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**Traditional banks, shadow banks
and the US credit boom –
credit origination versus financing**

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Non-technical summary

Research Question

The US credit boom has been identified as one of the causes of the global financial crisis and the resulting debt overhang is seen as the primary reason for the weak economic recovery. Most of the existing literature links the credit boom to the emergence of the shadow banking system, which became increasingly important in *financing* credit extended to ultimate borrowers, such as households. This paper adds to the existing literature by investigating the extent, to which the shadow banking system played part in the *origination* of the credit boom.

Contribution

The main contribution of the paper is to describe the process of credit intermediation in the shadow banking system, taking explicit account of traditional banks' role as creators of means of payment. This paper shows that the largest part of the shadow banking system merely transforms existing financial claims against ultimate borrowers that have been originated by traditional banks. In turn, the assets held by shadow banks are financed by converting ultimate lenders' deposits, which have been created by the traditional banking system in the process of loan granting, into shadow bank liabilities.

Results and Policy Recommendations

Based on US financial accounts data the paper quantifies how large a part the traditional and shadow banking systems played in the origination of the credit boom. The estimation results suggest that, shortly before the onset of the financial crisis, around 88% of loans to ultimate borrowers in the non-financial private sector held by the combined traditional and shadow banking system had been originated by traditional banks. The corresponding figure for the shadow banking system was only 12%. Accordingly, dampening credit creation by the traditional banking sector might be an additional policy instrument to reduce the build-up of systemic risk in the shadow banking system.

Nichttechnische Zusammenfassung

Fragestellung

Der Verschuldungsboom in den USA wurde als eine der Ursachen für die globale Finanzkrise identifiziert. Der aus dem Kreditaufbau resultierende Schuldenüberhang wird darüber hinaus als ein Hauptgrund für die schwache wirtschaftliche Erholung in den Jahren nach der Krise gesehen. Der Großteil der bestehenden Literatur verbindet den Kreditboom mit der Entstehung des Schattenbankensystems, welches zunehmend an Bedeutung für die *Finanzierung* von Krediten an Endschuldner wie private Haushalte gewann. Dieses Papier ergänzt die existierende Literatur, indem es die Rolle der Schattenbanken in der *Schöpfung* von Krediten analysiert.

Beitrag

Der Hauptbeitrag des Papiers ist es, den Prozess der Kreditintermediation im Schattenbankensystem zu beschreiben und dabei explizit die Rolle der Banken in der Schöpfung von Zahlungsmitteln zu berücksichtigen. Es wird aufgezeigt, dass der Großteil des Schattenbankensystems lediglich bestehende Kredite an Endschuldner wie private Haushalte transformiert, die zuvor von Geschäftsbanken geschöpft wurden. Die Forderungen der Schattenbanken werden dann wiederum finanziert, indem Einlagen, welche ebenfalls von den Geschäftsbanken im Prozess der Kreditschöpfung geschaffen wurden, in Verbindlichkeiten der Schattenbanken umgewandelt werden.

Ergebnisse und Politikempfehlungen

Basierend auf Daten der Gesamtwirtschaftlichen Finanzierungsrechnung der USA quantifiziert das Papier, in welchem Umfang das Schattenbankensystem zur Schöpfung des Kreditbooms beitrug. Die Schätzungen kommen zu dem Ergebnis, dass kurz vor Ausbruch der Krise in etwa 88% der von den Geschäftsbanken und dem Schattenbankensystem zusammen gehaltenen Kreditforderungen gegenüber Schuldner im nichtfinanziellen Privatsektor von den Geschäftsbanken geschöpft wurden. Der entsprechende Anteil des Schattenbankensystems belief sich auf lediglich 12%. Folglich könnte eine Abschwächung der Kreditschöpfung durch Geschäftsbanken ein zusätzliches Instrument darstellen, um dem Aufbau systemischer Risiken im Schattenbankensektor entgegenzuwirken.

Traditional Banks, Shadow Banks and the US Credit Boom – Credit Origination versus Financing*

Robert Unger (Deutsche Bundesbank)

Abstract

The US credit boom has been identified as one of the causes of the global financial crisis and the resulting debt overhang is seen as the primary reason for the weak economic recovery. Most of the existing literature links the credit boom to the emergence of the shadow banking system. This paper shows that the largest part of the shadow banking system merely transforms existing financial claims against ultimate borrowers that have been originated by traditional banks. Based on financial accounts data, it is estimated that, shortly before the onset of the financial crisis, just about 12% of loans to the non-financial private sector had been originated by shadow banks. Consequently, dampening credit creation by the traditional banking sector might be an additional policy instrument to reduce the build-up of systemic risk in the shadow banking system.

Keywords: banks, credit boom, credit creation, financial crisis, shadow banks, systemic risk

JEL classification: E40, E50, F30, G21, G23.

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1 Introduction

The US credit boom has been identified as one of the causes of the global financial crisis (see, for example, [Allen and Carletti, 2010](#); [Bank for International Settlements, 2008](#); [Borio and Disyatat, 2011](#); [Brunnermeier, 2009](#); [Hume and Sentance, 2009](#)). Furthermore, the resulting debt overhang is widely regarded as the primary reason for the weak economic recovery (see, for example, [Cecchetti, Mohanty, and Zampolli, 2011](#); [Jordà, Schularick, and Taylor, 2013](#); [Koo, 2013](#); [Mian and Sufi, 2014](#)).

Most of the existing literature (see, for example, [Adrian and Shin, 2009, 2010a](#); [Gorton, 2012](#); [Gorton and Metrick, 2010](#); [Klein, Lantz, Sweeney, and Wilmot, 2009](#); [Pozsar, Adrian, Ashcraft, and Boesky, 2013](#)) discusses the US credit boom in the context of the emergence of the shadow banking system. The two central results of this strand of research can be summarized as follows: Firstly, the shadow banking system became increasingly important in *financing* credit extended to ultimate borrowers, such as households. Secondly, as the shadow banking system lacked a governmental backstop comparable to the one enjoyed by the traditional banking system – deposit insurance and access to central bank liquidity – the maturity and liquidity transformation inherent in shadow banking credit intermediation made it vulnerable to a run on its liabilities.

This paper adds to the existing literature by investigating the extent, to which the shadow banking system played a part in the *origination* of the credit boom. Given the complexity of such a phenomenon, the paper should not be interpreted as an attempt to provide a comprehensive explanation for the cause(s) of the US credit boom. Rather, it restricts itself to the more modest task of exploring which part of the financial system – traditional banks¹ or shadow banks – would be able to satisfy an exogenously given demand for credit, i.e. which part of the financial system displays an "excessive elasticity" ([Borio and Disyatat, 2011](#), p. 2).

Building on the seminal work of [Pozsar et al. \(2013\)](#), the main contribution of this paper is to describe the process of credit intermediation in the shadow banking system, taking explicit account of traditional banks' role as creators of means of payment. Whereas the cited paper describes in rich detail how the shadow banking system transforms loans into marketable securities, it places only little emphasis on how these loans were originated in the first place. Building on the recently revived notion that the traditional banking system creates additional means of payment in the form of deposits in the process of credit creation (see, for example, [Benes and Kumhof, 2012](#); [Borio and Disyatat, 2010, 2011](#); [Disyatat, 2011](#); [McLeay, Radia, and Thomas, 2014](#); [Jakab and Kumhof, 2015](#)), this paper complements their description of the shadow banking system by illustrating how loans to ultimate borrowers, which later form the basis for the creation of marketable securities, are originated.

I show that of the three shadow banking subsystems identified in [Pozsar et al. \(2013\)](#) – the government-sponsored enterprise (GSE) subsystem, the internal shadow bank subsystem and the external shadow bank subsystem – only the last-named grants new loans to ultimate borrowers itself and can therefore be identified as having contributed to the origination of the credit boom. In contrast, the government-sponsored enterprise sub-

¹Below, traditional banks are understood as financial institutions whose main business is deposit-taking and granting loans. The corresponding sector in the Financial Accounts of the United States is Private Depository Institutions.

system as well as the internal shadow bank subsystem rely on the origination of loans by traditional banks for the creation of marketable securities. When a traditional bank grants a new loan to an ultimate borrower, such as a household, it simultaneously creates new demand deposits that serve as means of payment. The agent that accepts these deposits in return for the goods, services or assets sold becomes the ultimate lender that finances the loan granted to the ultimate borrower.

It is only then that the government sponsored enterprise subsystem and the internal shadow bank subsystem enter the picture. However, they merely transform an existing liability to the ultimate lender – the deposit – into a shadow bank liability, such as (asset-backed) commercial paper or money market mutual fund shares, and lengthen the intermediation chain to finance an existing credit claim against the ultimate borrower – the loan. Taken together, this part of the shadow banking system does not provide any additional credit to ultimate borrowers, nor does it generate any new ultimate financing to fund these claims.

Based on US financial accounts data I then quantify how large a part the traditional and shadow banking systems played in the origination of the credit boom. The estimates suggest that the largest share of the credit boom was originated by traditional banks, whereas shadow banks only had a substantial share in financing these claims. At the onset of the financial crisis at the end of 2007 Q2 approximately 60% of the combined assets of the traditional and shadow banking system were held by shadow banks that obtain funding on the capital markets. However, around 88% of the loans to ultimate borrowers in the non-financial private sector held by the combined traditional and shadow banking system had been originated by traditional banks. The corresponding figure for the shadow banking system amounted to only 12%. Consequently, dampening credit creation by the traditional banking sector might be an additional policy instrument to reduce the build-up of systemic risk in the shadow banking system.

The rest of the paper is structured as follows. Section two first outlines the credit intermediation process as represented in the existing literature and then describes in detail how traditional and shadow banks create credit when traditional banks' role as creators of means of payment is taken into account. Section three shows the extent to which traditional and shadow banks played a part in the origination of the credit boom. Finally, section four discusses the findings.

2 How do traditional and shadow banks create credit?

The contributions that highlight the role played by the shadow banking system in the recently observed credit boom and bust (see, for example, [Adrian and Shin, 2009, 2010a](#); [Gorton, 2012](#); [Gorton and Metrick, 2010](#); [Klein et al., 2009](#); [Pozsar et al., 2013](#)) rest on the (implicit) assumption that traditional banks, like any other financial intermediaries, act as a vehicle for allocating funds in the form of cash or real savings from a saver to a borrower (see [Figure 1](#) below).

What sets traditional banks apart from other financial institutions is that they perform liquidity and maturity transformation, a process that is commonly described as turning long-term, illiquid claims, such as loans, into short-term, liquid liabilities in the form of deposits, which are better tailored to savers' preferences and facilitate an optimal allocation of resources (see [Bryant, 1980](#); [Diamond and Dybvig, 1983](#)). Due to the maturity and

liquidity mismatch of their assets and liabilities, banks are prone to runs. To prevent the occurrence of bank runs, the traditional banking system has been underpinned by a safety net consisting of deposit insurance and the central bank's lender of last resort function. Whereas the former removes the credit risk from (retail) deposits, thereby reducing the risk of a run, the latter makes sure that banks can readily convert deposits into cash if depositors withdraw funds.

