Monetary Policy and Shadow Banking

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Monetary Policy and Shadow Banking

Luca Agnello, Vitor Castro, Fredj Jawadi and Ricardo M. Sousa*

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Taylor (1993): the monetary authority adjusts the short-term interest rate in response to the current inflation rate and the output gap.
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Several studies developed different versions of the monetary policy rule.

- Lagged interest rate term due to inertia or interest rate smoothing behaviour (Woodford, 1999), data uncertainty (Orphanides, 2003) or misspecification (Rudebusch, 2002).
- Forward-looking nature of economic behaviour and the importance of inflation targeting (Clarida et al., 1998).
- Real-time data in the information set of the central bank (Orphanides, 2001).
The Taylor rule is still the workhorse of monetary policy.

- English et al. (2002): policy actions during the Greenspan period are described well by a Taylor rule with inertia.
- Blinder and Reis (2005): the Fed adjusted the federal funds rate in reaction to changes in the “core” inflation.
- Clarida et al. (2000): a forward-looking Taylor rule that links the short-term interest rate to “expected” future inflation and output gap during the Volcker and the Greenspan tenures.
- Mehra and Minton (2007): a forward-looking behaviour, a focus on core inflation and smoothed interest rates appear to be the general characterization of the policy rule adopted in the Greenspan Fed.
The financial crisis of 2008-2009 raised fundamental questions about the goals of monetary policy and the role that the central bank can have in weathering the various macroeconomic dynamics with which it is continuously confronted.

- Taylor (2009): excessively expansionary monetary policy in the pre-crisis period helps to explain the emergence and the severity of the financial turmoil.
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- Taylor (2009): excessively expansionary monetary policy in the pre-crisis period helps to explain the emergence and the severity of the financial turmoil.

- Not surprisingly, a vast amount of work suggests that the original framework of Taylor (1993) should be extended to include other variables.
Monetary policy and **stock prices**:

- Cecchetti et al. (2000) and Chadha et al. (2004): strong response of central banks to variations in asset prices.
- Bernanke and Gertler (2001): once the predictive content of asset prices for the dynamics of inflation has been controlled for, central banks should avoid to react to asset prices.
  - Monetary authorities should act only to the extent that movements in asset prices might influence future inflation or damage real economic activity in the aftermath of a financial bubble burst.
- Woodford (2003): monetary policy should be designed to achieve macroeconomic stability in the face of nominal frictions.
- Svensson (2010): monetary policy should focus on price and output stability.
Monetary policy and housing prices:

- Aoki et al. (2004): the importance of housing wealth in providing collateral services to household consumption.
- Chirinko et al. (2008): housing price shocks play a more relevant role in the design of monetary policy than stock price shocks.
- Iacoviello and Neri (2010): the sensitivity of residential investment and housing prices to changes in monetary policy measures.
- Castro and Sousa (2012): while wealth composition drives the formulation of monetary policy, the attempts of central banks to counteract undesirable fluctuations in say, financial wealth, can lead to disruptions in housing wealth.
Since the Great Recession, there has been an increasing interest by academics, central banks and policy makers in understanding how central banks’ actions can impact the dynamics of the balance sheet of financial intermediaries (Adrian and Shin, 2008; Adrian and Shin, 2010a).
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Some works have also focused on the ‘risk-taking channel’ of the monetary policy transmission (Borio and Zhu, 2012).
Until the eighties, the dominant financial intermediaries were **traditional banks** (Boyd and Gertler, 1993).
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However, the role of market-based intermediaries increased exponentially over the last decades, and shadow banks, which lack the access to public sources of liquidity, became important providers of funding by translating long-term, opaque and risky assets into short-term liabilities (Pozsar et al., 2010).
High leverage ratios, pro-cyclical balance sheets and strong reliance on short-term financing are other relevant features of shadow banks (Adrian and Shin, 2009, 2010b; Duffie, 2010), which became more visible during the 2000s (Kalemli-Ozcan et al., 2011).
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Three causes for their expansion:

- the "search-for yield" i.e. monetary policy;
- the savings glut due to global imbalances; and
- innovation and/or regulation (i.e. incentives).

The asset growth of the shadow banking sector contributes to the counter-cyclical price of risk and compressed (increased) risk premia in the run up to (after) the crisis.
• Only a few studies quantify the impact of monetary policy actions on the balance sheets of financial intermediaries.

  • Angeloni et al. (2015): monetary policy shocks have a significant effect on different measures of bank risks.
  • Den Haan and Sterk (2011): the effect of monetary policy shocks on consumer credit and home mortgage credit prior to and during the Great Moderation.
    • A tightening of monetary conditions leads to an increase in non-bank mortgages, especially, during the Great Moderation.
  • Nelson et al. (2015): monetary policy surprises have a distinct impact on the balance sheet growth of commercial banks and shadow banks, even though their contribution to the asset growth of the financial sector as a whole has been small.
    • Unexpected monetary contractions reduce the asset growth of commercial banks and expand the asset growth of shadow banks, as securitization activity rises.
Yet, there is still an important gap in:

1. The literature concerning the response of central banks to developments in those balance sheets;
2. The opportunity to include them in the design of monetary policy measures.

Should monetary policy be 'leaning against the wind' of the growth in size of securities' brokers and dealers and shadow banks?
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We assess the response of the central bank to the growth rate of the size of non-bank financial intermediaries.
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Using quarterly data for the United States over the period 1946:Q1-2014Q4 and both linear and nonlinear econometric frameworks, we find that an increase in the asset growth of the securities’ brokers and dealers and the shadow banking sector leads to a rise in the federal funds rate, as it is perceived as posing financial risks.
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Using quarterly data for the United States over the period 1946:Q1-2014Q4 and both linear and nonlinear econometric frameworks, we find that an increase in the asset growth of the securities’ brokers and dealers and the shadow banking sector leads to a rise in the federal funds rate, as it is perceived as posing financial risks.

When controlling for endogeneity using IV-GMM estimators, our results confirm that inflation is the most important driver of monetary policy actions.

However, the central bank is also concerned about the developments in the economic activity and the growth of the assets held by securities’ brokers and dealers and shadow banks.
The estimates of a Switching Transition Regression (STR) model show that two different regimes characterize the dynamics of the federal funds rate.

