Shadow Banking and Financial Intermediation

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Abstract

This study focuses on how shadow banking, called fringe banking and parallel banking until recently, has become a central element for the US financial system. Using existing and new indicators of shadow banking, the paper uses two different Markov switching models to explore the role of shadow banking on bank lending cycle dynamics in the US. The findings show an alternating impact on bank lending, a positive (negative) impact in the expansion (contraction) phase of lending cycles. A third model that uses impulse-response analysis show that shadow banking has influences overall funding conditions in the financial system.

Key words: Shadow banking; financial architecture; credit cycles; financial instability.
JEL Classification: E12, E40, E50, G21, G23, G24.

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1. Introduction

This study investigates the nature of shadow banking and its role in the U.S. financial system. This study investigates the nature of shadow banking and its role in the U.S. financial system. Shadow banking can reflect overall funding conditions in the financial sector (Adrian & Shin, 2009a, p. 600) and our analyses show that shadow banking has gained a more central role in terms of amplifying bank lending cycles, affecting asset market conditions through term spread and risk premium, and hence gaining a destabilizing role in the financial system. In addition to using total asset sizes of shadow banking for these purposes, this study also develops a new aggregate indicator of shadow banking activities based on the New York Federal Reserve's Primary Dealer Statistics; and the results from both data sources confirm each other.

There is a growing consensus in the literature on the destabilizing role of shadow banking. Many studies focus on the originate and distribute (O&D) model, securitization, underwriting, and shadow banking activities as a source of financial instability and how these ultimately contributed to the subprime mortgage crisis (D'Arista & Schlesinger, 1993; Kregel, 2007; McCulley, 2009; Yellen, 2009; Wray, 2009; Nersisyan & Wray, 2010; Moe, 2014; D'Arista, 2018; Tokunaga & Epstein, 2019). The origins of the term, shadow banking, go back to a speech by Paul McCulley in 2007, where he (McCulley, 2009) likened it to Minsky's (2008 [1986]) fringe banking. Minsky had warned about the role of securitization and non-bank financial institutions in amplifying credit cycles as early as the 1970s (Minsky, 1975, pp. 10-11), and defined these activities as 'money manager' capitalism in 1980s (Minsky, 1989). According to Minsky (1989), the search for financial profits, and new practices to by-pass regulations were the leading causes of securitization and new types of financial

intermediation. Minsky had defined these intermediaries as fringe banking because they were located beyond the regulatory supervision, and their dependence on short-term funding had a destabilizing effect for the whole credit market (Minsky, 1975; Wray, 2009). D'Arista and Schlesinger (1993) also drew attention to these same developments, and defined these activities as parallel banking. Money market mutual funds, finance companies, and mortgage companies were making loans just like commercial banks, except they were lightly regulated and highly dependent on short-term money markets (D'Arista & Schlesinger, 1993, p. 158).

More recently, D'Arista (2018) has suggested that shadow banking has basically replaced traditional banking in the U.S. after the repeal of Glass-Steagall Act in 1999; and similarly, Caverzasi et al. (2019, p. 1047) argued that shadow banking "contributed to the development of an advanced form of finance-centered accumulation regime." Quite in line with these propositions, the objective of this study is to show how central shadow banking has become in the US financial system. Shadow banking started with non-bank lending and securitization activities, and their funding needs fueled the growth of repurchase (repo) and securities lending (or securities financing) market. These in turn offered leveraged trade opportunities for financial investors, and helped them to economize the use of cash holdings in their transactions. As its financial assets increased very rapidly in 1990s and 2000s, shadow banking became an important driver of credit expansion and overall funding conditions in the U.S. However, this market remained susceptible to instability as it lacked backstops (Mehrling, 2011). This study reports results from three empirical models that explore the intermediary role of shadow banking: Two different Markov switching models investigates the role of shadow banking in bank lending cycles, and

an impulse-response analysis show the role of repo and securities lending on the determination of term spread and risk premium.

The paper is organized as follows. The next section discusses two different possible measures of shadow banking; one based on the financial assets of non-bank lenders, and the second on the overall repo and securities lending transactions. Given these definitions, Section 3 evaluates the shadow banking and financial instability. Section 4 discusses the empirical models used. Two Markov switching models and a vector autoregression (VAR) model are estimated for different data sets. The Markov switching models are used to identify expansion and contraction phases of bank lending cycles. One Markov switching model uses the total financial assets of non-bank lenders, and another uses the overall volume of repo and securities lending, to explore the effect of shadow banking on cyclical dynamics. Both show that shadow banking activities lengthen expansions and diminish contractions. The effect of repo and securities lending on interest spreads is also examined by means of impulse functions. The results confirm similar findings in the existing literature that the lending volume in these markets has a negative effect on the term spread and a positive effect on the risk spread. The paper ends with some concluding remarks.

2. The Nature of Shadow Banking

An operational definition of shadow banking to measure its size in the financial system involves various challenges (Claessens & Ratnovski, 2014). One option is to use its total financial assets (Adrian & Shin, 2008, Adrian & Shin, 2009b; Pozsar et al., 2012). An alternative is to focus on the main funding instruments used by shadow banks, such as repo, reverse repo, securities lending and borrowing (Mehrling, 2011;

Krishnamurthy et al., 2014, Pozsar et al., 2012; Gabor & Vestergaard, 2016). Both approaches shed light on different aspects of shadow banking and its place in the overall financial system. This section gives an overview of shadow banking and its operations in light of these measures.

2.1. Institutions and Securitization

The institutional definition of shadow banking covers hedge funds, money market mutual funds (MMMFs), government sponsored enterprises (GSE), agency- and GSE-backed mortgage pools, issuers of asset-backed securities (ABS), finance companies, real estate investment trusts (REITs), security brokers and dealers, investment vehicles, mortgage brokers, finance companies, leasing and factoring companies, consumer credit companies, credit insurance companies (Adrian and Shin 2009b, IMF 2014). Shadow banks often borrow "short-term funds in the money markets and use these funds to buy assets with longer-term maturities" (Kodres, 2013, p. 42). Similar to traditional banks they engage in "credit, liquidity and maturity transformation" (Claessens & Ratnovski, 2014, p. 4), which can support traditional banking activities "by expanding access to credit or by supporting market liquidity, maturity transformation, and risk sharing" (IMF, 2014, p. 66). In this framework, shadow banking represents market-based lending as financial assets result from lending activities (Adrian & Shin, 2009a).

The total assets of shadow banking exceeded commercial banks' assets in mid-1990s (Figure 1), and remained higher thereafter even though they decreased after the crisis due to financial losses and new regulations just as commercial banking was much less affected (Adrian & Shin, 2009b).

FIGURE 1 HERE

Financial intermediation starts with loan initiations, and a commercial bank or a shadow bank can initiate these new loans. Once new loans are initiated they are warehoused which is financed by asset-backed commercial paper (ABCP). The loans are then pooled and structured into asset-backed securities (ABS), and warehoused, financed by commercial paper (CP), repurchase agreements (repos), similar short-term debt or structured credit instruments. ABSs are then pooled and structured into collateral debt obligations (CDO), which are finally marketed (Pozsar et al., 2012, p. 10-11). All these steps can be intermediated by a single financial institution or a number of different firms (Pozsar et al., 2012, p. 11). In traditional commercial banking, a new loan creates an asset (loan) and a liability (deposit) for the bank. By contrast, a new loan in shadow banking involves the creation of other debt instruments, generating a multiplicity of new assets and liabilities in the financial system. As a result, shadow banking-related financial instruments have become the biggest component of credit markets in the U.S. in 2000s (Pozsar et al., 2012, p. 6; Nersisyan, 2015, p. 549).