The shadow banking system is then described as performing essentially the same functions as the traditional banking system, albeit in a more complex and opaque way. Just like traditional banks, shadow banks issue short-term liabilities such as repos, (asset-backed) commercial paper or money market fund shares in order to finance long-term investments, thereby also performing liquidity and maturity transformation (see Figure 1 below). However, the shadow banking system has lacked and still lacks a safety net comparable to the one underpinning the traditional banking system. When the run on the shadow banking system finally occurred, it almost brought the financial system to its knees. As a consequence, the existing literature focuses mainly on analyzing the (instability of the) shadow banking system's funding model.

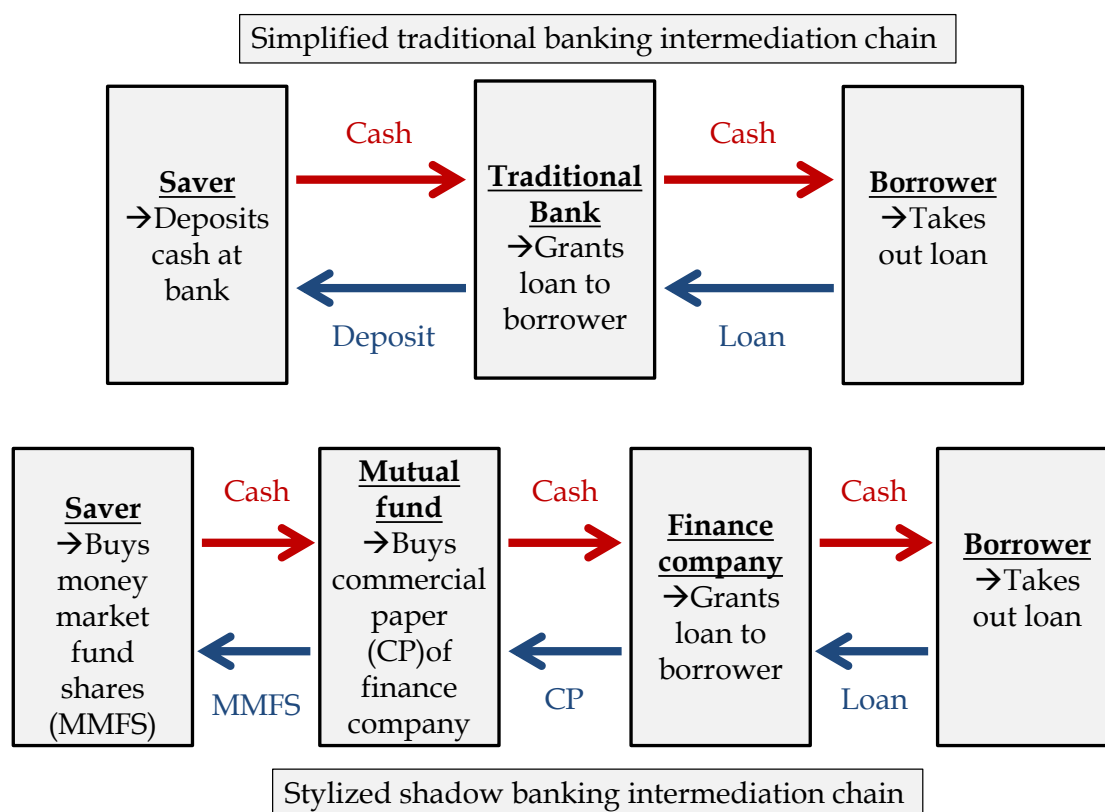


Figure 1: Stylized credit intermediation chains (Source: The author's own illustration. Notes: A red arrow indicates the direction of the flow of the cash. A blue arrow indicates the direction of the flow of the asset.)

Another crucial difference between traditional banks and shadow banks remains largely unexplored: Traditional banks' access to deposit insurance and central bank liquidity not

only reduces the risk of a run on their liabilities. It also enables the traditional banking system to issue a liability that all other sectors accept as a means of payment – demand deposits.² Due to their ability to create new means of payment in the process of loan granting, traditional banks’ credit supply is highly elastic. In contrast, shadow banks have to obtain funds from a fixed stock of existing means of payment if they want to grant credit, making their credit supply much less flexible. The following subsections will describe in more detail how traditional and shadow banks create credit, taking explicit account of traditional banks’ role as a creator of means of payment.

2.1 Traditional Banks

Figure 2 below depicts the process of credit creation in the traditional banking system.³ Detailed changes in the respective entities’ balance sheets are shown in Figure 9 in the appendix. As a traditional bank is able to issue a liability that is accepted as a means of payment – demand deposits – it has no need to pre-finance its loan. If Bank I wants to extend a loan it simply credits the borrower’s account with the amount to be loaned, thereby creating both an asset – the loan – and a liability – the deposit – at the same time (step I). As a loan is, in almost every instance, taken out in order to use the means of payment to purchase goods, services or an asset, it is very likely that the borrower instructs Bank I to transfer the money to an account holder at a different Bank II (step II). The agent with the account at Bank II that accepts the deposit in exchange for the item sold then becomes the ultimate lender for the loan that has been granted to the ultimate borrower at Bank I in the first place. As the ultimate lender is not determined until an agent accepts the deposit in exchange for the item sold, traditional banks can be characterized as *ex-post* intermediaries.⁴

To settle the payment between the two agents, Bank I instructs the central bank to debit its reserve account and credit Bank II’s reserve account by the same amount. Consequently, Bank II will credit the receiving customer’s account, thereby having a deposit as an additional liability and the reserve it received from Bank I through the central bank as an additional asset (step III).⁵ Assuming that Bank II does not have to execute any transfers of its customers’ deposits to Bank I, the latter will have to recover the lost reserve in order to fulfill its reserve requirements at the end of the holding period.⁶

²The use of demand deposits as a means of payment is further facilitated by the central bank, which provides the traditional banking system with both the infrastructure and the settlement media through which payments between private sector agents can be settled (see [Committee on Payment and Settlement Systems, 2003](#)).

³See [Greenham, Ryan-Collins, and Werner \(2011\)](#) and [McLeay et al. \(2014\)](#) for easily accessible discussions of how traditional banks create money in the process of loan granting.

⁴For ease of exposition this example and those which follow are kept as simple as possible. Alternatively, the customer of Bank II could spend the means of payment as well, which would then end up in someone else’s account, and so on. Notwithstanding this, whoever finally holds on to the deposit becomes the ultimate lender.

⁵For ease of exposition, it is assumed that Bank I already possesses reserves. This is, however, not a necessary condition for loan origination, as banks do have access to intraday central bank credit. See [Committee on Payment and Settlement Systems \(2012, chapter 3.2.1\)](#).

⁶Note that the creation of new deposits leaves the aggregate banking system in a reserve deficit, which has to be accommodated by the central bank if it wants to maintain its interest rate target. In jurisdictions where banks do not have to fulfill reserve requirements Bank I would try to recover the reserves

As Bank II has an excess of reserves it will, in normal times, be willing to lend the reserve back to Bank I, thereby replacing its reserve with a loan to Bank I.⁷ Bank I will then have an additional liability in the form of the loan from Bank II and a new asset in the form of the reserves (step IV).

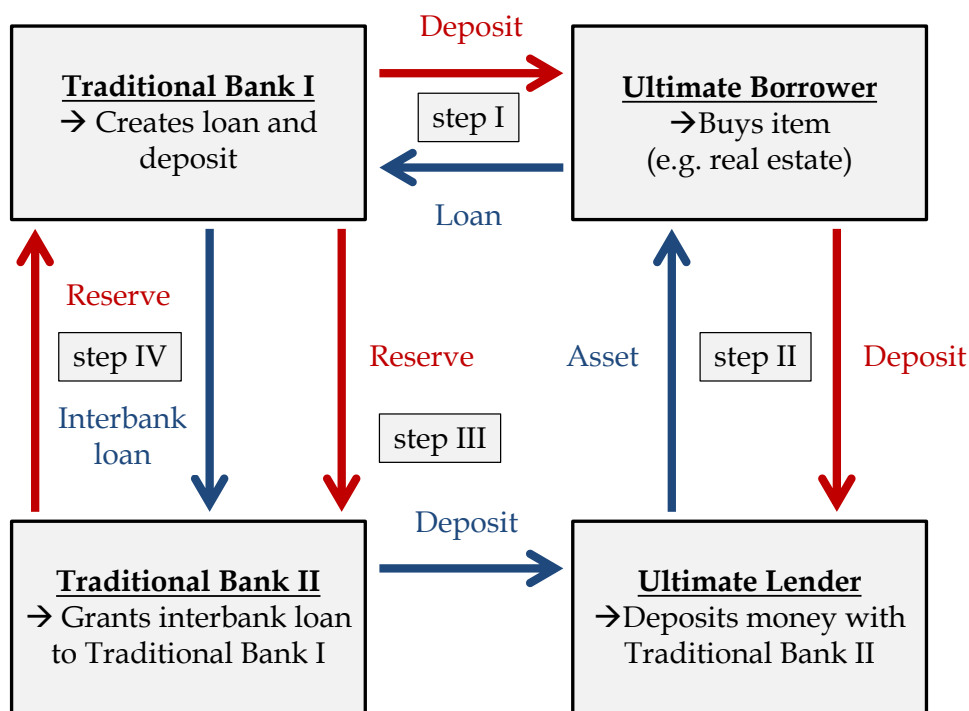


Figure 2: Credit creation: Traditional Banks – flow of funds (Source: The author’s own illustration. Notes: A red arrow indicates the direction of the flow of the means of payment in the form of the deposit or the reserve. A blue arrow indicates the direction of the flow of the asset. For ease of exposition not all interbank flows are depicted.)

In case that banks increase their lending in step, interbank loans will cancel each other out and the balance sheet of the entire traditional banking system expands continuously. As long as depositors do not run the banks and interbank markets function smoothly, the traditional banking system’s ability to expand is limited only by banks’ regulatory capital requirements as well as a sufficient amount of borrowers that the banks deem creditworthy. In consequence, credit expansion in the traditional banking sector is not subject to the laws of supply and demand to the same extent as it is for other parts of the financial system, since the traditional banking system does not have to raise funds from an agent with a surplus of means of payment before it can grant loans. Rather, it

from Bank II in order to rebuild its liquidity position.

⁷Note that until 2008 reserves held at the Fed did not bear any interest, which provided a strong incentive for traditional banks with excess reserves to reinvest them at traditional banks with a reserve deficit.

creates the means of payment lent to the ultimate borrowers in the act of lending itself (see, for example, Moore, 1988; Benes and Kumhof, 2012; Borio and Disyatat, 2010, 2011; Disyatat, 2011; McLeay et al., 2014; Jakab and Kumhof, 2015).⁸

During the boom phase of the financial cycle, it is unlikely that capital requirements become a binding constraint on lending for three reasons: Firstly, banks are highly profitable and can increase their capital base by retaining earnings. Secondly, as financial markets in general are buoyant, banks can easily issue new shares or other equity. Thirdly, as the (perceived) riskiness of borrowers decreases, risk weights of the assets held by banks are adjusted downwards, freeing regulatory capital and creating room for further balance sheet expansion. Taken together, the supply of traditional bank credit is almost infinitely elastic at the discretion of the banking system.⁹

2.2 Shadow Banks

Next, credit intermediation in the shadow banking sector is considered. Pozsar, Adrian, Ashcraft, and Boesky (2010) provide the most comprehensive characterization of the shadow banking system. Their paper describes in rich detail how the shadow banking system transforms loans into marketable securities, although they place only little emphasis on how these loans have been originated in the first place. They distinguish between three shadow banking subsystems: (1) the government-sponsored shadow banking subsystem (i.e. the government-sponsored enterprises (GSEs) Fannie Mae and Freddie Mac), (2) the "internal" shadow banking subsystem (i.e. financial holding companies (FHCs) with bank subsidiaries) and (3) the "external" shadow banking subsystem consisting of diversified broker-dealers (DBDs) and other non-bank financial specialists, such as finance companies. While the intermediation chains in all three subsystems differ in complexity and length, they have in common that they are ultimately financed on wholesale markets.

