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An Investigation of Some Macro-Financial Linkages of Securitization

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An Investigation of Some Macro-Financial Linkages of Securitization

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Abstract

Policy-makers have attributed the scale of the credit crisis and its profound impact on money markets (as well as financial sector stability) to the fast rise of securitization and the way it has arguably complicated both the conduct of monetary policy and the effect of interest rate transmission to the real economy. In our study, we examine whether financial innovation, specifically through securitization, has altered the nature of some macro-financial linkages, often with considerable policy implications. We find that securitization activity in the United States (mature market) and South Africa (emerging market) has indeed dampened the interest rate elasticity of real output via the balance sheet channel (while decreasing the interest rate pass-through from policy rates to market rates). That being said, current reservations about securitization do not invalidate the fact that securitization activity helps cushion the immediate impact of interest rate shocks to loan origination, which might be particularly effective in EM countries where poorly developed capital markets provide few alternatives to bank lending.

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I. INTRODUCTION

"Securitization had introduced a higher degree of uncertainty, creating non-linearities along the yield curve that impaired monetary policy effectiveness."

—*Christian Noyer, Governor of the Banque de France* ("Challenges for Monetary Policy from Financial Innovation and Globalization," IMF (European Office and Monetary and Capital Markets Department)/Bank of England/Banque de France Conference, Paris, January 29, 2008)

Increased sophistication of financial intermediation can change the nature of macro-financial linkages, often with considerable policy implications. The influence of monetary policy on interest rates and the real economy depends critically on the structure of the financial system and the maturity of capital markets. In particular, asset securitization can affect or permanently alter the transmission mechanism of monetary policy that ultimately permeates to the real economy by influencing consumption and investment decisions.

Financial innovation, specifically through securitization, provides an essential impetus for a more efficient allocation of capital. For instance, asset securitization has evolved into a widely-used capital market-based funding mechanism in many developed countries to mitigate balance sheet mismatches, remedy financing constraints, and optimize funding costs. Securitization offers issuers more flexibility to create securities with distinct risk-return profiles across the maturity structure to facilitate the unbundling, transformation and diversification of financial risks associated with different (and mostly illiquid) asset types.[2] This customization of risks according to the preferences and tolerances of agents improves the capacity of the financial system to bear risk and intermediate capital (Jobst, 2007 and 2008). In emerging market countries, securitization can also support local capital market development, facilitate investments in largely unexplored areas of economic activity, and expand the spectrum of financing options to finance housing and consumer deficits.

That said, financial innovation is not without inherent risks, and recent events suggest some reservations about the positive assessment of securitization. The evolution of structured finance illustrates that the risks from financial innovation have the potential to transpire in greater and more harmful ways than many other sources of risk from conventional finance instruments. Different forms of financial innovation, such as asset securitization, are bound to challenge the existing market order and, thus, if proven sustainable, have the potential to permanently alter the transmission mechanism of monetary policy and the way they affect the real economy by influencing consumption and investment decisions. The ongoing market turbulence in the wake of the recent U.S. sub-prime mortgage crisis (and

[2] Asset securitization involves converting a pool of designated financial assets into tradable liability and equity obligations as contingent claims backed by identifiable cash flows from the credit and payment performance of these asset exposures.

attendant dislocations in money markets in tandem with the failure of major brokerage firms and commercial banks with excessive bad debt write-offs) highlights how securitization mechanisms—together with poor credit origination standards, lack of regulatory foresight and lax supervision—can perpetuate market disruptions, with potentially adverse consequences for employment, growth, and welfare. These dislocations are created when regulation and transparency lag behind, while the originators incentives to ensure minimum standards are compromised.[3]

The current regulatory debate centers on considerable skepticism about the incentive structure of securitization, which might have encouraged issuers to cutback on screening and monitoring borrowers, resulting possibly in a systematic deterioration of lending and collateral standards. The fallout from the U.S. sub-prime market crisis fueled mounting regulatory unease about current risk measurement standards of structured finance products.[4] While securitization has greatly enhanced the secondary mortgage market in many countries, giving originators greater balance sheet flexibility (The Economist, 2008), the ability to securitize mortgages has also affected lender behavior, with lending standards experiencing greater declines in areas with higher mortgage securitization rates (Dell'Ariccia, 2008). However, recent studies also find that financial innovation has contributed to rising default rates and increased credit supply fuelled by poor screening of mortgage lenders intent on selling on loans in structured finance transactions (Mian and Sufi, 2008; Keys et al., 2008).

Besides financial stability, a key concern for policymakers is that structured finance has complicated monetary policy. As financial intermediation becomes more competitive as a result of greater capital market sophistication (particularly in EM countries), the macro-financial linkages are also likely to change, often with considerable implications for the execution of monetary policy. Given the greater complexity of financial products, the diversity of financial institutions, and the growing interdependence of financial markets, policy makers are indeed challenged in deciphering the implications of the highly sophisticated new derivative and structured financial products. In particular, they are now beginning to worry about how asset shocks in the structured finance market propagate across the financial system and how possible knock-on effects on bank balance sheets might affect the execution of monetary policy. As indicated by Jan Marc Berk of the Dutch central bank, "financial innovation has increased the supply of substitute sources of financing, providing

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[3] Notwithstanding greater risk diversification within the financial system through asset securitization, in the same way, the structural complexity arising from multi-layered security designs, diverse amortization schedules, and possible state-contingent funding of synthetic credit risk transfer, might obfuscate actual riskiness of these investments. Moreover, numerous counterparty links established in the commoditization of securitized asset risk and derivative claims also create systemic dependence susceptible to contagion.

[4] Moreover, capital market surveillance, banking supervision, and crisis resolution have become more intricate as the reach of financial innovation transcends national boundaries, while financial institutions are still lead-regulated at a national level.

more hedging opportunities, and reducing the impact of changes in policy interest rates (IMF, 2008).” In fact, the availability of alternative funding sources through financial innovation has helped substitute capital market finance for traditional bank deposits, which has changed the traditional capital structure of banks to a point where the “originate-to-distribute” banking model encouraged a disproportionate expansion of total assets.[5] This situation suggest greater resilience of credit supply to changes in monetary policy in an environment of cheap credit and excess liquidity at higher leverage.

In this paper, we examine how securitization—as an essential element of structural change in the financial sector over the last 25 years—has affected macro-financial linkages, notably in the transmission of monetary policy through both the interest rate and the credit channel.[6] Proponents of the latter claim that the traditional (interest rate) channel of monetary transmission alone cannot explain the magnitude, timing, and compositional effects of monetary policy actions on the real economy (see Figure 1). Instead, credit market frictions, such as the enhanced role of capital market finance relative to the significance of the banking sector in a financial system engender a “financial accelerator” mechanism (Bernanke and Gertler, 1995) that increases the impact of monetary policy on market rates while expanding the amount of loanable funds to banks (due to higher balance sheet leverage) to satisfy money demand. Without securitization, banks would lack adequate substitutes on both the asset and liability side of their balance sheets to avert the contraction of loan supply in response to monetary tightening.[7] However, faced with a more restrictive monetary policy, banks can sell assets through securitization (as off-balance sheet operation) to fund new lending. While securitization together with the emergence of “near-banks” and the shortening of the term of market liabilities does not appear to undermine monetary policy transmission *a priori*, it attributes greater importance to alternative funding channels, which debilitate the timeliness of output response to changes in monetary policy as financial institutions can lend more by increasing quantities rather than raising interest rates.[8]

[5] For instance, as a result, the five largest U.S. commercial and investment banks experienced a doubling in total assets to 80 percent of GDP in 2007, while banks in Europe reported asset ratios of 150 percent and higher.

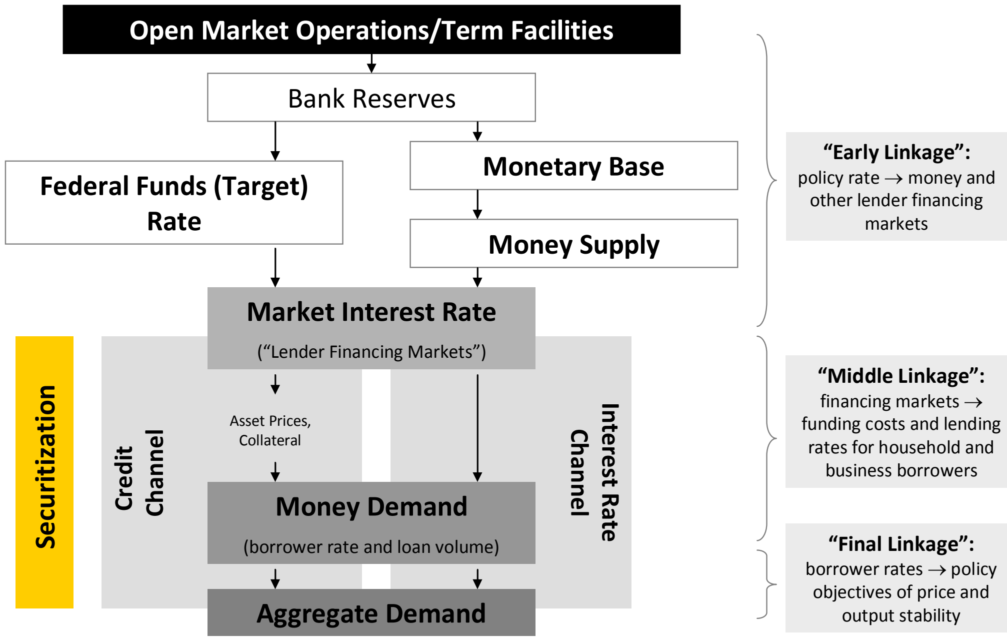
[6] In its basic concept the credit channel of monetary policy transmission functions via the lending by banks of proceeds from open market operations of the central bank to borrowers, whose purchase of goods and services generates proceeds sellers deposit with their own banks (which starts a new cycle of the credit channel).

[7] Conversely, credit rationing in response to the reintermediation of credit following the U.S. sub-prime mortgage crisis in 2007 demonstrated that as much as securitization (and other forms of capital market-based finance) has helped strengthen the resilience of credit supply to higher policy rates, it has also limited the ability of monetary policy to resolve liquidity problems.

[8] This study does not address the impact of the current credit crisis on bank funding markets as a conduit for monetary policy. Empirical work by the IMF (2008) demonstrates that the transmission of policy rate changes from policy rates to lender financing markets (i.e., the “early linkage” step of transmission channel) has been severely disrupted, particularly in the United States, while borrower financing rates have thus far been less affected. Thus, the impaired interest rate pass-through at early stages of the transmission means that changes in the policy interest rate are less likely to be effectively passed on to the middle and final stages. Amid higher

(continued)

Figure 1. Transmission Channels of Monetary Policy in the United States



More specifically, we test two basic hypotheses in this context:

- Securitization can enhance the transmission channel of monetary policy to short-term interest rates ("early and middle linkage") (see Figure 1). Since the financing cost for securitized assets is likely to be more closely aligned with market interest rates than the capital cost of bank lending[9], developing a liquid and tradable MBS market can potentially strengthen the link between the policy rate and market interest rates.

- Securitization can affect (quantity measures of) monetary policy transmission ("final linkage") by weakening the impact of interest rate changes on aggregate demand through the credit channel. Securitization breaks the balance sheet link between the banks' deposit base and lending activities by creating an additional window of funding (without increasing the balance sheet of lenders). If banks are able to resort to such alternative forms of external finance, securitization can weaken the transmission effect via the bank balance sheet, increase the resilience of banks to interest rate shocks, and

lending standards and slower credit growth unimpeded transmission of policy rates to borrower rates, however, suggests that banks are tightening credit by cutting back loan origination (rather than raising interest rates) as alternative funding sources are no longer readily available.

[9] Securitization transforms the proceeds from reference assets, such as mortgage loans, into contingent claims whose valuation is directly linked to asset price formation in capital markets.

eventually lead to a lower interest rate elasticity of real output. This effect is likely to be more pronounced in countries which have a bank-dominated financial sector (and rapidly expanding securitized issuance).

In this paper, we first analyze the influence of securitization on monetary policy in an economy with sophisticated financial markets and then apply a more tailored methodology to examine similar dynamics in the EM context. We focus on the U.S. mortgage market, where macro-financial linkages from securitization are generally better understood. Given the sophistication, depth, and liquidity of the U.S. securitization market (at least until mid-2007 before the start of the subprime mortgage crisis), we examine the market for residential mortgage-backed securities (RMBS) in order to understand the macro-financial implications associated with the rapid growth of securitization, and their significance for the execution of monetary policy. We conduct similar analysis in EM, although it was constrained by the scarcity of historical information and data availability (Jobst, 2006).

Previous research suggests that market rates respond more significantly to policy rates in the presence of securitization. Sellon (2000) finds that securitization affects the interest rate channel of monetary policy by causing market rates (e.g., mortgage rates) to respond more to the policy rate than without securitization. However, this effect might hold true only for mature economies with fully developed financial systems. Empirical evidence of such dynamics is still hard to discern from EM countries, given the limited history of securitization.