Securitization constitutes a central element in shadow banking; and similar to asset size, contraction and recovery is visible in the volume of securitization. The composition of securitized assets, or ABSs also changed after 2007 (Figure 2). Their volume increased steadily until 2007, followed by a contraction; and the composition of securitization has also changed. Car loan-back securities started to recover after 2011, while the volume of collateralized debt obligations (CDO) and collateralized loan obligations (CLO) started to rise after 2014. However, credit card- and student loan-backed securities never recovered after 2007. The composition of CDO/CLO also

reflects a change in securitization activities. The CDO/CLO has four subcategories. As shown in Figure 3, these are securities backed by (1) corporate bonds (CDO), (2) loans to non-investment grade corporations (CLO), (3) structural finance (SF), and (4) other securities. SF includes residential mortgage-backed securities (RMBS), CDO of CDOs, and other structural finance products; and the fourth subcategory includes collateral financial obligations and miscellaneous swaps (Blau, 2010, p. 99). Figure 3 demonstrates that structural finance (which includes RMBS) declined significantly after 2007, and this change may be interpreted as a prudential move for the shadow banking sector. However, another subprime lending security, CLOs, is increasing in recent years, and it can be source of concern for financial stability in the future. Structural finance analysts claim that CLOs are not as risky as RMBS. Corporations have a cash (revenue) flow in their businesses and the share of loans in these corporations' liabilities are smaller compared to mortgage loans (Blau, 2010, p. 101). This argument focuses on the riskiness of initial borrowers; however, the short-term nature of securities funding aggravates these risks as the panic of 2007-2008 showed. This new securitization activity can create another boom-bust cycle in the future (D'Arista, 2018, p. 161). The short-term nature of funding will be further discussed in the next subsection.

FIGURE 2 HERE

FIGURE 3 HERE

2.2. Instruments and Financing Operations

The institutional definition of shadow banking focuses on non-bank lending and securitization. In fact, financial intermediary role of shadow banking goes beyond these two components. Shadow banks finance their operations through short-term

funds, especially through repurchase agreements (repo), securities lending and pledges. Repo and securities lending market "grew out of the securitization of assets," and led to "the integration of banking with capital market developments" (Adrian & Shin, 2009b). Their development enabled shadow banking to integrate with the rest of the financial system. Thus, the volume of repo and securities lending gives us an alternative instrumental measure of the size of shadow banking. This approach is important to see the interconnectedness of financial institutions and shadow banking's central position in it. This alternative definition is based on the funding instrument, not the institutional character of the user.

Broadly speaking, securities financing represents borrowing/lending activities that use buy-backs/sell-backs of collateral security. Repurchase (repo), reverse repurchase (reverse repo) agreements, securities lending and borrowing, or pledges are examples of this type of finance. The collateral can be Treasury, agency and corporate bonds, agency mortgage-backed securities, equities, and other instruments (Baklanova et al., 2015). The cash borrower temporarily delivers the collateral to the lender, and collateral is transferred back after the debt is paid.[2] Securities financing started to grow in mid-1980s as volume of tradable Treasury bonds increased, and creditors gained the right to liquidate collateral if the borrower defaulted on loans (Garbade, 2006, p. 36). The repeal of Glass-Steagall Act in 1999 gave a further boost to these markets as the interconnectedness of financial institutions increased (D'Arista, 2018, p. 50-52).

[2] The Federal Reserve first used repo to supply short-term funding to commercial banks in 1917, and it became a standard monetary policy tool to monitor commercial bank reserves after 1951 (Garbade, 2006).

Four major groups in this system are cash borrowers, cash lenders, securities borrowers and securities lenders (Baklanova et al., 2015). The first group include hedge funds, brokers and dealers who borrow with repo to buy long-term debt assets, which they simultaneously post as collateral for the repo. Thus, cash borrowers can finance their long-term, high yield investments with low interest, short-term repo borrowing. The second group, cash lenders, is composed of money market mutual funds (MMMFs), government sponsored enterprises (GSEs), municipalities, insurance companies, and commercial banks. This group lends its cash through reverse repo with the temporary ownership of the collateral. Reverse repo is the only short-term, low-risk lending opportunity available for most actors in this group.[3] Securities lenders comprise the third group. Pension funds, sovereign wealth funds, mutual funds, exchange trade funds (ETFs), and insurance companies lend their securities for an extra return of lending fees. The fourth group, securities borrowers, which include hedges funds, and brokers and dealers, borrow securities to "cover short sales, remedy failed trades, or hedge risks" (Baklanova et al., 2015, p. 22).[4]

The collateral value is an important component of securities financing as these transactions not only settle borrowing and lending but also represent a price bidding process for the underlying asset. Consequently, "securities financing transactions are crucial in setting the price of financial assets and in particular the Treasury term premium," as well as "credit spreads" (Pozsar, 2014, p. 5-6). Through its price-setting

[3] Commercial banks are the only exception as banks started to earn interest on their excess reserves at the Fed.

[4] Unlike repos, securities lending does not represent "a sale outright sale of the securities" and does not have a specific "date and price" (Singh, 2012, p. 16). In balance sheets, securities lending is not included in repo accounts, and pledged assets are shown as off-balance sheet items. If a security is pledged to a primary dealer, the dealer does not own the pledged collateral but have legal rehypothecation rights, for this reason same asset can appear at different firms' control at a given time (Singh & Aitken, 2010).

role, securities financing has wider implications for the rest of the financial system and other macroeconomic variables (Mehrling, 2011, p. 102-103).

An example of cash funding with repo (Figure 4) can be helpful to understand these transactions. In this example, an insurance company holds cash, a hedge fund owns Treasury bonds, and the dealer is the intermediary. The hedge fund plans to buy a mortgage-backed security (MBS); and to fund the purchase, the hedge fund makes a repo agreement with the dealer and uses Treasury bonds as collateral. In this repo, the hedge fund delivers the Treasury bond and the dealer pays the cash. The collateral value is in excess of cash, and this difference is known as the haircut (Krishnamurthy et al., 2014, p. 2386). The hedge fund agrees to buy back the collateral at the expiration date of the repo by paying the cash amount plus an interest. The collateral bond passes to dealer, and dealer pays cash to the hedge fund, and hedge fund buys the MBS. The hedge fund's borrowing (repo) and the dealer's lending (reverse repo) are matched. The dealer can also fund its lending by borrowing from the insurance company through a repo transaction of its own, using the same Treasury bond that it received from the hedge fund as collateral. The insurance company reducing its cash holdings lends to the dealer through reverse repo and receives the collateral. In these transactions, two sets of lending take place, where the same Treasury bond is used as a collateral in both, for each leg of lending.[5] If the hedge fund intends to keep this MBS in its balance sheet with repo, these transactions have to be repeated, maybe on a

[5] This practice is called rehypothecation, and primary dealers in the U.S. can use the collateral they receive from their customers in their own funding and post it as collateral within some limits. Collateral can come through reverse repo, securities lending or securities pledged. Other institutions cannot rehypothecate the collateral they receive. Gabor and Vestergaard (2016, pp. 19-20) use a similar example, and in their example, the final receiver of the collateral, i.e., the insurance company in Figure 4, also swaps the Treasury bonds with another asset. However, in the U.S. only primary dealers can use rehypothecation of collateral they received. For details, see Singh & Aitkin (2010).

daily basis, as the maturity of the repo expires. Dealers can have various repo and reverse repo transactions with their customers with different collateral assets. Moreover, parties negotiate prices and interest rates for the collateral value and funding conditions every time a securities financing transaction takes place. They thus involve interest rate determination for the repo and a price determination for the collateral value, influencing both short-term and long-term interest rates at the same time.

