How Do You Complete the Picture of Credit Intermediation? Production and Consumption of Shadow Banking Services in the United States

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This paper measures credit intermediation services supplied by the "shadow banking system" of the United States. We adapt the reference-rate approach used to measure services supplied by commercial banks in the US national accounts by: (a) introducing aggregation methods that avoid double-counting as assets and liabilities pass through a chain of financial intermediaries, and (b) measuring margins from market information rather than regulatory information. The resulting measures reveal that: (1) shadow bank services (% of GDP) peaked in 2002, when the sector's gross production of services was almost as large as implicit services supplied by traditional banks; (2) shadow bank services fell after 2004 and were a drag on economic activity leading into and during the Great Recession; and (3) shadow banks supply depositor services largely to one another; thus the sector's main contribution to the wider economy is provision of borrower services.

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The migration of credit intermediation activity away from traditional banks created conditions that made a financial crisis possible, and a series of runs on what has come to be called "the shadow banking system" played a central role in the financial crisis of 2007-2008.[1] Although traditional depository institutions remain important in the overall credit intermediation process in the US, the shift towards intermediaries lacking government and monetary authority backstops is striking: Depository institutions held less than half (about 40 percent) of the loan liabilities of nonfinancial sectors in 2007, down from nearly 100 percent forty years earlier (Corrado, Reinsdorf, and Hood, 2012, figure 3, p. 8). Similarly, by 2007 deposits had fallen to around a third of the liabilities of credit intermediaries, down from around 85 percent in the mid-Seventies (see appendix A).

Measuring the size and growth of the nonbank intermediaries that comprise the shadow banking sector is an active research topic. Much of the work approaches the issue via balance sheet positions (Pozsar, Adrian, Ashcraft, and Boesky, 2010, 2013; Gorton, Lewellen, and Metrick, 2012; Gallin, 2013). In this paper we take a different approach and measure the size and growth of the shadow banking sector by its production of credit intermediation services. In other words, we take an output approach.

Other things being equal, measures based on balance sheet size are likely to overstate the relative importance of shadow banking in credit intermediation activity for two reasons. First, interest rate margins tend to be more compressed at shadow banks than at traditional banks, and these margins determine the revenue used to measure output of credit intermediation services. Ratios of services to assets or liabilities therefore tend to be smaller for shadow banks than for traditional banks. Shadow banks do not provide the same range of retail services as traditional banks: they do not have extensive ATM networks, automatic bill payment programs or friendly teller windows, for example, so this is unsurprising. Thus, while shadow banks provide the liquidity transformation services that are a central component of credit intermediation (Diamond and Dybvig, 1983), they eliminate many of the services provided by "brick and mortar" banks. Second, in the shadow banking system, the intermediation process tends to be broken in multiple steps done by specialized institutions (as documented, e.g., by Adrian and Shin, 2010), so the shadow bank assets generated by a loan to a final borrower can be a multiple of the amount of the loan. By using methods developed and applied in this paper, the output approach avoids this double counting. An output approach also makes possible comparisons of shadow banking activity with traditional banking activity and with overall economic activity as measured by GDP.[2]

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[1] Runs on instruments associated with shadow banking during the financial crisis are the basis of an extensive literature. For example, Kacperczyk and Schnabl (2010) and Covitz, Liang, and Suarez (2013) argue that a run on asset-backed commercial paper (CP) was an important contributor to the early part of the crisis. Lehman's failure then led to additional runs on CP, as well as money market mutual funds (MMMFs) and repos (for further discussion see Duffie, 2010; and Gorton and Metrick, 2012).

[2] Some previous research has also used an output approach but has done so in a more limited way than in this paper: Ashcraft and Steindel (2008) measured output from off-balance sheet mortgage- and asset-backed securities (MBSs and ABSs) sponsored by commercial banks; our own prior work presented estimates of borrower services supplied by finance companies (Corrado et al., 2012); and Greenwood and Scharfstein (2013) constructed a broad measure of output of borrower services associated with securitized loans but applied commercial bank margins without an adjustment for default risk.

We define our shadow banking sector using the Federal Reserve's Financial Accounts of the United States (or FAs) with an approach that has some notable parallels to Gallin (2013). We include all of the direct or securitized lending of nondepository financial institutions (excluding long-term funders such as pension funds and life insurers) and all of the funding that nondepository financial institutions obtain through short-term, deposit-like liabilities. All told, this amounts to exploiting information from nearly half of the 19 institutional sectors of the FAs.

The U.S. national accounts do not now record implicit services for shadow banks, and as we shall shortly see, this is a notable shortcoming of the way in which financial services output is portrayed in U.S. macroeconomic data. The institutional character of shadow banking is of course rather country-specific, but the basic message of this paper, that the production of credit intermediation services takes place in sizable quantities both inside and outside traditional entities is a broadly applicable one. Indeed, Claessens et al. (2012, p. 6) find that two-thirds of shadow banking now occurs outside the United States. Besides the United Kingdom, where it is quite important, shadow banking activity is occurring in the Euro area, China and other emerging markets. Furthermore, the System of National Accounts (European Commission et al. 2009, section 6.165) includes implicitly priced services associated with loans made by nondepository financial institutions in the international standards for national accounts.[3]

This paper has two main sections: One reviews our framework and general methods; another presents our application to the United States and analyzes results. A final section concludes.

I. Framework and Approach

The output of nondepository credit intermediaries that make up the shadow banking sector is measured by applying the reference rate approach, the same approach used in the U.S. NIPAs, as explained in Fixler, Reinsdorf, and Smith (2003, p. 35) and amended by Hood (2013b). The reference rate approach of the US national accounts is based on the theory of the user cost of money.[4]   The reference rate approach is also the recommended international standard in the SNA for measuring the implicitly priced credit intermediation services consumed by borrowers and depositors. In the SNA these services are known as "financial intermediation services indirectly measured" or FISIM. Even though financial intermediation is used in the academic literature to include intermediation through non-credit instruments, the scope of FISIM is limited to loans and deposits and similar credit instruments.

There are open research questions concerning national accounts guidelines and FISIM measurement practice, however. One area of contentious debate has been what reference rate or

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[3] The SNA stops short of recommending the inclusion in GDP of funder services from non-banks, which are analogous to the depositor services of traditional banks. However if the goal is to have a complete picture of the activities of the shadow banking sector without necessarily fitting into the conventional way of measuring GDP, funder services need to be included.

[4] The user cost theory for financial assets was developed by Diewert (1974) and Barnett (1978) and applied to banking by Hancock (1985), Fixler (1993), and Fixler and Zieschang (1999).

set of reference rates to use. With regard to completing the picture of credit intermediation, three central issues emerge:

1) How can we be sure we are capturing all credit intermediation services produced by domestic financial institutions, and what should we exclude?

2) How do we account for a financial services production technology that breaks the credit intermediation process into steps that are performed by different institutions?

3) How can the lack of the regulatory information on shadow bank operations be surmounted?

A. Adding financial intermediation to the circular flow

To address the first issue, we begin by asking how financial institutions can fit into Knight's circular flow model (CFM) of the economy. An answer to that question, offered in Corrado and Hulten (2014), is that the financial sector should be placed in the center of the circular flow to reflect its essential role as an intermediary for connecting providers investible funds with businesses (including household owner-occupiers) that need funds to finance their investment projects.[5] Although the issues we address differ from those in Corrado and Hulten (they focused on market valuations), we adopt their framework and place financial institutions in the center of the CFM (see figure 1). This permits us to focus on the service flows that originate from financial intermediaries (all of which are in the box with the dashed outline) and the producers and consumers of these flows. Consumers (households) are the investors; the producers are the usual businesses: corporations, small business and also households as owner-occupiers of homes.

The depiction of the organization of financial activities in figure 1 reveals that flows of credit intermediation services primarily occur (1) between financial institutions themselves or (2) between a financial institution on the one hand and, either consumers as investors or business as producers, on the other.   Issuance by nonfinancial businesses of financial instruments is not central in this set up (although this sort of activity is obviously not precluded).   Note that if the provision of financial services is a line of business for a nonfinancial company, it usually takes place through a finance company subsidiary or a holding company, both of which are shadow entities included in the financial sector of accounts such as the Federal Reserve's FAs. Indeed, the percentage of total U.S. short-term credit market liabilities outside the traditional banking sector that is on the balance sheet of institutions that we treat as shadow banks has stood at or above 97 percent for more than 10 years.[6]

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[5] Hulten (2006) set out the general reasoning for a special treatment of capital markets in the circular flow.

[6] In this regard, our framework appears rather different than the financial accounting framework of Diewert, Fixler, and Zieschang (2012) and Diewert (2013) even though both can be said to follow the functional approach to defining financial output set out by Wang (2004) and Wang, Basu, and Fernald (2009). Diewert (2013), for example, argues that depositor services are produced by nonfinancial firms issuing commercial paper. Although not apparent via figure 1, much of these services are then consumed by shadow banks, and accounting for such services also takes place in our scheme. This will become apparent in our discussion of production and value added in intermediation chains below.