Its relationship with the inflation rate, the output gap, the asset growth of securities’ brokers and dealers and the assets of the shadow banking sector enters differently according to the regime under consideration, suggesting an active on/off link.
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- Its relationship with the inflation rate, the output gap, the asset growth of securities’ brokers and dealers and the assets of the shadow banking sector enters differently according to the regime under consideration, suggesting an active on/off link.

The results of a Markov-Switching Vector Autoregressive (MSVAR) model also indicate that the relationship between the federal funds rate and the asset growth rate of non-bank financial intermediaries switches across two regimes.

- While the US monetary policy is generally neutral vis-à-vis changes in the size of non-bank financial intermediaries, the (sharp) collapse in the growth rate of assets of securities’ brokers and dealers and shadow banks is associated with a decline of the federal funds rate in times of crises.
Outline

1. Overview
2. Econometric Methodology
3. Data
4. Empirical Results
5. Conclusion

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Monetary Policy and Shadow Banking
We start by estimating an extended version of the Taylor rule using the DOLS regressor of Stock and Watson (1993):

\[
FFRATE_t = c + \beta_{INFL} INFL_t + \beta_{OG} OG_t + \\
+ \beta_{SBRDL} SBRDL_t + \varepsilon^*_{SBRDL,t}, \tag{1}
\]

\[
FFRATE_t = c + \beta_{INFL} INFL_t + \beta_{OG} OG_t + \\
+ \beta_{SHADBNK} SHADBNK_t + \varepsilon^*_{SHADBNK,t}, \tag{2}
\]
where

$$
\varepsilon^*_{SBRDL,t} = \sum_{i=-k}^{k} \beta_{\Delta INF, i} \Delta INF_{t+i} + \sum_{i=-k}^{k} \beta_{\Delta OG, i} \Delta OG_{t+i} + \\
+ \sum_{i=-k}^{k} \beta_{\Delta SBRDL, i} \Delta SBRDL_{t+i} + \varepsilon_t,
$$
and

\[ \varepsilon_{SHADBNK,t}^* = \sum_{i=-k}^{k} \beta_{\Delta{INFL},i} \Delta{INFL}_{t+i} + \sum_{i=-k}^{k} \beta_{\Delta{OG},i} \Delta{OG}_{t+i} + \sum_{i=-k}^{k} \beta_{\Delta{SHADBNK},i} \Delta{SHADBNK}_{t+i} + \varepsilon_{t}, \]
- **FFRATE** is the federal funds rate, **INFL** is the inflation rate, **OG** is the output gap, **SBRDL** is the growth rate of the assets of securities’ brokers and dealers, **SHADBNK** is the growth rate of the assets of the shadow banking sector, $\Delta$ denotes the first difference operator, $c$ is a constant, $k$ is the number of leads and lags of the explanatory variables, $\varepsilon_t$ and is the error term.

- For the purpose of comparison, we also consider these modified versions of the Taylor rule allowing for inertia and with the various regressors entering in lag terms.

- Finally, we estimate the standard Taylor rule with and without inertia.
To control for the presence of endogeneity in our model, we employ an efficient IV-GMM estimator, where the heteroscedasticity and autocorrelation are controlled for using the HAC procedure.
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As we are using time-series, autocorrelation should be a concern, hence the HAC procedure is suitable to deal with these issues.
In order to capture more interaction between the federal funds rate and its main determinants, as well as the growth rate of assets of securities’ brokers and dealers and the shadow banking sector, we extend equations (1) and (2) to a nonlinear framework.
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Using a particular class of threshold model, i.e. the STR models, we enable the relationship to be asymmetric and to exhibit time-variation and switching regime.
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Using a particular class of threshold model, i.e. the STR models, we enable the relationship to be asymmetric and to exhibit time-variation and switching regime.

The STR models introduced by Granger and Teräsvirta (1993) are preferred to the TAR models of Tong and Lim (1980), as they capture not only extreme states, but also a continuum of intermediate regimes for which the transition is smooth.
A two-regime STR model for the dynamics of the federal funds rate can be written as follows:

\[ \text{FFRATE}_t = \psi' z_t + \omega' z_t G(\eta, c, s_t) + \varepsilon_t, \quad t = 1, \ldots, T \] 

where \( \text{FFRATE}_t \) denotes the monetary policy instrument, 
\( z_t = (1, \text{INFL}, \text{OG}_t, \text{SBRDL})' \) or 
\( z_t = (1, \text{INFL}, \text{OG}_t, \text{SHADBNK})' \) is a vector of explanatory variables.
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The vectors \( \psi \) and \( \omega \) represent the parameter vectors in the linear and nonlinear parts of the model, respectively.
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The vectors \( \psi \) and \( \omega \) represent the parameter vectors in the linear and nonlinear parts of the model, respectively.

The error-term is assumed to be independent and identically distributed with zero mean and constant variance, 
\( \varepsilon_t \sim \mathcal{N}(0, \sigma^2) \).

\( G(\eta, c, s_t) \) is continuous and bounded between 0 and 1 in the transition variable \( s \), which can be an element of \( z_t \) or even a linear combination of elements of \( z_t \).
Granger and Teräsvirta (1993) and Teräsvirta (1994) suggest the (symmetric) Exponential function (ESTR) which identifies a central regime and two upper regimes and corresponds to

\[ G(\eta, c, s_t) = 1 - \exp \left[ -\eta (s_t - c)^2 \right], \eta > 0, \]  

where \( \eta \) indicates the smoothness of the transition between regimes and \( c \) determines where the transition occurs.
Granger and Teräsvirta (1993) and Teräsvirta (1994) suggest the (symmetric) Exponential function (ESTR) which identifies a central regime and two upper regimes and corresponds to

$$G(\eta, c, s_t) = 1 - \exp \left[ -\eta (s_t - c)^2 \right], \eta > 0, \quad (4)$$

where \(\eta\) indicates the smoothness of the transition between regimes and \(c\) determines where the transition occurs.