Other studies show that securitization dampens the impact of monetary policy on aggregate demand due to the availability of alternative funding sources. The level of securitization can have a significant impact on the degree to which a given change in monetary policy effects changes of aggregate demand and real output (Kuttner and Mosser, 2002). Since the bank balance sheet determines how monetary policy changes the demand or supply of credit (i.e., the way the policy rate is set to determine the market-clearing demand for funds), the credit channel is likely to be an important conduit of transmission.[10] In particular, monetary contraction reduces money supply and reservable deposits available for banks. At the same time, a downward sloping money demand curve implies that higher interest rates dampen interest-sensitive investment and expenditure (Rosenberg, 2005). The broader balance sheet channel reduces cash flows of firms (or leads to the decline of asset values/collateral), which, in turn, increases the external finance premium and the associated cost of capital (Levin et al., 2004). Declining liabilities force banks to shrink their asset base by curtailing lending (via an adjustment of

[10] Aggregate money demand is more influenced by the quantity of credit rather than its price, which takes place mainly through the balance sheet channel (Kamin et al., 1998).

prices, loan volumes, or both). However, securitization helps banks undo this effect of tightening monetary policy by providing them access to alternative sources of funds that substitute traditional funding sources (e.g., deposit-taking)—and decreases the market-clearing rate of money demand.[11] Financial market deepening tends to increase the use of securitization as the availability of reference assets and investment instruments increases in response to greater capital market maturity and lower transaction costs (ADB, 2007). Amid greater pervasiveness of securitization, liability constraints are probably less binding on bank balance sheets and asset growth, resulting in greater efficiency of loan origination.

We find that securitization activity does indeed lower the interest rate elasticity of real output.[12] In both cases, the United States and South Africa, controlling for the relative share of securitized mortgages alters the traditionally negative relation between output gap and real interest rates. Muted interest rate sensitivity implies a weaker effect of higher interest rates on money demand and/or greater availability of credit at the given policy rate (while controlling for increasingly forward-looking monetary policy might preserve a negative impact of monetary policy shocks).[13] In the United States, the negative effect of securitization on interest rate elasticity of output is unaffected by the general expansion of alternative sources of finance, which is a measure of financial sector deepening. While securitization dampens interest elasticity of real output, it also cushions the immediate impact of a positive interest rate shock to the bank's balance sheet, as the substitutability of funding sources makes banks less likely to curtail lending in response to tightening monetary policy, particularly in EM markets like South Africa.

Securitization, however, increases the interest rate pass-through, indicating that the credit channel (and its effect on money demand) may more than offset the interest rate channel. Rising securitization in the United States has facilitated the transmission from

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[11] Without securitization, the expansion of the asset side of the balance sheet would depend on the bank's ability to raise more deposits (or additional equity, hybrid and/or debt capital) for a capital coverage that supports the same volume of loans (with similar risk profile) under a contractionary monetary policy. This consideration also applies to quantity-based monetary measure, such as reserve requirements, which represent a tax on the banking system. For instance, higher reserve requirements may not impact the bank's lending decision if banks can raise off-balance sheet funding for the origination of new loans.

[12] Our study focuses on fixed-rate mortgages, which have gained increasing importance in the U.S. mortgage market. The examination of the transmission mechanism of securitization based on floating rate instruments (which still represent about 50 percent of the primary market, but tend to include fixed-rate rate terms for an initial period of the tenor) is outside the scope of our paper.

[13] At the same time, changes in the monetary policy communication and/or the information set of policy makers might alter the impact of monetary policy shocks, explaining muted interest elasticity based on traditional identification methods of macroeconomic effects (Barakchian and Crowe, 2008; Romer and Romer, 2004). Nonetheless, this conjecture does not conflict with the positive influence of securitization on money demand found in our analysis.

monetary policy to market interest rates over time. This, however, is not inconsistent with a more muted interest rate elasticity of output, as the presence of securitization enhances the role of the credit channel (through the bank balance sheet). Rising securitized issuance allows banks expand credit supply by adjusting quantities rather than prices (assuming that the impact of monetary policy shocks has remained unchanged), leaving monetary transmission via the interest rate channel largely unaffected. Our analysis of securitization in the bank-dominated financial system of South Africa demonstrates this point. While securitization dampens interest elasticity of real output, it also cushions the immediate impact of a positive interest rate shock to the bank's balance sheet and marginal loan origination. The substitutability of funding sources makes banks less likely to curtail lending in response to tightening monetary policy and a change in prevailing interest rates.

While securitization might affect the way in which monetary policy influences changes in interest rates, there is no clear evidence that securitization actually increases credit supply. Investors of securitized assets could alternatively have invested in other assets, such as bank deposits or capital enabling the banks to originate the same volume of loans in the traditional manner. In such a case, securitization would seem to involve the displacement of other forms of credit extension rather than an increase in the outright volume of credit.[14]

The paper is structured as follows. First, we provide evidence of the macro-financial linkages in the U.S. mortgage market by investigating the interest rate elasticity of output gap and the transmission channel of monetary policy based on different OLS-AR and VAR specifications in keeping with the existing literature. In the second part of the paper, we apply our approach to the financial sector in South Africa in order to assess whether our findings for the U.S. mortgage market apply to an advanced emerging market country with rapidly developing securitization activity. We then present our estimation results and discuss our findings. The fourth section provides an initial assessment of policy implications and concludes the paper.

II. Empirical Analysis

We analyze the secondary mortgage market in the United States in order to understand the macro-financial linkages of securitization in a well functioning financial system, which could provide meaningful lessons for the effects of securitization in EM.[15] More specifically, we examine whether securitization (i) alleviates liability constraints of banks in

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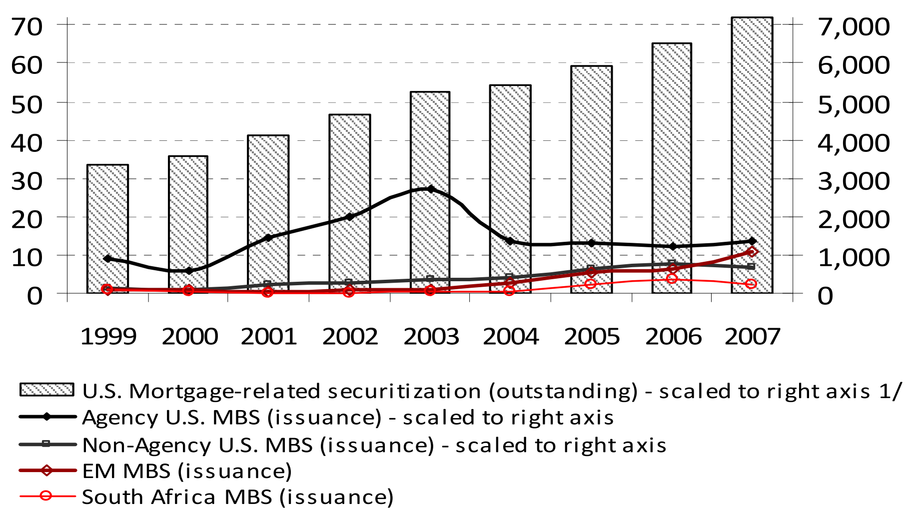
[14] Credits that are securitized are sold to final investors who would have committed their funds in alternative ways if they had not been able to purchase these specific securities.

[15] The empirical results for EM (South Africa) should be treated with caution, given the paucity of data and structural changes that have taken place in the monetary policy regime (e.g., move to inflation targeting).

times of monetary contraction ("credit supply effect") and/or (ii) helps maintain money demand at a certain policy rate by limiting credit rationing ("credit demand effect") (while allowing banks increase their balance sheet leverage).

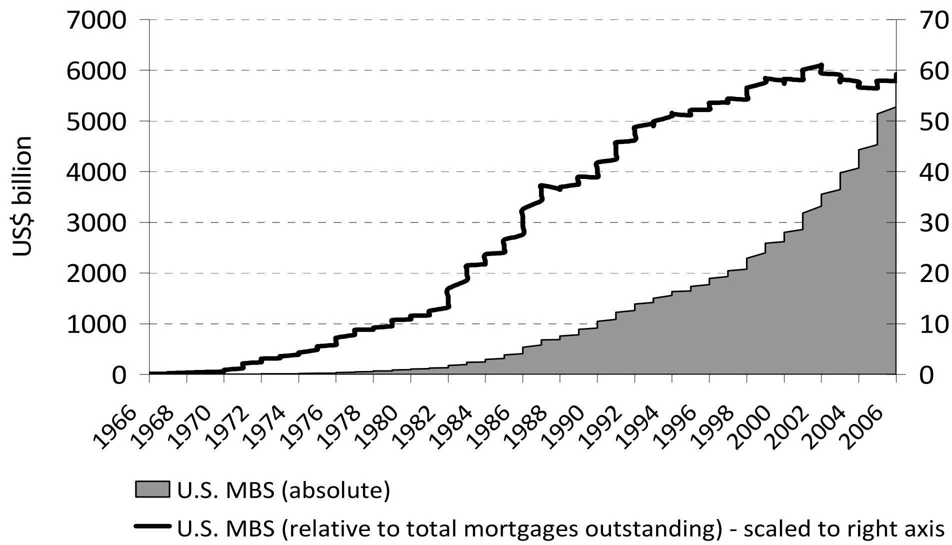
After exploring the influence of securitization on the interest rate elasticity of GDP and the monetary transmission channel of interest rates in the United States (i.e., the interest rate pass-through from policy rates to market rates), we adapt our approach to the bank-dominated secondary mortgage market in South Africa, where securitization has morphed into the most vibrant capital market segment over a period of little more than five years. Although South Africa has not escaped the economic fallout from the U.S. sub-prime mortgage crisis, it still hosts one of the most active securitization markets in EM after having exceeded an annual issuance volume of US$4 billion in 2006 (see Box 1). Nonetheless, still only a fraction of mortgages (about three percent) are securitized in South Africa, whilst more than 60 percent of the mortgage market is refinanced via structured finance transactions of private sector banks, financing houses or government programs and agencies (see Figures 2 and 3).

Figure 2. Mortgage-Related Securitization (Outstanding and Issuance) in the United States, Emerging Markets, and South Africa
(in billions of U.S. dollars, 1999–2007)



1/ Includes GNMA, FNMA, and FHLMC mortgage-backed securities (MBS), collateralized mortgage obligations (CMOs) and private-label MBS/CMOs. *Source:* U.S. mortgage agencies, Thomson Financial, Bloomberg, Dealogic, Securities Industry and Financial Markets Association (SIFMA).

Figure 3. Stock of U.S. Mortgage-Backed Securities
(in billions of U.S. dollars, 1966–2006)



Source: U.S. mortgage agencies, Securities Industry and Financial Markets Association (SIFMA), Federal Reserve Board of Governors.

A. Macro-Financial Linkages in Mature Economies—Evidence from the U.S. Secondary Mortgage Market

The interaction between the housing sector financing and monetary policy has changed following deregulation, which prompted greater competitiveness in the U.S. mortgage market. [16] In a bank-based financial system, credit supply and its effect on housing are largely driven by monetary policy. In general, lower money supply reduces deposit flows to banks (and other savings institutions), causing less mortgage lending due to limited funds and cut-backs in residential investment, home purchases, and housing starts. While housing credit activity is normally an early indicator of the influence of monetary policy on the economy, it has gradually lost much of its former significance as a result of the full integration of the primary mortgage market with the capital market (Kahn, 1989), creating more diversified sources of funding of mortgage loans, such as securitization. The supply of mortgage credit is no longer subject to sharp swings in availability of thrifts to secure deposits. Instead, mortgage credit is generally available at a going interest rate that is less affected by the

[16] This study assumes that the Federal Fund rate is a good indicator of monetary policy innovations and does not attempt to establish or refute this in the empirical model.

transmission channel of monetary policy.[17] This has lowered the chance that tightening monetary policy leads to non-price rationing of mortgage credit (McCarthy and Peach, 2000). Conversely, banks would adjust quantities (rather than prices) if securitization (or similar technologies) did not exist in times of contractionary monetary policy.

The growing use of mortgage securitization seems to have reduced the efficacy of U.S. monetary policy on the real economy but increased the interest rate pass-through (by creating higher liquidity and credit volume).[18] Previous research shows that the reaction of mortgage rates to changes in the U.S. Federal Funds rate has strengthened, while the interest elasticity of GDP growth has become close to zero, suggesting that the efficacy of monetary policy may not be working through the interest rate channel but through the credit channel of a wider range of providers of mortgage loans (Estrella, 2001 and 2002). Interest channel-based funding of bank loans appears to have become less important as a determinant of GDP growth in light of increasing mortgage securitization (in lieu of deposits) as an alternative source of funds (Mayer, 2007), whose off-balance sheet transfer of credit risk fosters loan origination while leaving capital coverage unchanged. At the same time, more forward-looking and endogenous (rather than proactive) U.S. monetary policy might explain a muted response of output to monetary policy shocks under conventional identification methods of transmission mechanisms, which do not take into account these considerations. Other studies have found that there has been an increased response of consumer and mortgage loans to interest rate changes (Sellon, 2000). Kolari et al. (1998) find that mortgage interest rates have indeed declined with the growth of securitization in the mortgage markets. In other words, there may well be a need to undertake a larger monetary policy move to achieve its same intended objective in terms of output.