The names shown in the financial institutions block of figure 1 are illustrative, not comprehensive. They are designed to distinguish between two essential types of institutions: "pass-though" financial institutions, such as pension funds and insurers, on the left, and intermediaries that use deposits and other "runnable" sources of funding. Institutions on the left are assumed to provide direct, fee-based services to investors (i.e., mainly asset management services, not maturity transformation), whereas activities on the right are a mix of direct and indirectly provided credit intermediation services. Shadow banks are a sub-set of these "runnable" intermediaries.
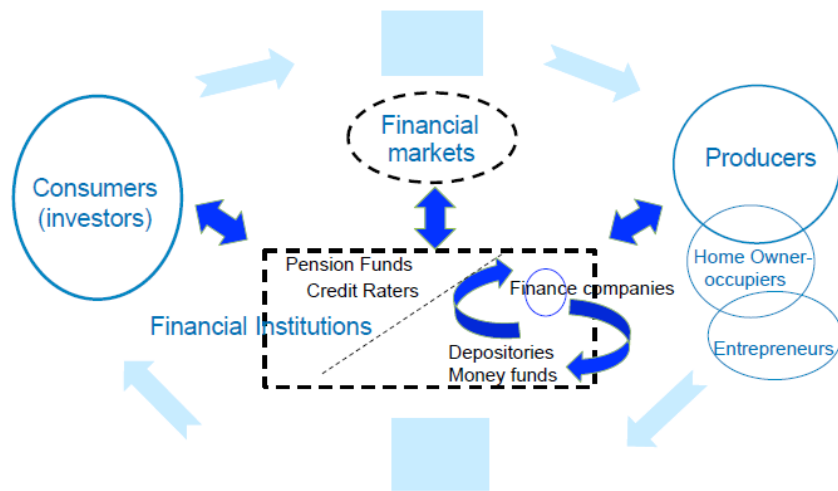

FIGURE 1. MODIFIED CIRCULAR FLOW

Figure 1's ring fence of financial intermediaries helps frame the activities that can be viewed as shadow banking. In the financial accounts of the United States, there are 15 major sub-sectors of the financial sector in the U.S., as shown in figure 2. These sub-sectors collectively correspond to the financial activities sector in the industry classification system used in the United States (NAICS 52), with the noteworthy exception that holding companies, financial leasing, and credit rating agencies are outside of this central sector. Eight of the sub-sectors in the FAs are primarily long-term funders performing asset management and insurance functions, i.e., they are what we have termed pass-through institutions. The remainder are credit intermediaries, nine of which are the shadow banks highlighted in figure 2.

Though the term shadow banking suggests an absence of information, by using the FAs we are able to cover almost all of the relevant credit intermediation activity. A few gaps in the data on nondepository financial sectors in the FAs that affect our estimates should, however, be noted. Insufficient information is available on security lending liabilities for us to include them; no

information is available on the use of leverage by hedge funds; and commercial paper and repo positions are not broken down by term, so we cannot take account of changes in average maturity like the shortening that occurred during the crisis.[7] All that said, we believe we are able to derive measures of credit intermediation activity by financial institutions that are close to comprehensive and afford new insights into the importance of nonbank intermediaries in the recent evolution of the U.S. economy.

FIGURE 2: SUB-SECTORS OF FINANCIAL BUSINESS IN THE FINANCIAL ACCOUNTS OF THE U.S.

Traditional banks
1. Monetary Authority

2. Private Depository Institutions
     U.S.-chartered Depository Institutions, ex. Credit Unions
     Foreign Banking Offices in U.S.
     Banks in U.S.-Affiliated Areas
     Credit Unions

Long term funders and pass-through institutions
3. Property-Casualty Insurance Companies
4. Life Insurance Companies

5. Private and Public Pension Funds
     Private Pension Funds
     State & Local Government Employee Retirement Funds
     Federal Government Employee Retirement Funds

7. Mutual Funds
8. Closed-End and Exchange-Traded Funds
Shadow banks
6. Money Market Mutual Funds
9. Government-Sponsored Enterprises
10. Agency- and GSE-Backed Mortgage Pools
11. Issuers of Asset-Backed Securities
12. Finance Companies
13. Real Estate Investment Trusts (mortgage REIT segment)
14. Security Brokers and Dealers
15. Holding Companies
16. Funding Corporations

Note: Sectors are numbered in the order in which they appear in the FAs.

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[7] Trade credit can also be important for financial stability, as was illustrated by its role in the dot-com bubble and subsequent stock market crash. Trade credit is excluded from our analysis because we know very little about its terms and risks, but also because financial institutions are not materially involved; it is largely a B2B activity with a very small footprint in the macroeconomic circular flow.

B. Intermediation chains

The production technology of the shadow banking sector breaks up the credit intermediation process into steps that are performed by different institutions. This makes the treatment of intermediation chains a critical issue in measuring the output of nonbank intermediaries.

FLOWS OF SERVICES

Accounting for the transactions that occur along an intermediation chain that links a final borrower to a final funder is the same sort of problem as accounting for flows of intermediate inputs inside a consolidated sector of an economy. The standard solution to this problem is to calculate, via Domar (1961) aggregation, a sectoral output measure that includes only the output produced within the sector for use outside the sector. (Sectoral output is a term used in productivity analysis for aggregates of industries whose production technology entails the use of own-produced intermediate inputs as well as standard inputs of labor, capital, and intermediates purchased from other sectors). The financial services production process we are modeling need not account for standard inputs (because they are already accounted for in the usual way), so we use the term *consolidated output* to refer to FISIM produced by shadow banks for use outside the sector.

When considering the consolidated output of the shadow bank system, it is important to keep in mind that many intermediation flows occur within the sector, i.e., between the institutional sub-sectors of the shadow bank system.[8] We thus compute FISIM for each institutional sector of the shadow banking system separately and sum these outputs of FISIM to obtain the *gross output* of the shadow banking sector. The consolidated output is then obtained by subtracting off the within-sector uses of each sub-sector's output. After further excluding FISIM inputs supplied by traditional banks and other sectors, we obtain a value-added type measure for the implicit services contributed by the shadow banking sector to the rest of the economy.[9] This of course is not precisely value added because we ignore non-FISIM inputs and outputs, and thus we call it *net output*.

Finally, to complete the picture of credit intermediation from a national accounts perspective, we estimate the value of the final uses of intermediation services. This measure, which we call *final purchases*, represents the impact that including shadow banking FISIM has on the estimate of GDP. A notable portion of the flows that we estimate (shadow bank FISIM, and inputs into the

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[8] GSEs and funding corporations, for example, hold repo assets, and so consume some of the depositor services produced by net repo borrowers.

[9] Inputs of FISIM supplied by other sectors are based on shadow bank holdings of short-term assets, mostly commercial paper, issued by non-shadow, non-depository businesses. This mainly reflects CP issuance by nonfinancial business although a small portion reflects services supplied by pass-through financial business. Our measure of inputs supplied by other sources is not necessarily all FISIM attributable to nonfinancial and pass-through financial business, but as a practical matter, for the United States, it is very close.

production of shadow bank FISIM) imply a reallocation of existing sector value added, but the value of final purchases adds to total value added of the economy.

<center>BALANCE SHEETS</center>

Final uses of borrower services and of funder ("depositor") services can be calculated using balance sheets that consolidate shadow banks into a sector, and that also have consolidated sectors for depository institutions, nonfinancial businesses, and households (consumers). We adopt the aggregation approach of Gallin (2013) for compiling a consolidated balance sheet for the shadow banking sector (which, like the process for computing consolidated output described above, has notable parallels to Domar aggregation). This consolidated balance sheet can be constructed from the sector tables and instrument tables of FAs with some assumptions about the distribution among counterparties of each sector's positions.

Figure 3 sets out a stylized version of the requisite balance sheets as per the revised CFM. Compared with the actual calculations, the balance sheets in figure 3 have been simplified in four notable ways: (1) shadow bank and traditional credit intermediaries (CIs) are combined into a single CI sector; (2) deposits and deposit-like assets held by nonfinancial businesses are ignored; and (3) personal loans to consumers are ignored; (4) consumers/investors hold bonds only through pass-through entities. These items are not essential to the points we wish to make with the figure. In the figure, consumers (column 1) own all of the equity in the economy, and their holdings consist of equity in nonfinancial business and equity in financial business. As seen in column 2, producers use nonfinancial assets N^P (capital) to produce goods and nonfinancial services, and a fraction $(L + B^P)/N^P$ of that capital is leveraged and held as financial assets in financial business. This is seen in column 6, which shows the financial sector on consolidated basis. Column 6 underscores that financial services production uses standard inputs (labor and capital) to produce output, including the services connected with its financial assets and liabilities.

Before turning to how we estimate prices for these financial assets, it is useful to explain what is meant by shadow bank deposits. The shadow banking analog of deposits are the short-term and current liabilities that permit shadow bank funders to obtain cash in much the same way that depositors can withdraw money from a retail bank. Money-like instruments that can be turned into cash at par value on short notice provide the same kind of liquidity and cash management services that depositors at traditional banks receive.

Two credit instruments that we treat as shadow banking deposits are securities repurchase agreements (repos) and commercial paper (CP). The SNA (11.59 and 17.254) recommends including short-term repo liabilities in measures of depositor services for traditional banks. We argue that CP plays a similar role to repos in credit intermediation by shadow banks. Asset-backed commercial paper, for example, is a key link in the intermediation chain by which investments in money market mutual funds (MMMFs) undergo maturity transformation and fund mortgages Kacperczyk and Schnabl (2010, p. 36). To generate a complete picture of intermediation services produced by shadow banks, we thus include CP in our measure of depositor services.