The second function is Logistic (LSTR), which enables also to identify two different regimes (i.e. an inner regime and an upper regime):

$$G(\eta, c, s_t) = \left\{ 1 + \exp \left[ -\eta (s_t - c) \right] \right\}^{-1}, \eta > 0. \quad (5)$$
The specification of STR model is carried out in three main steps.

1. Considering the linear benchmark model using information criteria and autocorrelation function.

2. The application of linearity tests (Luukkonen et al., 1988; Teräsvirta, 1994) is then required to test linearity against non-linearity.

3. Sequential Fisher tests (Teräsvirta, 1994) are applied to select the appropriate transition function.

The estimation of STR model is done by Nonlinear Least Squares.
Nonlinear frameworks

MSVAR

- An alternative approach to capture nonlinear aspects of monetary policy reaction function consists of estimating a Markov-Switching VAR models (MS-VAR).
  - Multiple time series might be subject to regime shifts associated with events such as financial crises (Jeanne and Masson, 2000; Hamilton, 2005) or abrupt changes in economic policy (Hamilton, 1988; Davig, 2004; Sims and Zha, 2006).
  - Krolzig (1997) establishes taxonomy of models belonging to the MS-VAR class.
    - They can be classified depending on which VAR parameters are allowed to shift across regimes.
The less restrictive MS-VAR specification is the one where the intercept (or mean), the autoregressive coefficients and the variance-covariance matrix are conditioned on the unobservable regime variable $s_t$ which indicates the regime prevailing at time $t$:

$$Y_t = \begin{cases} 
A_{01} + \sum_{i=1}^{p} A_{i1} Y_{t-i} + \Sigma_{1}^{\frac{1}{2}} e_t & \text{if } s_t = 1 \\
\vdots & \\
A_{0M} + \sum_{i=1}^{p} A_{iM} Y_{t-i} + \Sigma_{M}^{\frac{1}{2}} e_t & \text{if } s_t = M 
\end{cases}, \quad (6)$$

where $Y_t$ is the $k$-dimensional time-series, $M$ stands for the number of regimes, $p$ for the number of lags of the autoregressive terms to take into account and $e_t \sim NID \left(0, I_k\right)$. 

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The unobservable realization of the regime $s_t \in \{1, \ldots, M\}$ is governed by a discrete-state Markov stochastic process, which is defined by transition probabilities:

$$p_{ij} = \Pr(s_{t+1} = j \mid s_t = i), \quad \sum_{j=1}^{M} p_{ij} = 1 \ \forall i, j \in \{1, \ldots, M\}.$$  

(7)

More precisely, it is assumed that $s_t$ follows an irreducible ergodic $M$ state Markov process with the transition matrix

$$P = \begin{bmatrix}
p_{11} & p_{12} & \cdots & p_{1M} 
p_{21} & p_{22} & \cdots & p_{2M} 
\vdots & \vdots & \ddots & \vdots 
p_{M1} & p_{M2} & \cdots & p_{MM}
\end{bmatrix},$$

(8)

where $p_{iM} = 1 - p_{i1} - p_{i2} - \ldots - p_{i,M-1}$ for $i = 1, \ldots, M.$
In what concerns the estimation techniques, a Maximum likelihood (ML) estimation of the model is based on an implementation of the Expectation-Maximization (EM) algorithm proposed by Hamilton (1990) for this class of model.

In our study, $Y_t$ is a $(4 \times 1)$ vector of endogenous variable including: the federal funds rate ($FFRATED_t$), output gap ($OG_t$), inflation rate ($INFL_t$) and the growth rate of assets held by securities’ brokers and dealers ($SBRDL_t$) or the shadow banking sector ($SHADBNK_t$).
We also assume that $M = 2$ (i.e. two regimes) and all the parameters of the model are allowed to switch across regimes. This latter assumption is particularly important to account for the well-documented shifts in the conduct of US monetary policy during the great moderation (Benati and Surico, 2009).

Finally, we remove the stringent assumption of homoscedasticity in the error structure.
Data

- Quarterly data for the United States over the period 1946:Q1-2014Q4.

- Policy instrument: the federal funds rate.
  - Board of Governors of the Federal Reserve System.
Inflation rate: computed using data for the implicit GDP deflator that is generated via the information about the nominal and the real GDP.

- Bureau of Economic Analysis (BEA).

Output gap: computed using data for the real GDP.

- BEA.
- This is transformed into natural log terms and the Hodrick-Prescott filter is applied to generate the output gap in percentage of potential output.
We follow Adrian and Shin (2010a, b), Adrian et al. (2010) and Berrospide and Edge (2010) and construct the growth rate of the assets of securities’ brokers and dealers and the growth rate of the assets of the shadow banking sector.

- Data from the Flow of Funds Accounts of the Board of Governors of the Federal Reserve System.

- Securities’ brokers and dealers are treated separately from shadow banks, which include three types of financial intermediaries: 1) finance companies; 2) issuers of asset-backed securities (ABS); and 3) funding corporations.
Finance companies generate loans in a way that is similar to that of commercial banks.

Financial intermediaries of "information-problematic" borrowers and typically involved in larger risk-taking behaviour than commercial banks (Carey et al., 1998).

Issuers of asset-backed securities special purpose vehicles (SPVs) that hold pools of loans and use them as collateral in their issuances.

Funding corporations include subsidiaries of foreign bank and non-bank financial firms that raise funds in the commercial paper market and transfer them to foreign parent companies abroad or their banking offices in the United States.
Linear frameworks
DOLS

- Both the asset growth of the securities’ brokers and dealers and the asset growth of the shadow banking sector enter positively and significantly in the monetary policy reaction function.

- The central bank takes into account the size of these financial intermediaries when setting up the interest rate: an increase in the asset growth of such financial intermediaries is seen as posing financial stability risks, thus, the federal funds rate is raised.

- Similar evidence is obtained when we allow for inertia in the conduct of monetary policy, as both the asset growth of the securities’ brokers and dealers and the asset growth of the shadow banking sector keep their positive and significant coefficients.
In what concerns the other regressors, we find that:

- the coefficient associated with inflation is positive, significant and large in magnitude (monetary policy aggressively counteracts the inflationary pressures by raising the interest rate);
- the output gap also enters positively and significantly the monetary policy reaction function (a widening of the gap between actual output and potential output leads to an increase in the federal funds rate); and
- the coefficient associated with the lagged interest rate is also positive, relatively large in magnitude and statistically significant (inertia is a good characterization pattern of monetary policy conduct).
## Table 1. Monetary policy and shadow banking - DOLS model.