In this section, we examine the impact of securitization on both (i) the interest rate elasticity of real output and (ii) the dispersion of mortgage interest rates (i.e, interest rate pass-through) in order to gauge the efficacy of the monetary policy in the United States. Curiously, Bernanke and Gertler (1995) find that the potential effect of securitization on monetary policy transmission might be largest when the development of local capital market attributes less economic significance to the conventional credit channel via the banking system. In our study, we introduce a richer model specification that allows us to disentangle the influence of financial deepening (i.e., bond and equity market size and bank credit relative to GDP) from securitization per se, which tends to increase as capital markets

[17] Mortgage-backed securities (MBS) lower the cost of capital by making the mortgages self-financing at a fair market rate on a reference portfolio of mortgage loans that are detached from the originator's balance sheet (and creditworthiness).

[18] To the extent other capital market instruments provide similar off-balance sheet treatment and capital relief, these instruments could also be influencing the transmission channel in a similar fashion.

develop. We also acknowledge rising financial disintermediation of mortgage loans in the U.S. financial system. However, this study largely focuses on the GSE issued MBS market and does not take into account the private label securitization market.

Monetary transmission in the presence of Securitization (OLS and VAR estimation)

We present two modeling approaches (OLS and VAR) to test the hypothesis that more pervasive securitization may limit the efficacy of monetary policy to change real economic variables as banks can substitute traditional liabilities to finance credit supply, with money demand more likely to be met at a given policy or target rate set my monetary authorities.

Our OLS-AR(2) model is based on the original dynamic IS curve by Rudebusch and Svensson (1999) as well as Johansen and Juselius (1994), which specify the marginal (contractionary) influence of the real interest rate on the output gap as

$$y_t = \alpha(w_t) + \sum_{j=1}^{p} \beta_j y_{t-j} + \beta_3(w_t)(\bar{i}_{t-1} - \bar{\pi}_{t-1}) + \varepsilon_t \,, \tag{1}$$

where

$$\alpha(w_t) = \alpha_1 \tag{2}$$

and

$$\beta_3(w_t) = \beta_3 < 0 \,, \tag{3}$$

with quarterly output gap y_t lagged by one (t-1) and two quarters (t-2), the four-quarter average of the current and lagged effective Federal Funds rate $\bar{i}_{t-1}$ (based on monthly weighted average), the average inflation $\bar{\pi}_{t-1}$ over the same four quarters, and non-autoregressive i.i.d. residuals ε_t, so that the long-term mean of the output gap is defined as

$$E(y_t) = \left(1 - \left(\sum_{j=1}^{p} \beta_j\right)\right)^{-1} E\left(\alpha(w_t) - \beta_3(w_t)(\bar{i}_{t-1} - \bar{\pi}_{t-1})\right). \tag{4}$$

Estrella (2002) extends this model to test the effects of mortgage securitization on the reaction of output to monetary policy moves by conditioning both the coefficient β_3 of the real interest rate and the intercept term on the ratio S_t of securitized home mortgages to the value of all home mortgages (in percent),[19] so that

[19] Estrella (2002) finds that variations in the securitization of multi-family home mortgages seem to have a much stronger business cycle component (than changes in securitized single-family home mortgages). For the purpose of this study, we have used the combined ratio, which is dominated by single-family home mortgages.

$$\alpha(w_t) = \alpha_1 + \alpha_2 S_t \quad (5)$$

and

$$\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t .\text{[20]} \quad (6)$$

In extending equations (5) and (6) above to equations (7) and (8) below, we follow Roldos (2006) and introduce the financing ratio F_t, which reflects the changing level of direct financing (i.e., equity, bonds, commercial paper or other capital-market based sources of external funding, with securitized issuance excluded) relative to indirect (or intermediated) financing (i.e., bank loans to the non-financial private sector, with household loans excluded) over the chosen sample period. By controlling for F_t, we allow interest elasticity and its interaction effect with the prevalence of securitization to vary with the degree of financial sector sophistication. In this way, we present a more refined approach to examine the influence of financial market deepening (i.e. bond and equity market size and bank credit relative to GDP) on the use of securitization, which tends to increase as capital markets develop. In addition, we include credit growth $K_t = \ln\left(\frac{\kappa_t}{GDP_t} \bigg/ \frac{\kappa_{t-1}}{GDP_{t-1}}\right)$ as the logarithmic difference between private sector credit κ to GDP over two subsequent periods in order to control for the relative importance of the credit channel to growth of aggregate demand.

Inference procedures of standard parametric models, such as OLS, assume non-integration and level stationarity of endogenous variables. Thus, we first analyze the stochastic properties of each variable in our sample in order to ascertain mean reversion by ruling out stochastic behavior (with a constant forecast value and time-varying auto covariance). Based on the classical Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979 and 1981) and Phillips-Perron (PP) (1988) unit root tests, we find that the output gap, the real interest rate (over an extended sample time period), and credit growth are all I(0) level stationary. Since the securitization ratio S_t is I(1) integrated, we introduce a time trend *t* in order to control for the linear effect of continuously increasing securitization on the relation between changes in output gap and monetary policy. Thus, based on equation (1), we estimate the following model (and subsets thereof):

$$\alpha(w_t) = \alpha_1 + \alpha_2 S_t t + \beta_4 F_t + \beta_5 K_t + \beta_6 S_t t F_t + \beta_7 S_t t F_t K_t \quad (7)$$

and

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[20] Our sample covers quarterly observations over a time period extending from the third quarter of 1970 to the end of 2006. The output gap is defined by the logarithm difference between actual real output and potential output (OECD, 2007). The real interest rate is the simple difference between four-quarter average of the effective U.S. Federal Funds rate and the annualized CPI (IMF, 2007). Data on the securitization and financing ratios were obtained from the Flow of Funds publication of the U.S. Federal Reserve Board (2007).

$$\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t + \beta_{3,3} F_t + \beta_{3,4} K_t + \beta_{3,5} S_t t F_t + \beta_{3,6} S_t t F_t K_t . \quad (8)$$

with the financing ratio F_t and the logarithmic difference of relative credit growth K_t as control variables and a simple lag structure without gaps at a maximal order of *p*=2 in order to sufficiently accommodate delayed demand effects to interest rate changes.[21]

As an alternative model of investigating interest elasticity, we adopt an unrestricted VAR framework to study the response of output to monetary policy shocks—with and without controlling for securitization and financial sector depth as instrumental variables (Hamilton, 1994; Davidson and MacKinnon, 1993). As an useful alternative to structural modeling procedures, the linear simultaneous equation system of VAR measures the dynamic impact of random disturbances on contemporaneous changes of both output gap and interest rates as stationary endogenous variables, without imposing a cointegration restriction on their long-term intertemporal relation.

We model the five-dimensional VAR specification of vector $X_t = (\Delta y, \Delta r_t, \Delta r_t \times \Delta S_t, \Delta r_t \times \Delta F_t, \Delta r_t \times \Delta S_t \times \Delta F)'$ of quarterly output gap $\Delta y_t = y_t - y_{t-1}$, real interest rate $\Delta r_t = (\bar{i}_t - \bar{\pi}_t) - (\bar{i}_{t-1} - \bar{\pi}_{t-1})$, the securitization ratio $\Delta S_t = S_t - S_{t-1}$, the financing ratio $\Delta F_t = F_t - F_{t-1}$, and their interactive term with the real interest rate at first differences at time *t* as

$$X_t = C + \sum_{j=1}^{p} \Phi_t X_{t-j} + \mathrm{E}_t , \quad (9)$$

with C as a (2x1) vector of constants c_1 and c_2, Φ_t as (5x5) parameter coefficient vector matrix of jointly dependent past X_t values (compounded by lag structure *p*=2 number of lags), and E_t as (5x1) vector $\left(\varepsilon_t^{(\Delta y_t)}, \varepsilon_t^{(\Delta r_t)}, \varepsilon_t^{(\Delta S_t)}, \varepsilon_t^{(\Delta F_t)}, \varepsilon_t^{(\Delta S_t \times \Delta F_t)}\right)'$ of non-autoregressive i.i.d. residuals $\varepsilon_t \sim N(0, \Sigma)$ with variance-covariance matrix Σ.[22] The assumption of not serially

[21] The choice of the maximum lag order *p* (and the specification of the lag structure in general) reflects a trade-off between over-parameterization (and the corresponding loss of degrees of freedom) and over-simplification. Since the lag order should capture the overall information processing and aggregation time in each market, we rely mainly on individual partial autocorrelation in our sample to inform the optimal lag structure (Taylor and Peel, 2000; Lütkepohl, 1991). After the specification of the lag order (not before), the residuals are found to be neither heteroskedastic nor autocorrelated, which ensures efficient statistical inference with appropriate error terms of the regression coefficients. Otherwise, a weighted regression estimation would be warranted.

[22] The estimation is done in first differences as the securitization variable is I(1). Furthermore, errors are uncorrelated with their own lagged values and all endogenous variables, but may be contemporaneously correlated with each other.

correlated residuals is not restrictive, since any residual serial correlation could be easily absorbed by a higher polynomial lag as long as normality holds. However, in this case statistical inference would be inefficient and would warrant regression weights to inform a correct estimation of statistical errors.

We focus primarily on the output gap equation and its impulse-response function in order to measure the interest rate elasticity of output and its sensitivity to interest rate shocks. The VAR specification defines the contemporaneous average quarterly change of the output gap as dependent on its previous changes and past changes of the average real interest rate. The model is estimated both statically for non-overlapping sample periods and dynamically (reverse recursive and ten-year rolling window with quarterly updates) based on a heteroskedasticity consistent coefficient covariance (White, 1980). There is a particular focus on the evolution of the coefficient of the real interest rate at one lag, which can reasonably be interpreted as the "short-term elasticity" of real activity to changes in the policy rate. Any innovations of the policy rate in the variance-covariance matrix show how monetary policy shocks impact on output.

Interest rate pass-through (OLS estimation)

We also apply a modified form of our original OLS specification above to test the hypothesis that securitization enhances the interest rate pass-through of monetary policy on the level of market rates, such as mortgage interest rates. In the case of the United States, we define the interest rate pass-through as

$$m_t = \alpha + \sum_{j=1}^{p} \beta_j m_{t-j} + \sum_{j=0}^{p} \left(\gamma_{j+1,1} + \gamma_{j+1,2} S_t\right) \bar{i}_{t-j} + \sum_{j=0}^{p} \varphi_{j+1} \bar{\pi}_{t-j} + \varepsilon_t \,, \tag{10}$$

based on the structural identification of the policy rate affecting market rates (and not vice-versa), where m_t is the end-of-quarter 30-year mortgage rate, $\bar{i}_{t-j}$ is the four-quarter average of current and lagged effective Federal Funds rates (with and without "securitization control"), $\bar{\pi}_{t-j}$ is the average inflation over the same four quarters, and non-autoregressive i.i.d. residuals ε_t, in order to examine adjustments in mortgage rates in response to changes of policy rates for a simple lag structure p=2. The specification of equation (10) seems robust to potential inefficiencies caused by multi-collinearity. We use the traditional linear approach of Granger causality testing (Granger, 1969)[23] to examine the joint short-term dynamics of

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[23] Granger causality finds a positive association between two scalar-valued, stationary and ergodic time series $\{X_t\}$ and $\{Y_t\}$ if there is a significant reciprocal (autoregressive) influence of past information, i.e. the lagged polynomial of either variable, on the conditional probability distribution of the other.

exogenous factors. While the mortgage rate and the output gap could Granger cause each other, changes in inflation or the federal fund rate are independent of variations in mortgage rates.

Findings

We find that securitization activity dampens the interest rate elasticity of output. Controlling for the relative share of securitized mortgages alters the traditionally negative relation between output gap and real interest rates.[24] Our OLS estimation results indicate that the interaction term of the securitization ratio and the real interest rate has a positive coefficient and remains statistically significant even after we control for the time trend of both the securitization ratio and the real interest rate (see Table 1). This observation vindicates the results from an earlier study by Estrella (2002) who finds that securitization tempers the sensitivity of output to monetary policy.[25] Also our VAR estimation results (see Table 2) are consistent with this finding, confirming that increasing securitization repeal the negative feedback effect of monetary policy on investment.

Financial deepening has spurred increased securitization activity but has not significantly affected the direct capacity of securitization to dampen interest rate elasticity. Although securitization activity seems to increase with greater availability of alternative sources of finance (indicated by a higher financing ratio as a measure of financial sector development) amid persistent credit growth, greater financial deepening has not amplified the impact of securitization on the efficacy of monetary policy. In fact, greater market-based financing has slightly reduced the marginal effect of securitization on interest rate elasticity of output. The economic and statistical significance of the interaction term between the securitization ratio and the real interest rate decreases after we control for the financing ratio (see Tables 1–2).[26] Since the financing ratio does not include securitized issuance in its numerator, we implicitly control for the positive relation between financial deepening and the incidence of securitization in order to disentangle the contemporaneous effect of both factors on interest rate elasticity. Thus, lower interest rate elasticity of output seems to largely be attributable to securitization, which offers an important and unique

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[24] The Taylor Rule also indicates a positive relation between real interest rates and output gap. Our model does not account for this assumptions as the causality appears doubtful in our specification.

[25] Controlling for a non-linear increase in securitization ratio over the sample period through exponential transformation ($\exp\left(\beta_{3,2}S_t\right)$) increases both economic and statistical significance of our results but makes the interpretation of our estimation results more difficult.

[26] The average value of the financing ratio over the sample period is 1.01, which, if applied to the regression coefficient of the interaction term, delivers the marginal effect of securitization on interest rate elasticity after controlling for financial sector deepening.

channel of diversified funding that helps maintain steady credit supply. Credit growth, in turn, is not a cause of muted interest elasticity but appears to result from broader and deeper capital markets that foster an environment of increasing disintermediation amenable to securitization.