FIGURE 3: STYLIZED BALANCE SHEETS FOR THE ECONOMY OF THE CIRCULAR FLOW MODEL

Balance sheet for Investors, Producers and Financial Institutions.							
Balance sheet items	Investors/ consumers	Producers		Financial Institutions			
		A B C	Total	C.I.	Pass.	Total	
						Gross	Net
	(1)		(2)	(3)	(4)	(5)	(6)
Productive Assets			N^P	N^{F1}	N^{F2}	N^F	N^F
Financial Assets	E+D			L	B	L B	L B^P
Financial liabilities			L B^P	D B^F		D B^F	D
Equity[1]			E^P	E^{F1}	E^{F2}	E^F	E^F
Net worth	E+D						

1. Includes reserves.
C.I. = credit intermediaries
Pass. = asset managers and insurors

E=Equity=E^P+E^F
N=Nonfinancial assets
D=Deposits

L=Loans
B=Bonds

In addition, assets that are held by MMMFs can be assumed to be safe, short-term instruments even if they are not CP or repos, and investors in MMMFs obtain deposit like services from the liabilities for these funds. Figure 4 shows the relative sizes of MMMF liabilities that are used to calculate depositor services for shadow banks. Our gross output of the MMMF sector reflects the entire value of depositor services consumed by investors in MMMF shares, and we thus include all credit market instruments held by MMMFs, i.e., we include corporate bonds and asset-backed securities, not just commercial paper and repos. As may be seen, there are dramatic upward movements in these components prior to the crisis.

FIGURE 4: LIABILITIES USED TO CALCULATE SHADOW BANKING SERVICES
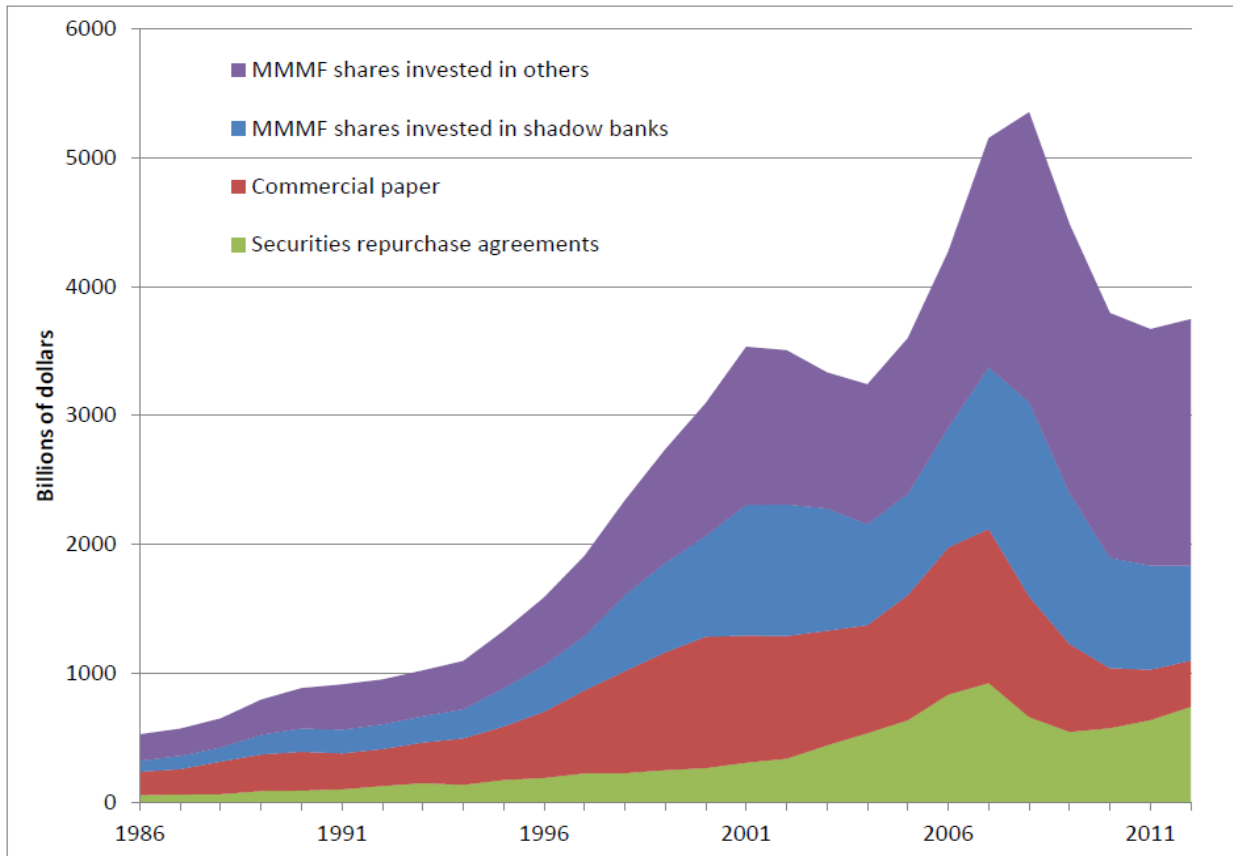
C. The Reference Rate

The approach to measuring FISIM that is recommended in SNA2008 (and in SNA1993) uses a single reference rate. A practical issue that then arises is selecting the instrument or set of instruments on which to base the reference rate. However, two conceptual questions have also been raised in the literature.

The first conceptual question concerns the treatment of the component of the interest rate paid by borrowers that is needed to cover expected losses of principal from defaults. A recent change made to the U.S. national accounts removes an estimate of the interest that banks must set aside to cover expected default costs (Hood, 2013b) from the measure of borrower FISIM, and in this paper similar adjustments are made. Second, along with the adjustment to the loan interest rate remove expected default costs, a set of adjustments to the reference rate approach is proposed in Wang (2004) and Wang, Basu, and Fernald (2009). These adjustments would add risk premiums that reflect the risk characteristics of each type of the loan to the reference rate that is used to measure borrower services on that type of loan. This implies the use of multiple reference rates, rather than a single reference rate. Basu, Inklaar, and Wang, 2011) provide an example of implementation of the multiple reference rate approach.

TREATMENT OF EXPECTED DEFAULT LOSSES AND RETURNS TO RISK BEARING

Let r^R be a reference rate available on an instrument that does not entail provision of services to the creditor or the debtor, i.e., a rate that represents the opportunity cost of funds for the financial intermediary and for investors. In the NIPAs, the reference rate for commercial banks is based on rates that banks receive on their Treasury and Federal agency bonds and on market rates for Treasury bonds.

Let r^D be the interest rate paid on deposits or analogs to deposits. Then the user cost of that liability ρ^D is:

$$(1) \quad \rho^D = r^R - r^D .$$

Depositors purchase implicitly priced services from the bank via foregone interest. The value of these services equals this user cost times the balance in the deposit account.

For loans, we define the user cost ρ^L as the margin between the loan rate net of expected default costs $(r^L - \delta)$ and the reference rate:

$$(2) \quad \rho^L = (r^L - \delta) - r^R .$$

Borrowers implicitly purchase services by paying an interest margin above the opportunity cost of funds. However, part of the aggregate amount of interest collected on a portfolio of loans to risky borrowers must be used to replace the principal lost due to defaults, and $r^L - \delta$ is the yield to the lender after these losses are covered. [10]

The adjustment for expected default losses is not included in the basic version of the reference rate approach presented in SNA2008 and SNA1993, but this adjustment is needed because the interest that the lender must use to cover the cost of defaults is not available to pay the costs of engaging the labor and capital needed to produce services. In the NIPAs, the adjustment for expected default costs δ is estimated by loan type based on historical charge-off patterns (see Hood 2013b), and is rather consequential both for the level of FISIM and for its growth rate after the crisis. Figure 5 shows that charge-off rates are very large for credit card loans, where the corresponding interest rate is very high, too, and sizeable for other loan types as well.

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[10] If the interest rate on loans is measured as the contract interest rate, the default premium must cover both the interest that is not collected and the principal that is lost. The way that loan interest is measured in the NIPAs already excludes interest that is not expected to be collected, so the default premium covers losses of principal.
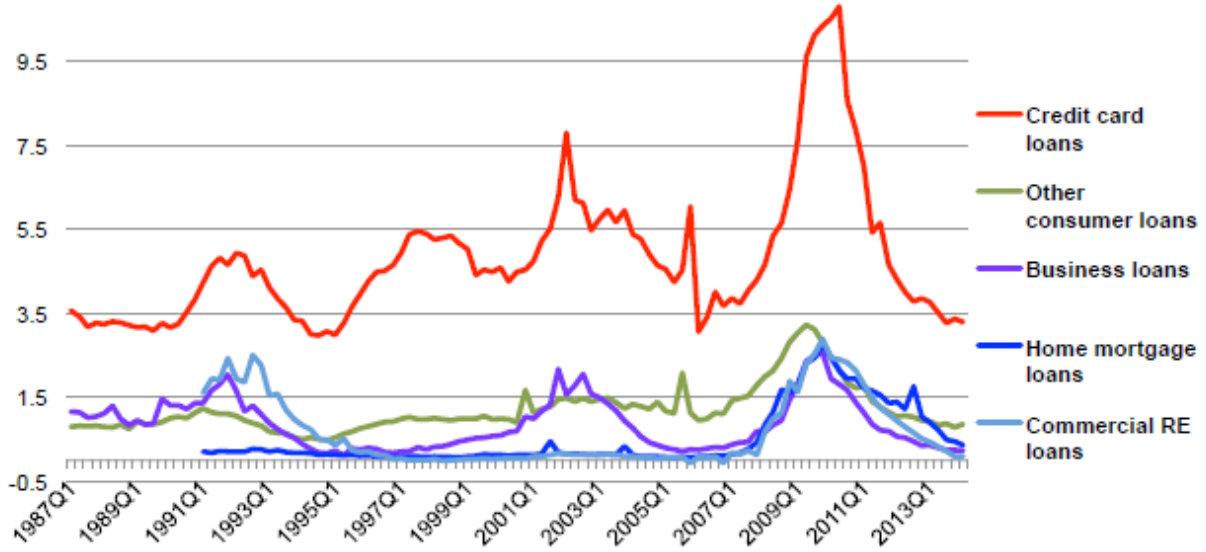
FIGURE 5: COMMERCIAL BANK CHARGE-OFF RATES BY LOAN TYPE

Consider now the question of whether to include a risk premium term in the reference rate. Besides excluding expected default costs from borrower FISIM, Wang and her co-authors advocate a definition for FISIM that excludes the return to risk-bearing. To exclude the return to risk-bearing from FISIM, the risk-free reference rate is replaced by a risk-adjusted reference rate. The Wang et al. (2009) position on the use of risk-adjusted reference rates that follows from (a) the view that the investor/consumer is the equity holder of the bank, as in our framework, and (b) the assumption that risk aversion causes investors to demand a premium ϕ in the form of a higher expected rate of return when the risk posed by a borrower adds significant variance to the return on a diversified portfolio.[11]   Thus we have both a risk premium that compensates the investor for the disutility of bearing risk by generating earnings that the lender can retain or pay out in dividends, and a default premium that compensates a lender for the part of the principal loaned out that is will not be repaid and any interest that is included in r^L that will not be paid.