<table>
<thead>
<tr>
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<th>(2)</th>
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<td>4.0746***</td>
<td>0.6974***</td>
<td>0.7576***</td>
<td>4.6766***</td>
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<td>[2.912]</td>
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<tr>
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<td>0.0576</td>
<td>0.2307*</td>
<td>0.2019**</td>
<td>0.6811***</td>
<td>0.2355**</td>
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<td>0.2019**</td>
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<td>0.608</td>
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</table>

Notes: Robust t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Some authors like Den Haan and Sterk (2011) and Nelson et al. (2015) emphasize that monetary policy actions also have an impact on the growth of non-bank mortgage lending, as well as on securitization activity.

To explore this channel, we use the DOLS estimator to estimate the effect of the federal funds rate on the asset growth of the securities’ brokers and dealers and the asset growth of the shadow banking sector.
In line with the work of Nelson et al. (2015), we find that a rise in the federal funds rate is associated with an acceleration of the activity of non-bank intermediaries:

- the coefficient associated with the federal funds rate is positive and significant in both the equation for the asset growth of the securities’ brokers and dealers and the equation for the asset growth of the shadow banking sector;
- shadow banks tend to counteract the intensification of liquidity constraints imposed by tightening monetary policy actions with a potential rise in securitization activity.
In line with the work of Nelson et al. (2015), we find that a rise in the federal funds rate is associated with an acceleration of the activity of non-bank intermediaries:

- the coefficient associated with the federal funds rate is positive and significant in both the equation for the asset growth of the securities’ brokers and dealers and the equation for the asset growth of the shadow banking sector;
- shadow banks tend to counteract the intensification of liquidity constraints imposed by tightening monetary policy actions with a potential rise in securitization activity.

As for the other explanatory variables:

- an increase in inflation typically has a positive effect on the activity of the financial intermediaries under analysis;
- the coefficient associated with the output gap is also positive, although its statistical significance is weak; and
- the asset growth of the financial intermediaries displays strong persistence.
### Table 2. Asset growth of financial intermediaries and monetary policy - DOLS model.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
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Notes: Robust t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1
Linear frameworks
IV-GMM

- Presence of heteroscedasticity in all specifications and endogeneity.
- The HAC procedure is suitable to deal with serial autocorrelation.
  - Four lags of $INFL_t$ and $OG_t$ are used as instruments for these variables;
  - The second lag of the federal funds rate ($FFRATE_t$) is also used as an instrument for its lag, when it is included in the equation.
  - Other variables have proved to be exogenous according to the $C$-statistic (difference-in-Sargan statistic).
- The Cragg-Donald statistic shows that the instruments are not weak.
Monetary authority reacts significantly to inflation and, to a lesser degree, the output gap.

- When inflation increases, the monetary authority reacts quite strongly by raising the federal funds rate.
- Its reaction to an improvement in the economic conditions has not proved to be so strong or so highly significant.
Monetary authority reacts significantly to inflation and, to a lesser degree, the output gap.

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- Its reaction to an improvement in the economic conditions has not proved to be so strong or so highly significant.

Even when endogeneity is controlled for, there is a robust indication that monetary authorities respond to the asset growth of securities’ brokers and dealers and the asset growth of shadow banks.
Monetary authority reacts significantly to inflation and, to a lesser degree, the output gap.

- When inflation increases, the monetary authority reacts quite strongly by raising the federal funds rate.
- Its reaction to an improvement in the economic conditions has not proved to be so strong or so highly significant.

Even when endogeneity is controlled for, there is a robust indication that monetary authorities respond to the asset growth of securities’ brokers and dealers and the asset growth of shadow banks.

A dynamic model indicates that there is a significant degree of persistence, but the main conclusions remain unchanged.
### Table 3. Monetary policy and shadow banking - IV/GMM HAC model

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<tr>
<th>VARIABLES</th>
<th>(1)</th>
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<td>{17.70}</td>
<td>{16.10}</td>
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</table>

Notes. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Heteroscedasticity and autocorrelation are controlled for using the HAC procedure for the IV/GMM estimator. Four lags of Inflation and OutputGap are used as instruments for these variables; the second lag of the federal funds rate
To account for the fact that monetary authorities may react to inflation and output gap with some lag, we test these extended monetary rules using the first lag of all variables.

- monetary authorities react not only to lagged inflation and output gap, but also to the lagged effects of the asset growth of securities’ brokers and dealers and the asset growth of shadow banks.
To account for the fact that monetary authorities may react to inflation and output gap with some lag, we test these extended monetary rules using the first lag of all variables.

- monetary authorities react not only to lagged inflation and output gap, but also to the lagged effects of the asset growth of securities’ brokers and dealers and the asset growth of shadow banks.

- Usual findings with a Taylor rule:
  - monetary authorities react strongly to inflation and, to a lesser degree, the output gap, which is clearer when the persistence in the process is controlled for.
To account for the fact that monetary authorities may react to inflation and output gap with some lag, we test these extended monetary rules using the first lag of all variables.

- monetary authorities react not only to lagged inflation and output gap, but also to the lagged effects of the asset growth of securities’ brokers and dealers and the asset growth of shadow banks.

- Usual findings with a Taylor rule:
  - monetary authorities react strongly to inflation and, to a lesser degree, the output gap, which is clearer when the persistence in the process is controlled for.

- These simple Taylor rules should be extended with information from securities’ brokers and dealers and shadow banks.
  - the central bank indeed incorporates it in the decisions about the interest rate.
Next, we explore a bit further the reaction of monetary authorities, allowing for different estimators to control for endogeneity and a different set of instruments.

Our benchmark model considers all regressors lagged one period and uses as instruments lags 2 to 4 of the federal funds rate, inflation, output gap and financial variables.

Endogeneity remains an issue, especially when the two-step GMM HAC procedure is employed.