The diversified supply of external finance in the United States has fostered the surge of securitization without *directly* affecting the efficacy of monetary policy. Financial sector deepening in the United States demonstrates how a large variety of alternative funding channels has raised disintermediation to a point where securitization at the margin influences the efficacy of monetary policy materially. Pervasive securitized issuance by non-deposit taking financial institutions has long helped disintermediate large parts of the U.S. banking sector. While other forms of external finance are highly developed, they do not seem to significantly weaken the response of output to changes in monetary policy.

The dynamic estimation of our VAR model and the associated impulse-response analysis show that the influence of securitization on the efficacy of monetary policy has increased and seems to have an outsized impact relative to declining interest rate volatility over time. If we split the sample into two non-overlapping periods, we can distinguish between the long-term effect of securitization on interest rate elasticity at times when the financing ratio is low (from 1970 to 1990) and high (from 1991 to 2006) (see Figures 4–6). While low levels of securitization have hardly affected interest rate elasticity before 1991, rising securitization has gradually dampened the general sensitivity of output to monetary policy ever since. Although interest rate volatility had decreased by almost 25 percent ("great moderation") between the two time periods, suggesting a structural decline in interest rate elasticity without any change in the sensitivity of real activity to changes in policy rates, we still find a significant impact of securitization. The increase of securitization activity has reduced the cumulative effect of interest rate shocks on output gap by more than 90 percent. Interest rate elasticity, on average, has remained unaffected by the greater availability of alternative forms of external finance other than securitization in the wake of increasing disintermediation and financial deepening.

However, the declining interest rate elasticity of real output should not be seen as evidence of impeded monetary transmission. In fact, the transmission from monetary policy to market interest rates is more effective in the presence of securitization despite. After having reached a critical mass, securitization facilitates the transmission of policy rates. Our OLS estimation results of the interest rate pass-through suggest that a higher share of securitized mortgages (which results in a higher securitization ratio) initially dulls the sensitivity of mortgage interest rates to changes of the policy rate (see Tables 3–4). Since the 1990s, however, among other things, a sustained increase of securitized issuance seems to have reversed this relation and has enhanced the sensitivity of mortgage rates to changes in the Federal Funds rate under a more transparent monetary policy regime. The more efficient interest rate transmission is not inconsistent with the declining efficacy of monetary policy (i.e., lower interest rate elasticity of output), as the presence of securitization (and the availability of alternative means of banks to fund their lending) increases the liquidity of mortgage markets while enhancing the role of the credit channel by helping banks satisfy money demand at a certain policy rate without credit rationing during times of monetary contraction. That said, the relation between policy rates and mortgage rates can be more complex due to the existence of other factors omitted in this analysis, such as long-term inflation expectations and risk premia (e.g., repayment risk) embedded in mortgage rates.

B. Macro-financial Linkages in Emerging Economies—Evidence from the South African Mortgage Market

In this section, we examine whether the above findings about the U.S. mortgage market can be replicated in EM. We choose South Africa as one of the more advanced EM countries, where securitization activity has grown considerably over the last five years owing largely to financial innovation and increasing sophistication on the back of an adaptive regulatory stance aimed at facilitating local capital market development in a small open economy. Since 2001, when only R6.2 billion (US$750 million) of asset-backed securities (ABS) were issued, the securitization market has grown at an annual rate of more than 60 percent, culminating in record issuance of R31.7 billion (US$5.1 billion) in 2006 (see Figure 2 and Box 1). Although South Africa has not escaped the economic fallout from the U.S. sub-prime mortgage crisis,[27] it still hosts one of the most active securitization markets in EM, with total overall issuance of more than US$15 billion to date representing more than one third of total issuance in EMEA. That said, securitized issuance remains at a very low level relative to mortgage origination by mature market standards. In the first quarter of 2007, the RMBS market represented merely three percent of the total amount of outstanding mortgage loans, almost equivalent to the United States in 1972.

[27] In 2007, securitized issuance has dropped to slightly less than R10.0 billion (US$1.4 billion) as a result of the global credit crisis.

Box 1: Mortgage Securitization in South Africa

The South African securitization market has been maturing rapidly over the last five years. Prior to 2001, regulatory constraints restricted securitization activity to only a few transactions. On the heels of the first securitization regulations for conventional (true sale) structures and general capital market reforms, South Africa's first residential mortgage-backed securitization (RMBS) transaction, Thekwini I (Pty) Limited, was launched, followed shortly thereafter by the first asset-backed securitization (ABS) of car loans and lease receivables. Since then, South Africa has registered a phenomenal surge of securitization activity, having reached a total overall issuance of more than R83.2 billion (US$12.8 billion) before the global credit crisis, spurred by the adoption of a comprehensive securitization framework in 2004.

Asset securitization has emerged as a main funding option for commercial banks to redress growing monetary constraints and acquire diversified sources of liquidity. South African commercial banks have traditionally funded themselves on a short-term basis. However, over the recent two years, they have come under pressure from the Reserve Bank to improve their term financing as retail deposits have not kept up with surging credit growth of mortgage and consumer loans. Aside from senior debt, balance sheet securitization of residential mortgages (and more recently of retail credit) has become a key mechanism to fund South Africa's housing deficit. The bank-sponsored securitization of retail asset portfolios, in particular car loans and residential mortgages has been the main source of supply, with the biggest securitization asset classes mapping directly how the bank's major loan portfolio are comprised.

Residential mortgages are the dominant asset class of the domestic securitization market. After overcoming initial legal impediments, residential mortgage-backed securities (RMBS) have recently overtaken ABS on car loans, lease receivables, and credit cards as the top securitization sector in terms of gross market value. The development of RMBS was initially complicated by the Public Finance Management Act (PFMA), 1999 (Act No. 1 of 1999) (as amended by Act No. 29 of 1999), which presented some new twists to the standard way of conducting RMBS transactions.

RMBS were first issued by non-bank financial service companies, such as specialized mortgage lenders and consumer finance companies, before banks have begun to resort to mortgage securitization to manage asset-liability mismatches and diversify their investor base. After the first RMBS issuance in the 1980s by the former United Building Society, the securitization market began in earnest in November 2001, when SA Home Loans, a full-service mortgage operator jointly funded by JP Morgan and Standard Bank, emulated the successful business model of non-bank mortgage lenders in Australia by raising finance through RMBS. It took four years for another non-bank mortgage originator, Sanlam Home Loans, to copy SA Home Loans' approach of using a conduit to warehouse loans and commoditize repayment proceeds by means of term securitization once volumes built up. Before SA Home Loans and Sanlam Home Loans carved out niches for themselves, large commercial banks dominated the mortgage market in the wake of consolidation of South Africa's building societies. Banks are latecomers to mortgage securitization. Now, that banks are competing aggressively on price, non-bank lenders have adopted a new strategy of focusing on service and product innovation by offering fixed rate and interest free mortgages.

Despite the healthy growth of securitization in South Africa over the last five years, higher originator and asset class concentration cloud the overall positive outlook amid weakening primary market activity and low investor confidence after the U.S. sub-prime mortgage crisis. Since only a handful of large banks and specialized lenders are behind the bulk of securitization transactions issued so far, origination and servicer risk from narrow asset supply poses challenges to investor diversification, which are exacerbated by poor asset diversity given the narrow range of deal types in the existing market.

Monetary transmission in the presence of securitization (OLS estimation)

We first specify interest rate elasticity of output similar to the U.S. example of the IS equation as[28]

$$\alpha(w_t) = \alpha_1 + \alpha_2 \begin{Bmatrix} S_t t \\ S_t \end{Bmatrix} \tag{11}$$

and

$$\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t \begin{Bmatrix} S_t t \\ S_t \end{Bmatrix}. \tag{12}$$

based on the general specification of equation (1), with a simple lag structure (without gaps) at a maximal order of *p*=2 in order to sufficiently accommodate delayed demand effects in capacity utilization to interest rate changes. We interact the securitization ratio S_t with time trend *t* as one modification of equations (5) and (6) above. However, unlike in the U.S. case, we do not control for the influence of financial system maturity (in the form of the financing ratio F_t) due to limited data availability. As an alternative model specification, we replace the securitization ratio S_t above with dummy variable S_t', which registers the existence of securitized issuance at time *t*, so that

$$\alpha(w_t) = \alpha_1 + \alpha_2 S_t' \tag{13}$$

and

$$\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t'. \tag{14}$$

Balance sheet effects in the presence of securitization (VECM)

As an alternative model of measuring interest elasticity (and the transmission of monetary policy) in the presence of securitization activity, we adopt a *restricted* VAR framework in the form of a three-dimensional vector error correction mechanism (VECM) (similar to equation (9)). In general, a VECM specification defines the long-term joint time series dynamics of endogenous variables within a linear system of simultaneous equations while controlling for intertemporal adjustments. In the VECM model, the long-run behavior of variables that share at least one cointegration vector is restricted to converge to their cointegrating relation while allowing a wide range of short-term random disturbances

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[28] For purposes of consistency and ease of comparability, we maintain the same index of the regression coefficients as in equation (3).

(Johansen, 1990; Johansen, and Juselius, 1991).[29] Based on the degree of cointegration, deviations from the long-run equilibrium of level changes are offset through a series of partial short-run adjustments over the sample period. These intertemporal corrections indicate the short-term lead-lag relation of the endogenous variables.

Our application of a VECM specification is motivated by Bernanke and Blinder (1992), who examine how interest rate shocks to the bank balance sheet affect the real economy. The model estimates show the direction of causality (and its significance) between output growth and concurrent changes in the composition of the aggregate bank balance sheet over the short run and the nature of their intertemporal (long-term) relation in response to unanticipated interest rate shocks (see Appendix). Given the dominant role of banks in the financial system of many EM countries, the responsiveness of bank balance sheets to monetary policy offers an interesting area of investigating the macro-financial implications of securitization.[30] Any effect of securitization on the sensitivity of deposit generation, loan origination, and investment activities of banks holds important insights into the accessibility of finance in EM countries in the presence of off-balance sheet activity.

Findings

Similar to the United States, we find that the growing use of mortgage securitization in South Africa has, to some extent, eroded the general sensitivity of real output to monetary policy. However, these results are to be treated with caution, given the short history of mortgage securitization in South Africa (unlike in the United States). That said, we also control for the existence of securitized issuance in each quarter of the sample period (in addition to the relative share of securitized mortgages). Our OLS estimation results show that introducing a dummy variable for securitization reverses the traditionally negative relation between output gap and real interest rates (see Table 5). The interaction term of the securitization dummy and the real interest rate indicates significant positive interest elasticity. Controlling for the securitization ratio truncates the sample time period to only the most recent observations of consistent growth of securitized issuance. Despite the apparent estimation uncertainty from this dramatic loss of degrees of freedom, the interest relate elasticity of output remains significantly positive.[31]

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[29] Although the cointegration restriction of VECM does not require level stationarity of the constituent time series (unlike VAR), it implies difference stationarity of each time series regardless of the individual degree of integration.

[30] While securitization tends to be associated with deeper local capital markets, the potential of securitization to influence credit supply via the bank balance sheet might, however, be offset by a contemporaneous decline of the role of banks in providing access to credit as markets mature.

[31] Interacting changes of the securitization ratio and real interest rates indicates negative interest rate elasticity of output, which is explained by intermittent slowdowns of securitized issuance amid declining real interest rates explain this finding.

The lower interest elasticity of output is in line with our benchmark findings that the impact of securitization on the efficacy of monetary policy is not directly affected by financial sector development. We find that the decline in the efficacy of monetary policy in South Africa concurs with our evidence from the United States when we do not control for the financing ratio. Interest elasticity of output seems more likely to be affected by securitization than any form of external finance. Thus, securitization in EM with bank-based financial systems offers an important step towards greater capital market maturity while preserving stable credit supply (and diversified funding) at the expense of lower interest rate elasticity.

Our results indicate that securitization in South Africa might have contributed to lower efficacy of monetary policy on bank lending over the long run. Given the dominant role of banks in the financial system, the influence of securitization on the transmission of monetary policy is likely to show in the credit channel. We find that the relation between output growth and monetary policy tends to become positive and stronger when banks securitize mortgage loans. In fact, the cointegrating vector of loan origination and real interest rates in our VECM specification suggests that the balance sheet effect of securitization allows banks to adjust prices rather quantities, which prevents the contraction of long-term credit supply during times of higher interest rates (see Table 6 and Figure 7). As opposed to Kashyap and Stein (1994) our findings suggest that financial innovation (and possibly financial deregulation) does not necessarily diminish the importance of the bank lending channel in EM countries, where banks dominate the financial sector. The impact of securitization is also more likely to most pronounced in financial systems with a predominance of fixed-rate mortgages.

Securitization appears to also cushion the immediate impact of positive (short-term) interest rate shocks to bank lending, indicating a possibly delayed transmission of monetary policy to market rates (unlike in the United States). Our estimation results for error correction in the VECM framework of balance sheet transmission in South Africa reveal that securitization alters the short-term dynamics between bank lending and changes in real interest rates (as indicated by higher and less significant adjustment coefficients λ of error correction). In the presence of securitization, the impact of interest rate shocks on bank lending is positive but relatively less severe and persistent (see Table 6), possibly as a result of a less efficient interest rate transmission. At the same time, positive interest rate elasticity of real output highlights that banks have fully absorbed interest rate shocks thanks to lower susceptibility to changes in monetary policy.