(3) $\rho^L = (r^L - \delta) - (r^R + \phi)$

   = lender's yield – investor's required rate of return.

Wang at al. (2009) argue that the value added of a nonfinancial business should be invariant to whether it obtains its capital from bank loans or by issuing bonds, and that this will happen only

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[11] As explained in (Wang et al., 2009, p. 282), the risk premium reflects the extent to which the probability of default is correlated the marginal utility of consumption, i.e., the risk premium compensates risk-averse investors for bearing systematic, non-diversifiable risk.

if the ϕ term is included in the reference rate. Because investors are risk-averse, the loan interest rate and the bond coupon rate would both have to include the risk premium that reflects the undiversifiable risk presented by the business's operations. If the reference rate used to measure borrower services on bank loans does not include a risk premium, that component of the loan interest will be counted in intermediate inputs of borrower services used by the non-financial business. This will make the measure of the value added of the nonfinancial business lower if it takes out a bank loan than if it issues bonds. Therefore, for loans that are close substitutes for funding that could have been obtained through marketed bonds, the inclusion of the risk premium in the reference rate is conceptually appropriate.

Nevertheless, as argued in Reinsdorf (2011), this argument does not apply to loans that are not substitutes for funding that could have been obtained from the securities market, such as commonly occur in relationship lending. If the nonfinancial business would not exist at all without the financing from the bank, including a return to risk bearing in the measure of the output produced by the bank is reasonable. Most of the loans that commercial bank loans originate and retain are not close substitutes for financing by issued marketed securities. Furthermore, in practice, the implementation of the multiple reference rate approach involves use of credit market instruments with matching maturities to the loan or deposit on which FISIM is being measured. The effect of maturity-matched reference rates is to exclude the liquidity transformation and maturity transformation performed by the bank from the measure of its output. Yet liquidity transformation and maturity transformation are basic elements of what banks do.

Loans that are suitable for the shadow banking activity of securitization tend to be closer substitutes for borrowing in credit markets than the kind of non-standardized loans that depend on the relationship between the bank and the borrower. This suggests that risk-adjusted reference rates are appropriate for measuring the borrower services of shadow banks engaged in securitization. Consider the trusts that hold pools of mortgages or loans and issue securities in the shadow bank sector, e.g., the GSE-sponsored pools in the United States. We can estimate borrower FISIM produced by these and related entities using the spread between the interest rate paid by those borrowing from the pool (adjusted for default costs, so that it is a yield to the pool) and the interest rate received by the investors in the securities issued by the pool. The latter clearly reflects the inclusion of a risk premium (it is the rate of return to pool investors), so this procedure is equivalent to using a risk-adjusted reference rate to measure borrower services on securitized mortgages and loans.

All told, and as described in more detail below, we use the spread over the rate paid to investors in GSE pools for many of the loan margins that we need for the estimation of borrower FISIM for shadow banks. In some cases, however, we use of the commercial bank business loan FISIM margin from the U.S. national accounts for estimates of business borrower services produced by the shadow system. We do the latter mainly because relevant information on interest payments, default risk, and cost of funds is not available for business borrowing from shadow entities, but also because many loans are in fact very much like loans from commercial banks, e.g., business equipment loans issued by finance companies. All told, then, the procedures for estimating borrower services for shadow banks are similar to those used in the NIPAs for traditional banks, except that we use risk-adjusted reference rates for certain types of institution or instrument.

Another question is which reference rate to use in measuring depositor or funder services. Deposits are distinguishable from other types of short term liabilities of financial institutions because retail depositors behave differently from suppliers of short term funding via marketable instruments or wholesale funding arrangements such as repos. Even though depositors at traditional banks have the right to withdraw funds on a current or short term basis, they can be counted on not exercise that right in a coordinated fashion that leads to large outflows in the aggregate. (Indeed, even on an individual basis, deposit current accounts are rarely closed, and during the financial crisis, deposits tended to grow at the same time as withdrawals of short-term funding from other kinds of instruments were causing liquidity crises for financial institutions dependant on these instruments.) As a sticky, stable source of funding, retail deposits have a high value for banks. Even though most deposits are current or short-term in nature, their effective maturity is much longer, and the amount that banks are willing to spend on depositor services in order to attract deposits can therefore be measured using a medium term instrument for the reference rate.

This difference in behavior of depositors from other suppliers of short term funding suggests that if the multiple reference approach is used, the reference rate for measuring FISIM on deposits would be higher than the reference rate for measuring implicitly priced services to the short-term funders of shadow banks. It can be argued that shadow banks should thus be willing to spend on less providing services to their short term funders, than a bank would be willing to spend on providing services to its depositors because short-term funded obtained through marketed instruments tends to be more volatile and entails a risk of occasional large losses to a financial institution that is uses it for maturity transformation.

Nevertheless, we will leave the idea of using a short-term reference rate to measure funder services of shadow banks to future research for two reasons. First, to get a complete picture of shadow banking, we want to show the importance of changing user cost margins on short-term sources of funding in the changing fortunes of shadow banks. Second, although they may have less security than depositors, the suppliers of short term funding to shadow banks generally receive the same core services of liquidity provision and means-of-payment insurance as bank depositors do. For purposes of the research in this paper, we therefore will use the commercial bank reference rate to measure both implicit sales of depositor services at commercial banks and the analogous funder services at shadow banks.

II. Measurement

The NIPAs use data on balance sheet positions, interest flows and charge-offs to measure credit intermediation services of commercial banks. For nondepository institutions, balance sheet positions are available from the FAs, but direct data on interest flows are not available. Therefore, to measure the credit intermediation output of shadow banks we must model their interest spread income net of credit losses. In other words, for each of our institutional sectors, which we will denote by the subscript S, we must obtain estimates of r_S^R r_S^D , r_S^L and δ_S using data on market interest rates and external data on default losses. In particular, we model r_S^L by combining information on market interest rates at the times when loans were originated with information on payoff and charge-off patterns.

Table 1 summarizes how the components of user cost for each shadow bank institutional sector are measured. (GSEs and GSE-backed pools are combined, as are security broker-dealers, funding corporations, and holding companies; thus six sectors or groups of sectors are shown). The reference rate is the pass-through rate paid to investors in GSE pools r^{GSE}, an average of it and the reference rate for commercial banks r^R_{CB}, or just the latter. The rate paid to "depositors" is either the repo rate (calculated from commercial bank Call Report data) or the 30-day commercial paper (CP) rate; the average maturity of CP held by shadow bank institutions is 30 days (Kacperczyk and Schnabl, 2010). Procedures for calculating rates or margins for measuring borrower services vary depending on the data that is available and the institutional characteristics, and we now review some of these key components of user cost in more detail.

Borrower services from GSEs and GSE-sponsored pools are measured by multiplying the services margin by outstanding mortgage balances. Because the boundary between the accounts of the GSEs and the GSE-sponsored pools is porous, we combine the mortgage balances held by these two institutional sectors of the FAs and treat the relatively small amount of mortgages that are directly held by GSEs the same way as the mortgages in the GSE-backed pools.

The vast majority of the interest paid by GSE borrowers is passed through to investors. A small fraction of the remainder is used to cover losses due to defaults, leaving a modest spread that is retained by the mortgage pool manager as compensation for providing borrower services. Our estimate of this spread ranges from 0.61 percentage points in the late 1990s to about 0.5 percentage points at the time of the financial crisis.[12] This spread declines over the crisis in part because it is adjusted for expected credit losses, which are estimated to range from less than 1 basis point (0.01%) in the late 1990s and early-mid 2000s to more than 25 basis points during the crisis.[13]

The majority of loans held by ABS-issuers are home mortgage loans, and historically more than two-thirds of the overall borrower services of shadow banks were provided by mortgage-issuing,

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[12] The interest rate spread that represents the service margin is the weighted average coupon (WAC) rate paid by the borrowers less the pass-through rate paid to the investors in the mortgage pool, minus an adjustment for expected default losses GSE. Data from eMBS.com covering the mortgage pools outstanding in 2012-2013 provide WACs, pass-through rates and remaining principal balances, broken out by origination year and sponsor. Using the remaining principal balances as weights, we combine all the pools of a given vintage to get the average WAC and pass-through rate for that vintage. The overall average spread retained by mortgage pool managers in 2012 is calculated as an average of the spreads on the various outstanding vintages in that year, with each vintage weighted by its share of the overall remaining principal balance. Next, by assuming that shares of year $t-1$, year $t-2$, and so on, do not change when year t is redefined to be an earlier year, we are able to calculate average spreads retained by pool managers in the years before 2012.