Monetary authorities react strongly to inflation (and, to a lesser degree, the output gap) and the growth in brokers and dealers assets and shadow banking assets.
Table 4. Monetary policy rules and shadow banking - dynamic lagged.

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<th>IV-2SLS (firate)</th>
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<td>(0.1416)</td>
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Observations 200 240 200 240 200 240 200 240
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[0.2903] [0.0078] [0.1360] [0.1345] [0.1170] [0.1049] [0.1170] [0.1049]
S-Y 5% c.v. 13.95 13.95 13.95 13.95 13.95 13.95 13.95 13.95

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Heteroscedasticity and autocorrelation are controlled for using the HAC procedure for the IV-hac and GMM2s-hac estimators. Lags 2 to 4 for the Fed's funds rate (ffrate), Inflaion, Output Gap, and the respective financial variables (ysbrodag or ysabnkag) are used as instruments. For the endogeneity and overidentification (Sargan-Hansen-J) tests are reported the respective statistics and p-values (in squared brackets). The Cragg-Donald Wald F statistic is reported for the weak identification test, as well as the Stock-Yogo critical values at 5% in brackets.
We also test for the possibility of reverse effects on the financial variables.

We replace the dependent variable by either the asset growth rate of securities’ brokers and dealers or the asset growth rate of the shadow banking sector.

No evidence of endogeneity is found in this case, which means that we do not need to incur in this complexity to estimate this different equation.

Despite the persistence of each financial variable, only the output gap has a significant (negative) impact on the behaviour of the asset growth of securities’ brokers and dealers and shadow banks.

Over time, a better economic environment tends to undermine such growth.
### Table 5. Monetary policy rules and shadow banking

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
<th>(ysbrdrag)</th>
<th>(yshadbnkag)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-rob</td>
<td>IV-rob</td>
<td>IV-hac</td>
<td>IV-hac</td>
<td>GMM2s-hac</td>
<td>GMM2s-hac</td>
<td></td>
<td></td>
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<tr>
<td>L.frate</td>
<td>0.3802</td>
<td>0.1561</td>
<td>0.3802</td>
<td>0.1561</td>
<td>0.3802</td>
<td>0.1561</td>
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<td>0.0490</td>
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<tr>
<td></td>
<td>(0.3418)</td>
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<td>(0.1710)</td>
<td>(0.3480)</td>
<td>(0.1623)</td>
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</tr>
<tr>
<td>L.Infl</td>
<td>0.4796</td>
<td>-0.7473</td>
<td>0.4796</td>
<td>-0.7473</td>
<td>0.4796</td>
<td>-0.7473</td>
<td>0.4937</td>
<td>-0.2646</td>
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</tr>
<tr>
<td></td>
<td>(2.0889)</td>
<td>(0.6881)</td>
<td>(2.2732)</td>
<td>(0.7946)</td>
<td>(2.2846)</td>
<td>(0.9198)</td>
<td>(2.2368)</td>
<td>(0.8713)</td>
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</tr>
<tr>
<td>L.outputgap</td>
<td>-1.9717***</td>
<td>0.0706</td>
<td>-1.9717***</td>
<td>0.0706</td>
<td>-1.9717***</td>
<td>0.0706</td>
<td>-2.0299***</td>
<td>-0.0659</td>
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<tr>
<td></td>
<td>(0.5365)</td>
<td>(0.1644)</td>
<td>(0.5688)</td>
<td>(0.1595)</td>
<td>(0.5479)</td>
<td>(0.1719)</td>
<td>(0.4905)</td>
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<tr>
<td>L.ysbrdrag</td>
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<td>0.7851***</td>
<td>0.0845</td>
<td>0.7851***</td>
<td>0.0822</td>
<td>0.7298***</td>
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<td>(0.0593)</td>
<td>(0.1644)</td>
<td>(0.0593)</td>
<td>(0.1644)</td>
<td>(0.0593)</td>
<td>(0.1644)</td>
<td>(0.0593)</td>
<td>(0.1644)</td>
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<tr>
<td>L.yshadbnkag</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9127***</td>
<td>0.9127***</td>
<td>0.9127***</td>
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<tr>
<td></td>
<td></td>
<td>(0.0320)</td>
<td></td>
<td></td>
<td>(0.0382)</td>
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<td>(0.0392)</td>
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<td></td>
<td>0.9340***</td>
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</tr>
<tr>
<td>Constant</td>
<td>0.3968</td>
<td>0.6239</td>
<td>0.3968</td>
<td>0.6239</td>
<td>0.3968</td>
<td>0.6239</td>
<td>0.4670</td>
<td>0.6116</td>
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<tr>
<td></td>
<td>(1.5215)</td>
<td>(0.4337)</td>
<td>(1.5215)</td>
<td>(0.4337)</td>
<td>(1.5215)</td>
<td>(0.4337)</td>
<td>(1.2810)</td>
<td>(0.5068)</td>
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<tr>
<td>Observations</td>
<td>199</td>
<td>237</td>
<td>199</td>
<td>237</td>
<td>199</td>
<td>237</td>
<td>199</td>
<td>237</td>
<td></td>
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</tr>
<tr>
<td>R-squared</td>
<td>0.6313</td>
<td>0.8974</td>
<td>0.6313</td>
<td>0.8974</td>
<td>0.6313</td>
<td>0.8974</td>
<td>0.6308</td>
<td>0.8956</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endog. Test</td>
<td>8.670</td>
<td>6.315</td>
<td>7.119</td>
<td>0.998</td>
<td>5.671</td>
<td>0.543</td>
<td>5.671</td>
<td>0.543</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>[0.0699]</td>
<td>[0.1768]</td>
<td>[0.1297]</td>
<td>[0.9101]</td>
<td>[0.2251]</td>
<td>[0.9692]</td>
<td>[0.2251]</td>
<td>[0.9692]</td>
<td></td>
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<tr>
<td></td>
<td>[0.0080]</td>
<td>[0.0000]</td>
<td>[0.0624]</td>
<td>[0.0000]</td>
<td>[0.0659]</td>
<td>[0.0002]</td>
<td>[0.0659]</td>
<td>[0.0000]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-Y 5% c.v.</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td>[13.95]</td>
<td></td>
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</tr>
</tbody>
</table>

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Heteroscedasticity and autocorrelation are controlled for using the HAC procedure for the IV-hac and GMM2s-hac estimators. Lags 2 to 4 for the Fed's funds rate (frate), Inflation, OutputGap, and the respective financial variables (ysbrdrag or yshadbnkag) are used as Instruments. For the endogeneity and overidentification (Sargan-Hansen-J) tests are reported the respective statistics and p-values (in squared brackets). The Cragg-Donald Wald F statistic is reported for the weak identification test, as well as the Stock-Yogo critical values at 5% In brackets (maximal IV relative bias); the Kleibergen-Paap rk Wald F statistic was also computed (not reported here).
In line with Granger and Teräsvirta (1993) and Teräsvirta (1994), we first specify the linear model and apply linearity tests.