FIGURE 4 HERE

In sum, securities financing plays a crucial role in the financial system in the determination of asset prices and interest rates. Dealer activities shed light on securities financing transactions as they reflect funding conditions in the financial system. The expansion and contraction of their balance sheet can be "seen as a barometer of overall funding conditions" (Adrian & Shin, 2009a, p. 600).

Despite their importance, no complete data coverage for all dealer activities exists. As a practical solution, this study uses in what is to follow the New York Fed's Primary Dealer Statistics as a proxy for dealer activities.[6] Primary dealers are financial intermediaries with a trading relationship with the New York Fed (Garbade, 2006, p. 27). Figure 5 shows a summary of primary dealers' total transactions. Securities-in represents all reverse repo, securities borrowing, and security pledges to be received, showing the sum of the dealers' overall lending to other institutions. Securities-out represents the dealers' borrowing activities. Figure 5 retracks the descriptive information given above about the rapid increase in securities financing through 2007,

[6] Measuring the full size of securities transactions market in the U.S. is beyond the scope of this study. For a discussion of data gaps, and alternative measurements see Krishnamurthy et al., 2014; and Baklanova et al., 2015.

and its contraction thereafter. At its peak, the volume of lending by primary dealers surpassed $4 trillion. After the crisis, market size declined as primary dealers have changed their collateral standards and new regulations were introduced (Singh & Aitkin, 2010: p. 5, and 10). These data show primary dealers as net borrowers in securities financing market, however, the term structure of these transactions sheds further light on this issue. Figure 6 shows the term composition of these securities financing transactions. Primary dealers are net borrowers in overnight (O/N) transactions, and net lenders in term transactions. Primary dealers thus not only intermediate transactions in this market but also transform maturity. In contracts with Treasury bond collateral, primary dealers are net borrowers and net lenders in contracts with other collaterals. Together with the term structure of these transactions, dealers are net borrowers in more liquid transactions (short-term and lower risk), and net lenders in less liquid transactions (long-term and higher risk).[7]

FIGURE 5 HERE

FIGURE 6 HERE

As these graphs reveal the size shadow banking grew until 2007 and declined afterwards. A recent recovery has begun in terms of securitization activities (Figure 2) while the composition of securitization has changed as collateral loan obligations have replaced mortgage-backed securities (Figure 3). The volume of securities financing thus gives us an alternative, instrumental way of measuring the size of shadow banking (Figures 5-6).

[7] Collateral compositions of securities-in and securities-out are not included here, but these compositions are available upon request.

3. Shadow Banking and Instability

The role of shadow banking in the subprime mortgage crisis has been a point of interest since the collapse of Lehman Brothers. McCulley (2009) among others have argued that lack of regulation in this sector was responsible for the financial crisis. In a seminal study, (Pozsar et al., 2012, pp. 11-12) emphasized the nature of short-term funding, especially securities financing as a destabilizing mechanism. As discussed above, securities financing requires a chain of borrowing activities, and a failure to finance can lead to "a forced liquidation of positions" (Nersisyan, 2015, p. 552). These sources of instability can be amplified if some of these intermediaries are "highly leveraged" and "vulnerable to runs," resulting in "financial turmoil by reducing asset values and help to spread the stress to traditional banks" (IMF, 2014, p. 240). As the overall system depends on short-term funding, a shortage of liquidity can create bigger funding problems elsewhere in the system (Adrian & Shin, 2009b, p. 604).

The Financial Services Modernization (FSM) Act of 1999 repealed the Glass-Steagall Act and opened new opportunities for financial services. Commercial banks could securitize loans with independent broker houses before 1999, and independent brokers had an incentive "not to buy bad quality loans" (Nersisyan, 2015, p. 551). The FSM Act enabled bank holding companies to engage in commercial and investment banking under one roof. This change eased loan standards in commercial banking and increased the securitization activities in non-bank units of the financial holding companies. With these new bank holding companies, transformation of regulated commercial bank assets to less regulated assets increased with securitization (D'Arista, 2018). In 2000s, financial institutions also invested in each other's ABS issues and financed these operations with short-term funding; and as a result, securitization

did not help to “disperse risks associated with bank lending” but it increased such risks (Adrian & Shin, 2009b, p. 11). These activities also attracted funds all around the world due to the U.S. dollar’s dominant position, and the fragility in the U.S. spread to other economies in 2000s (Tokunaga & Epstein, 2018).

Gorton and Metrick (2012) argued that a run on the repo market triggered the panic in 2007 and 2008. Copeland et al. (2014) on the other hand rejected the idea of a market wide run on repo, and held that some individual dealers such as Lehman Brothers were subject to a run. In a similar way, (Krishnamurthy et al., 2014, p. 2415) emphasized the impact of rising risk aversion among lenders. This risk aversion increased the cost of finance, and repo funding for private securitized assets declined. According to this view, the 2007-2008 panic was similar to a credit crunch rather than a system-wide repo run.

A new group of studies also focused on the nature of securities financing as the main source of financial instability (Mehrling, 2011; Pozsar, 2014; Gabor & Vestergaard, 2016). Leaving aside securitization, shadow banking is similar to traditional banking. Both types of institutions borrow short-term in order to lend long term; and this nature of the business brings solvency and liquidity risks (Mehrling, 2011). Traditional banks face solvency risks when borrowers default on loans, and liquidity risk when deposit holders withdraw deposits. Unlike shadow banks, bank capital, deposit insurance, and discount lending create “backstops” for these problems (Mehrling, 2011, p. 117). Without these backstops in the past, traditional banking used to experience frequent crisis in the U.S.

The example in Figure 4 above highlights the importance of backstops. The dealer in Figure 4 functions similar to a traditional bank. Lending activity creates new

assets and liabilities; the dealer's new asset is reverse repo and new liability is repo, similar to a bank's loans and deposits. The difference between a dealer and a commercial bank is the absence (or existence) of backstops. As its deposits are withdrawn, the bank either reduces its reserves or can borrow from other institutions, including the Fed. The banking system has ability to create new liabilities and has a backstop, which the dealer does not have. Thus, dealers' intermediation role is interrupted if dealers cannot borrow with repo, creating instability in the financing of securities.

In sum, securities financing enables market participants to economize on cash holdings. In this way, repo becomes an alternative to cash in the hierarchy of money (Mehrling, 2011; Pozsar, 2014; Gabor & Vestergaard, 2016). However, repo can replace money if another party is willing to supply cash for collateral. But, if no party is willing to post cash, dealers cannot fund their clients and the lending comes to a halt, giving rise to a run on repo (Gorton & Metrick, 2012) or a credit crunch (Krishnamurthy et al., 2014).

4. Data and Empirical Analyses

In the empirical analysis of shadow banking, research is hampered by gaps in the publicly available data. There are basically two approaches to deal with this problem. The institutional approach uses the financial asset size of shadow banking. For instance, Adrian and Shin (2008) use the total asset size of shadow banking in their analysis, and show how shadow banking affect macroeconomic variables. Financial Stability Board, the international monitoring agency, also uses the institutional approach in its annual shadow banking reports. IMF also takes a similar approach,

except it also includes non-core liabilities of commercial banks in its measure of shadow banking. (Haruntyunyan, 2015). A clear advantage of this approach is the availability of long-term data. Another advantage is that it shows the balance sheet developments of shadow banking relative to other financial institutions. However, balance sheets might fail to reflect shorter term changes as they represent a snapshot of financial activities at the end of each quarter. Moreover, pledged securities and rehypothecation activities are not at all shown in balance sheets.