Building on the characterization of the traditional banking system in the previous subsection, this paper adds to their description of the shadow banking system by illustrating how the loans to ultimate borrowers, which later form the basis of marketable securities, are *originated*. Loan origination is understood here as the provision of a means of payment to the agent taking out a loan. Accordingly, when the funds for a borrower are provided by a traditional bank, loans that are intermediated by a mortgage broker are also identified as having been originated by the traditional bank. The same reasoning applies to loans originated by non-bank mortgage lenders that obtain the means of payment to finance the loan through a warehouse line of credit from a traditional bank, as

⁸That traditional banks differ from other financial intermediaries in their ability to create additional means of payment in the process of loan granting was a commonly accepted idea up to the 1960s (see, for example, Hayek, 1933; Mises, 1934; Wicksell, 1936). Starting with the work of Gurley and Shaw (1960) Tobin and Brainard (1963) and Tobin (1963) traditional banks lost their status as "special" financial intermediaries. See Trautwein (2000) for a synopsis of "old" and "new" views of credit intermediation and, Werner (2014) for a comprehensive literature review.

⁹This does not, of course, imply that every single bank can grant as much credit as it sees fit. However, the aggregate traditional banking system is never short of financing, since it is automatically created as a byproduct of lending. Furthermore, during the bust phase of the financial cycle, when banks' balance sheets are saddled with non-performing loans, profits are weak and capital markets are in the doldrums, capital requirements can, of course, become a binding constraint on the expansion of the traditional banking system. For a further discussion of restrictions on the expansion of traditional banks' balance sheets, see McLeay et al. (2014).

they are both economically equivalent to "genuine" loan origination by traditional banks.

As indicated by Pozsar et al. (2010, 2013), loan origination in the case of the government-sponsored shadow banking subsystem as well as the internal shadow banking subsystem is performed by traditional banks or traditional bank subsidiaries that can create the corresponding deposit to back the loan by simply crediting the borrower's account, thereby having an almost infinitely elastic supply of funds. In contrast to this, entities in the external shadow banking subsystem need to acquire deposits from an agent with a surplus of means of payment before they can actually grant a loan, and are thus much less flexible in their ability to accommodate additional credit demand. For ease of exposition, Banks I and II are consolidated into one traditional banking sector in the following paragraphs.

2.2.1 GSE Subsystem

Figure 3 below illustrates the process of credit intermediation in the GSE subsystem. Detailed changes in the respective entities' balance sheets are shown in Figure 10 in the appendix. The starting point is a situation in which the consolidated traditional banking sector has extended loans to various ultimate borrowers and deposits have increased by the same amount (step I). The ultimate borrowers used the means of payment to purchase items from other agents who, by accepting the deposits, became the ultimate lenders (step II). It is not till then that the shadow banking system enters the picture. In a next step, the GSE issues a debt security such as commercial paper, which might be purchased by the agents that just sold items to the ultimate borrowers and now have a surplus of means of payment. As a consequence, these agents' deposits are transferred to the account of the GSE, which holds them temporarily as an asset. The agents that had a surplus of means of payment have thereby conducted an asset swap: deposits for commercial paper (step III). Subsequently, the GSE uses the deposits to purchase the loans granted to the ultimate borrowers from the traditional banking sector (step IV). As a consequence, the deposits of the GSE are destroyed and bank funding of the loans has been replaced by market funding.¹⁰ Finally, the loans are bundled together to form an asset-backed security (ABS) which is then retained on the GSE's balance sheet (step V).

¹⁰For ease of exposition, the description abstracts from institutional realities. As the GSEs do have accounts at the Federal Reserve, the following sequence would be a more accurate description of payment flows: As the GSE sells commercial paper to the non-bank sector, demand deposits are destroyed and reserves flow from the traditional banks' accounts at the Federal Reserve system to the account of the GSE. When the GSE then purchases loans from the traditional banking system they are paid for by the reserves obtained from the issuance of the security. The end result is the same: Loans have been removed from the traditional banking systems' balance sheet and deposits have been replaced by market funding in the form of commercial paper.

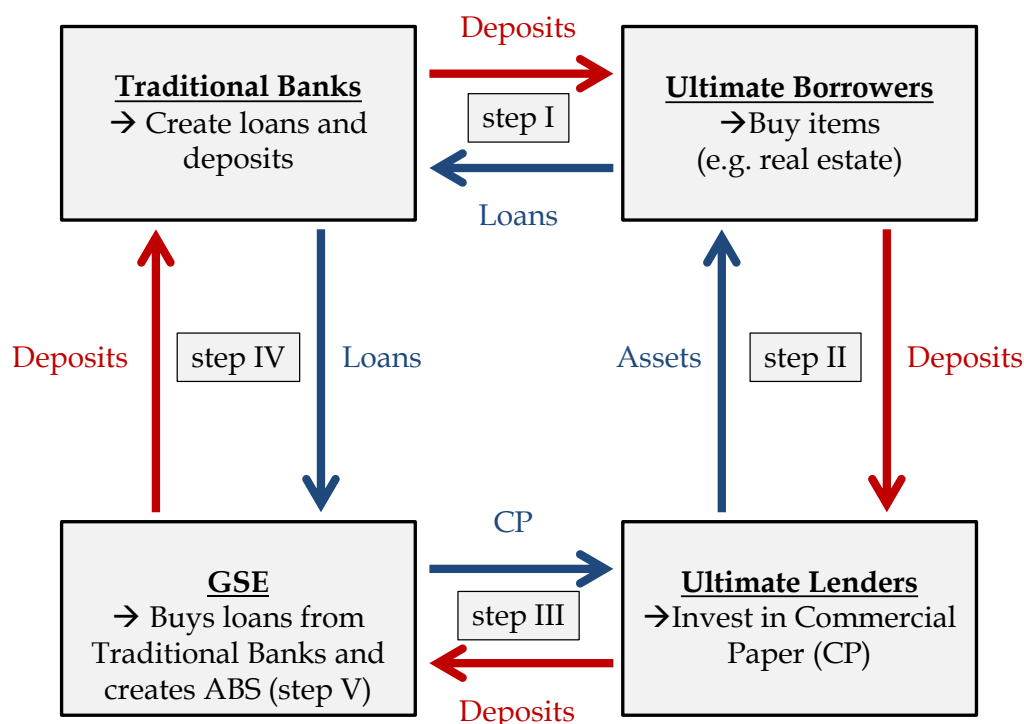


Figure 3: Credit creation: GSEs – flow of funds (Source: The author’s own illustration. Notes: A red arrow indicates the direction of the flow of the means of payment in the form of the deposit. A blue arrow indicates the direction of the flow of the asset. For ease of exposition, not all interbank flows are depicted.)

2.2.2 Internal Shadow Banking Subsystem

Figure 4 below depicts credit intermediation in the internal shadow banking subsystem, which works in a very similar way to the process in the GSE subsystem discussed in the previous paragraphs. Detailed changes in the respective entities’ balance sheets are shown in Figure 11 in the appendix. As a starting point, consider again the case in which the traditional banking system has originated new loans and created the corresponding deposits (step I). Again, the ultimate borrowers used the means of payment to purchase items from other agents, who became the ultimate lenders by accepting the deposits (step II). Subsequently, the loans are sold to the internal shadow banking system in the form of a Structured Investment Vehicle (SIV), which finances them with a temporary credit line from the sponsoring traditional banks (step III). Then, the (receivable of the) loans are securitized and transformed into asset-backed commercial paper (ABCP) which is sold, for example, to the agents that just disposed their items and now have a surplus of means of payments (step IV). These agents thereby engage in an asset swap: deposits for asset-backed commercial paper. The internal shadow bank then uses the deposits to repay the line of credit from the sponsoring traditional banks (step V). As in the case of the GSE subsystem, bank funding of loans via deposits has been replaced by market

funding.

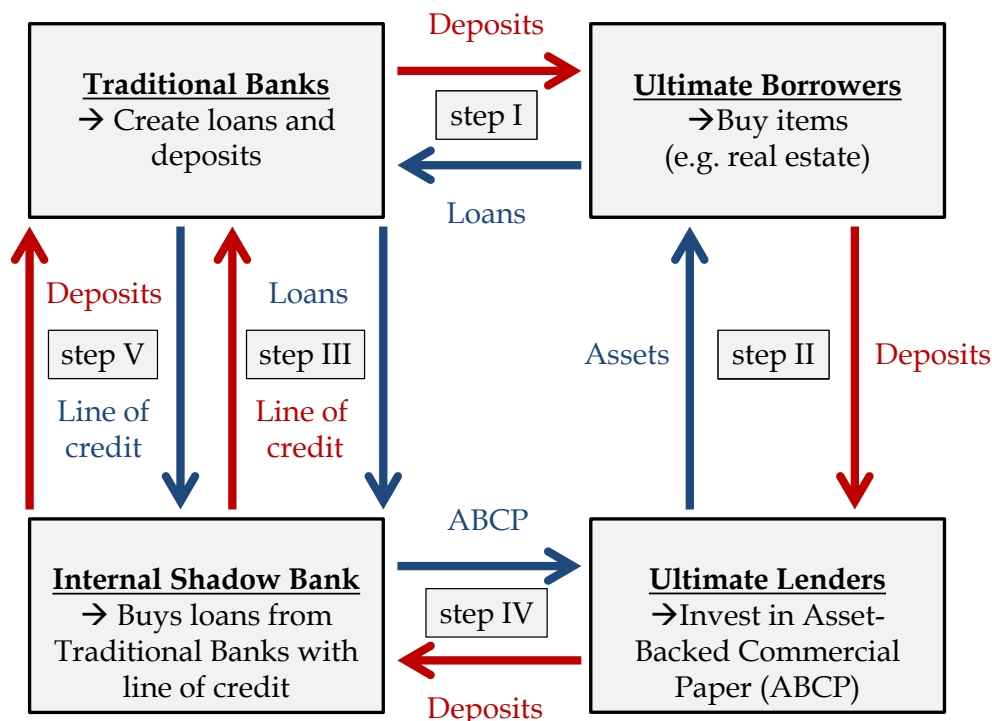


Figure 4: Credit creation: Internal Shadow Banks – flow of funds (Source: The author’s own illustration. Notes: A red arrow indicates the direction of the flow of the means of payment in the form of the deposit. A blue arrow indicates the direction of the flow of the asset. For ease of exposition, not all interbank flows are depicted.)

2.2.3 External Shadow Banking Subsystem

Finally, Figure 5 below illustrates the credit intermediation process in the external shadow banking system, exemplified by a finance company. Detailed changes in the respective entities’ balance sheets are shown in Figure 12 in the appendix. Contrary to the previous two cases, the traditional banking sector has not granted any additional loans and, accordingly, no new means of payment in the form of demand deposits have been created. Before the external shadow bank can extend credit, it has to obtain deposits from an agent with a surplus of means of payment. This can be done, for example, by issuing commercial paper (step I). The agents that exchange their deposits for the commercial paper likewise engage in an asset swap. In a second step, the external shadow bank grants a loan and instructs its corresponding traditional bank to transfer the deposits to the ultimate borrower’s account (step II). The ultimate borrower can then use the means of payment to buy an asset, for example from the ultimate lender that provided the financing for the external shadow bank in the first place (step III).