We start by assessing the null hypothesis of linearity against its alternative of a STR type of nonlinearity using Luukkonen et al. (1988) linearity tests.

We find that the most appropriate linear model should include one lag, which enables to capture inertia in the monetary policy reaction function.
The linearity is rejected for several transition variables, but the strongest rejection takes place in the case of the output gap (at the 1% significance level), suggesting it as a potential transition variable.

Table 6: Linearity tests.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>p=1</td>
<td>s₁</td>
<td>OG₁</td>
</tr>
<tr>
<td>p=1</td>
<td></td>
<td>OG₁</td>
</tr>
<tr>
<td>p-value</td>
<td>(0.01)**</td>
<td>(0.00)</td>
</tr>
</tbody>
</table>

Notes: p refers to the lag number. s₁ denotes the optimal transition variable for which linearity is strongly rejected. The values in parenthesis refer to the p-values of linearity tests. OG₁ corresponds to the output gap. Models 1 and 2 differ by the inclusion of the annual asset growth of securities' brokers and dealers in Model 1 and the annual asset growth...
Next, we check the suitable transition function, by testing linearity against nonlinearity of exponential or logistic type and choosing the one that displays the strongest evidence of linearity rejection (Teräsvirta, 1994).

The logistic function is preferred to the exponential function for both models, so we focus on the LSTR specification.

**Table 7: Selection of the transition function** $G(\eta, c, s_t)$.

<table>
<thead>
<tr>
<th>$s_t$</th>
<th>Model 1</th>
<th>$H_{03}$</th>
<th>$H_{02}$</th>
<th>$H_{01}$</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\logit$</td>
<td>ESTR or LSTR</td>
<td>0.01</td>
<td>0.03</td>
<td>0.15</td>
<td>ESTR or LSTR</td>
</tr>
</tbody>
</table>

**Table 7 Notes:** The Teräsvirta (1994) tests are also useful for specifying the transition function while testing whether it is exponential or logistic. $H_{01}$, $H_{02}$ and $H_{03}$ are the null hypotheses in Teräsvirta (1994) tests which are based on Fisher tests.
### Table 8. Monetary policy and shadow banking - LSTR model

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Model 1 with brokers and dealers</th>
<th>Model 2 with shadow banking sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regime 1</td>
<td>Regime 2</td>
</tr>
<tr>
<td>Constant</td>
<td>1.00***</td>
<td>4.395**</td>
</tr>
<tr>
<td></td>
<td>(5.20)</td>
<td>(-2.08)</td>
</tr>
<tr>
<td>L.FFR/rate</td>
<td>-0.339***</td>
<td>3.961**</td>
</tr>
<tr>
<td></td>
<td>(-3.72)</td>
<td>(-2.51)</td>
</tr>
<tr>
<td>L.INFL</td>
<td>2.478***</td>
<td>-2.763**</td>
</tr>
<tr>
<td></td>
<td>(6.70)</td>
<td>(-1.56)</td>
</tr>
<tr>
<td>INFL</td>
<td>1.846***</td>
<td>-0.763**</td>
</tr>
<tr>
<td></td>
<td>(5.17)</td>
<td>(-0.42)</td>
</tr>
<tr>
<td>L.OG</td>
<td>0.529</td>
<td>0.416</td>
</tr>
<tr>
<td></td>
<td>(4.50)***</td>
<td>(0.68)</td>
</tr>
<tr>
<td>OG</td>
<td>0.722***</td>
<td>-4.235***</td>
</tr>
<tr>
<td></td>
<td>(3.89)</td>
<td>(-2.78)</td>
</tr>
<tr>
<td>L.SBRDLRAG</td>
<td>-0.004</td>
<td>0.343**</td>
</tr>
<tr>
<td></td>
<td>(-0.46)</td>
<td>(0.68)</td>
</tr>
<tr>
<td>SBRDLRAG</td>
<td>0.046***</td>
<td>-0.232**</td>
</tr>
<tr>
<td></td>
<td>(4.87)</td>
<td>(-2.28)</td>
</tr>
<tr>
<td>L.SHAD</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SHAD</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.508**</td>
<td>2.764***</td>
</tr>
<tr>
<td></td>
<td>(1.96)</td>
<td>(3.28)</td>
</tr>
<tr>
<td>$c$</td>
<td>-0.199**</td>
<td>1.316***</td>
</tr>
<tr>
<td></td>
<td>(-2.05)</td>
<td>(9.72)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.62</td>
<td>0.67</td>
</tr>
<tr>
<td>ARCH (p-value)</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>ADF</td>
<td>-3.696</td>
<td>-4.705</td>
</tr>
<tr>
<td>LM test(p-value)</td>
<td>0.142</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Note: L denotes first lag. (***), (**), and (*) refer to significance at 1%, 5% and 10% statistical level, respectively. ADF denotes the statistics of ADF test. LM test is the statistics of omitted linearity test.
Regarding the model with brokers and dealers:

- In the first regime, the central bank increases its policy rate after a rise in inflation and the output gap, as well as when it observes an expansion of the size of financial intermediaries.
- In the second regime, there is also a response to the asset growth of securities’ brokers and dealers, but the adjustment of the federal funds rate is faster.
Regarding the model with brokers and dealers:

- In the first regime, the central bank increases its policy rate after a rise in inflation and the output gap, as well as when it observes an expansion of the size of financial intermediaries.
- In the second regime, there is also a response to the asset growth of securities’ brokers and dealers, but the adjustment of the federal funds rate is faster.