[13] δ_{GSE} is measured as a geometrically-weighted moving average of the net rates at which losses of principal were charged off by mortgage lenders in previous years. The average life of a mortgage loan is set at 10 years and a geometric smoothing parameter of 0.1 is used; as described in Hood (2013a), this produces an expected credit loss rate that reacts gradually to changes in experience. The charge-off rates come from 10-K filings of Fannie Mae, and are adjusted for effects of changing accounting practices.

FA Sector (S)	Reference Rate r_S^R	Depositor Rate r_S^D	Borrower Rate (margin) r_S^L	Exp. Credit Loss δ_S
1. GSEs and GSE-backed pools (GSE)	r^{GSE}	Bonds held by MMMFs[a]: r^{CP30}	Mortgages: coupon rates relative to r^{GSE}	Fannie Mae credit loss rate[b]
2. Private ABS Issuers (ABS)	Weighted average of r^{GSE} and r_{CB}^R	a. Bonds held by MMMFs[a]: r^{CP30} b. CP liab.[a]: r^{CP30}	a. Mortgages: r_{GSE}^L b. Auto:[c] r^{Auto} c. Non-auto con.: r^{Con} d. Trade credit: $r^{C\&I}$	a. δ_{GSE} b. Auto loan default index[d] c. Bank charge-off rates c. Bank charge-off rates
3. Finance companies $(FinC)$	Weighted average of r^{GSE} and r_{CB}^R	a. Bonds held by MMMFs[a]: r^{CP30} b. CP liab.[a]: r^{CP30}	a. Mortgages: r_{GSE}^L b. Auto: r^{Auto} c. Non-auto con.: r^{Con} b. Business: $r^{C\&I}$	a. δ_{GSE} b. Auto loan default index c. Bank charge-off rates d. Bank charge-off rates
4. Security broker-dealers, funding corps and holding companies (BD/HC)	r_{CB}^R	a. Repos[a]: r^{Repo} b. CP liab.[a]: r^{CP30} c. Bonds held by MMMFs[a]: r^{CP30}	$r^{C\&I}$	Bank charge-off rates
5. Mortgage REITs	r^{GSE}	Same method as $r_{BD/HC}^D$	r_{GSE}^L	δ_{GSE}
6. MMMFs	n.a.	Average industry margin[a]	n.a.	n.a.

LEGEND:

r^{Auto} = finance company auto loan rates; r^{Con} = commercial bank consumer non-auto loan rate

$r^{C\&I}$ = commercial bank commercial and industrial loan rate

r^{CP30} = 30-day commercial paper rate

r^{GSE} = weighted average of pass-through rates of GSE-backed pools

r^{Repo} = commercial bank repo rate

NOTES:

a. Borrower services on commercial paper, repurchase agreement and bond liabilities of shadow banks that are held by MMMFs are allocated to output of MMMFs. Bonds held by MMMFs pay r^{CP30} by assumption.

b. Calculated from annual reports.

c. Auto service margins are calculated at origination, and in any given month they are an average of margins in the mix of outstanding loans.

d. S&P/Experian index.

TABLE 2— TOTAL IMPLICITLY PRICED CREDIT INTERMEDIATION SERVICES, BILLIONS OF DOLLARS

		1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	**Total services**	210.7	279.7	367.6	428.7	436.9	429.9	406.9	400.9	420.1	532.1	519.2	446.8	439.3
2.	Depository institutions[a]	149.7	191.4	192.2	205.3	218.2	225.4	244.5	266.9	278.4	270.0	247.6	252.9	246.8
3.	Commercial banks[b]	118.2	154.8	151.7	157.7	164.9	170.7	187.8	207.6	222.3	217.9	197.8	200.0	191.4
4.	Shadow banking system	61.0	88.3	175.5	223.4	218.7	204.5	162.4	134.0	141.8	262.1	271.6	193.9	192.5
5.	**Borrower services**	101.2	190.9	195.9	199.6	216.8	230.3	256.0	291.8	313.5	281.0	242.6	217.3	221.7
6.	Depository institutions	52.4	100.4	106.7	109.4	116.4	122.3	135.6	156.9	175.6	169.2	151.7	154.0	151.7
7.	Shadow banking system	48.8	90.4	89.2	90.2	100.3	107.9	120.4	134.9	137.9	111.9	90.9	63.2	70.0
8.	**Depositor services**	109.5	88.8	171.7	229.1	220.1	199.6	150.9	109.1	106.6	251.1	276.6	229.5	217.6
9.	Depository institutions	97.3	90.9	85.5	95.9	101.8	103.0	108.9	110.0	102.7	100.8	95.9	98.9	95.1
10.	Shadow banking system	12.2	-2.1	86.3	133.2	118.4	96.6	42.0	-0.9	3.9	150.2	180.7	130.7	122.5
11.	FISIM inputs, shadow banks	5.3	-2.3	51.4	77.8	68.1	50.8	22.9	-2.0	0.0	92.8	105.6	75.7	71.5
12.	Consolidated shadow banking services	56.4	91.4	128.6	151.0	156.8	159.5	145.0	137.2	141.4	177.6	173.6	125.7	133.2
13.	FISIM inputs, other institutions	5.0	-2.7	48.3	74.1	64.2	48.1	19.9	-2.6	0.5	85.4	98.9	69.7	62.4
13.	Net services, shadow banks	56.0	91.0	127.1	149.3	154.5	156.4	142.5	136.6	141.3	176.7	172.7	124.3	130.1
14.	Final purchases, shadow banking services	29.2	43.0	69.4	82.2	81.3	78.8	62.8	54.8	53.8	77.4	78.6	61.7	72.2
	Memos (% GDP):													
15.	Traditional depository institutions	1.95	1.86	1.81	1.87	1.90	1.84	1.87	1.93	1.92	1.83	1.72	1.69	1.59
16.	Shadow banks, gross	0.80	0.86	1.65	2.03	1.90	1.67	1.24	0.97	0.98	1.78	1.88	1.30	1.24
17.	Shadow banks, consolidated	0.73	0.88	1.20	1.36	1.34	1.27	1.09	0.99	0.98	1.20	1.20	0.83	0.84
19.	Shadow banks, net	0.61	0.82	0.85	0.93	1.02	0.98	0.95	0.94	0.88	0.74	0.62	0.33	0.38
20.	Shadow banks, final purchases	0.38	0.42	0.65	0.75	0.71	0.64	0.48	0.40	0.37	0.53	0.55	0.41	0.46

NOTES–

a. Includes estimates of FISIM for savings institutions and credit unions from Hood (2013a), which are available through 2011.
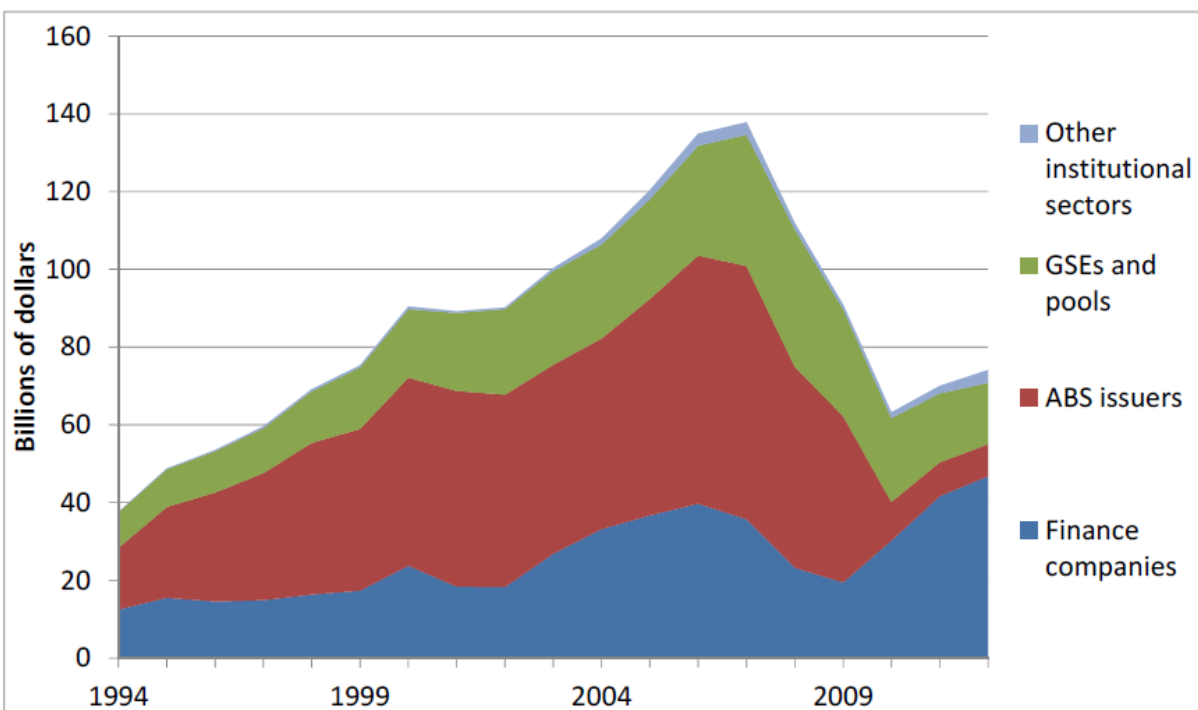
b. Values are from the NIPAs.