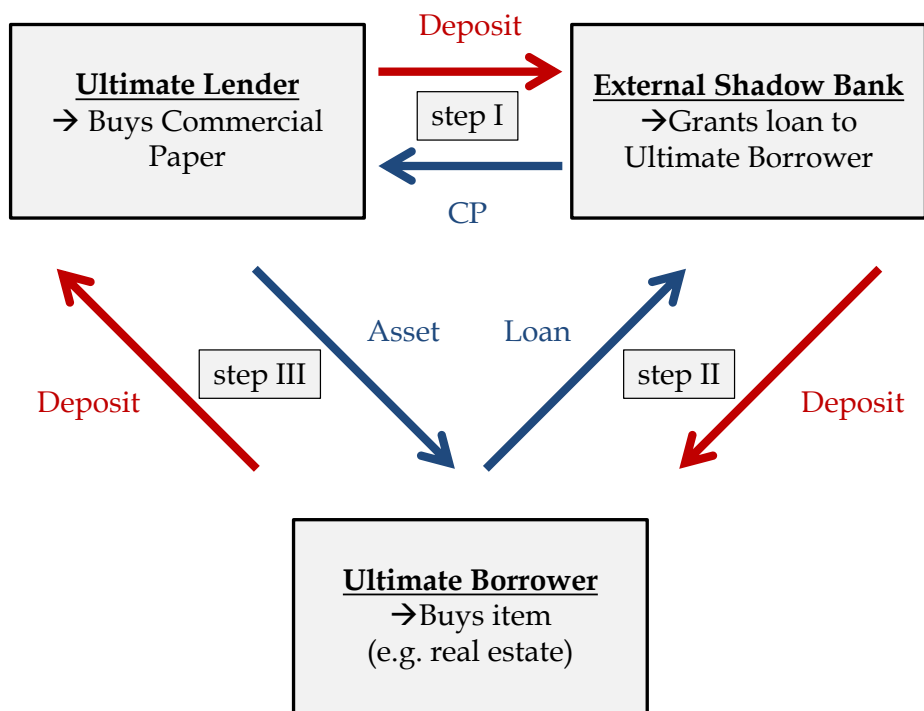


Figure 5: Credit creation: External Shadow Banks – flow of funds (Source: Own illustration. Notes: A red arrow indicates the direction of the flow of the means of payment in the form of the deposit. A blue arrow indicates the direction of the flow of the asset. For ease of exposition, not all interbank flows are depicted.)

Credit intermediation by an external shadow bank thus differs fundamentally from the process of credit intermediation in the GSE and internal shadow banking system subsystem: Both the GSE and the internal shadow bank subsystems rely on the origination of loans by traditional banks for the creation of marketable securities. The GSE and the internal shadow bank subsystems then simply transform existing claims against ultimate borrowers – the loans – and the corresponding liabilities to the ultimate lenders – the deposits – into marketable assets and liabilities. In contrast, the external shadow banking subsystem independently originates new loans and can therefore be identified as having extended additional credit to ultimate borrowers. Using financial accounts data, the next section will show in detail how the different sectors of the financial system contributed to the origination of the credit boom observed over the past decades.

3 Who created the US credit boom?

A common way of making the case that the shadow banking system has become more important than the traditional banking system in providing credit to the economy is shown in Figure 6 below (see, for example, [Adrian and Shin, 2010a](#)). It compares the volume

of financial assets held, respectively, by the traditional banking sector and all sectors that can be subsumed under the shadow banking system – the government-sponsored enterprises (GSEs), the agency- and GSE-backed mortgage pools, the security brokers and dealers, the finance companies and the ABS issuers.¹¹

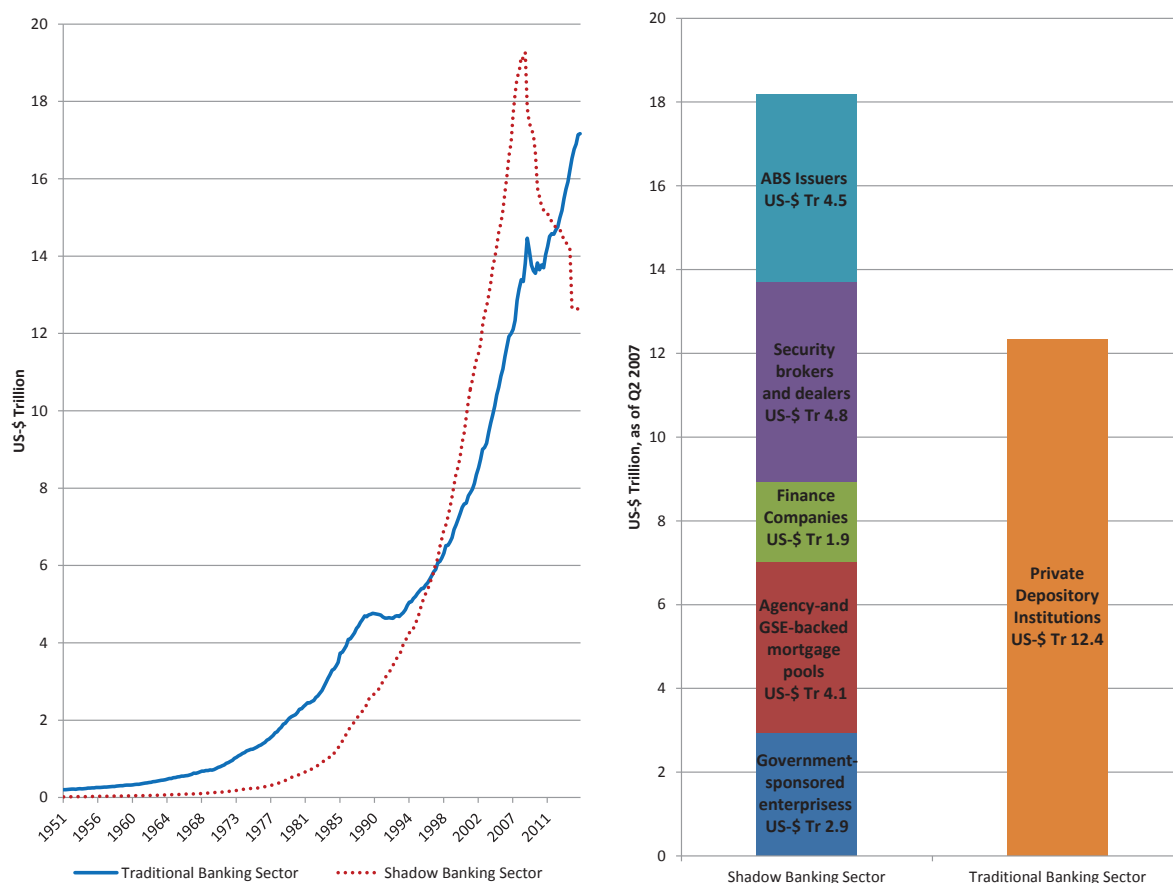


Figure 6: Financial assets by holding sector (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States, the author’s own calculations. Financial assets of the traditional banking sector correspond to total financial assets of private depository institutions. Financial assets of the shadow banking sector correspond to the sum of total financial assets of GSEs, agency- and GSE-backed mortgage pools, security brokers and dealers, finance companies and ABS issuers.)

Seen from this perspective, the shadow banking system continuously gained in importance relative to the traditional banking system up until the crisis. In 2007 Q2, shortly before the onset of the financial crisis, traditional banks accounted for around 40% of the financial assets of the combined traditional and shadow banking systems, GSEs for 9.6%, agency- and GSE-backed mortgage pools for 13.4%, ABS issuers for 14.7%, security brokers and dealers for 15.7%, and finance companies for 6.2%. Taken together, approximately 60% of the financial assets were held by shadow banks that obtain funding on the capital markets.

While the graphs in Figure 6 above paint an accurate picture with respect to the extent to which the traditional and shadow banking systems provided financing to the economy,

¹¹See <http://www.federalreserve.gov/apps/fof/> for detailed descriptions of the respective sectors.

they give a misleading account of the role played by the respective parts of the financial system to the origination of the underlying claims against the ultimate borrowers. To gain a better understanding of their importance with respect to credit origination, the assets of the various parts of the financial system have to be rearranged, depending on whether traditional banks or shadow banks originated the loans to the ultimate borrowers. As shown in the previous section, only the external shadow banking system creates new claims against ultimate borrowers. The other two subsystems of the shadow banking system – the GSEs (including the GSE mortgage pools) as well as the internal shadow banking system – simply refinance existing claims and cannot therefore be identified as having provided additional credit to ultimate borrowers on their own. Accordingly, the assets of these subsystems have to be added to those of the traditional banking system if one is interested in obtaining an accurate impression of where the credit claims came from in the first place.

As the aim of the calculation is to estimate the amounts of loan obligations of the non-financial private sector that were originated by traditional banks and shadow banks, respectively, any forms of direct financing such as bonds or equities issued on behalf of non-financial businesses and claims against sectors other than the non-financial private sector are subtracted from the total financial assets of the particular sectors. Accordingly, all cross-holdings of assets such as deposits held at traditional banks by all other sectors or the GSE securities held by traditional banks, are deducted as well. Figure 13 in the appendix shows the adjusted assets held by the traditional and shadow banking sectors calculated in this way.¹² The adjusted assets as a percentage of total financial assets correspond on average to around 64% for traditional banks, 86% for the GSEs and the GSE mortgage pools, 75% for ABS Issuers and 86% for finance companies. For the security brokers and dealers the percentage is on average a mere 0.8%, reflecting their negligible role in providing loans to the non-financial private sector.¹³ Figure 14 in the appendix shows time series for the volume of the adjusted assets as well as their share in total financial assets for the different sectors.

In a next step, these adjusted assets are divided into those assets that are originated by traditional banks and those that are originated by shadow banks. Since the adjusted assets of the GSEs and the GSE mortgage pools can easily be identified as being originated by the traditional banking system and have a corresponding counterpart in the financial accounts of the US, they are allocated to the pool of assets originated by traditional banks. The adjusted assets of the security brokers and dealers and the finance companies, which constitute the external shadow banking system, are allocated to the group of assets originated by shadow banks. The allotment of the adjusted assets of the ABS issuers is a bit more cumbersome. ABS issuers are special purpose vehicles that hold assets for both finance companies, which are a part of the external shadow banking system, and traditional banks. However, the available data do not allow for an identification of the originator of the respective assets held by ABS issuers.

To provide estimates of the assets that are originated by traditional banks and finance

¹²See Sections C and D in the appendix for a detailed description of the underlying time series and the respective calculations.

¹³Whereas securities and broker dealers play an unimportant role with regard to credit origination, they loom large in the creation of and market-making for structured debt securities.

companies, a two-step procedure is applied:¹⁴ In a first step, the respective share in the combined assets of traditional banks and finance companies is calculated for the instruments of total mortgages, consumer credit as well as other loans and advances. In a second step, the respective shares of traditional banks and finance companies in these three instruments are multiplied by the corresponding asset value of the instrument held by the ABS issuers (see Figure 15 in the appendix for the results of this calculation) and allocated to the pool of assets originated by traditional and shadow banks, respectively. Figure 7 below shows the time series for both absolute values of the assets estimated to be originated by traditional banks or shadow banks and their respective share in total origination.