Furthermore, securitization seems to help banks absorb more readily unexpected positive interest rate shocks to deposits and securities investment. Banks are capable of raising more deposits and are more likely to invest in securities over the short run when interest rates increase (see Tables 7–8 and Figures 8–9). Without securitization, an unexpected positive shock to interest rates reduces securities investment but increases deposit taking in South Africa. However, since 2002, deposit growth and securities investment seems relatively less affected by interest rate shocks in the presence of securitization. Nonetheless, their short-term sensitivity to interest rate changes is now less consistent over time. In particular, the positive sensitivity of the former increases in economic and statistical significance.

We acknowledge that our estimation results warrant careful interpretation. The outsized effect of securitization on bank lending might be influenced by explosive credit growth in South Africa since the late 1990s. Moreover, the low statistical power and small sample of observations for time periods of securitization activity imply substantial parameter uncertainty. Controlling for securitization limits the sample size to only 17 observations of each endogenous variable, which leaves only six (seven) degrees of freedom depending on whether VECM is defined with or without the securitization dummy.

III. Conclusion

Our study of indicates that the transmission of monetary policy and its impact on the real economy may have become more complex, owing partly to financial innovation, such as securitization. We find evidence in both a mature market (United States) and an emerging market (South Africa) economy that a rise in securitized issuance has lowered the degree of sensitivity of output to changes in interest rates while facilitating efficient interest rate pass-through. This changing nature of macro-financial linkage, attributed to the process of securitization, is driven by the ability of banks to leverage their asset origination by securitizing loans (an off-balance sheet operation) giving them access to additional funding sources. Securitized issuance allows banks expand credit supply by adjusting quantities rather than prices while leaving general interest rate pass-through largely intact. In this light, overall monetary transmission—including through channels other than interest rates, such as the credit channel via securitization markets—may be less constrained.[32] A lower incidence of credit rationing implies a higher change of the banking sector meeting money demand during monetary contraction.

A key contribution of our study is to isolate the impact of financial deepening from securitization. Our study shows evidence that financial sector deepening has resulted in a greater availability of reference assets and investment instruments that benefit securitized issuance. However, the impact of interest rate changes on output has not been significantly altered by financial market deepening itself (proxied by direct to indirect financing) but rather

[32] In other words, banks increase lending by increasing overall loan volume rather than lowering interest rates. The disintermediation process, whereby loans shift from heavily capitalized banks to lightly capitalized market funded “near-banks” adds to the capital needs of the system and may attenuate the procyclicality of credit contraction, when there is a higher change of credit rationing via prices (rather than quantities) in the presence of securitization.

by the fact that greater financial deepening has increased securitization. Thus, the nature of securitized issuance, and its effect on bank balance sheets (and/or the nature of financial intermediation), seems to be critical to the efficacy of monetary policy. That said, in EM countries, such as South Africa, where banks still play the dominant role in the financial sector, a rapid increase of securitization activity might suffice to weaken the response of output to changes in monetary policy in the absence of a broad and liquid local capital market if most securitization activity is sponsored by banks.

We also find that the response of market rates to a change in policy rates is more pronounced in the presence of securitization, especially in the case of matured markets like the United States.[33] This transmission mechanism, however, is more muted in EM countries with bank-dominated financial systems, due to greater importance of the credit channel. Over the last 15 years, a significant increase of securitized issuance in the United States has enhanced the sensitivity of mortgage rates to changes in the policy rate despite declining interest rate elasticity of real output. In contrast, the South African case provides some evidence that in EM countries where secondary mortgage markets lack sufficient liquidity, the interest rate pass-thorough is mostly determined by the credit channel.

From a broader perspective, our study attempts to provide a better understanding of the changing nature of the macro-financial linkages in a well-functioning financial system that can help inform policy-making in EM economies. To this end, there are two key implications. First, we believe that securitization might help banks in EM countries better absorb unexpected positive interest rate shocks to their balance sheet amid greater availability of alternative funding sources. In the presence of securitization, banks seem more capable of funding their lending and are more likely to invest in securities after interest rate increases. In South Africa, banks' tolerance to interest rate shocks explain the persistent credit growth in spite of the positive interest rate elasticity of real output over the recent past.[34] Second, the findings indicate that there may well be a need for monetary policy to take into account the changing macro-financial linkages of the transmission mechanism due to financial innovation

[33] While we show that securitization might affect the efficacy of monetary policy, our findings cannot deliver evidence that securitization changes monetary aggregates by actually increasing credit supply. Investors of securitized assets could alternatively have invested in other assets, such as bank deposits or capital enabling the banks to originate the same volume of loans in the traditional manner. In such a case, securitization would seem to involve the displacement of other forms of credit extension rather than an increase in the outright volume of credit.

[34] In some instances, securitization caters to leveraged security designs that could encourage greater risk taking in a benign economic environment but entail more adverse economic consequences when stress occurs. These adverse consequences of financial sector vulnerabilities are potentially far more severe in many EM economies with small local capital markets.

such as securitization. To this end, policymakers may need to undertake a larger monetary policy move to achieve its same intended objective in terms of output as financial innovation continues to thrive in deeper financial markets.[35]

There are, however, some caveats to our empirical findings which merit further research. First, monetary policy-making in and of itself has undergone significant transformation during the time period of our study. Thus, enhanced transparency of monetary policy regimes could have altered the reaction function of output, which might have some bearing on our results. Second, the secular decline in interest rate volatility during the latter part of our sample could have muted the interest rate sensitivity of output and the bank balance sheet – though this effect seems marginal compared to the decline of the normalized impulse-response to interest rate shocks. Third, the rapid growth of the private label mortgage securitization in the United States, partly based on sub-prime loans, are outside the scope of our analysis. Fourth, the case for EM securitization, including our findings for South Africa, is still subject to significant data constraints. While our study has addressed some of these issues, further research could add to this evolving literature on the interaction between monetary policy and financial innovation.

[35] However, the sound development of securitization markets warrants adequate valuation and credit rating of structured finance products at origination in order to limit excessive risk-taking by issuers and investors alike. As illustrated during the U.S. sub-prime mortgage crisis, false assumptions about risk behavior, lose lending standards and improvident investment infected the securitization process and discredited a very important and intrinsically very safe market.

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Table 1. United States—OLS Estimation Results: Is Dynamic Equation of Output Gap with Instrumental Variable Controls for Securitization and Financial Depth (1970–2006)

Model	(1)	(2)	(3)	(4)	(5)	(6)
α_1	0.0138	0.0249	0.0691	-0.5082	-1.6473	-2.2638
(std. error)	*0.0920*	*0.1623*	*0.1752*	*3.4683*	*3.3719*	*3.3242*
α_2	...	-0.1249	0.0008**	0.0009	0.0009	-5.0976
(std. error)	...	*0.2470*	*0.0004*	*0.0008*	*0.0008*	*5.4275*
β_1	1.1716***	1.1593***	1.1159***	1.1144***	1.1628***	1.1926***
(std. error)	*0.0913*	*0.0909*	*0.0941*	*0.0932*	*0.0806*	*0.0790*
β_2	-0.2780***	-0.2762***	-0.2364***	-0.2463***	-0.2697***	-0.2884***
(std. error)	*0.0896*	*0.0903*	*0.0932*	*0.0969*	*0.0865*	*0.08184*
$\beta_{3,1}$	**-0.0392**	**-0.0820***	**-0.1924*****	**-0.5709**	**-0.3439**	**-0.2479**
(std. error)	***0.0285***	***0.0460***	***0.0705***	***0.9975***	***1.0277***	***1.0051***
$\beta_{3,2}$	**...**	**0.0002***	**0.0003*****	**0.0004****	**0.0003****	**0.0004****
(std. error)	***...***	***0.0001***	***0.0001***	***0.0002***	***0.0002***	***0.0002***
$\beta_{3,3}$	...	...	...	0.4406	0.2303	0.1323
(std. error)	...	...	...	*1.0945*	*1.1218*	*1.0932*
$\beta_{3,4}$	...	...	...	...	1.9493	-0.3811
(std. error)	...	...	...	...	*1.8344*	*2.4450*
$\beta_{3,5}$	**...**	**...**	**-0.0002*****	**-0.0003****	**-0.0003***	**-0.0003***
(std. error)	***...***	***...***	***0.0001***	***0.0001***	***0.0002***	***0.0002***
$\beta_{3,6}$	...	...	...	...	...	0.0011**
(std. error)	...	...	...	...	...	*0.0006*
β_4	...	...	...	0.6078	1.8033	2.4693
(std. error)	...	...	...	*3.6029*	*3.4983*	*3.4477*
β_5	...	...	...	...	-12.1610*	-16.8156*
(std. error)	...	...	...	...	*6.8252*	*9.1726*
β_6	...	...	0.0003**	0.0003	0.0003	0.0002
(std. error)	...	...	*0.0002*	*0.0004*	*0.0003*	*0.0004*
β_7	...	...	...	...	...	0.0007
(std. error)	...	...	...	...	...	*0.0012*
Adj. R^2	0.8571	0.8573	0.8615	0.8602	0.8619	0.8629

Note: *Sample time period*: 1970 (3rd qtr.)-2006 (4th qtr.), 144 obs. The following cases have been estimated based on the general model specification $y_t = \alpha(w_t) + \sum_{j=1}^{p} \beta_j y_{t-j} + \beta_3(w_t)(\bar{i}_{t-1} - \bar{\pi}_{t-1}) + \varepsilon_t$ (see equation (1)): (i) elasticity varying with *S*, *F*, and *K*, and joint effects of *S* and *F* as well as *S*, *F*, and *K*: $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t + \beta_4 F_t + \beta_5 K_t + \beta_6 S_t t F_t + \beta_7 S_t t F_t K_t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t + \beta_{3,3} F_t + \beta_{3,4} K_t + \beta_{3,5} S_t t F_t + \beta_{3,6} S_t t F_t K_t$; (ii) elasticity varying with *S*, *F*, and *K*, and joint effects of *S* and *F*: $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t + \beta_4 F_t + \beta_5 K_t + \beta_6 S_t t F_t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t + \beta_{3,3} F_t + \beta_{3,4} K_t + \beta_{3,5} S_t t F_t$; (iii) elasticity varying with *S* and *F*, and joint effects of *S* and *F*: $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t + \beta_4 F_t + \beta_6 S_t t F_t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t + \beta_{3,3} F_t + \beta_{3,5} S_t t F_t$; (iv) elasticity varying with *S* and *F*: $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t + \beta_4 F_t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t + \beta_{3,3} F_t$; (v) elasticity varying with *S*: $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t$; (vi) base case: $\alpha(w_t) = \alpha_1$ and $\beta_3(w_t) = \beta_{3,1}$. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The shaded areas highlight the coefficient values of the interest elasticity of the output gap. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 2. United States—Estimation Results: VAR(2,2) Simultaneous Equation Model with Instrumental Variable Controls for Securitization and Financial Depth (1970–2006)

$X_{1\text{-}5}$	Δy_t	Δr_t	Δr_t x ΔS_t	Δr_t x ΔF_t	Δr_t x ΔS_t x ΔF_t
C	0.0056	-0.0069	-0.0274*	-0.0015***	-0.0006***
(std. error)	*0.0740*	*0.0292*	*0.0172*	*0.0005*	*0.0002*
$\Phi_{1,1}$	0.1473*	0.0437	0.0174	0.0012**	0.0004
(std. error)	*0.0844*	*0.0333*	*0.0197*	*0.0010*	*0.0003*
$\Phi_{1,2}$	0.1819**	0.0927***	0.0513***	0.0004	0.0002
(std. error)	*0.0858*	*0.0338*	*0.0200*	*0.0010*	*0.0003*
$\Phi_{2,1}$	0.2612	0.8934***	0.1533**	-0.0003	0.0005
(std. error)	*0.2449*	*0.0966*	*0.0571*	*0.0017*	*0.0008*
$\Phi_{2,2}$	-0.7391***	-0.2755***	-0.0915*	0.0006	-0.0007
(std. error)	*0.2416*	*0.0953*	*0.0563*	*0.0016*	*0.0008*
$\Phi_{3,1}$	0.4810	0.0942	0.1561	0.0006	0.0042***
(std. error)	*0.4258*	*0.1679*	*0.0992*	*0.0029*	*0.0014*
$\Phi_{3,2}$	0.3272	4.0543	-3.2491	0.2184*	-0.0524
(std. error)	*0.4320*	*6.9468*	*4.1052*	*0.1196*	*0.0570*
$\Phi_{4,1}$	-10.2420	4.0543	-3.2491	0.2184	-0.0524
(std. error)	*17.6152*	*6.9468*	*4.1052*	*0.1196*	*0.0570*
$\Phi_{4,2}$	24.4643	-8.8211	2.6075	0.0869	0.0447
(std. error)	*17.2767*	*6.8133*	*4.0263*	*0.1173*	*0.0559*
$\Phi_{5,1}$	-14.1511	23.2849	28.8850***	-0.0670	0.3271***
(std. error)	*37.8327*	*14.9198*	*8.8168*	*0.2569*	*0.1225*
$\Phi_{5,2}$	-56.3022	-10.6537	-28.4559***	-0.1058	-0.2766**
(std. error)	*38.7940*	*15.2990*	*9.0409*	*0.2634*	*0.12558*
Adj. R^2	0.1194	0.5995	0.3798	0.0568	0.1553

Note: Sample time period: 1970 (3rd qtr.)–2006 (4th qtr.), 144 obs. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The shaded areas highlight the coefficient values of the first- and second order interest elasticity of the output gap (with and without controlling for degree of securitization activity and/or financial sector depth). *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed). Note that our specification of endogenous variables at first differences affects a positive interest rate elasticity of output gap. The progressive shading of the output gap equation indicates the critical values for each combination of the securitization and financing ratios.