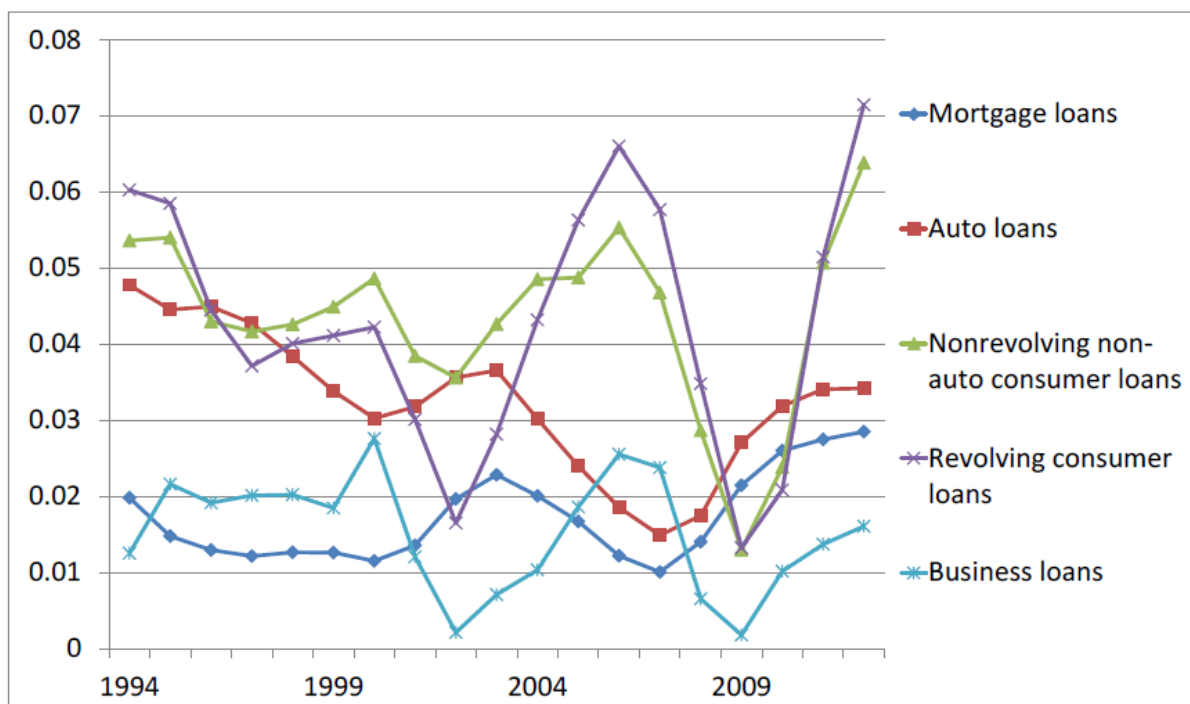FIGURE 6. BORROWER SERVICES OF SHADOW BANKS, 1994–2012.

FIGURE 7. USER COST MARGINS FOR FINANCE COMPANY LOANS, 1994–2012.

or primarily mortgage-issuing institutions (figure 6). This situation changed dramatically after the financial crisis of 2007-2008: finance companies are now the dominant producer of shadow-banking borrower services.

B. Borrower services: Finance Company Loans

Finance company loans consist of loans for autos, mortgages, revolving consumer credit (mainly credit cards), non-revolving consumer credit excluding autos, and business loans. The procedure for estimating the average rate being paid on auto loans combines rate data on cohorts of loans using appropriate weights, and is similar to the procedure used for mortgages. As set out in table 1, for mortgages the interest rate that finance companies receive net of expected losses from defaults is assumed to equal the average net interest rate net received by the GSE-backed pools. For revolving consumer credit, we use the commercial bank interest rate for credit cards, and for non-revolving consumer credit other than auto loans, we use the commercial bank personal loan rate. Finally, for business loans we use the commercial bank commercial and industrial loan rate.

To estimate expected rates of loss due to defaults for revolving consumer debt we use bank charge-off rates for credit cards. For non-revolving consumer loans, we average banks' charge-off rate on non-revolving consumer loans with their charge-off rate on credit cards. By itself, the charge-off rate for non-revolving consumers loans from banks would be too low because non-revolving loans from banks include auto loans, which are collateralized, and bank loans tend to go to safer borrowers than finance company loans.

For the reference rate for the finance company sector we use an average of the GSE pass-through rate and the commercial bank reference rate, with weights determined by mortgage and non-mortgage loan balances. The implied user cost margins for loans made by finance companies are shown in figure 7. For mortgages, finance companies have larger, more volatile margins than GSEs. Their auto loan margins behave similarly to their mortgage margins, turning down after 2003, then rebounding after the financial crisis as the reference rate drops. By contrast, margins on revolving consumer loans and on business loans rise before the recessions of 2001 and 2008-2009, then fall during the recession, only to rebound again after the recession has passed.

Multiplying the user cost margins by the corresponding loan balances gives the borrower services of finance companies. Total borrower services of finance companies grew rapidly prior to the financial crisis, declined sharply from 2007 to 2009, and then recovered starting in 2010 as margins on revolving consumer loans widened (figure 8). Balances owed on mortgages grew rapidly at finance companies from the late 1990s to 2006, and this growth leads to rising borrower services on mortgages up to 2004. From 2005 to 2009, changes in borrower services on mortgages are driven mainly by changes in their user cost margin; after 2009 falling mortgage balances pull down borrower services.

Borrower services on business loans are consistently smaller than on total consumer loans (revolving loans, non-revolving non-auto loans, and auto loans), even though in terms of balances consumer loans only become more important than business loans in the mid-2000s. The behavior of margins on business loans leads to a collapse of services to business during the

downturn of 2000-2002, as well as a rebound a few years later, and then collapse again in the Great Recession.
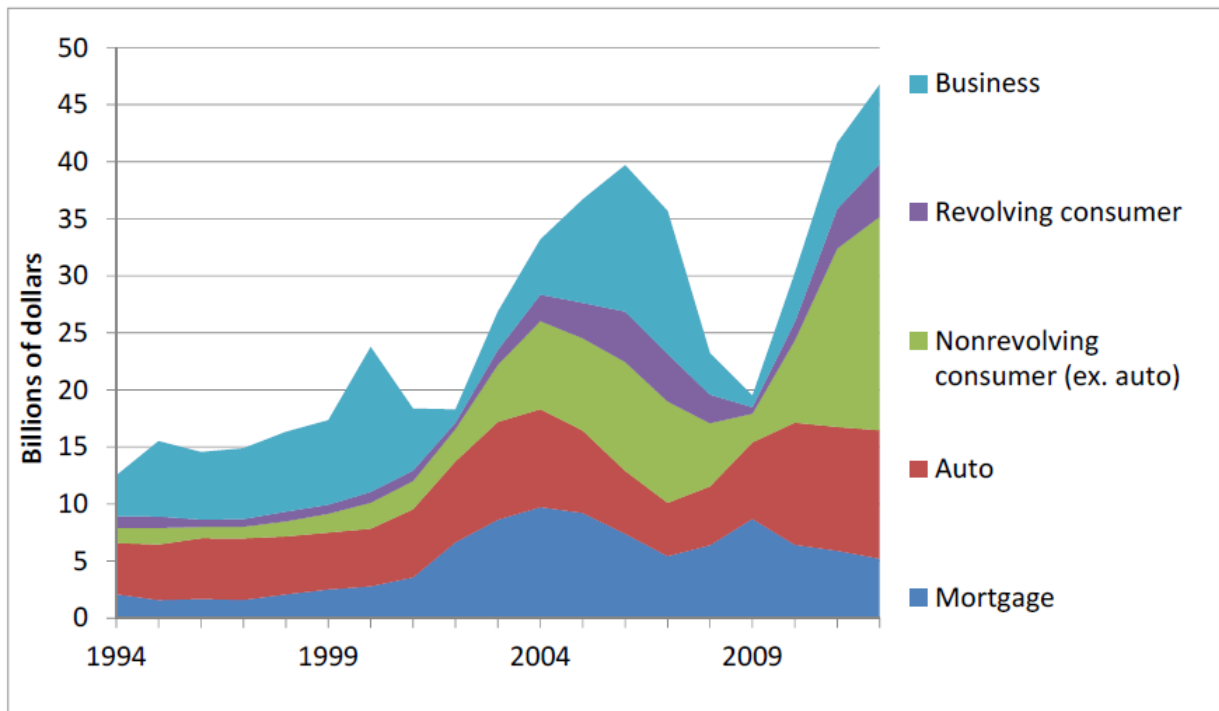

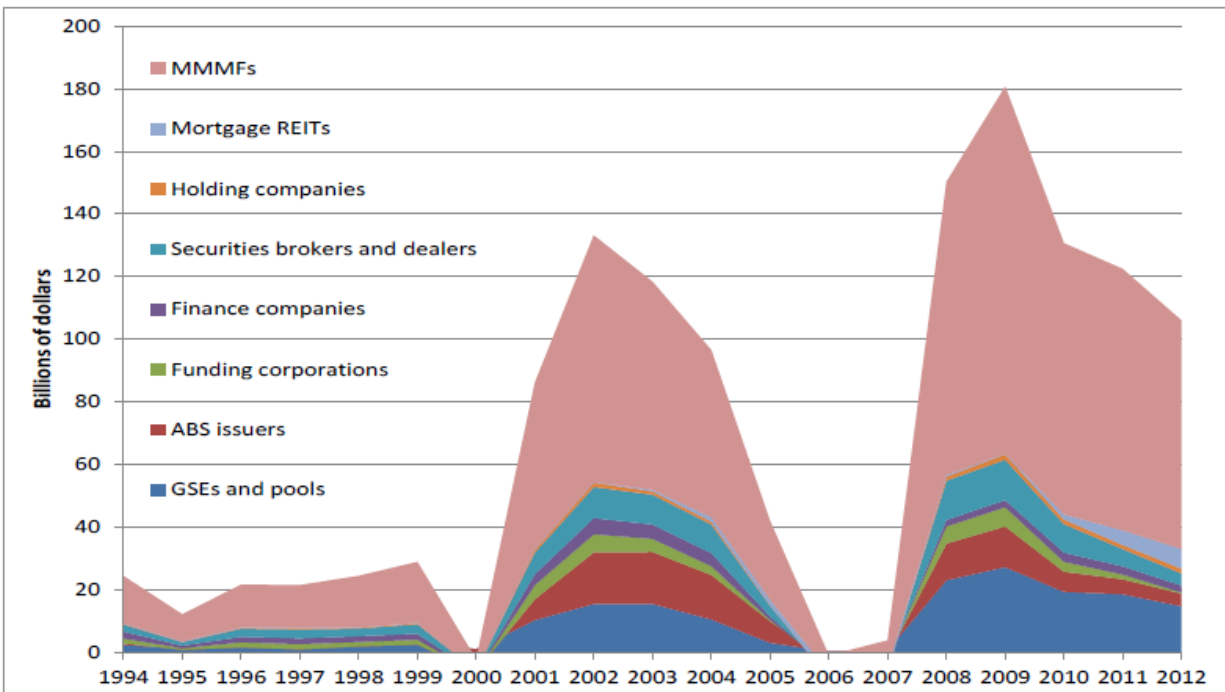FIGURE 8. FINANCE COMPANY BORROWER SERVICES, 1994–2012.