As for the LSTR model including the shadow banking sector:

- In regime 1, the reaction of monetary policy towards the change in the inflation rate is still positive and significant, but the output gap no longer plays a role.
- An increase in the asset growth of shadow banks enters with a positive and significant coefficient.
- In regime 2, when the output gap exceeds the threshold level, there is a switch in the monetary policy rule, as an increase of the inflation rate implies a cut in the federal funds rate.
Regarding the estimates of nonlinear parameters, both the threshold and the transition speed estimates are statistically significant.

The values of the transition speed show that the transition is sharper when considering the asset growth of the shadow banking sector.

Moreover, while the model with securities’ brokers and dealers implies that the switch between regimes occurs in 1997:Q4, the model with shadow banks suggests that it occurs later (i.e. 2007:Q1).
Quite similar for both models.
Two distinct regimes that characterize the federal funds rate.
We estimate two MS-VAR models where the growth rates of financial assets of securities’ brokers and dealers and shadow banks are alternatively treated as endogenous variables.

Each equation can be interpreted as an augmented US monetary policy reaction which explains whether and how the balance sheet dynamics of non-bank financial intermediaries imply a response by the central bank.
Figure 3 depicts the smoothed probabilities of regime one as (endogenously) identified from the two MS-VAR models.

- The red bars denote the US recession periods as dated by the National Bureau of Economic Research (NBER).
The dating of regime 1 is broadly the same for both the two model specifications.

It encompasses the four major financial crises over the last 40 years in the US:

1. the commercial bank capital squeeze in 1973-1975;
2. the savings and loan crisis (S&L) in 1984-1991;
3. the burst of the dotcom bubble in 2000-2001; and

In most of the times, and, notably, since the eighties, regime 1 and US recessionary episodes tend to overlap.
The evolution of asset growth rates and federal funds rate across the regime one (grey shaded area) and over the entire sample of analysis is depicted in Figure 4.

Luca Agnello, Vitor Castro, Fredj Jawadi and Ricardo M. Sousa

Monetary Policy and Shadow Banking
As expected, the asset growth of securities’ brokers and dealers and shadow banks share the same pattern, with the former being more volatile than the latter.

At a first glance, both series tend to decline during regime 1 and to moderately increase during regime 2 and notably in the run-up to financial crises.

With regard to the dynamics of federal funds rate, if we exclude the period of the seventies, we observe that the most significant cuts in the federal funds rate occurred during regime 1, while monetary tightening tends to occur during regime 2.
Overall, the US monetary policy behaves in a counter-cyclical way.

The signs and the statistical significance of the coefficients associated with inflation and output gap suggest that, during both regimes, the Federal Reserve takes action by dampening inflationary pressures or boosting growth when the economy is lagging.
Overall, the US monetary policy behaves in a counter-cyclical way.

- The signs and the statistical significance of the coefficients associated with inflation and output gap suggest that, during both regimes, the Federal Reserve takes action by dampening inflationary pressures or boosting growth when the economy is lagging.

Moreover, the estimates across regimes indicate that the federal funds rate adjusts to fluctuations in the asset growth rate of non-bank financial intermediaries in a non-linear fashion:

- In regime 2, there is no statistical evidence of a causal relationship going from asset growth to interest rates (i.e. US monetary policy is neutral vis-à-vis changes in asset values)
- In regime 1, the (sharp) collapse of asset growth rates affecting brokers and dealers and shadow banks is associated with a decline in the federal funds rate.
Even though, our estimates indicate that part of such monetary policy corrections are consistent with the policy strategy that prescribes an accommodative stance during bad times (i.e. negative output gap and low inflation), the statistical significance of the asset growth variables and the positive sign associated with their coefficients also suggests that the Fed further focuses on the dynamics of these financial intermediaries as they gauge financial risks.

Thus, in line with the so-called "leaning against the wind" policy view, financial stability objectives appear to lead to the adoption of a more aggressive posture by the central bank: in response to negative shocks, as reflected in the sharp deterioration of financial intermediaries’ balance sheets, interest rate cuts are deeper than otherwise.
Table 9. Monetary policy and shadow banking - MSVAR model

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Regime 1 (1)</th>
<th>Regime 2 (2)</th>
<th>Regime 1 (3)</th>
<th>Regime 2 (4)</th>
</tr>
</thead>
<tbody>
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<td>L.FFRrate</td>
<td>0.8015***</td>
<td>1.0113***</td>
<td>0.7917***</td>
<td>0.9715***</td>
</tr>
<tr>
<td></td>
<td>(17.2540)</td>
<td>(73.3911)</td>
<td>(14.9607)</td>
<td>(54.0208)</td>
</tr>
<tr>
<td>L.Inflation</td>
<td>0.9251***</td>
<td>0.4158***</td>
<td>0.9602***</td>
<td>0.3238***</td>
</tr>
<tr>
<td></td>
<td>(3.6137)</td>
<td>(2.6828)</td>
<td>(3.3413)</td>
<td>(2.6204)</td>
</tr>
<tr>
<td>L.OutputGap</td>
<td>0.3175***</td>
<td>0.0710***</td>
<td>0.2161***</td>
<td>0.0117</td>
</tr>
<tr>
<td></td>
<td>(4.2623)</td>
<td>(2.7413)</td>
<td>(2.5180)</td>
<td>(0.3725)</td>
</tr>
<tr>
<td>L.Brokers&amp;Dealers</td>
<td>0.0132**</td>
<td>0.00001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.9631)</td>
<td>(0.0164)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.ShadowBanking</td>
<td></td>
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<td>0.0369*</td>
<td>0.0068</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.6747)</td>
<td>(1.5319)</td>
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<td>Constant</td>
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<td>-0.1232</td>
<td>-0.4313</td>
<td>-0.0078</td>
</tr>
<tr>
<td></td>
<td>(-0.4943)</td>
<td>(-1.5434)</td>
<td>(-1.1527)</td>
<td>(-0.1089)</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-1121.1</td>
<td>-1118.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variances</td>
<td>1.47***</td>
<td>0.08***</td>
<td>1.64***</td>
<td>0.12***</td>
</tr>
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<td>Transition Probs</td>
<td>0.92</td>
<td>0.94</td>
<td>0.87</td>
<td>0.92</td>
</tr>
<tr>
<td>Ergodic Probs</td>
<td>0.46</td>
<td>0.54</td>
<td>0.36</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Notes: Sample: 1964q1-2014q3 (BRDL) and 1954q3-2014q3 (SHDBK). Robust t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
Given that all the variables entering our MS-VAR models are treated as endogenous, a reversal causal relationship running from changes in the federal funds rate to the balance sheet growth of financial intermediaries cannot be ruled out ex-ante.