As an alternative, the instrumental approach uses securities financing as a functional representative of shadow banking. This approach does not limit shadow banking to a certain type of financial institutions and provides a higher frequency data; and these two aspects constitutes the advantages of the instrumental approach. Primary Dealers Statistics of the Federal Reserve Bank of New York can be used for this approach. However, this dataset does not cover non-primary dealer activities.[8] And even with this disadvantage, Primary Dealers Statistics is still the most comprehensive dataset for securities financing (Baklanova et al., 2015, pp. 45-46).

This section uses both types of data coverage in its three sets of empirical investigations due to these advantages and disadvantages. The first investigation focuses on the impact of shadow banking on commercial bank lending cycles; and this investigation uses the total financial asset size of shadow banking. The second analysis replicates the first one with securities financing data. And finally, the third investigation uses repo and securities financing data to evaluate the role of shadow banking on risk and term spreads in debt markets. First two investigations show that

[8] The size of non-primary dealer activities are expected to represent a minor share of overall activities, but it is not known with certainty (Baklanova et al., 2015, p. 48).

there is a relationship between shadow banking activities and commercial bank lending cycles. The third investigation reveals the impact of securities financing on term and risk spreads.

4.1. Shadow Banking and Commercial Bank Lending

Shadow banking can interact with commercial bank lending in two different ways. Shadow banking can initiate new loans or buy loan receivables from commercial banks through securitization. These activities can affect overall funding conditions in lending markets. Moreover, shadow banks' own funding is limited to short-term markets, and funding conditions can determine the volume of shadow banking activities. Shadow banking can contribute to credit expansion in tranquil times, and a distress in money markets can quickly spread to shadow banking, as risks are materialized. As a result, shadow banking can amplify the expansion and contraction phases of a credit cycle (Sieron, 2016).

Based on these insights, this part focuses on the relationship between shadow banking and bank loans. As a first attempt, vector autoregression (VAR) models and co-integration analyses are used, but these estimations did yield any statistically significant results. As an alternative to these linear models, a Markov regime-switching model is used in this part.

As the exact dates of bank lending cycles are unknown, the relationship between bank lending and shadow banking activities can be shown with an MS model, and regime switches can represent bank lending cycles. Equation (1) shows the Markov switching autoregressive (MSAR) model used in this part. MSAR models can

have state-invariant or state-dependent constant term, coefficients and AR terms. The general specification of MSAR models in shown in equation 1 below:

$$y_t = \mu_{s_t} + x_t\alpha + z_t\beta_{s_t} + \sum_{i=1}^{n} \phi_{i,s_t}\left(y_{t-i} - \mu_{s_{t-i}} + x_{t-i} + z_t\beta_{s_{t-i}}\right) + \varepsilon_{s_t} \quad (1)$$

$$\varepsilon_{s_t} \sim \text{i. i. d. } N(0, \sigma_s^2)$$

where y_t is the independent variable, μ_{s_t} is state-variant intercept, x_t is state-invariant coefficient, α, z_t is vector of endogenous variables, β_{s_t} represents state-dependent coefficients, and ϕ_{i,s_t} is state-variant i^{th} AR term. In MS models, number of states are exogenously determined, and the duration of a state and transition between states are random. The probability of current state j, depends on the previous state; and transition probabilities follow a Markov chain:

$$p_{ij} = p(S_{t+1} = j | S_t = i) \;\&\; \sum_{i=1}^{j} p_{ij}$$

where i, j = 1, 2, …. And Markov transition probabilities for k states can be summarized as

$$P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1k} \\ p_{21} & p_{22} & \cdots & p_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ p_{k1} & p_{k2} & \cdots & p_{kk} \end{bmatrix}$$

Total loan of depository institutions is the dependent variable; total assets of shadow banking, risk premium and term spread are independent variables. Total loans of depository institutions and total assets of shadow banks are normalized by GDP. Risk premium is the yield difference between 3-month commercial paper rate and 3-month Treasury bill, and term spread is the difference between 10-year Treasury bond and 3-month Treasury bill yields. Shadow bank assets are defined as the total assets of money market mutual funds (MMMFs), government sponsored enterprises (GSE), agency- and GSE-backed mortgage pools, issuers of asset-backed securities (ABS), finance companies, real estate investment trusts (REITs), security brokers and dealers, and finance companies. Even though hedge fund activities can be included in shadow banking, these activities are reported under the household sector in the Federal Reserve data, and total assets of shadow bank activities do not include hedge funds.

The risk premium and term spread variables can yield a series of information. These two yield differences can capture the changes in short and long-term interest rates. The difference between 3-month commercial paper and Treasury bill reflects the risk premium in money markets. And shadow banks finance their operations through issuing commercial paper (CP), repurchase agreements (repos), or similar debt or structured credit instruments (Luttrell, 2012, p. 5; Pozsar et al., 2012, pp. 11-12). A run on shadow banks led to a rapid increase in this risk premium in 2008 (Luttrell, 2012, p. 7), thus this spread can reflect the ease or distress of shadow banking finance. The term spread can be a proxy for the slope of the yield curve. As discussed in the previous section, transactions in securities financing market can influence the term spread.

All variables are quarterly and the sample covers the period between the first quarter of 1983 and the fourth quarter of 2016. Data for bank loans, shadow banks, and GDP are taken from Financial Accounts (formerly Flow of Funds tables) of the Board of Governors of the Federal Reserve, and term spread and risk premium are taken from the Federal Reserve Bank of St. Louis FRED Economic database. As all the variables, except real GDP growth rate, were not stationary, first differences are used and unit root tests did not show evidence of further unit root problems. Schwarz's Bayesian Information Criterion (SBIC) is used for model specification of state-invariant and state-variant variables as a well as AR terms. A three-regime model is first sought but the estimation did not give any results. MSAR(4) model with two regimes showed statistically significant results as shown in Table 1. State 1 reflects contraction phases, and state 2 reflects expansion phases. Shadow banking activities have a positive (negative) impact on bank lending in the expansion (contraction) phase of bank lending cycles. As a result, if shadow bank activities diminish bank lending in contraction, and augment in expansion; shadow bank activities can increase the amplitude of commercial bank lending cycles.

TABLE 1 HERE

Risk premium has an adverse impact in State 1, and show a positive relationship with bank lending in State 2. The negative coefficient may signal liquidity shortage in contraction phases. Shadow banks can easily finance their position in expansion phases, and can buy new loan receivables from commercial banks and contribute to bank lending cycles. However, shadow banks may be reluctant to invest in long-term loan receivables in contraction phases.

The coefficient of term spread is negative in both states, but statistically insignificant only in state 1. The slope of the yield curve is expected to be positive in economic expansions, as a result a positive coefficient was expected for term spread in state 2. A negative coefficient of the term spread may mean that there is a negative relationship between a relative rise in long-term interest rates and overall bank lending.

The existence of two regimes verifies the instability of the bank lending and the role of shadow banking activities. There is not a linear relationship between these two activities. The smooth probabilities of these two regimes can reflect lending cycles, and Figures 7 and 8 show these cycles with U.S. recessions. Smooth probabilities show that state 2 is more persistent than state 1. The expected durations of regimes can be estimated with transitional probabilities as $P_{ii}= (1/(1-P_{ii}))$; expected durations show that state 1 lasts on average for six quarters and state 2 continues for fifteen quarters. The variance of state 2 is larger than state 1, which may reflect the volatility is actually stronger in expansion phases.