Table 3. United States—OLS Estimation Results of the Mortgage Interest Rate Pass-through, with Instrumental Variable Controls for Securitization (1970–2006)

Model	(1)	(2)
α	0.4349**	0.2555
(std. error)	*0.1724*	*0.1817*
β_1	0.9899***	0.9644***
(std. error)	*0.0879*	*0.0924*
β_2	-0.1410*	-0.1077
(std. error)	*0.0845*	*0.0885*
$\gamma_{1,1}$	0.2291***	0.1324**
(std. error)	*0.0441*	*0.0563*
$\gamma_{1,2}$	-	0.0078***
(std. error)	*-*	*0.0028*
$\gamma_{2,1}$	-0.0935*	0.1503*
(std. error)	*0.0557*	*0.0865*
$\gamma_{2,2}$	-	-0.0186***
(std. error)	*-*	*0.0045*
$\gamma_{3,1}$	-0.0171	-0.1836***
(std. error)	*0.0471*	*0.0598*
$\gamma_{3,2}$	-	0.0114***
(std. error)	*-*	*0.0022*
φ_1	0.2670	0.3323*
(std. error)	*0.1688*	*0.1771*
φ_2	-0.4631	-0.5119
(std. error)	*0.3259*	*0.3286*
φ_3	0.2276	0.2349
(std. error)	*0.1724*	*0.1721*
Adj. R^2	0.9821	0.9841

Note: Sample time period: 1970 (3rd qtr.)–2006 (4th qtr.), 144 obs. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The shaded areas highlight the coefficient values of the first-order interest rate pass-through. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed). Model 1 does not include the interaction terms of the Federal Funds rate and the securitization ratio.

Table 4. United States—Summary Table of OLS Estimation Results for the Interest Rate Pass-Through (Different Time Periods)

Sample Period	Full Sample (see Tab. 3)	Before 1980Q4	1980Q4-1993Q4	1994Q1-2006Q4
Average securitization ratio $\overline{S}$ *(In percent)*	28.86	16.58	31.67	56.26
Sensitivity of mortgage rate *m* to Federal Funds rate $\overline{i_t}$				
without controlling for S_t				
$\gamma_{1,1}$	0.2291***	0.2451***	0.2038**	0.4556**
(std. error)	*0.0441*	*0.0460*	*0.0782*	*0.2088*
controlling for S_t				
$\gamma_{1,1}$	0.1324**	0.1381**	0.0680	10.511***
(std. error)	*0.0563*	*0.0568*	*0.1285*	*3.1080*
$\gamma_{1,2}$	0.0078***	0.0090**	0.0010*	0.1744***
(std. error)	*0.0028*	*0.0035*	*0.0059*	*0.0527*

Note: Sample time period: 1970 (3rd qtr.)–2006 (4th qtr.), 144 obs. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The shaded areas highlight the coefficient values of the first-order interest rate pass-through. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 5. South Africa—OLS Estimation Results: IS Dynamic Equation of Output Gap with Instrumental Variable Controls for Securitization (1965–2006)

		With Securitization Ratio S_t		With Securitization Dummy S'_t
Model	(1)	(2)	(3)	(4)
α_1	0.1791	-0.9139***	-0.8955***	0.0068
(std. error)	*0.0766*	*0.3809*	*0.3646*	*0.0802*
α_2		22.3918	0.0294	0.0294
(std. error)		*21.7404*	*0.0284*	*0.0455*
β_1	0.7682***	0.9610	0.9576***	0.7633***
(std. error)	*0.07826*	*0.2436*	*0.2425*	*0.0786*
β_2	0.0402	-0.1604***	-0.1601	0.0497
(std. error)	*0.0786*	*0.2995*	*0.2965*	*0.0793*
$\beta_{3,1}$	-0.0247	0.1771	0.1739	-0.0286*
(std. error)	*0.0160*	*0.1288*	*0.1238*	*0.0166*
$\boldsymbol{\beta_{3,2}}$		**-0.10967**	**-0.0007**	**0.1389**
(std. error)		***0.2195***	***0.0013***	***0.1463***
obs.	*166*	*17*	*17*	*166*
Adj. R^2	0.6329	0.9163	0.9171	0.6310

Note: Sample time period: 1965 (3rd qtr.)-2006 (4th qtr.) [166 obs.] and 2002 (4th qtr.)-2006 (4th qtr.) [17 obs.] depending on model specification. The following cases have been estimated based on the general model specification $y_t = \alpha(w_t) + \sum_{j=1}^{p} \beta_j y_{t-j} + \beta_3(w_t)(\bar{i}_{t-1} - \bar{\pi}_{t-1}) + \varepsilon_t$ (see equation (1)): two configurations of the IS equation (with the securitization ratio and the securitization dummy respectively): (i) elasticity varying with securitization ratio *S* (and time trend): $\alpha(w_t) = \alpha_1 + \alpha_2 S_t t$ and $\beta_3(w_t) = \beta_{3,1} + \beta_{3,2} S_t t$; (ii) elasticity varying with *S* only: $\alpha(w_t) = \alpha_1 + \begin{Bmatrix} \alpha_2 S_t \\ \alpha'_2 S'_t \end{Bmatrix}$ and $\beta_3(w_t) = \beta_{3,1} + \begin{Bmatrix} \beta_{3,2} S_t \\ \beta'_{3,2} S'_t \end{Bmatrix}$; as well as (iii) base case: $\alpha(w_t) = \alpha_1$ and $\beta_3(w_t) = \beta_{3,1}$. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The shaded areas highlight the coefficient values of the interest elasticity of the output gap. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 6. South Africa—Estimation Results: VECM(3,2) Simultaneous Equation Model of Balance Sheet Effects (Bank Lending) with Instrumental Variable Control for Securitization (1987–2006 and 2002–2006)

	Total Sample, No Securitization Control			Recent Time Period, No Securitization Control			Recent Time Period, With Securitization Dummy S'_t		
Model	(1)			(2)			(3)		
$X_{1\text{-}3}$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta loans_t/loans_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta loans_t/loans_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta loans_t/loans_t$
β (for eq. (17)) [CI_1]	1	-	-0.4154	1	-	-0.2278	1	-	-1.7654***
(std. error)			*0.3900*			*0.3409*			*0.4721*
β (for eq. (18))	-	1	-0.5599	-	1	-1.2875*	-	1	1.8518
(std. error)			*0.8068*			*0.7676*			*3.3356*
$\lambda_{1\text{-}3}$ (for eq. (17))	-0.1341***	0.0351	0.0049	-0.1382***	0.0454	-0.0101	-0.8455	-2.1354*	0.0212
(std. error)	*0.0355*	*0.0446*	*0.0101*	*0.0371*	*0.0479*	*0.0047*	*0.8479*	*1.2468*	*0.1603*
$\lambda_{1\text{-}3}$ (for eq. (18))	-0.0069	-0.0751***	-0.0117***	-0.0054***	-0.0770***	-0.0101**	0.0197	-0.3855**	0.0262
(std. error)	*0.0146*	*0.0183*	*0.0041*	*0.0157*	*0.0203*	*0.0047*	*0.1345*	*0.1977*	*0.0254*
C	-0.0285	0.0168	0.0587***	-0.0220	0.0211	0.0572***	-0.1888	1.1165	-0.0176
(std. error)	*0.0530*	*0.0664*	*0.0151*	*0.0526*	*0.0679*	*0.0157*	*0.6389*	*0.9395*	*0.1208*
$\Phi_{1,1}$	0.4587***	-0.1820	0.0095	0.4648***	-0.2205	0.0014	0.3648	0.5434	-0.0532
(std. error)	*0.1121*	*0.1405*	*0.0319*	*0.1097*	*0.1447*	*0.0328*	*0.6588*	*0.9686*	*0.1245*
$\Phi_{1,2}$	0.0427	-0.1782	-0.0039	0.0475	-0.1715	-0.0023	-0.1924	0.9638	-0.0018
(std. error)	*0.1126*	*0.1412*	*0.0321*	*0.1123*	*0.1447*	*0.0335*	*0.5962*	*0.8767*	*0.1127*
$\Phi_{2,1}$	0.0624	0.8049***	0.0200	0.0628	0.7858***	0.0189	-0.4514*	0.4151	0.0568
(std. error)	*0.0874*	*0.1096*	*0.0249*	*0.0859*	*0.1107*	*0.0257*	*0.2569*	*0.3777*	*0.0486*
$\Phi_{2,2}$	0.1528*	-0.0490	-0.0251	0.1384	0.0028	-0.0103	0.2761	-0.3207	-0.0659
(std. error)	*0.0924*	*0.1159*	*0.0263*	*0.0895*	*0.1154*	*0.0267*	*0.2540*	*0.3734*	*0.0480*
$\Phi_{3,1}$	0.6761	0.1251	-0.0250	0.7348*	0.4389	-0.0638	-2.4017	-2.3206	-0.2874
(std. error)	*0.4314*	*0.5409*	*0.1228*	*0.3983*	*0.5133*	*0.1190*	*1.8744*	*2.7561*	*0.3543*
$\Phi_{3,2}$	-0.3194	0.5159	-0.0967	-0.3086	0.1591	-0.1012	-2.9231	-0.2499	-0.1274
(std. error)	*0.4156*	*0.5211*	*0.1183*	*0.3979*	*0.5128*	*0.1188*	*2.2051*	*3.2424*	*0.4169*
Ξ_1	-	-	-	-	-	-	0.1680	-0.3342	0.0174
(std. error)	-	-	-	-	-	-	*0.2356*	*0.3464*	*0.0231*
obs.			*78*			*17*			*17*
Adj. R^2	0.4705	0.7043	0.0556	0.4724	0.6887	-0.0114	0.6094	0.8617	0.2641

Note: Sample time *period*: 1987 (3rd qtr.)-2006 (4th qtr.) [78 obs.] and 2002 (4th qtr.)-2006 (4th qtr.) [17 obs.] depending on model specification. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The dark shaded areas highlight the short-term error correction (λ) to establish convergence towards a long-term relation (β) of loan origination and the real interest rate respectively, while the light shaded areas show the short-term dynamics of changes in the real interest rate vis-à-vis changes in loan origination by banks. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 7. South Africa—Estimation Results: VECM(3, 2) Simultaneous Equation Model of Balance Sheet Effects (Bank Securities Investment) with Instrumental Variable Control for Securitization (1987–2006 and 2002–2006)

	Total Sample, No Securitization Control			Recent Time Period, No Securitization Control			Recent Time Period, with Securitization Dummy S_t'		
Model		(1)			(2)			(3)	
X_{1-3}	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta invest_t/invest_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta invest_t/invest_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta invest_t/invest_t$
β (for eq. (17))	1	-	-0.4157	1	-	3.4576***	1	-	1.5941***
(std. error)			*0.3898*			*1.1156*			*0.4092*
β (for eq. (18))	-	1	-0.6708	-	1	-10.1754***	-	1	-8.0567***
(std. error)			*0.9063*			*1.9478*			*1.2768*
λ_{1-3} (for eq. (17))	-0.1377***	0.0602	-0.0054	0.3873	-1.0006***	-0.2353	0.5451	-1.5298***	-0.4925
(std. error)	*0.0363*	*0.0438*	*0.0163*	*0.2773*	*0.2412*	*0.2260*	*0.4445*	*0.3192*	*0.3416*
λ_{1-3} (for eq. (18))	-0.0074	-0.0808***	-0.0002	0.1123	-0.5332***	-0.0414	0.0613	-0.3807***	0.0408
(std. error)	*0.0138*	*-0.0808*	*0.0048*	*0.1362*	*0.1185*	*0.1110*	*0.1271*	*0.0913*	*0.0977*
C	0.0040	0.0168	0.0019*	0.1815**	-0.0443	-0.0242	0.4321	-1.7197***	-0.9076
(std. error)	*0.0460*	*0.0555*	*0.0246*	*0.0741*	*0.0644*	*0.0603*	*0.7687*	*0.5521*	*0.5908*
$\Phi_{1,1}$	0.4691***	-0.0969	-0.0100	-0.5791	0.6188	0.5208	-0.6478	0.8476**	0.6208
(std. error)	*0.1101*	*0.1329*	*0.0048*	*0.5005*	*0.4354*	*0.4079*	*0.5855*	*0.4205*	*0.4500*
$\Phi_{1,2}$	0.0260	-0.2021	0.0329	-0.4177	0.7342*	-0.0181	-0.4307	0.5221	-0.1512
(std. error)	*0.1132*	*0.1366*	*0.0394*	*0.4825*	*0.4197*	*0.3932*	*0.5311*	*0.3814*	*0.4081*
$\Phi_{2,1}$	0.0799	0.7818***	-0.0058	-0.0097	0.1761	-0.1044	-0.0028	0.0183	-0.1880
(std. error)	*0.0883*	*0.1065*	*0.0307*	*0.2604*	*0.2265*	*0.2122*	*0.2945*	*0.2115*	*0.2263*
$\Phi_{2,2}$	0.1259	-0.0335	-0.0140	0.2397	0.0942	-0.0527	0.3389	0.0678	-0.0525
(std. error)	*0.0931*	*0.1124*	*0.0324*	*0.2093*	*0.1820*	*0.1705*	*0.2474*	*0.1777*	*0.1901*
$\Phi_{3,1}$	-0.3747	0.4925	0.1053	-0.6243	-0.9760**	0.3183	-0.8336	0.3866	1.0517*
(std. error)	*0.3464*	*0.4182*	*0.1207*	*0.5453*	*0.4743*	*0.4443*	*0.7580*	*0.5443*	*0.5825*
$\Phi_{3,2}$	-0.0975	0.7604*	-0.1084	-0.5919	-0.2416	0.3144	-0.7135	0.7764*	0.8571*
(std. error)	*0.3489*	*0.4212*	*0.1215*	*0.4325*	*0.4743*	*0.3524*	*0.6608*	*0.4746*	*0.5079*
Ξ_1	-	-	-	-	-	-	-0.700	0.4852***	0.2566
(std. error)	-	-	-	-	-	-	*0.2196*	*0.1577*	*0.1688*
obs.			*78*			*17*			*17*
Adj. R^2	0.4600	0.7204	-0.0555	0.5483	0.9441	0.2379	0.4785	0.9560	0.2174