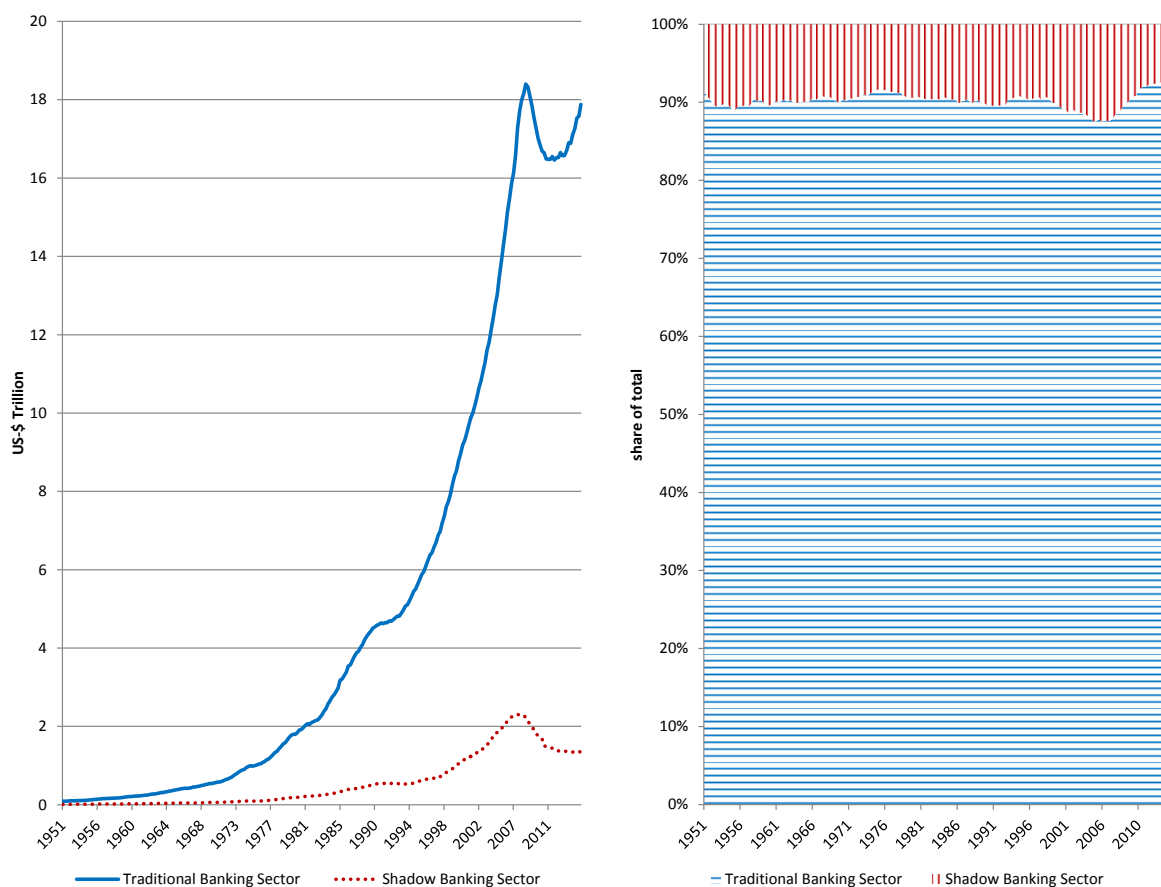


Figure 7: Adjusted assets by originating sector (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States, the author’s own calculations. The adjusted assets for the traditional banking sector correspond to all loan obligations of the non-financial private sector to depository institutions, government-sponsored enterprises, agency- and GSE-backed mortgage pools and all loan obligations of the non-financial private sector to ABS issuers estimated to be originated by the traditional banking sector. The adjusted assets for the shadow banking sector amount to all loan obligations of the non-financial private sector to security and broker dealers, finance companies and all loan obligations of the non-financial private sector to ABS issuers estimated to be originated by the shadow banking sector.

As can be inferred from the graph, the share of assets originated by shadow banks

¹⁴See Section D in the appendix for a mathematical formulation of these calculations.

steadily fluctuated around 10% until the beginning of the early 2000s. From then on, the ratio started to increase slightly, reaching a high of 12.5% in 2006 Q3. In 2007 Q2, shortly before the onset of the financial crisis, the share of loan obligations originated by shadow banks in the combined claims originated by traditional and shadow banks stood at a mere 12.1%. In absolute figures the adjusted assets which had been originated by traditional banks amounted to US\$16.6 trillion, while those that had been originated by a shadow bank stood at only US\$2.3 trillion. Accordingly, whereas the shadow banking system provided a large share of *financing* to the economy, its contribution to the *origination* of loans to the non-financial private sector was negligible.

4 Discussion

What sets traditional banks apart from all other financial institutions is their ability to issue a liability that serves the non-bank sector as a means of payment: demand deposits. In consequence, traditional banks do not face the same funding constraints as all other financial intermediaries do, making their loan supply highly elastic. As long as capital requirements are met, the traditional banking system can accommodate additional credit demand by simply creating new means of payment in the process of loan granting. When these means of payment are spent by the ultimate borrower, the agent accepting these deposits in return for the item exchanged becomes the corresponding ultimate lender.

The largest part of the shadow banking system enters the credit intermediation process only after the loans to the ultimate borrowers and the means of payment to finance them have already been created. What it then does is to transform these existing assets and liabilities and refinance them in a longer and more complex intermediation chain. By doing so, it provides an alternative store of value to institutional cash pools that do not want to hold most of their liquid assets in the form of (uninsured) demand deposits (see [Pozsar, 2011, 2014](#)). However, it does not grant any additional credit to ultimate borrowers, nor does it generate any new ultimate financing to fund these claims. Only a very small part of the shadow banking system actually extends additional credit to ultimate borrowers and can therefore be identified as having contributed to the origination of the credit boom observed over the last decades.¹⁵

The shadow banking system has arguably increased the elasticity of the traditional banking system by relaxing capital requirements. As selling loans to the GSEs or warehousing them in off-balance sheet vehicles frees scarce bank capital, the lending capacity is expanded. The question that immediately follows from this assessment is whether this relaxation of capital requirements was a necessary condition for the credit boom originated by the traditional banking system? Whereas a full-blown structural analysis is beyond the scope of this paper, I provide some back-of-the-envelope calculations to shed some first light on that question. The estimation results would suggest that holding all assets sold to the GSEs, the agency- and GSE-backed mortgage pools and the ABS issuers on the

¹⁵The above does not imply that the traditional bank is the ultimate cause of the credit creation process. For example, an institutional investor with a surplus of means of payment might approach a traditional bank and encourage it to originate new loans which could be used to produce structured securities that the institutional investor can then buy. However, the institutional investor's surplus of means of payment might, in turn, quite possibly have arisen from a deposit inflow from an agent that received the deposits created in the process of loan origination by a traditional bank.

balance sheet of the traditional banking system would have created an additional capital need of around 25.2% of the existing capital base as of 2007 Q2, a non-negligible, albeit not tremendously high figure (see the red line in the left-hand graph in Figure 8 below).¹⁶ If traditional banks had simply kept their equity base constant, the (aggregate) Tier 1 capital ratio as of 2007 Q2 would have fallen from 10.4 % to 7.4 %, and the (aggregate) total regulatory capital ratio would have declined from 12.8 % to 9.1%, which is still in line with common benchmarks (see the right-hand graph in Figure 8 below).¹⁷

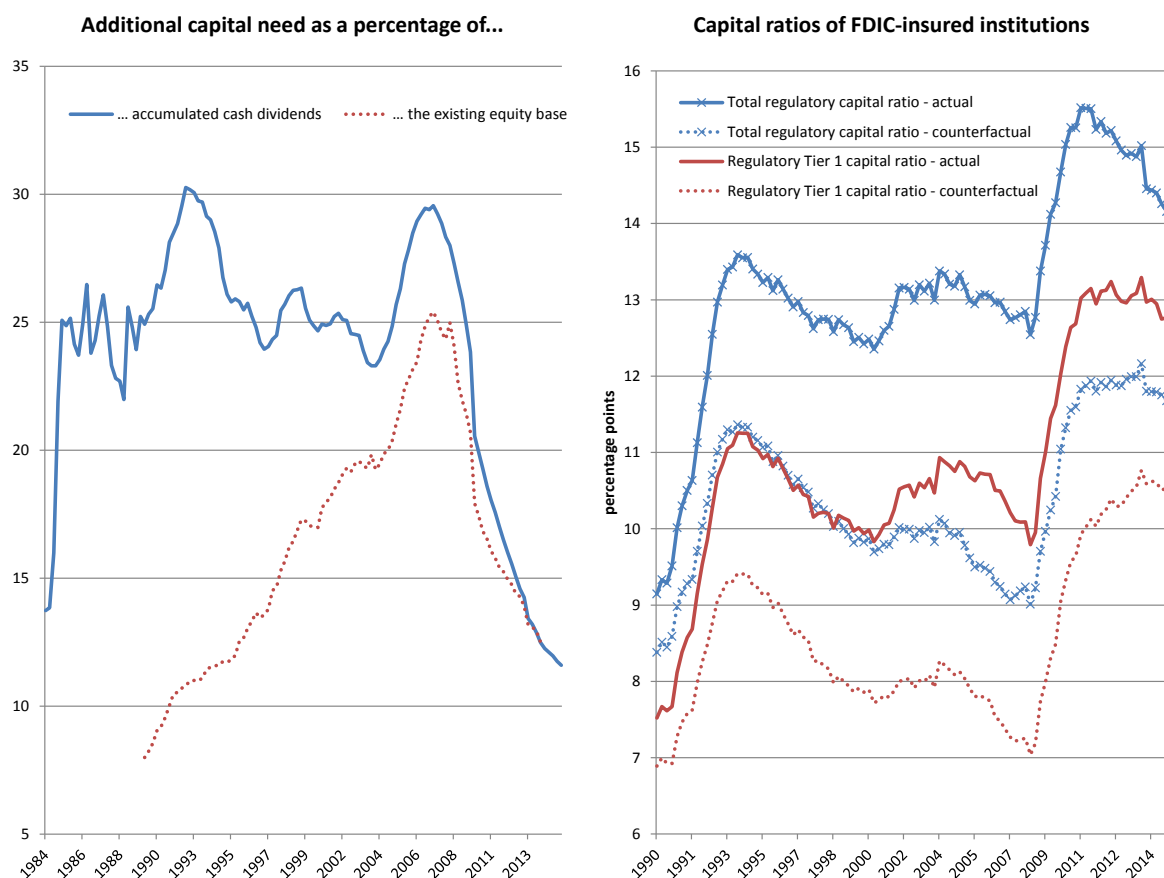


Figure 8: Additional capital need put into perspective (Source: FDIC, the author’s own calculations. For details on the calculation of the additional capital need, see Section D in the appendix. The red line in the left-hand graph shows the additional capital need arising from the change in assets between 1990 Q1, and the respective point in time as a percentage of the then existing equity base of FDIC-insured institutions. The right-hand graph displays the actual total regulatory and regulatory Tier 1 capital ratios as well as the respective counterfactual ratios, where the factual capital base is related to the sum of the factual risk-weighted assets plus the (risk-weighted) assets sold to the GSEs, the agency- and GSE-backed mortgage pools and the ABS issuers. The blue line in the left-hand graph shows the additional capital need for the accumulated flow of assets since 1984 Q1 as a percentage of the accumulated cash dividends paid out by FDIC-insured institutions over the same time period. See Section D in the appendix for details on the data sources and calculations.)