FIGURE 7 HERE

FIGURE 8 HERE

Figure 7 also showed that the smooth probability of state 1 peaks around major global financial turbulences. These are (1) 1987 stock market crash in the U.S., (2) Asian crisis of 1997, Russian and LTCM crisis of 1998, (3) subprime mortgage crisis of 2007 in the U.S., and (4) European debt crisis of (2010). Such events are usually marked with a shortage of liquidity and a rise in risk premium. In such epochs, shadow bank activities cannot support bank lending as these institutions also face liquidity shortage. The probability of state 2 can reflect the expansionary phase of the lending

cycles. The lending cycles do not necessarily coincide with the business cycles as financial variables react to new information. However, an increase in the smooth probability of state 1 can be a precursor of a coming recession. Higher risk premiums and a shortage of liquidity turns into credit slow down and these developments translate into a slowdown in economic activities.

4.2. Securities Financing and Commercial Bank Lending

This subsection builds on the previous subsection with a different data set. Instead of total financial assets of shadow banking, this part uses securities-in of primary lenders to represent shadow banking activities. Total bank lending of depository institutions is the dependent variable, securities-in and term spread are independent variables. As the data set covers the period between 1998 and 2018, monthly series are used for maximum number of observations; and real GDP growth rate is dropped as it is not available in monthly data. As securities-in and risk premium are highly correlated, risk premium is also dropped from the estimation.[9]

Total loans of depository lending is taken from the H.8 Assets and Liabilities of Commercial Banks of the Federal Reserve, securities-in is estimated from the Primary Dealers Statistics of the New York Fed, and term spread is from the FRED Economic Database of the St. Louis Fed. All variables are adjusted for seasonality; total loans and securities-in are deflated by consumer price Index (CPI), and natural logarithms are used for these two variables. And first differences are used for all variables.

[9] An alternative model is also estimated with risk premium. The coefficients, states, and smooth probabilities of the alternative model are similar main model of this subsection. This alternative model can be shared upon request.

In this part, a Markov-switching dynamic regression (MSDR) is used instead of MSAR, as an MSDR model allows a quicker adjustment process after regime changes in high frequency data. The general specification of MSDR model is given in equation 2:

$$y_t = \mu_{s_t} + x_t\alpha + z_t\beta_{s_t} + \varepsilon_{s_t} \quad (2)$$

$$\varepsilon_{s_t} \sim \text{i.i.d. } N(0, \sigma_s^2)$$

where y_t is the independent variable, μ_{s_t} is state-variant intercept, x_t is state-invariant coefficient, α, z_t is vector of endogenous variables, β_{s_t} represents state-dependent coefficients. Based on SBIC, a two-state model with constant intercept and variance is chosen, and securities-in and term spread are state-variant variables. Table 2 shows the estimation of the MSDR model. Similar to the previous subsection, State 1 represents the contraction phase and State 2 represents expansion phase. All variables and intercept are statistically significant, and securities-in has a negative coefficient in State 1 and a positive coefficient in State 2. And the absolute value of the coefficient is State 1 is greater than State 2 which means the negative impact of securities-in on bank lending is larger during contraction phases. Similarly, the coefficient of term spread is negative in both states, but impact of term premium on bank lending is stronger in contraction phases.

TABLE 2 HERE

Parallel to MSAR model in the previous subsection, State 2 is more persistent than State 1. Expected duration for State 1 is 5 months and for State 2 is 17 months.

The smooth probability graphs of two regimes are shown in Figures 9 and 10. The smooth probability of State 1 peaks between January 2007 and December 2008 and captures the panic in securities financing markets. Similarly, this probability peaks again in July 2010 during the European debt crisis.

FIGURE 9 HERE

FIGURE 10 HERE

In sum, the MSDR model of this part confirms the results of the previous subsection. Overall repo and securities lending operations of primary dealers or their gross lending has a state-variant effect on bank lending. Securities-in has a positive (negative) impact on bank lending in the expansion (contraction) phase of bank lending cycles. Shadow banking either measured by total financial asset size or the volume of securities financing is playing a major on bank lending cycles.

4.3. Securities Financing and Interest Spreads

This part focuses on the relationship between primary dealers' borrowing/lending activities and interest spreads in bond and money markets. As discussed above, securities financing transaction are believed to be influential on funding conditions and especially on interest spreads (Adrian & Shin, 2009a, p. 9; Mehrling, 2011, p. 103; and Pozsar, 2014, p. 6). Based on these earlier arguments, this part uses overall repo and securities lending activities of primary dealers to investigate their impact on term spread and risk premium. Securities-in represents dealers' overall lending, and securities-out represents their overall borrowing.

Adrian and Shin (2008), in their regression analyses, showed that shadow banking has an important effect on interest rates and other macroeconomic variables.

Their study used total financial assets of shadow banking institutions to represent shadow banking activities. This study also used these total assets for an empirical investigation between shadow banking and interest spreads (with or without and bank loans) in vector autoregressive (VAR) analyses, yet VAR models did not yield statistically significant results. For this reason, this subsection uses securities financing data of primary dealers and interest spreads in a VAR model. The variables in this model are securities-in, securities-out, term spread and risk premium. Similar to previous subsection data covers between February 1998 and June 2018, securities-in and securities-out are in real natural logarithms, and first differences of all variables are used.

The lag length of the VAR model is chosen as 4 based on Akaike Information Criterion (AIC). Orthogonalized impulse-response functions (OIRF) are estimated for this VAR model. The graphs of statistically significant OIRFs are shown in Figure 11, these impulse response functions confirm the Adrian and Shin's (2008) results with a different econometric method. Overall repo activities have an impact on term spread and risk premium. A positive shock to securities-in leads to an increase in risk premium and a decline in term spread. Similarly, securities-out has a positive impact on term spread no statistically significant impact on risk premium.

FIGURE 11 HERE

These results confirm the arguments in the previous section. Securities lending market enables financial investors to buy long-term assets with short-term borrowing. As Adrian and Shin (2008) points out a step yield curve represents profit opportunities for this type repo activities. As repo borrowing increases, the term spread decrease, and risk premium increase; and finally profit opportunities decline. These changes can

stall repo finance; and as a result, liquidity can dry up in repo market. As similar developments in 2007 and 2008 showed, lack of liquidity and rising risks can initiate a repo run on some borrowers. In sum, repo market breeds financial instability through its own operations. This instability is not limited repo markets or shadow banking; changes in term and risk spreads affects credit conditions for the rest of the economy.

5. Conclusion

The objective of this study is to explain how shadow banking gained a central role in the U.S. financial markets. Shadow banking comprises non-bank lending and securitization activities, which led to the growth of repo and securities lending market to meet the short-term funding needs to finance these activities. These markets offer leveraged trade opportunities for financial investors, helping them economize the use of cash holdings to settle transactions. Two different, yet related approaches have emerged in how the size of shadow banking is measured.

The first approach focuses on non-bank lending and overall securitization activities, which helps to highlight the relative share of shadow banking in the financial system and overall credit mechanism. The second approach focuses on repo and securities market, which highlights interest rate determination and their destabilizing potential. These two approaches are best thought as complementary rather than being alternatives to each other.

In terms of asset size shadow banking is as large as commercial banking, and has remained so even after the subprime mortgage crisis. There has also been a rebound in securitization activities in recent years, and collateral loan obligations appear to have replaced residential mortgage-backed securities. The empirical

analysis above shows that shadow banking activities have an alternating impact on bank lending cycles. They augment commercial bank lending in the expansion phases of lending cycles, while detracting from it in the contraction phases. In this way, their effect is to extend the amplitude of bank lending cycles.