FIGURE 9. DEPOSITOR SERVICES OF SHADOW BANKS, 1994-2012

C. Depositor Services

As is indicated in table 1, user cost margins on the CP or repo liabilities of an institutional sector are based on the spread between the sector's reference rate and the rate paid on CP or repos. Figure 9 shows the resulting estimates of depositor services.

In figure 9, the depositor services associated with CP or repo liabilities that are directly used to obtain funding from outside the shadow banking sector are classified as output of the sector of the liability issuer. However, the CP or repo liabilities that are used to obtain funding intermediated by an MMMF are included in MMMF depositor services. The GSE bonds held by MMMFs also are included in the depositor services intermediated by MMMFs (and by assuming that they pay the 30-day CP rate).[14]

Besides the user cost margins on the assets of MMMFs, the depositor services of MMMFs also include a second margin representing the spread between the interest received by the MMMF on its assets and the interest paid to the MMMF shareholders. This margin—which is already measured in the NIPAs as part of mutual fund services—represents an implicit payment by the shareholders for the depositor services of the MMMF itself.

In figure 9, shadow bank depositor services grow slowly in the early years, reflecting the then slow growth in the value of liabilities (recall figure 4). Before the recessions of 2001 and 2007-2008 depositor services fall, while after the onset of these recessions they rise. This volatility is driven by prices, as user cost margins for depositor services contracted as short term rates rose before those recessions, and expanded when these rates fell with the arrival of the recessions. A particularly sharp run-up on rates paid on repos and CP took place between 2004 and 2007, followed in 2008 by the rapid decline these rates (and consequent rebound in gross depositor services). The decline in rates in 2008 can be largely attributed to funding facilities put in place by the Federal Reserve.

After the crisis, ABS issuers fade in importance. Interestingly, the mortgage REITs have a different fate and show strong growth in 2011-2012. Funding corporations, which include the Federal Reserve's credit facilities related to the crisis, also rebound before eventually fading as these facilities were wound down.

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[14] The depositor services on the financial instruments that MMMFs buy from outside the shadow banking sector are included in the gross output of depositor services that MMMFs deliver to their shareholders but not the net output because MMMFs use inputs from outside the shadow banking sector to produce these services. The user cost margin on the instruments bought from outside the shadow banking sector is assumed to equal the overall average user cost margin on instruments that the MMMFs buy from issuers inside the shadow banking sector.

D. Total Output of Credit Intermediation Services

As a benchmark for comparison with the shadow banking sector, we also calculate the total credit intermediation services produced by the depository institutions that make up the traditional banking sector based on user cost margins. Savings institutions and credit unions are two types of depository institutions that are not measured in the NIPAs with a user cost approach. Fortunately, however, user cost measures of their output of credit intermediation services are calculated in Hood (2013a). Combining those estimates for savings institutions and credit unions with the estimates for commercial banks from the NIPAs yields a measure of the total services produced by traditional intermediaries that can be compared with our new measures of credit intermediation services produced by shadow banks.

Line 1 of table 2 shows the total implicitly priced credit intermediation services of the combined traditional and shadow banking sectors from 1995 to 2011. Lines 15 and 16 of the table show that total intermediation services peak at 3.85 percent of GDP in 2002 and 2003. Although the services supplied by traditional banks remained at the 2002/3 relative rates through 2007, services supplied by shadow banks began to fall after 2002/3. Figure 10 charts these data as a percent of GDP; ratios to GDP for borrower services also are shown.

GROSS OUTPUT OF CREDIT INTERMEDIATION SERVICES OF SHADOW BANKS

The shadow banking sector's output of implicit borrower services slows from 2006-7, peaking at $137.9 billion in 2007. This is just as the subprime mortgage markets became severely troubled. Shadow banks' implicit borrower services falls sharply after 2007 but appears to have stabilized by 2011, albeit at a rate lower (relative to GDP) than in 1995.

Total implicit credit intermediation services of shadow banks behave a bit differently from borrower services alone because of the volatile influence of implicit depositor services. Total implicit output of shadow banks rose rapidly from 1995 to 2002, to a peak of $234.5 billion. Total implicit services of shadow banks declined four years earlier than borrower services because rising yields on shadow bank liabilities squeezed the user cost margins for depositor services starting in 2004.

Implicit depositor services then played a key role in what might seem to be a surprisingly rapid recovery from the crisis. The implicit output of shadow banks rebounded from $0.2 billion in 2006 to $188.3 billion in 2009. Many of the stabilization measures taken by the Federal Reserve during the crisis were directed at, or channeled through, the shadow banking sector. Figure 10 also shows the output of credit intermediation services of the depository institutions, or traditional banks. At the shadow banking system's peak in production in 2002, their implicit credit intermediation services was slightly above that produced by the traditional banking sector. Although total services produced by shadow banks have declined in relative terms since then, total services were larger in 2011 relative to production by traditional banks than they were in the 1990s.
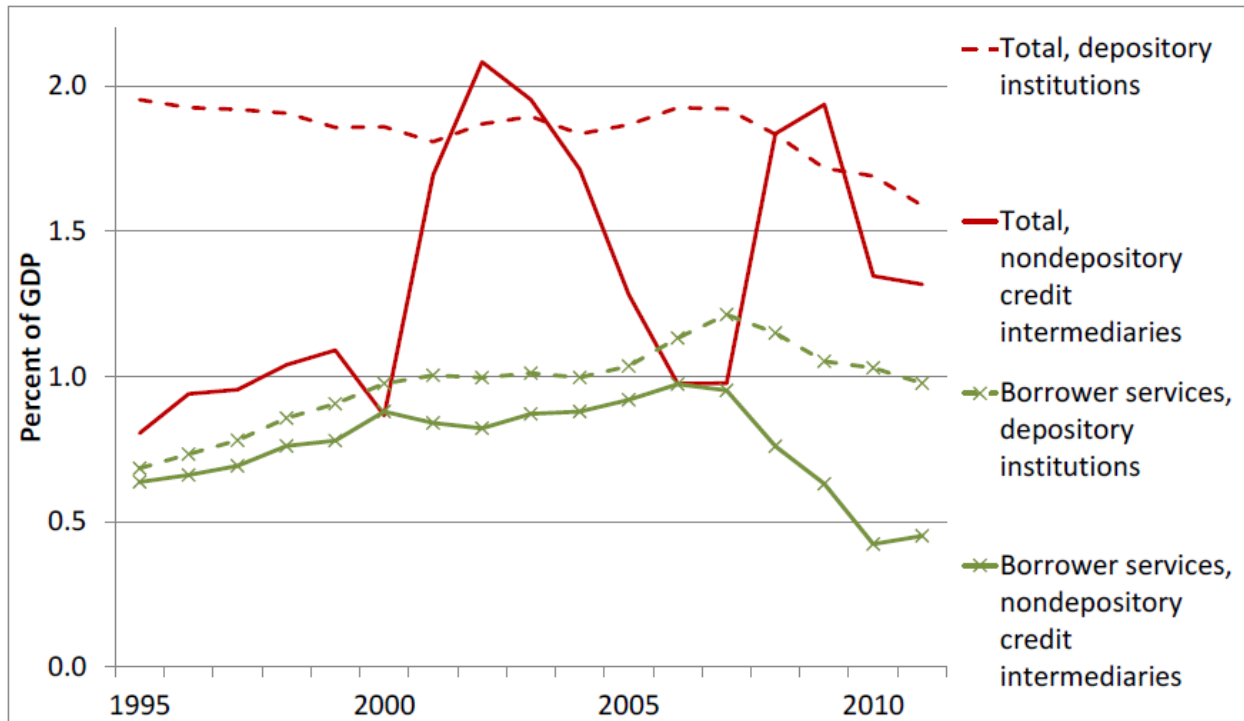
FIGURE 10. TOTAL AND BORROWER IMPLICIT SERVICES, TRADITIONAL AND SHADOW BANKS, 1995–2011.
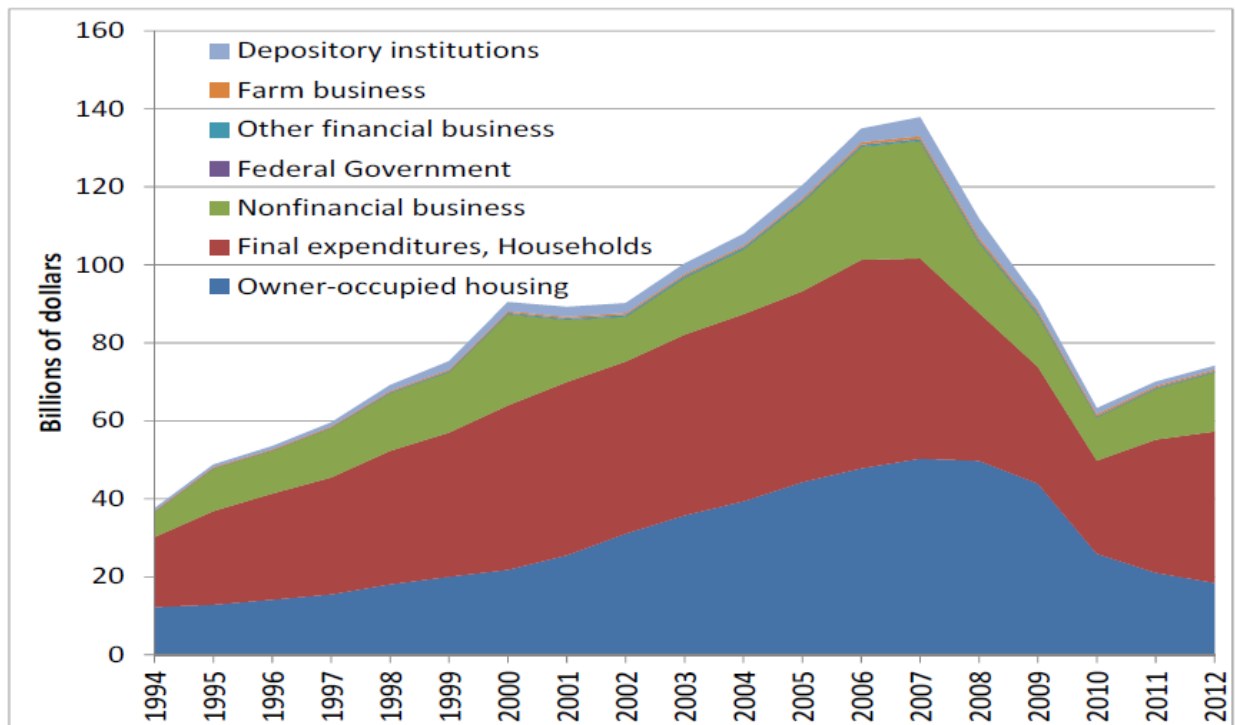