¹⁶The calculations imply an additional capital need of around US\$301 billion, compared to a total regulatory capital of US\$1,196 billion as of 2007 Q2 according to FDIC data. See Section D in the appendix for details on the data sources and calculations.

¹⁷The then prevailing Basel II framework prescribed a total regulatory capital ratio of at least 8% and a Tier 1 capital ratio of at least 4%.

An alternative way of putting the additional capital need into perspective is to relate it to the accumulated cash dividends paid out by traditional banks over the time period during which these assets were originated, where the latter can be regarded as a key metric for the capacity to generate capital through retained earnings. The additional capital need for the assets sold to the GSEs, the agency- and GSE-backed mortgage pools and the ABS issuers between 1984 Q1 (first period for which data on cash dividends is available) and 2007 Q2 amounted to 29.4% of the cash dividends payed out over the same time span. This suggests that traditional banks could have easily build up additional equity capital by retaining part of their earnings paid out as dividends (see the blue line in the left-hand graph in Figure 8 above).¹⁸ As a last resort, traditional banks could have issued new shares.¹⁹ Taken together, the calculations suggest that the traditional banking system would most likely have had the financial capacity to hold the loans on its balance sheet.

However, it might still be argued that banks would have been unwilling to originate all these loans if they would have needed to keep them on their balance sheet. Indeed, empirical studies (see, for example, [Mian and Sufi, 2009](#); [Keys, Mukherjee, Seru, and Vig, 2010](#)) suggest that the securitization process reduced financial intermediaries' incentives to thoroughly screen subprime borrowers and thereby expanded the supply of credit.²⁰ However, the main reason for traditional banks offloading loans from their balance sheet was to take advantage of regulatory arbitrage opportunities (see [Acharya, Schnabl, and Suarez, 2013](#)). By providing explicit guarantees on the securities held off-balance they remained exposed to the corresponding credit risk, suggesting that they believed, at least to some extent, in the soundness of their investments.

All in all, it remains unclear how many of the loans would have been extended if traditional banks had needed to carry them on their own balance sheets. Notwithstanding this uncertainty, even if traditional banks had been unwilling to grant loans of dubious credit quality if it had not been for the possibility of offloading them to the shadow banking system, the latter would have needed the traditional banking system's ability to create new means of payment in order to grant loans of the magnitude witnessed during the credit boom. Taken as a whole, the emergence of the shadow banking system was conceivably a necessary, albeit not a sufficient condition for the credit boom observed over the past decades.

This dependence of the shadow banking system on the traditional banking system can be nicely illustrated by the pro-cyclical behavior of the security brokers and dealers, as documented in [Adrian and Shin \(2010b\)](#). The authors show that an improvement in

¹⁸Accumulated cash dividends for the period 1984 Q1 to 2007 Q2 amounted to US\$1000 billion according to FDIC data. See Section D in the appendix for details on the data sources. The increase in the adjusted assets of the GSEs, the agency- and GSE-backed mortgage pools and the adjusted assets of ABS issuers allocated to traditional banks over the same time period would imply an additional capital need of around US\$294 billion. Note that the cash dividends paid out would have been enough to cover the additional capital need in every individual quarter between 1984 Q1 and 2007 Q2.

¹⁹The perspective taken here is inevitably static. Using parts of the earnings paid out as cash dividends to increase the capital basis, taken by itself, would have reduced the return on equity and made it more difficult to sell shares. At the same time, keeping the loans on their balance sheets would have provided the traditional banking system with a steady income stream instead of a one-off fee for the loan origination, thereby increasing profits and dividend payouts.

²⁰While confirming the findings cited above, [DellAriccia, Igan, and Laeven \(2012\)](#) find that demand factors likewise contributed to a relaxation of lending standards and the expansion of credit.

economic fundamentals increases the market value of assets and thus the net worth of the security brokers and dealers, which allows an increase in leverage. However, to take advantage of this opportunity, the security brokers and dealers have to find new assets to invest in and acquire additional funds to finance the expansion of their balance sheets.

If traditional banks had not increased both the supply of assets – the loans issued to ultimate borrowers which serve as the basis for structured debt securities – as well as the supply of means of payment to finance these assets – the deposits that the ultimate lenders accepted in exchange for the item sold to the ultimate borrower – the room for balance sheet expansion would have been much smaller and the pro-cyclicality of the security brokers and dealers strongly reduced. This point is made more formally in [Jakab and Kumhof \(2015\)](#). They show that changes in bank lending are far larger, happen much faster, and have much larger effects on the real economy in a DGSE model where banks can create additional means of payment in the lending process than in models where financial intermediaries rely solely on an inflexible supply of loanable funds.

In conclusion, all the points made above should not be interpreted as suggesting that the shadow banking system should be left unregulated. Given the inherent fragility of its funding model, regulators have rightly implemented various policy measures that aim at making the shadow banking system more stable. Notwithstanding these positive achievements, the findings of the paper seem to suggest that dampening credit creation by the traditional banking sector might be an additional policy instrument to reduce the build-up of systemic risk in the shadow banking system.

A Balance sheets

	Traditional Bank I		Traditional Bank II		Ultimate Borrower		Ultimate Lender	
	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
step I	Loan ↑ Reserves	↑ Deposits Equity	Reserves	Equity	Deposits ↑ ↑ Loan		Real estate Net worth	
step II	Reserves Loan	Deposits Equity	Reserves	Equity	Real estate ↑ Deposits ↓	Loan	Deposits ↑ Real estate ↓	Net worth
step III	Reserves ↓ Loan	↓ Deposits Equity	Reserves ↑ Reserves	↑ Deposits Equity	Real estate	Loan	Deposits	Net worth
step IV	Reserves ↑ Loan	↑ Loan TB II Equity	Loan TB I ↑ Reserves ↓ Reserves	Deposits Equity	Real estate	Loan	Deposits	Net worth
final balance sheets	Reserves Loan	Loan TB II Equity	Loan TB I Reserves	Deposits Equity	Real estate	Loan	Deposits	Net worth

Figure 9: Credit creation: Traditional Banks – balance sheets (Source: The author’s own illustration. Notes: Balance sheet items highlighted in red and blue represent *stocks* of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent *flows* of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

	Traditional Banks	GSE	Ultimate Borrowers	Ultimate Lenders																						
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Figure 10: Credit creation: GSEs – balance sheets (Source: The author’s own illustration. Notes: Balance sheet items highlighted in red and blue represent *stocks* of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent *flows* of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

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step IV	<table border="1"> <tr> <td>Loan ISB</td> <td>↑↓ Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Loan ISB	↑↓ Deposits	Reserves	Equity	<table border="1"> <tr> <td>Deposits ↑</td> <td>↑ ABCP</td> </tr> <tr> <td>Loans</td> <td>Loan CB</td> </tr> </table>	Deposits ↑	↑ ABCP	Loans	Loan CB	<table border="1"> <tr> <td>Real estate</td> <td>Loans</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Real estate	Loans			<table border="1"> <tr> <td>ABCP ↑</td> <td></td> </tr> <tr> <td>Deposits ↓</td> <td>Net worth</td> </tr> </table>	ABCP ↑		Deposits ↓	Net worth		
Loan ISB	↑↓ Deposits																					
Reserves	Equity																					
Deposits ↑	↑ ABCP																					
Loans	Loan CB																					
Real estate	Loans																					
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step V	<table border="1"> <tr> <td>Loan ISB ↓</td> <td>↓ Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Loan ISB ↓	↓ Deposits	Reserves	Equity	<table border="1"> <tr> <td>Deposits ↓</td> <td>↓ Loan ISB</td> </tr> <tr> <td>Loans</td> <td>ABCP</td> </tr> </table>	Deposits ↓	↓ Loan ISB	Loans	ABCP	<table border="1"> <tr> <td>Real estate</td> <td>Loans</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Real estate	Loans			<table border="1"> <tr> <td>ABCP</td> <td>Net worth</td> </tr> <tr> <td></td> <td></td> </tr> </table>	ABCP	Net worth				
Loan ISB ↓	↓ Deposits																					
Reserves	Equity																					
Deposits ↓	↓ Loan ISB																					
Loans	ABCP																					
Real estate	Loans																					
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final balance sheets	<table border="1"> <tr> <td>Reserves</td> <td>Equity</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Reserves	Equity			<table border="1"> <tr> <td>Loans</td> <td>ABCP</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Loans	ABCP			<table border="1"> <tr> <td>Real estate</td> <td>Loans</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Real estate	Loans			<table border="1"> <tr> <td>ABCP</td> <td>Net worth</td> </tr> <tr> <td></td> <td></td> </tr> </table>	ABCP	Net worth				
Reserves	Equity																					
Loans	ABCP																					
Real estate	Loans																					
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Figure 11: Credit creation: Internal Shadow Banks – balance sheets (Source: The author’s own illustration. Notes: Balance sheet items highlighted in red and blue represent *stocks* of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent *flows* of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

	Traditional Banks	External Shadow Bank	Ultimate Borrower	Ultimate Lender														
	<i>Assets</i>	<i>Liabilities</i>	<i>Assets</i>	<i>Liabilities</i>														
step I	<table border="1"> <tr> <td>Real estate</td> <td>↑↓ Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Real estate	↑↓ Deposits	Reserves	Equity	<table border="1"> <tr> <td>Deposits ↑</td> <td>↑ CP</td> </tr> </table>	Deposits ↑	↑ CP	<table border="1"> <tr> <td></td> <td></td> </tr> </table>			<table border="1"> <tr> <td>CP ↑</td> <td rowspan="3">Net worth</td> </tr> <tr> <td>Deposits ↓</td> </tr> <tr> <td>Real estate</td> </tr> </table>	CP ↑	Net worth	Deposits ↓	Real estate		
Real estate	↑↓ Deposits																	
Reserves	Equity																	
Deposits ↑	↑ CP																	
CP ↑	Net worth																	
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step II	<table border="1"> <tr> <td>Real estate</td> <td>↑↓ Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Real estate	↑↓ Deposits	Reserves	Equity	<table border="1"> <tr> <td>Loan ↑</td> <td></td> </tr> <tr> <td>Deposits ↓</td> <td>CP</td> </tr> </table>	Loan ↑		Deposits ↓	CP	<table border="1"> <tr> <td>Deposits ↑</td> <td>↑ Loan</td> </tr> </table>	Deposits ↑	↑ Loan	<table border="1"> <tr> <td>CP</td> <td rowspan="3">Net worth</td> </tr> <tr> <td>Real estate</td> </tr> <tr> <td></td> </tr> </table>	CP	Net worth	Real estate	
Real estate	↑↓ Deposits																	
Reserves	Equity																	
Loan ↑																		
Deposits ↓	CP																	
Deposits ↑	↑ Loan																	
CP	Net worth																	
Real estate																		
step III	<table border="1"> <tr> <td>Real estate</td> <td>↑↓ Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Real estate	↑↓ Deposits	Reserves	Equity	<table border="1"> <tr> <td>Loan</td> <td>CP</td> </tr> </table>	Loan	CP	<table border="1"> <tr> <td>Real estate ↑</td> <td></td> </tr> <tr> <td>Deposits ↓</td> <td>Loan</td> </tr> </table>	Real estate ↑		Deposits ↓	Loan	<table border="1"> <tr> <td>Deposits ↑</td> <td rowspan="3">Net worth</td> </tr> <tr> <td>Real estate ↓</td> </tr> <tr> <td>CP</td> </tr> </table>	Deposits ↑	Net worth	Real estate ↓	CP
Real estate	↑↓ Deposits																	
Reserves	Equity																	
Loan	CP																	
Real estate ↑																		
Deposits ↓	Loan																	
Deposits ↑	Net worth																	
Real estate ↓																		
CP																		
final balance sheets	<table border="1"> <tr> <td>Real estate</td> <td>Deposits</td> </tr> <tr> <td>Reserves</td> <td>Equity</td> </tr> </table>	Real estate	Deposits	Reserves	Equity	<table border="1"> <tr> <td>Loan</td> <td>CP</td> </tr> </table>	Loan	CP	<table border="1"> <tr> <td>Real estate</td> <td>Loan</td> </tr> </table>	Real estate	Loan	<table border="1"> <tr> <td>Deposits</td> <td rowspan="2">Net worth</td> </tr> <tr> <td>CP</td> </tr> </table>	Deposits	Net worth	CP			
Real estate	Deposits																	
Reserves	Equity																	
Loan	CP																	
Real estate	Loan																	
Deposits	Net worth																	
CP																		