The second approach that focuses on repo and securities lending markets highlight borrowing (lending) activities that use buy-backs (sell-backs) of a collateral security. This collateral-backed borrowing has two important implications. First, unlike other borrowing, it settles simultaneously the borrowing interest rate and the price of the collateral asset, influencing thus both the short-term and long-term interest rates. Second, the activities that provide short-term funding for long-term positions are only sustainable when a positive term spread between long-term and short-term rates exists. Financial instability thus arises as this spread declines, when borrowers face heightened liquidity risks. Liquidity problems in such conditions can lead to funding shortages and failures given that repos and securities lending markets do not have the type of backstops commercial banks have.

The empirical analysis above based on this second approach showed results similar to those the first approach produced. The effect of aggregate lending in securities financing market is again shown to raise the amplitude of the lending cycle. They augment bank lending in the expansion phase and weaken it during the contraction phase of bank lending cycles. Yet another result reported above shows a significant relationship between funding activities in securities lending market and interest spreads. Aggregate lending has a negative impact on term spread between 10-year Treasury bonds and 3-month Treasury bill, and a positive impact on the risk premium between 3-month commercial paper and 3-month Treasury bill. Liquidity in

securities market depends on a low risk premium and high term premium, yet lending activities tend to have an opposite effect on these spreads.

While these two approaches highlight different dimensions of shadow banking, they both show that it plays a crucial role in credit cycles and interest rate determination.

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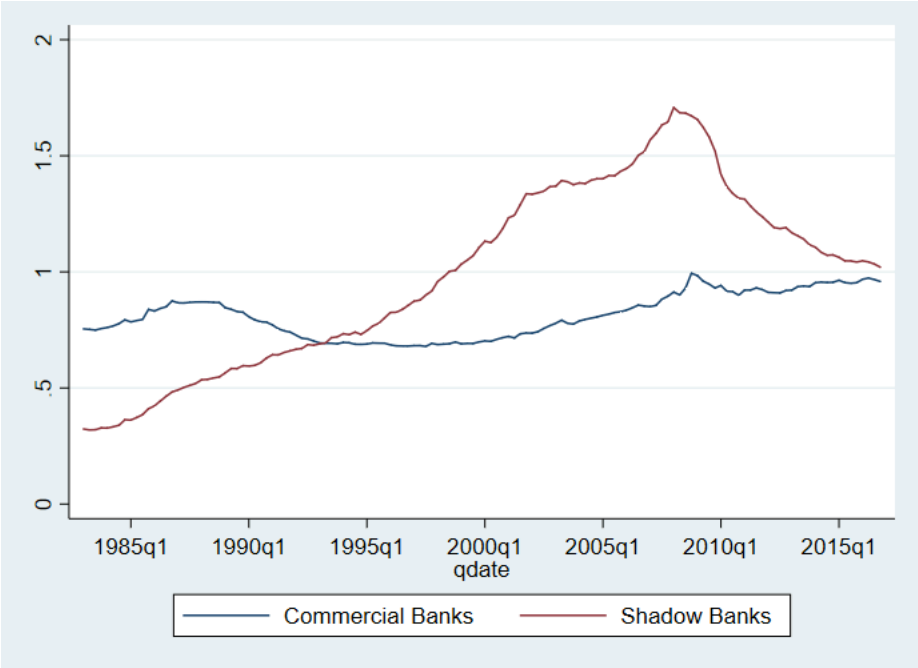
Figure 1. Total Assets as a ratio of GDP[a,b]

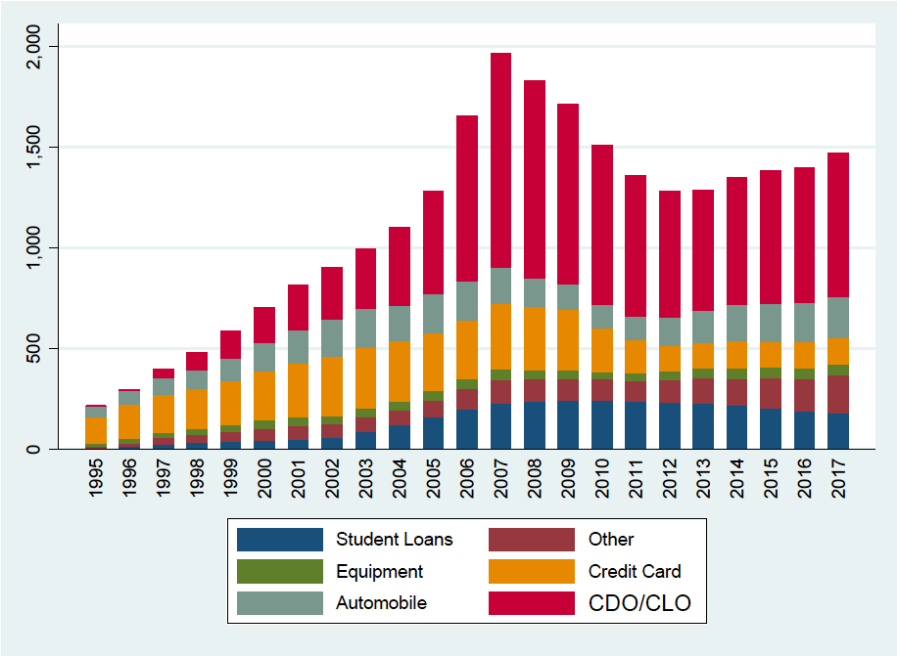


Source: Estimated from L.110, L.121, L.125, L.126, L.127, L.128, L.129, L.130, L.132 tables of Financial Accounts of the U.S., The Federal Reserve.

[a] Shadow banking assets are defined as the total assets of money market mutual funds (MMMFs), government sponsored enterprises (GSE), agency- and GSE-backed mortgage pools, issuers of Asset-backed securities (ABS), finance companies, real estate investment trusts (REITs), security brokers and dealers, and finance companies.

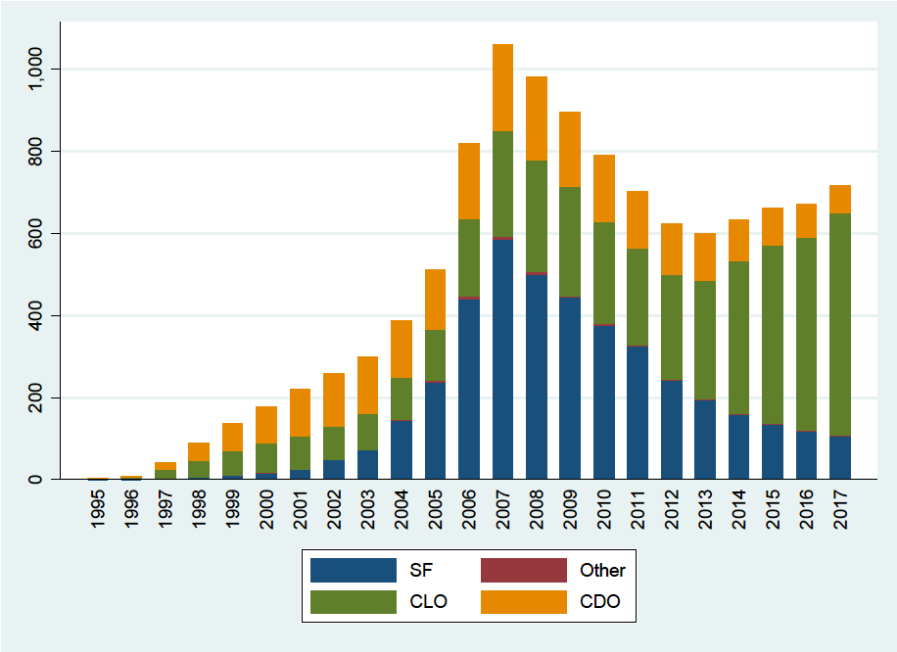
[b] As Federal Reserve reports hedge funds under household sector, hedge funds are not included in shadow bank definition.