FIGURE 11. BORROWER SERVICES OF SHADOW BANKS BY USING SECTOR, 1994-2012.

Finally, it is important to note that interventions undertaken by the Federal Reserve after the financial crisis increased the depositor services output of shadow banks both indirectly by lowering short-term interest rates and directly by creating funding corporations, which are included in our some shadow banking sector. These actions staunched what might otherwise have been a sharp decline in shadow banking sector services. By contrast, credit intermediation services supplied by the traditional banking sector began a mild downtrend in 2007.

USES OF BORROWER AND FUNDER SERVICES

To compute uses of the services of shadow banks, we use sector balances in the corresponding assets holdings (for depositor services) and liabilities (for borrower services) in the financial accounts. We assume, for example, that sectors use depositor services associated with commercial paper in proportion to their commercial paper assets. Borrower services from mortgages are sectored according to asset holdings of shadow banks by type of mortgage first, then by mortgage liability holdings of users within these sectors. Uses are computed for each institutional sector and instrument separately, then summed to yield total uses.

Figure 11 shows uses of borrower services. While uses of borrower services both by the owner-occupied housing sector and for household consumption increase over the sample period before the crisis, owner-occupied housing sees a rapid expansion in the early to mid 2000s, followed by a rapid decline that continues through the end of the series. Household final uses, however, show a rebound after the crisis. No borrower services of shadow banks are used internally. Figure 12 shows uses of depositor services. In contrast to borrower services, in most years more than half of depositor services are used within the shadow banking sector. This mostly reflects the large quantities of services used by MMMFs. MMMFs are the source of services furnished to households.

Overall, were these estimates incorporated into the U.S. National Accounts, we would see an increase in GDP ranging from about four tenths of a percent to about three quarters of a percent. The contribution of this sector to GDP peaks in 2002 at 0.77 percent.

NET SERVICES OF SHADOW BANKS

We define the "\net output" of implicitly priced services of shadow banks as the sector's consolidated gross output of such services (total gross output of FISIM less inputs of FISIM from other shadow banks) less its consumption of implicitly priced services from outside the sector.

Measuring the implicit output of shadow banks on a net (or approximate value-added) basis largely eliminates the volatility that is caused by fluctuating margins on depositor services: Net services of shadow banks climb steadily until 2006, then decline over the financial crisis and Great Recession (figure 13).16 Canceling out intra-sector flows of FISIM in order to measure the shadow banking sector's output on a consolidated basis reduces its volatility; then subtracting \new" FISIM produced by other sectors (mostly by nonfinancial firms17) eliminates volatility

due to fluctuations in short-term interest rates. Figure 13 also shows that when measured on a net basis, the output of the shadow banking sector declines in 2008 in part because of the post-crisis inputs from the Federal Reserve.

The shadow banking sector is consistently both a producer and a user of depositor services, but it is not a significant user of borrower services. Figure 14 shows both output produced by and inputs used by the shadow banking sector. We can see that uses of depositor services inputs closely track production of depositor services. On the other hand, the shadow banking sector produces substantially more borrower services than it uses.

Depositor services are stable on a consolidated basis only. Figure 15 shows net borrower services (borrower services produced less borrower services inputs consumed) for institutional sectors within the shadow banking system. Funding corporations play a large, counterbalancing role as users of depositor services.

During the financial crisis, a large, persistent gap appeared between the gross and the net output measures because the shadow banking sector began to consume borrower services on loans from the Federal Reserve and increased its use of depositor services. Indeed, the remarkably quick rebound of the shadow banking sector's gross output in 2008-2009 is more than explained by a rise in inputs of credit intermediation services supplied by other sectors. The margin between loan and deposit rates remained wide through 2012.

Much of the drop-off in the shadow banking sector's net output thus appears to stem from a reallocation of value added to other sectors. Among these other sectors was nonfinancial business, suggesting that a portion of the Fed's support to the financial system during the crisis may have benefitted "Main Street" and not just "Wall Street." But the main part of the net decline in shadow banking output during and after the crisis stemmed from the sharp decline in its production of borrower services, which would have had a contractionary effect on household and nonfinancial business investment and consumption. On a net basis, the decline in output of the shadow banking system was due almost exclusively to a reduction in its production of borrower services.

III. CONCLUSION

The growth of the shadow banking sector was a key development in the U.S. economy, playing a central role in the financial crisis. By developing extensive estimates of the services produced by shadow banks and used by other sectors, we complete the picture of credit intermediation in the United States. The measurement challenges we surmounted, we believe, were considerable: We accounted for borrowing and lending along the intermediation chains that link final borrowers and final funders in a way that avoided double counting. We used data on interest rates, loan originations, default rates and loan pay-off patterns to model the effective rates needed to estimate user cost margins because we did not have information on interest flows available from reports filed by traditional banks that allow for direct estimation of user cost margins. We estimated the inputs from other sectors, including traditional banks, the monetary authority, and other producers of FISIM such as nonfinancial firms and non-depository, non-shadow financial

firms. This was done for shadow bank lenders in nine institutional sectors of the Federal Reserve's Financial Accounts.

The user cost approach to sizing the shadow banking sector provides insights into the role played by implicitly priced intermediation services in the recent cyclical behavior of the U.S. economy. Shadow banking emerges as more than 70 percent the size of traditional banking from 2000 to 2011, and the precipitous fall in shadow bank borrower services during and after the recent financial crisis is one of our more striking results. Moreover, our estimates show a drop in gross shadow banking output from 2002 to 2007 of more than 3/4 percent of GDP—a notable drag on the economy unseen at the time due to gaps in measurement we fill in this paper. Finally, even though it appears that gross depositor services of shadow banks are quite volatile, so is the consumption of depositor services by shadow banks. This indicates that the shadow banking system as a whole does not seem to be contributing much to depositor services consumed by final users, at least on a net basis. Nevertheless, within the shadow banking system, there is substantial heterogeneity in production and consumption of depositor services. Such a situation may suggest that the role that shadow banking played in the financial crisis had more to do with the asset and liability positions of institutions within the shadow banking sector, rather than of the sector as a whole.

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**Appendix: Comparing the Size of the Shadow Banking System
to Traditional Banking using a Simple Balance Sheet Approach**

A simple way to gauge the growing importance of shadow banking in US credit intermediation is compare total credit market liabilities of shadow banks to total deposits at commercial banks, savings institutions or credit unions. Note, however, that comparing liabilities of shadow banks to deposits will tend to make the shadow banking system seem large for two reasons. First, shadow bank institutions sometimes borrow from each other, and the borrower may even relend the funds to another shadow bank. The consolidated liabilities of the shadow banking sector to other sectors of the economy are thus smaller than the gross liabilities. Second, the liabilities of depository institutions include some credit market instruments other than deposits, and the use of these credit market instruments can be viewed as a shadow banking activity conducted within the traditional banking sector. There non-deposit credit market liabilities of traditional banks have grown along with the shadow banking system, but they remain much smaller than their deposits.

Figure A1 shows that in the mid-1970s deposits were more than 6 times as large as credit market liabilities of shadow banks, but by the time of the financial crisis deposits had fallen to not much more than half the size of shadow bank liabilities. In 2007 deposits began to grow rapidly, and by 2008 shadow bank liabilities were falling rapidly. As a result, in the aftermath of the financial crisis, deposits grew to over 90 percent of shadow bank liabilities.

Figure A1: Credit Market Liabilities of Nondepository Credit Intermediaries compared with Deposits