Note: Sample time period: 1987 (3rd qtr.)-2006 (4th qtr.) [78 obs.] and 2002 (4th qtr.)-2006 (4th qtr.) [17 obs.] depending on model specification. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The dark shaded areas highlight the short-term error correction (λ) to establish convergence towards a long-term relation (β) of securities investment and the real interest rate respectively, while the light shaded areas show the short-term dynamics of changes in the real interest rate vis-à-vis changes in securities investment by banks. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 8. South Africa—Estimation Results: VECM(3, 2) Simultaneous Equation Model of Balance Sheet Effects (Bank Deposits) with Instrumental Variable Control for Securitization (1987–2006 and 2002–2006)

	Total Sample, No Securitization Control			Recent Time Period, No Securitization Control			Recent Time Period, with Securitization Dummy S'_t		
Model	(1)			(2)			(3)		
$X_{1\text{-}3}$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta deposits_t/deposits_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta deposits_t/deposits_t$	$\Delta y_t/y_t$	$\Delta r_t/r_t$	$\Delta deposits_t/deposits_t$
β (for eq. (17))	1	-	0.0209	1	-	-4.9767***	1	-	-5.0662***
(std. error)			*1.0310*			*0.5762*			*1.2993*
β (for eq. (18))	-	1	6.0466**	-	1	15.2983***	-	1	11.3588
(std. error)			*2.9999*			*4.2061*			*9.1529*
$\lambda_{1\text{-}3}$ (for eq. (17))	-0.1531***	0.0078	-0.0006	-0.9734*	-1.9865***	-0.0809	0.5346	0.8486	0.0714
(std. error)	*0.0359*	*0.0449*	*0.0022*	*0.5616*	*0.7701*	*0.0725*	*0.5580*	*0.8165*	*0.0734*
$\lambda_{1\text{-}3}$ (for eq. (18))	-0.0066	-0.0612***	-0.0001	-0.0022	-0.4066***	-0.0063	-1.1295	-2.2329*	-0.0705
(std. error)	*0.0099*	*0.0124*	*0.0006*	*0.0904*	*0.1240*	*0.0117*	*0.8006*	*1.1717*	*0.1053*
C	-0.1077**	-0.1087**	0.0111***	0.3670***	-0.1893	0.0437***	-0.0228	-0.4515***	-0.0030
(std. error)	*0.0580*	*0.0724*	*0.0036*	*0.1114*	*0.1527*	*0.0144*	*0.1180*	*0.1727*	*-0.0155*
$\Phi_{1,1}$	0.4729***	-0.1602	-0.0035	0.4007	0.6482	0.0419	0.5134	0.8465	0.0360
(std. error)	*0.1043*	*0.1302*	*0.0064*	*0.4111*	*0.5638*	*0.0530*	*0.5858*	*0.8573*	*0.0770*
$\Phi_{1,2}$	0.0246	-0.1500	0.0086	-0.0449	0.9770*	0.0673	0.0472	1.1328	0.0627
(std. error)	*0.1080*	*0.1348*	*0.0067*	*0.3748*	*0.5139*	*0.0484*	*0.5109*	*0.7476*	*0.0672*
$\Phi_{2,1}$	-0.0044	0.7151***	0.0004	-0.3964*	0.3242	0.0124	-0.4134*	0.3466	0.0192
(std. error)	*0.0911*	*0.1138*	*0.0056*	*0.2173*	*0.2979*	*0.0280*	*0.2336*	*0.3404*	*0.0310*
$\Phi_{2,2}$	0.1525*	-0.0624	-0.0010	0.1787	-0.2723	-0.0429**	0.1472	-0.3219	-0.0475*
(std. error)	*0.0897*	*0.1120*	*0.0055*	*0.1460*	*0.2001*	*0.0188*	*0.2088*	*0.3056*	*0.0275*
$\Phi_{3,1}$	1.6668	4.4046*	0.3248***	-7.3070***	-0.3837	-0.5507*	-7.7003***	-2.1550	-0.5848
(std. error)	*2.0452*	*2.5531*	*0.1262*	*2.5016*	*3.4303*	*0.3227*	*3.0001*	*4.3904*	*0.3945*
$\Phi_{3,2}$	4.9262**	5.9435**	0.0493	-6.2987**	2.919	-0.3530	-6.4996*	2.3303	-0.3089
(std. error)	*2.0582*	*2.5694*	*0.1271*	*2.8708*	*3.9366*	*0.3704*	*3.1394*	*4.5943*	*0.4128*
Ξ_1	...	...	...	...	...	...	-0.0520	-0.3097	-0.0084
(std. error)	...	...	...	...	...	...	*0.1722*	*0.2520*	*0.0227*
obs.			*78*			*17*			*17*
Adj. R^2	0.4978	0.7220	0.0390	0.7533	0.9241	0.0929	0.7214	0.9023	-0.0645

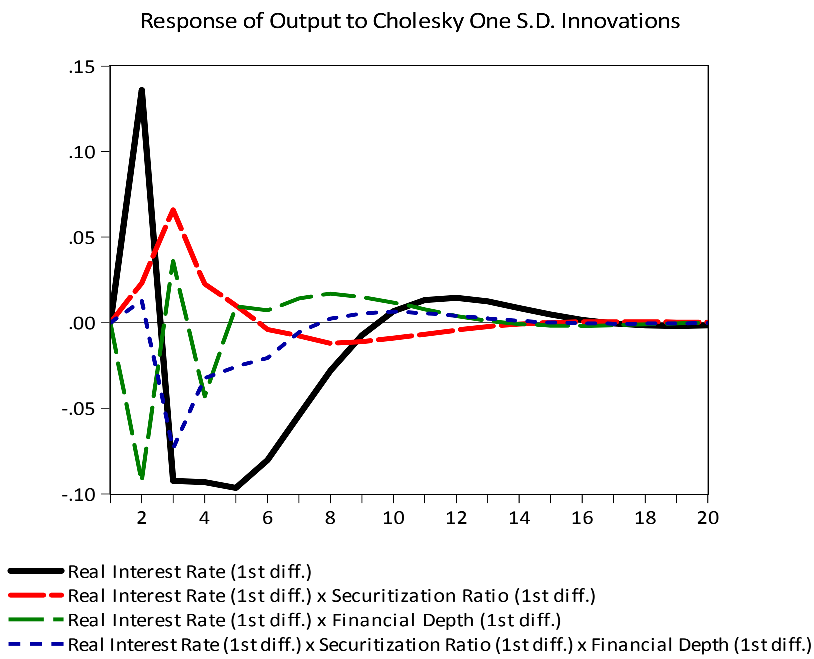
Note: Sample time period: 1987 (3rd qtr.)-2006 (4th qtr.) [78 obs.] and 2002 (4th qtr.)-2006 (4th qtr.) [17 obs.] depending on model specification. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The dark shaded areas highlight the short-term error correction (λ) to establish convergence towards a long-term relation (β) of deposit growth and the real interest rate, while the light shaded areas show the short-term dynamics of changes in the real interest rate vis-à-vis changes in bank deposit growth. *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Table 9. South Africa—Estimation Results (Summary Table): VECM(3,2) Simultaneous Equation Model of Balance Sheet Effects (Bank Lending, Bank Deposits, Bank Securities Investments) with Instrumental Variable Control for Securitization (1987–2006 and 2002–2006)

	VECM Equation with Δy_t, Δr_t, and **Δ*loans*$_t$** (with CI of r_t, and *loans*$_t$ according to eq. (20)) [see Table 6]			VECM Equation with Δy_t, Δr_t, and **Δ*deposits*$_t$** (with CI of r_t, and *deposits*$_t$ according to eq. (20)) [see Table 7]			VECM Equation with Δy_t, Δr_t, and **Δ*invest*$_t$** (with CI of r_t, and *invest*$_t$ according to eq. (20)) [see Table 8]		
	Total Sample, no Sec. Control	*Recent Time Period, no Sec. Control*	*Recent Time Period, with Sec. Dummy*	*Total Sample, no Sec. Control*	*Recent Time Period, no Sec. Control*	*Recent Time Period, with Sec. Dummy*	*Total Sample, no Sec. Control*	*Recent Time Period, no Sec. Control*	*Recent Time Period, with Sec. Dummy*
Model	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
β	-0.5599	-1.2875*	1.8518	6.0466**	15.2983***	11.3588	-0.6708	-10.1754***	-8.0567***
(std. error)	*0.8068*	*0.7676*	*3.3356*	*2.9999*	*4.2061*	*9.1529*	*0.9063*	*1.9478*	*1.2768*
λ_2 (real interest r_t)	-0.0751***	-0.0770***	-0.3855**	-0.0612***	-0.4066***	-2.2329*	-0.0808***	-0.5332***	-0.3807***
(std. error)	*0.0183*	*0.0203*	*0.1977*	*0.0124*	*0.1240*	*1.1717*	*-0.0808*	*0.1185*	*0.0913*
λ_3 (*B/S variable above*)	-0.0117***	-0.0101**	0.0262	-0.0001	-0.0063	-0.0705	-0.0002	-0.0414	0.0408
(std. error)	*0.0041*	*0.0047*	*0.0254*	*0.0006*	*0.0117*	*0.1053*	*0.0048*	*0.1110*	*0.0977*
$\Phi_{2,1}$ (Δr_t)	0.0200	0.0189	0.0568	0.0004	0.0124	0.0192	-0.0058	-0.1044	-0.1880
(std. error)	*0.0249*	*0.0257*	*0.0486*	*0.0056*	*0.0280*	*0.0310*	*0.0307*	*0.2122*	*0.2263*
$\Phi_{2,2}$ (Δr_t)	-0.0251	-0.0103	-0.0659	-0.0010	-0.0429**	-0.0475*	-0.0140	-0.0527	-0.0525
(std. error)	*0.0263*	*0.0267*	*0.0480*	*0.0055*	*0.0188*	*0.0275*	*0.0324*	*0.1705*	*0.1901*

Note: Sample time period: 1987 (3rd qtr.)-2006 (4th qtr.) [78 obs.] and 2002 (4th qtr.)-2006 (4th qtr.) [17 obs.] depending on model specification. Estimations are based on heteroskedasticity consistent coefficient covariance (White, 1980). The table summarizes the results in Tables 6-8, with long-term relation (β) of the real interest rate and the chosen balance sheet variable (loans, deposits or investment), the short-term error correction between the real interest rate (λ_2) and the chosen balance sheet variable (loans, deposits or investment) (λ_3), as well as the marginal effect of changes in the real interest rate ($\Phi_{2,1}$ and $\Phi_{2,2}$) at one and two changes of the chosen balance sheet variable (loans, deposits or investment). *, **, and *** indicate the 10 percent, 5 percent, 1 percent level of statistical significance (two-tailed).