Figure 2. Securities Outstanding (USD Billions)



Source: Securities Industries and Financial Markets Association (SIFMA).

Figure 3. US CDO/CLO Outstanding (USD Billions)



Source: Securities Industries and Financial Markets Association (SIFMA).

Figure 4. Repo with Treasury Bonds

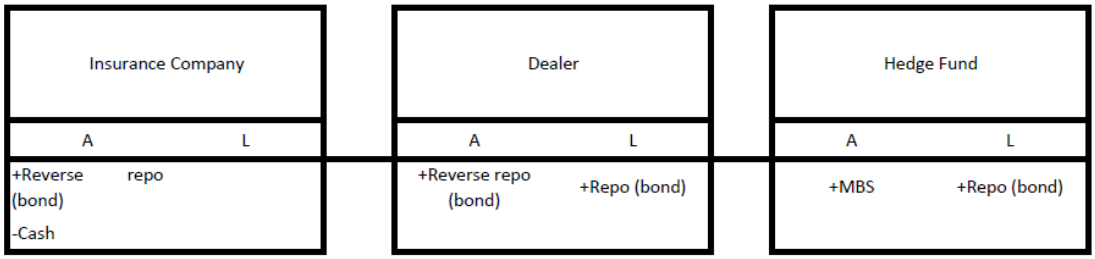
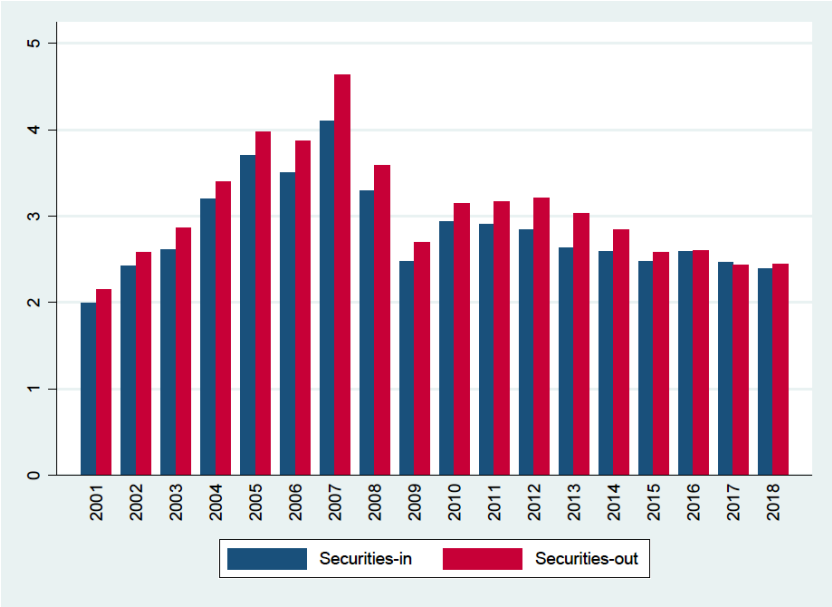
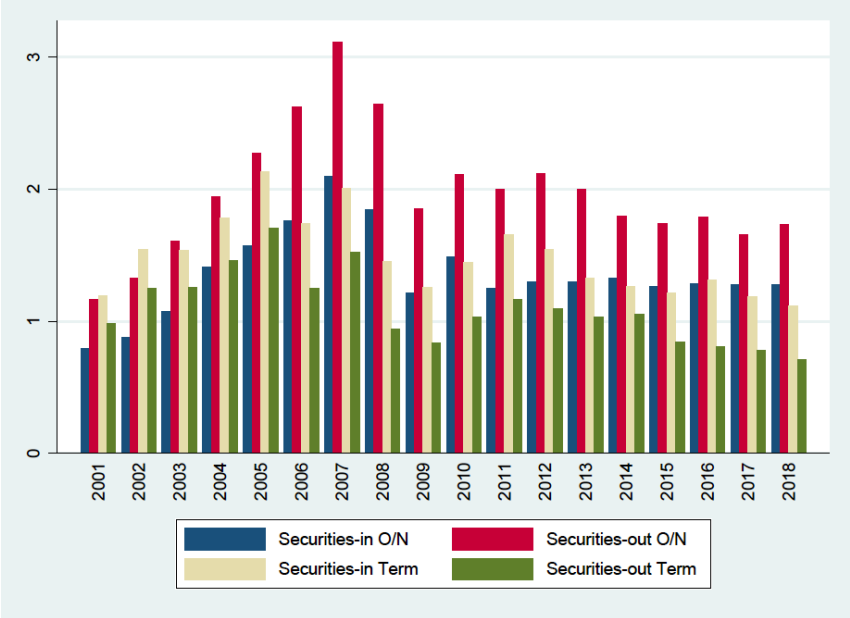


Figure 5. Primary Dealer Overall Transactions[a] (USD Trillions)



Source: Estimated from the Primary Dealers Statistics of the New York Fed.
[a] 2018 levels represent June 2018.

Figure 6. Term Structure of Primary Dealer Transactions[a] (USD Trillions)



Source: Estimated from the Primary Dealers Statistics of the New York Fed.
[a] 2018 levels represent June 2018.

Table 1. MSAR(4) Estimation

	Parameter	Coefficient	Standard error	z	$P > z$
	μ_t	0.0002	0.003	0.07	0.943
	GDP_t	0.0003*	0.0002	1.74	0.082
	$AR(1)$	-0.015	0.089	-0.18	0.859
	$AR(2)$	0.212***	0.071	2.98	0.003
	$AR(3)$	0.134	0.93	1.44	0.15
	$AR(4)$	0.553***	0.78	7.07	0.000
State 1	$shadow_t$	-0.073**	0.0302	-2.42	0.015
	$risk_t$	-0.006**	0.002	-2.46	0.014
	$term_t$	-0.002	0.001	-1.29	0.198
State 2	$shadow_t$	0.214***	0.034	6.31	0.000
	$risk_t$	0.007***	0.002	3.5	0.000
	$term_t$	-0.004	0.001	-4.18	0.000
	σ_1	0.002	0.0005		
	σ_2	0.004	0.0003		
	P_{11}	0.836	0.078		
	P_{12}	0.163	0.078		
	P_{21}	0.064	0.041		
	P_{22}	0.935	0.041		
	Log likelihood	525.588			

Note: *, **, *** denote significance at 10%, 5%, and 1%.