Figure 12: Credit creation: External Shadow Banks – balance sheets (Source: The author’s own illustration. Notes: Balance sheet items highlighted in red and blue represent *stocks* of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent *flows* of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

B Additional graphs

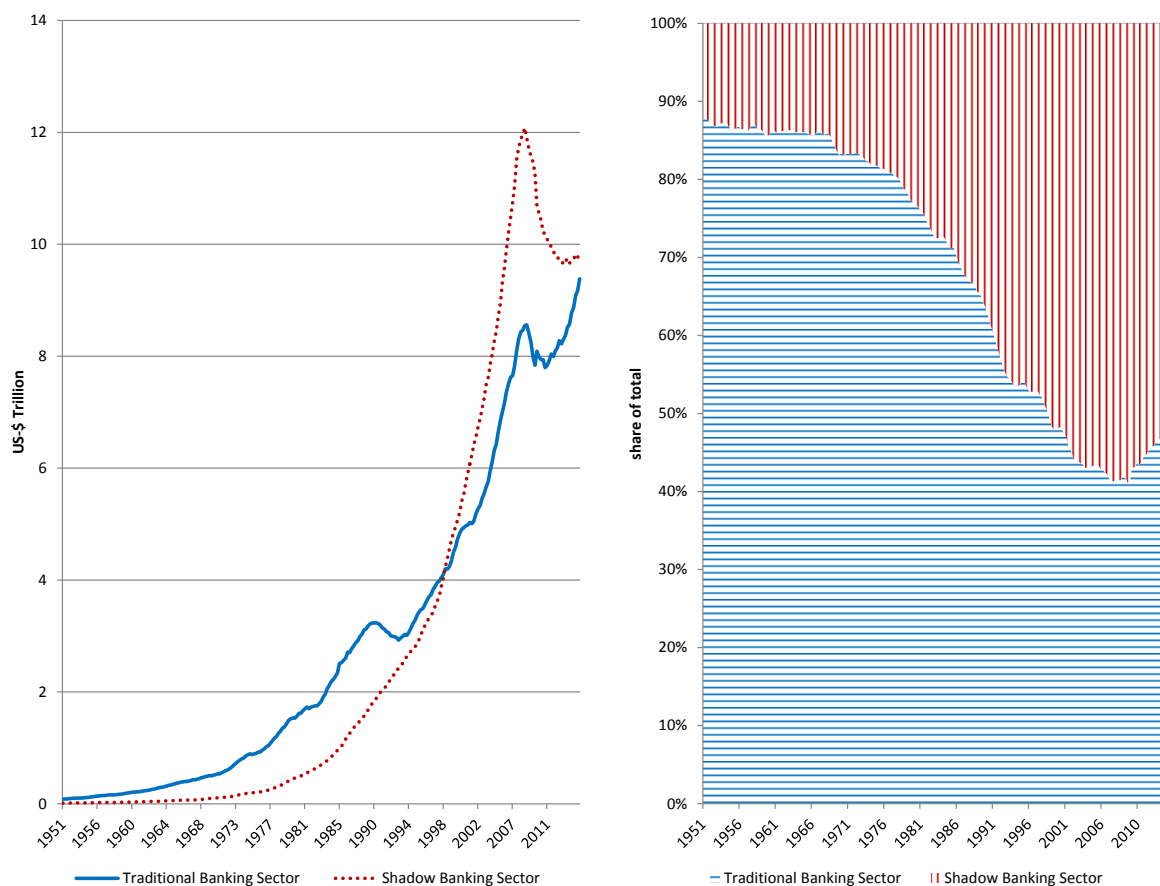


Figure 13: Adjusted assets by holding sector (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States, the author's own calculations. The adjusted assets of the traditional banking sector correspond to all loan obligations of the non-financial private sector to private depository institutions. The adjusted assets of the shadow banking sector correspond to the sum of all loan obligations of the non-financial private sector to GSEs, agency- and GSE-backed mortgage pools, security brokers and dealers, finance companies and ABS issuers. See sections C and D in the appendix for a detailed description of the underlying time series and the calculations.)

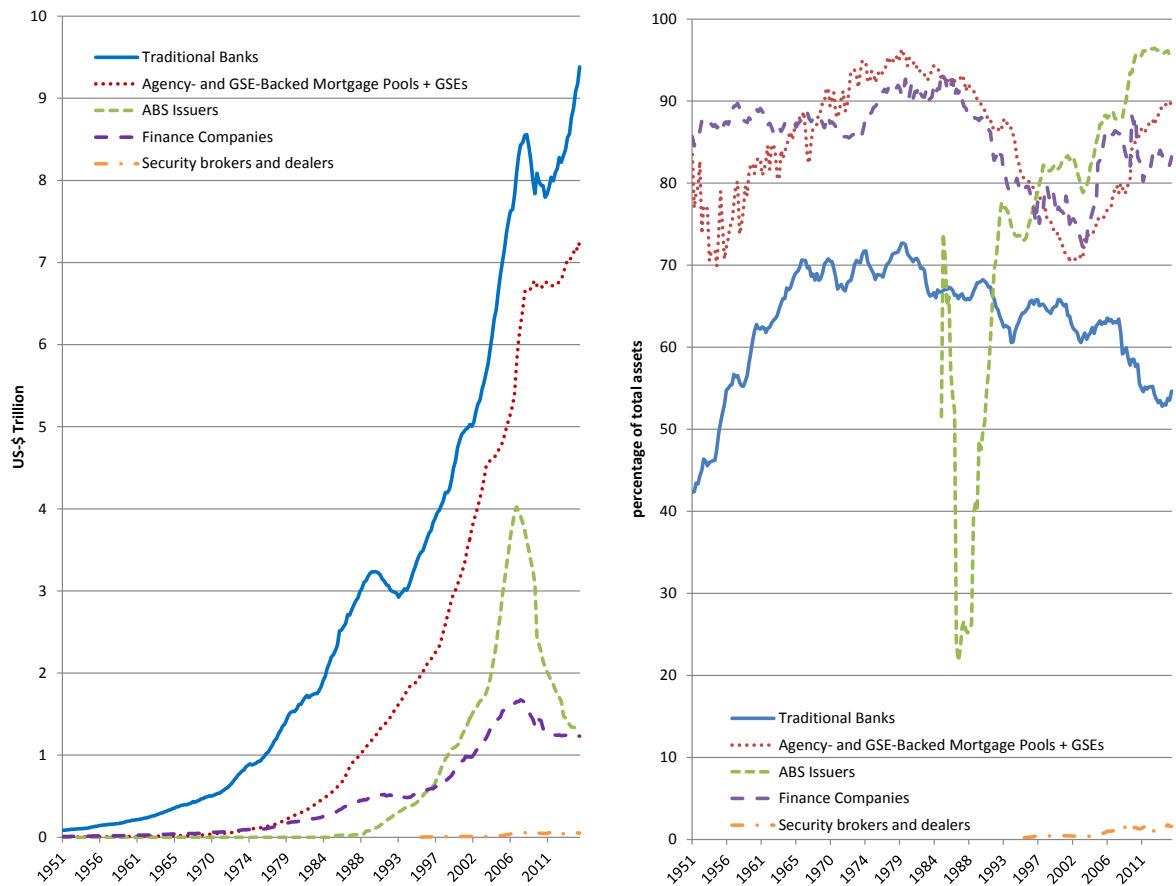


Figure 14: Adjusted assets by holding sector (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States, the author's own calculations. The adjusted assets correspond to all loan obligations of the non-financial private sector to the respective sector. See sections C and D in the appendix for a detailed description of the underlying time series and the calculations.)

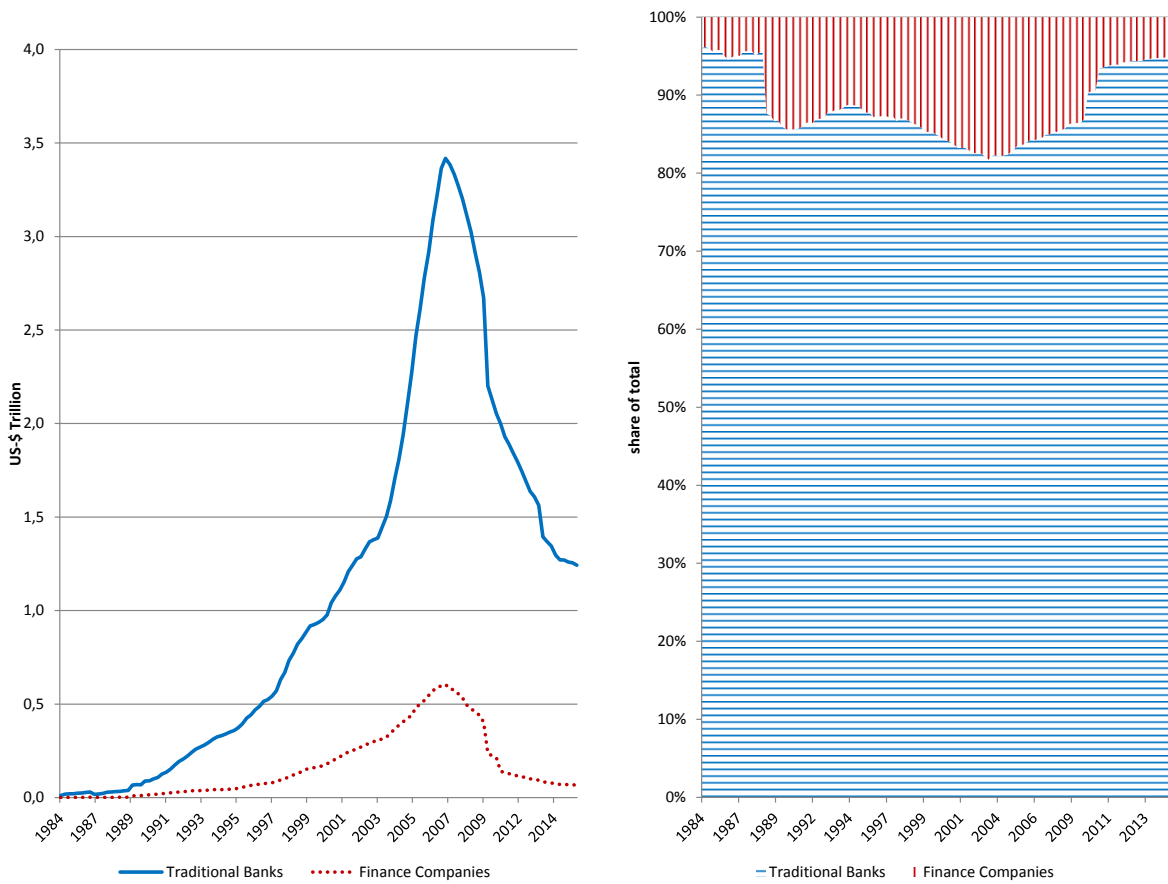


Figure 15: Assets held by ABS Issuers by originating sector (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States, the author's own calculations. The assets held by ABS issuers by originating sector correspond to the respective shares of traditional banks and finance companies in the instruments total mortgages, consumer credit as well as other loans and advances multiplied with the corresponding asset value of the instrument held by the ABS issuer. See section D in the appendix for details on the calculations.)

