and risk taking (see, for example, Brissimis *et al*, 2008).

REFERENCES

Acharya, V. V., L. H. Pedersen, T. Philippon and M. P. Richardson, 2012, "Measuring Systemic Risk", CEPR Discussion Paper No. DP8824.

Basel Committee on Banking Supervision (BCBS), 2009, "Strengthening the Resilience of the Banking Sector", Bank for International Settlements.

Berger, A. N., L. F. Klapper and R. Turk-Ariss, 2009, "Bank Competition and Financial Stability", *Journal of Financial Services Research*, 35, pp 99–118.

Brissimis, S. N., M. D. Delis and N. I. Papanikolaou, 2008, "Exploring the Nexus Between Banking Sector Reform and Performance: Evidence from Newly Acceded EU Countries", *Journal of Banking and Finance*, 32, pp 2,674–83.

DeYoung, R. and K. P. Roland, 2001, "Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Total Leverage Model", *Journal of Financial Intermediation*, 10, pp 54–84.

Gonzalez, F., 2005, "Bank Regulation and Risk-taking Incentives: An International Comparison of Bank Risk", *Journal of Banking and Finance,* 29, pp 1,153–84.

Papanikolaou, N. I., 2009, "How Output Diversification Affects Bank Efficiency and Risk: An Intra-EU Comparison Study", in M. Balling, E. Gnan, F. Lierman and J. P. Schoder (Eds), 2009, *Productivity in the Financial Services Sector* (Brussels, Belgium: Central Bank of Luxembourg/SUERF, Editions Larcier): pp. 229–57.

Papanikolaou, N. I. and C. P. Wolff , 2013, "The Role of On- and Off-balance-sheet Leverage of Banks in the Late 2000s Crisis", Luxembourg School of Finance Working Paper Series.

Rime, B. and K. J. Stiroh, 2003, "The Performance of Universal Banks: Evidence from Switzerland", *Journal of Banking and Finance,* 27, pp 2,121–50.

Uhde, A. and U. Heimeshoff, 2009, "Consolidation in Banking and Financial Stability in Europe: Empirical Evidence", *Journal of Banking and Finance,* 33, pp 1,299–311.

Wu, D., J. Yang and H. Hong, 2011, "Securitization and Banks' Equity Risk", *Journal of Financial Services Research,* 39, pp 95–117.