Figure 7. Smooth Probabilities for State 1

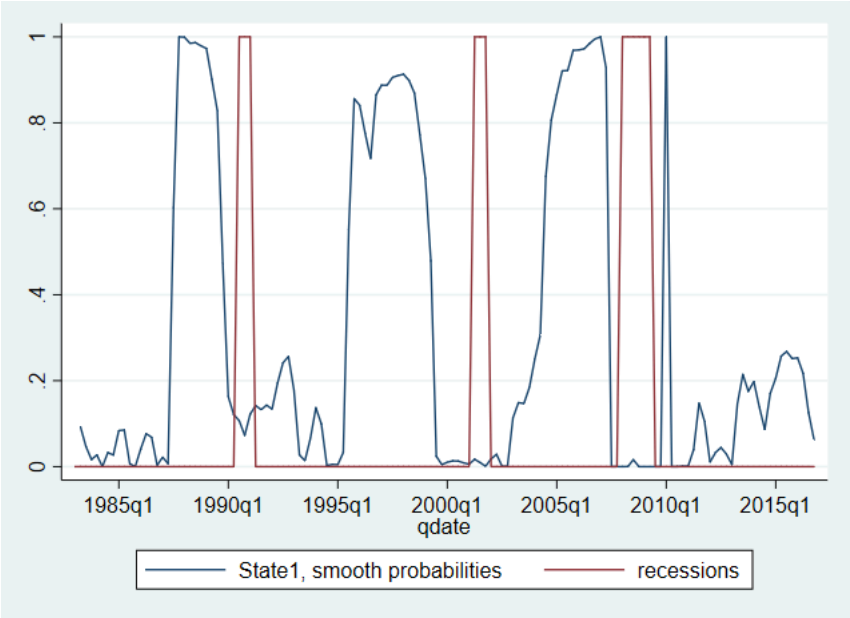


Figure 8. Smooth Probabilities for State 2

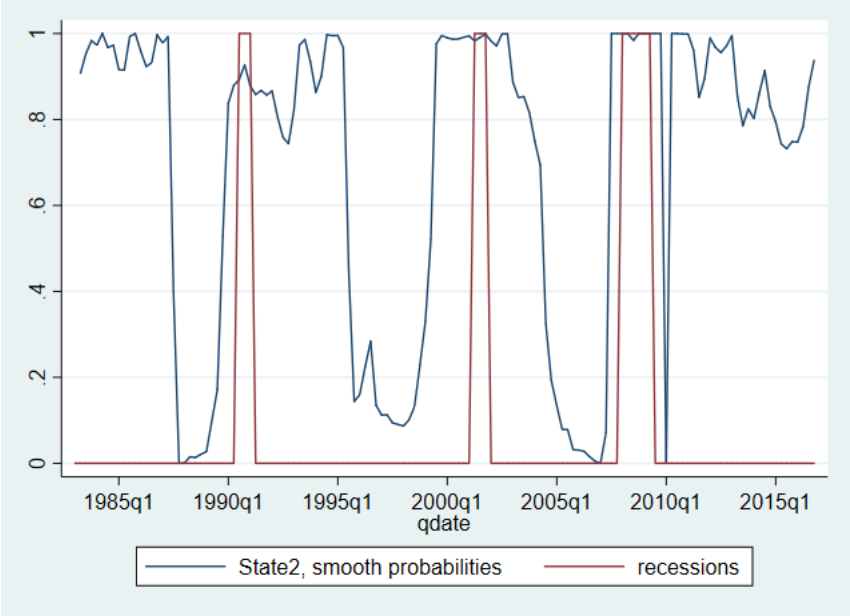


Table 2. MSDR Estimation

	Parameter	Coefficient	Standard error	z	$P > z$
	μ_t	0.001	0.0001	9.99	0.000
State 1	$secin_t$	-0.171	0.033	-5.12	0.000
	$term_t$	0.006	0.002	2.82	0.005
State 2	$secin_t$	0.100	0 .025	3.92	0.000
	$term_t$	-0.007	0.001	-7.01	0.000
	σ	0.001	0.00007		
	P_{11}	0.801	0.069		
	P_{12}	0.198	0.069		
	P_{21}	0.058	0.028		
	P_{22}	0.941	0 .028		
	Log likelihood	1200.982			

Note: All estimates are significant at 1%.

Figure 9. Smooth Probabilities for State 1

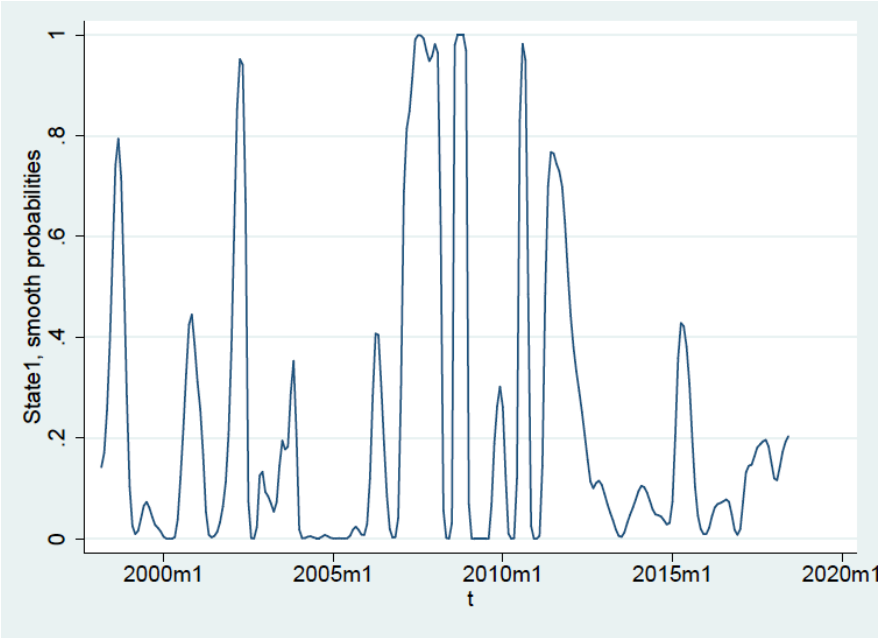


Figure 10. Smooth Probabilities for State 2

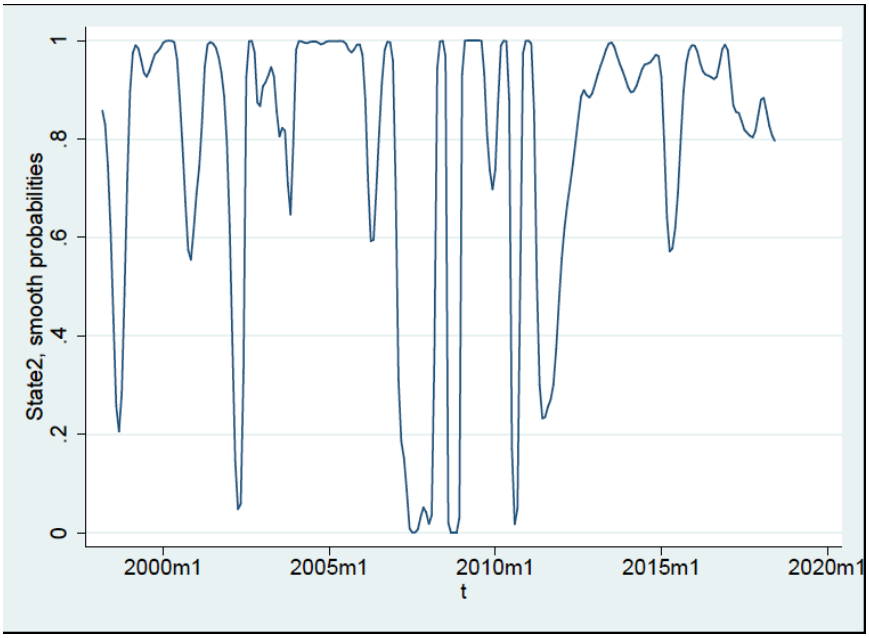


Figure 11. Impulse-Response Functions