C Financial accounts data

Variable name	Series description	Unique identifier
PDI^{tfa}	Private depository institutions; total financial assets	Z1/Z1/FL704090005.Q
PDI^{lnec}	Private depository institutions; depository institution loans n.e.c.; asset	Z1/Z1/FL703068005.Q
PDI^{ola}	Private depository institutions; other loans and advances; asset	Z1/Z1/FL703069005.Q
PDI^{tm}	Private depository institutions; total mortgages; asset	Z1/Z1/FL703065005.Q
PDI^{cc}	Private depository institutions; consumer credit; asset	Z1/Z1/FL703066005.Q
GSE^{tfa}	Government-sponsored enterprises; total financial assets	Z1/Z1/FL404090005.Q
GSE^{tm}	Government-sponsored enterprises; total mortgages; asset	Z1/Z1/FL403065005.Q
GSE^{ola}	Government-sponsored enterprises; FHLB, Farm Credit System, and Sallie Mae loans; asset	Z1/Z1/FL403069305.Q
$GSEMP^{tm}$	agency- and GSE-backed mortgage pools; total mortgages; asset	Z1/Z1/FL413065005.Q
$IABS^{tfa}$	Issuers of asset-backed securities; total financial assets	Z1/Z1/FL674090005.Q
$IABS^{ola}$	Issuers of asset-backed securities; securitized other loans and advances; asset	Z1/Z1/FL673069005.Q
$IABS^{tm}$	Issuers of asset-backed securities; total mortgages; asset	Z1/Z1/FL673065005.Q
$IABS^{cc}$	Issuers of asset-backed securities; consumer credit; asset	Z1/Z1/FL673066000.Q
FC^{tfa}	Finance companies; total financial assets	Z1/Z1/FL614090005.Q
FC^{mfb}	Finance companies; nonfinancial business loans; asset	Z1/Z1/FL613069500.Q
FC^{tm}	Finance companies; total mortgages; asset	Z1/Z1/FL613065000.Q
FC^{cc}	Finance companies; consumer credit; asset	Z1/Z1/FL613066005.Q
SBD^{tfa}	Security brokers and dealers; total financial assets	Z1/Z1/FL664090005.Q
SBD^{nfb}	Security brokers and dealers; syndicated loans to nonfinancial corporate business; asset	Z1/Z1/FL663069803.Q

Table 1: Financial accounts time series used in calculations (Source: Board of Governors of the Federal Reserve: Financial Accounts of the United States. Available at <http://www.federalreserve.gov/apps/fof/FOFTables.aspx>.)

D Calculation of variables

Total financial assets by holding sector at time t for the traditional banking system TBS_t^{tfa} and the shadow banking system SBS_t^{tfa} are calculated in the following way:

$$TBS_t^{tfa} = PDI_t^{tfa} \quad (1)$$

$$SBS_t^{tfa} = GSE_t^{tfa} + IABS_t^{tfa} + FC_t^{tfa} + SBD_t^{tfa} \quad (2)$$

The adjusted assets by holding sector at time t are calculated as follows:

$$PDI_t^{aah} = PDI_t^{lnec} + PDI_t^{ola} + PDI_t^{tm} + PDI_t^{cc} \quad (3)$$

where PDI_t^{aah} equals the adjusted assets of the traditional banking sector at time t .

$$GSE_t^{aah} = GSE_t^{tm} + GSE_t^{ola} + GSEMP_t^{tm} \quad (4)$$

where GSE_t^{aah} equals the adjusted assets of the government-sponsored enterprises (including the agency- and GSE-backed mortgage pools) at time t .

$$IABS_t^{aah} = IABS_t^{ola} + IABS_t^{tm} + IABS_t^{cc} \quad (5)$$

where $IABS_t^{aah}$ equals the adjusted assets of the issuers of asset-backed securities at time t .

$$FC_t^{aah} = FC_t^{nfb} + FC_t^{tm} + FC_t^{cc} \quad (6)$$

where FC_t^{aah} equals the adjusted assets of the finance companies at time t .

$$SBD_t^{aah} = SBD_t^{nfb} \quad (7)$$

where SBD_t^{aah} equals the adjusted assets of the security brokers and dealers at time t .

The adjusted assets by holding sector for the traditional banking system TBS_t^{aah} and the shadow banking system SBS_t^{aah} at time t are calculated in the following way:

$$TBS_t^{aah} = PDI_t^{aah} \quad (8)$$

$$SBS_t^{aah} = GSE_t^{aah} + IABS_t^{aah} + FC_t^{aah} + SBD_t^{aah} \quad (9)$$

The adjusted assets held by ABS issuers estimated to have been originated by tradi-

tional banks PDI_t^{ABS} and finance companies FC_t^{ABS} at time t are calculated as follows:

$$\begin{aligned}
PDI_t^{ABS} = & IABS_t^{ola} \times \frac{(PDI_t^{lnec} + PDI_t^{ola})}{(PDI_t^{lnec} + PDI_t^{ola} + FC_t^{nfb})} \\
& + IABS_t^{tm} \times \frac{PDI_t^{tm}}{(PDI_t^{tm} + FC_t^{tm})} \\
& + IABS_t^{cc} \times \frac{PDI_t^{cc}}{(PDI_t^{cc} + FC_t^{cc})}
\end{aligned} \tag{10}$$

$$\begin{aligned}
FC_t^{ABS} = & IABS_t^{ola} \times \frac{FC_t^{nfb}}{(PDI_t^{lnec} + PDI_t^{ola} + FC_t^{nfb})} \\
& + IABS_t^{tm} \times \frac{FC_t^{tm}}{(PDI_t^{tm} + FC_t^{tm})} \\
& + IABS_t^{cc} \times \frac{FC_t^{cc}}{(PDI_t^{cc} + FC_t^{cc})}
\end{aligned} \tag{11}$$

Finally, the adjusted assets by originating sector for the traditional banking system TBS_t^{aao} and the shadow banking system SBS_t^{aao} at time t are calculated in the following way:

$$TBS_t^{aao} = PDI_t^{aah} + GSE_t^{aah} + PDI_t^{ABS} \tag{12}$$

$$SBS_t^{aao} = FC_t^{aah} + SBD_t^{aah} + FC_t^{ABS} \tag{13}$$

For the calculation of the additional capital need that would have arisen had the traditional banks held all the assets sold to the GSEs, the agency- and GSE-backed mortgage pools and the ABS issuers on their own balance sheets, it is assumed that mortgages and other loans held by the GSEs and the agency- and GSE-backed mortgage pools have a risk weight of 20%. For mortgages, consumer loans and other loans and advances held by ABS issuers and estimated to have been originated by traditional banks a risk weight of 75%, 100% and 100% is assigned. The risk weighted assets claims are assumed to create a capital charge of 8%. Accordingly, the additional capital requirement $capneed_t$ at time t is calculated as follows:

$$\begin{aligned}
capneed_t = & GSE_t^{aah} \times 0.2 \times 0.08 \\
& + (IABS_t^{tm} \times \frac{PDI_t^{tm}}{(PDI_t^{tm} + FC_t^{tm})} \times 0.75 \times 0.08) \\
& + (IABS_t^{ola} \times \frac{(PDI_t^{lnec} + PDI_t^{ola})}{(PDI_t^{lnec} + PDI_t^{ola} + FC_t^{nfb})} \times 1.0 \times 0.08) \\
& + (IABS_t^{cc} \times \frac{PDI_t^{cc}}{(PDI_t^{cc} + FC_t^{cc})} \times 1.0 \times 0.08)
\end{aligned} \tag{14}$$

All calculations for the capital need put into perspective as shown in figure 14 are based on data from the Balance Sheet, the Quarterly Income and the Ratios By Asset Size Group statements provided by the FDIC on <https://www2.fdic.gov/qbp/>. The additional capital need as a percentage of accumulated cash dividends $(\frac{capneed}{div})_t$ at time t is calculated in the following way:

$$(\frac{capneed}{div})_t = \frac{capneed_t}{\sum_{Q1.1984}^t div_t} \quad (15)$$

where $capneed_t$ is the additional capital need as calculated above and $\sum_{Q1.1984}^t div_t$ equals the accumulated cash dividends between 1984 Q1 and time t according to the Quarterly Income statement of the FDIC.

Accordingly, the additional capital need as a percentage of the existing capital base $(\frac{capneed}{equity})_t$ at time t is calculated as follows:

$$(\frac{capneed}{equity})_t = \frac{capneed_t}{totalcap_t} \quad (16)$$

where $capneed_t$ is the additional capital need as calculated above and $totalcap_t$ corresponds to the total risk based capital (PCA definition) at time t according to the Balance Sheet statement of the FDIC.

The total regulatory capital ratio CAR_t and the regulatory Tier 1 capital ratio $T1R_t$ correspond to the Total Risk-Based Capital Ratio (PCA) and the Tier 1 Risk-Based Capital Ratio (PCA) at time t according to the Ratios By Asset Size Group statement of the FDIC. The counterfactual capital ratios are calculated as follows:

$$CAR_t^{counter} = \frac{totalcap_t}{(RWA_t + capneed_t * \frac{1}{0.08})} \quad (17)$$

$$T1R_t^{counter} = \frac{tier1cap_t}{(RWA_t + capneed_t * \frac{1}{0.08})} \quad (18)$$

where RWA_t correspond to the risk-weighted assets at time t . They are calculated by multiplying the Risk-Weighted Assets to Total Assets ratio from the Ratios By Asset Size Group statement of the FDIC with Total Assets according to the Balance Sheet statement of the FDIC. $tier1cap_t$ corresponds to the Tier 1 risk-based capital (PCA definition) according to the Balance Sheet statement of the FDIC at time t . $capneed_t$ is multiplied by $\frac{1}{0.08}$ to translate the additional capital need into the corresponding risk-weighted assets.

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