To shed some light on this potential linkage, we now focus on the equations that explain the dynamics of asset growth of securities’ brokers and dealers and shadow banks.

We find that a two-way (reversal causality) relationship exists, but is mainly confined to a particular regime, i.e. regime 1 (when we consider the shadow banking sector) and regime 2 (when we account for securities’ brokers and dealers).
We show that, in both cases, the interest rate policy has a positive impact on the dynamics of the asset growth.

- In regime 2, monetary contractions tend to expand the size of the shadow banking sector instead of reducing it.
- In regime 1, monetary easing reduces the activity of securities’ brokers and dealers.

Our empirical findings are in line with the work of Haan and Sterk (2011). Following a monetary policy contraction, non-bank mortgages increase, as opposed to standard bank mortgages which display a significant reduction. Nelson et al. (2015) also document this result as a "waterbed" effect, whereby commercial banks circumvent tighter funding liquidity constraints following a contractionary monetary policy shock by increasing their securitization activity.
We show that, in both cases, the interest rate policy has a positive impact on the dynamics of the asset growth.

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Table 10. Asset growth and monetary policy - MSVAR model.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Brokers and dealers (1)</th>
<th>Brokers and dealers (2)</th>
<th>Shadow banking (3)</th>
<th>Shadow banking (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regime 1</td>
<td>Regime 2</td>
<td>Regime 1</td>
<td>Regime 2</td>
</tr>
<tr>
<td>L.FFRRate</td>
<td>0.6064</td>
<td>0.5507***</td>
<td>0.2756**</td>
<td>-0.0812</td>
</tr>
<tr>
<td></td>
<td>(1.2498)</td>
<td>(2.0985)</td>
<td>(2.1389)</td>
<td>(-0.6090)</td>
</tr>
<tr>
<td>L.Inflation</td>
<td>-1.4570</td>
<td>5.4466*</td>
<td>-0.5550</td>
<td>0.7462</td>
</tr>
<tr>
<td></td>
<td>(-0.5496)</td>
<td>(1.8220)</td>
<td>(-0.7734)</td>
<td>(0.8324)</td>
</tr>
<tr>
<td>L.OutputGap</td>
<td>-1.4951*</td>
<td>-1.1740**</td>
<td>0.4879**</td>
<td>-0.0496</td>
</tr>
<tr>
<td></td>
<td>(-1.9258)</td>
<td>(-2.3335)</td>
<td>(2.2620)</td>
<td>(-0.2332)</td>
</tr>
<tr>
<td>L.Brokers&amp;Dealers</td>
<td>0.7630***</td>
<td>0.6991***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(11.045)</td>
<td>(10.7159)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.ShadowBanking</td>
<td></td>
<td></td>
<td>0.7801***</td>
<td>0.9968***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(13.4597)</td>
<td>(30-2482)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.2417</td>
<td>-1.9289</td>
<td>0.3516</td>
<td>0.4628</td>
</tr>
<tr>
<td></td>
<td>(0.3512)</td>
<td>(-1.2559)</td>
<td>(0.3581)</td>
<td>(0.8502)</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-1121.1</td>
<td>-1118.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variances</td>
<td>163***</td>
<td>31***</td>
<td>9.51***</td>
<td>8.01***</td>
</tr>
<tr>
<td>Transition Probs</td>
<td>0.92</td>
<td>0.94</td>
<td>0.86</td>
<td>0.92</td>
</tr>
<tr>
<td>Ergodic Probs</td>
<td>0.45</td>
<td>0.56</td>
<td>0.36</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Notes: Sample: 1964q1-2014q3 (BRDL) and 1954q3-2014q3 (SHDBK). Robust t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.
In this paper, we investigate the response of the central bank to the growth rate of the size of non-bank financial intermediaries.
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Using quarterly data for the United States over the period 1946:Q1-2014Q4 and both linear and nonlinear econometric frameworks, we find that an increase in the asset growth of the securities’ brokers and dealers and the shadow banking sector leads to a rise in the federal funds rate, as it is perceived as posing financial risks.
When controlling for endogeneity, using IV-GMM estimators, our results confirm that inflation is the most important target for the monetary authority, but it is also concerned over the developments in the economic activity and financial variables, such as the asset growth of securities’ brokers and dealers and the shadow banks.
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In particular, the central bank reacts by raising the interest rates to increases in those assets.
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In particular, the central bank reacts by raising the interest rates to increases in those assets.

Hence, we argue that the monetary rule should be extended with information about the size of the balance sheet of securities’ brokers and dealers and shadow banks.
From the STR modeling, we find a threshold relationship between the federal funds rate and the asset growth of shadow banks, suggesting a monetary policy reaction function that changes by regime with regard to variations in the inflation rate, the output gap and the asset growth of non-bank financial intermediaries.
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In particular, when the output gap is low, the Fed adjusts its policy rate vis-à-vis changes in the asset growth of securities’ brokers and dealers; when the output gap is high, the monetary authority is more concerned about the dynamics of inflation.
The results of the MS-VAR model indicate that, in bad times, the Fed focuses on the dynamics of the size of the shadow banking sector, as it gauges financial risks.
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In line with the so-called "leaning against the wind" policy view, the mandate of financial stability increases the aggressiveness of monetary policy.
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In line with the so-called "leaning against the wind" policy view, the mandate of financial stability increases the aggressiveness of monetary policy.

Thus, in response to a sharp deterioration of the balance sheet of non-bank financial intermediaries, interest rate cuts are deeper than otherwise.
END