Figure 4. United States—Impulse-Response Graphs of Interest Rate Elasticity: VAR(5,2) Simultaneous Equation Model with Instrumental Variable Controls for Securitization and Financial Depth (1970–2006)



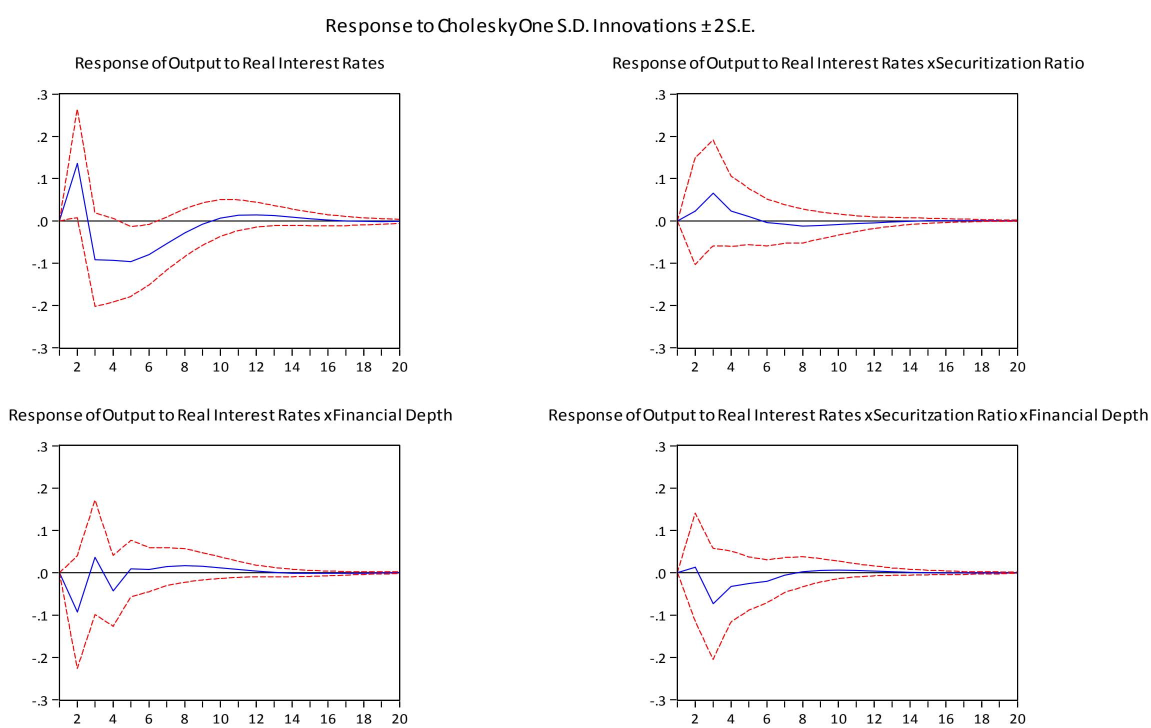
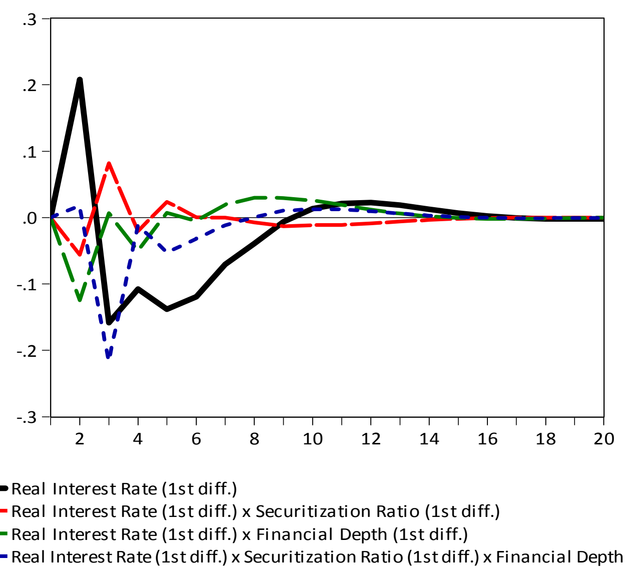


Figure 5. United States—Impulse-Response Graphs of Interest Rate Elasticity: VAR(5,2) Simultaneous Equation Model with Instrumental Variable Controls for Securitization and Financial Depth (1970–1990)

Response of Output to Cholesky One S.D. Innovations



Response to Cholesky One S.D. Innovations ± 2 S.E.

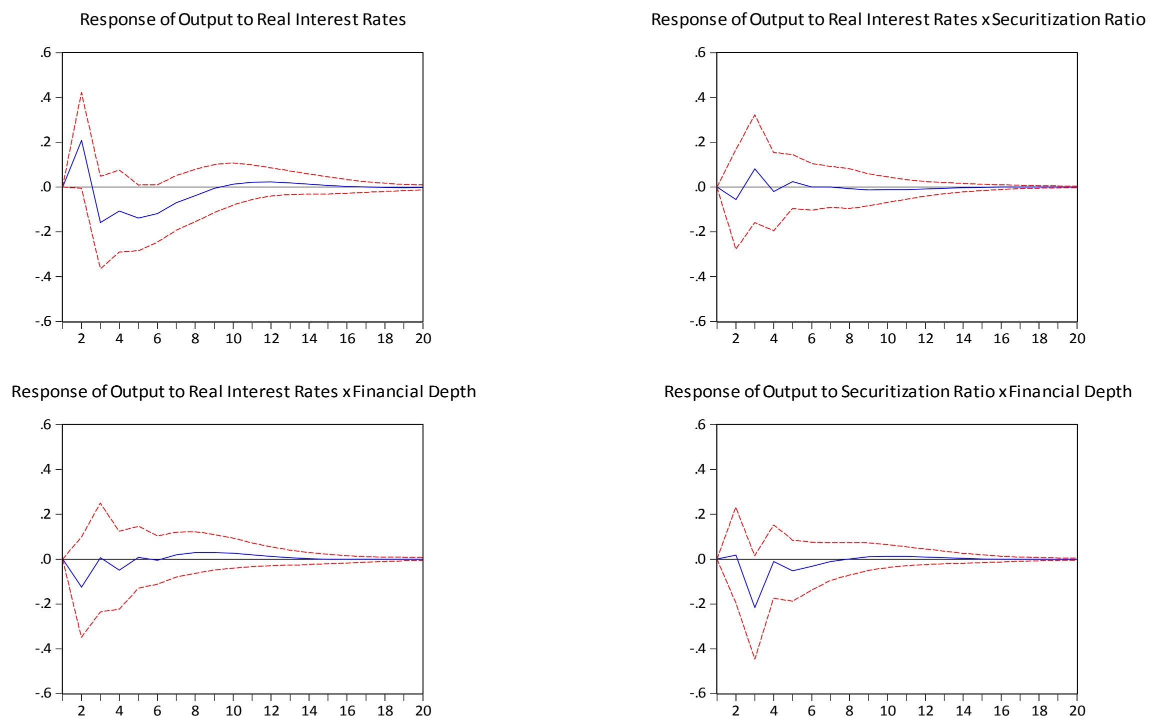
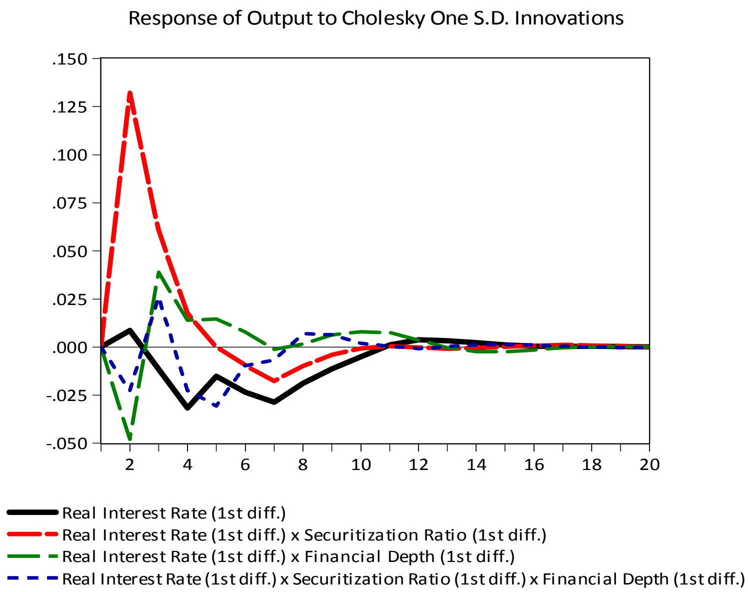


Figure 6. United States—Impulse-Response Graphs of Interest Rate Elasticity: VAR(5,2) Simultaneous Equation Model with Instrumental Variable Controls for Securitization and Financial Depth (1991–2006)



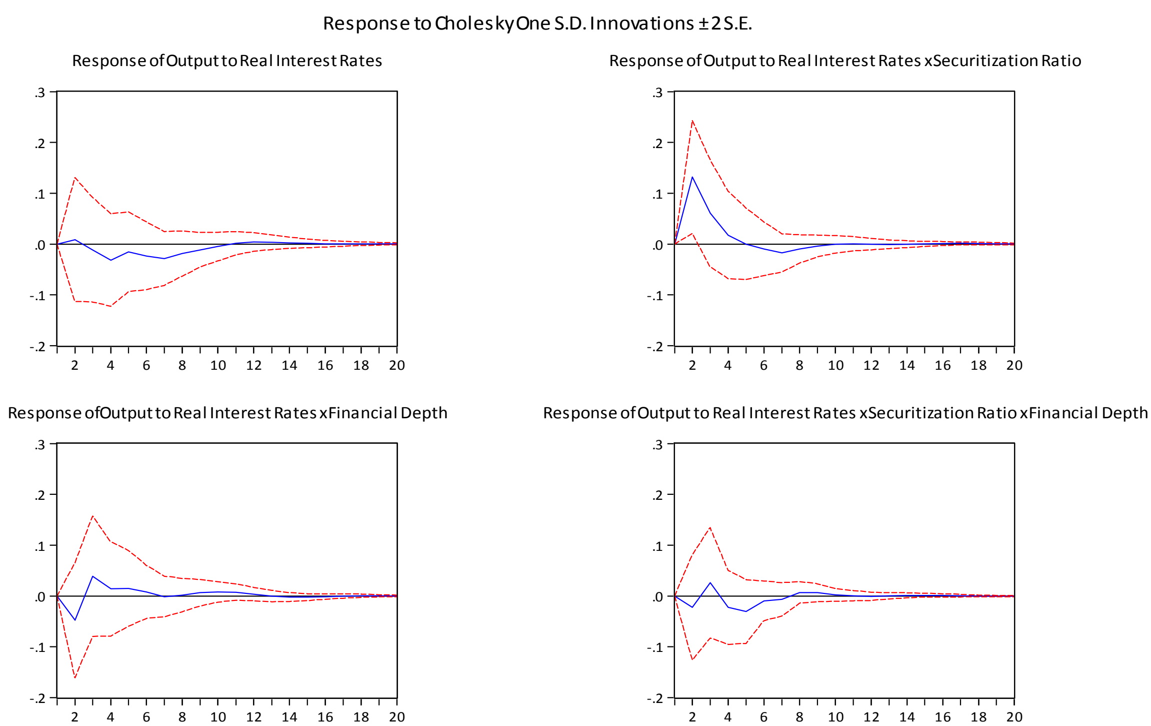
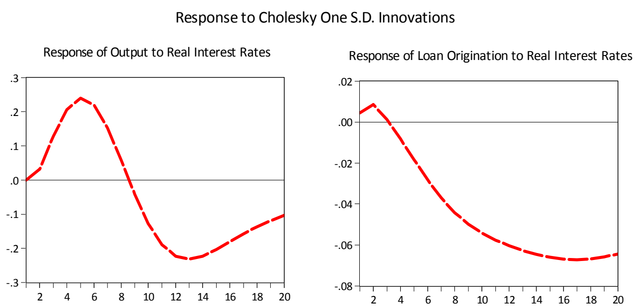


Figure 7. South Africa—Impulse-Response Graphs of Interest Rate Elasticity: VECM(3,2) Simultaneous Equation Model of Balance Sheet Effects (with Bank Lending as Bank Balance Sheet Variable) with and without Control for Securitization (1987–2006 and 2002–2006)

Total Sample (1987Q3–2006Q4)



Sample with Securitization (2002Q4–2006Q4)

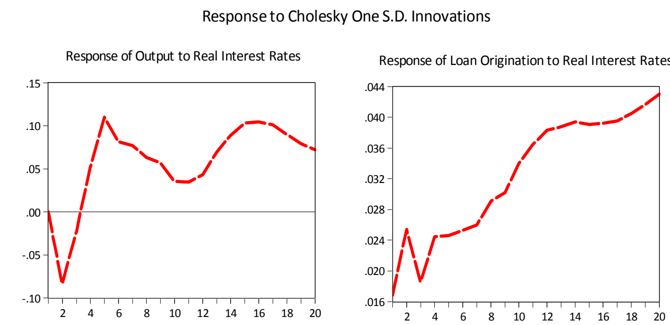
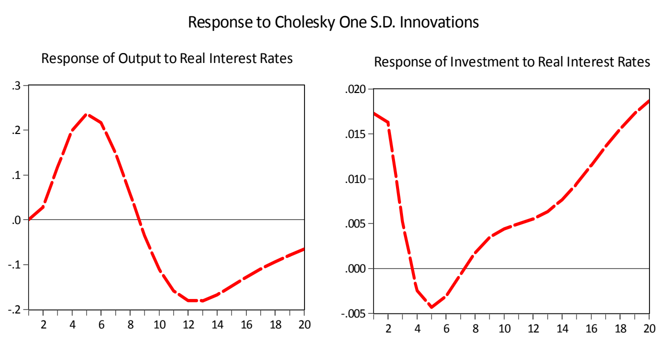


Figure 8. South Africa—Impulse-Response Graphs of Interest Rate Elasticity: VECM(3,2) Simultaneous Equation Model of Balance Sheet Effects (with Bank Securities Investment as Bank Balance Sheet Variable) with and without Control for Securitization (1987–2006 and 2002–2006)

Total Sample (1987Q3–2006Q4)



Sample with Securitization (2002Q4–2006Q4)

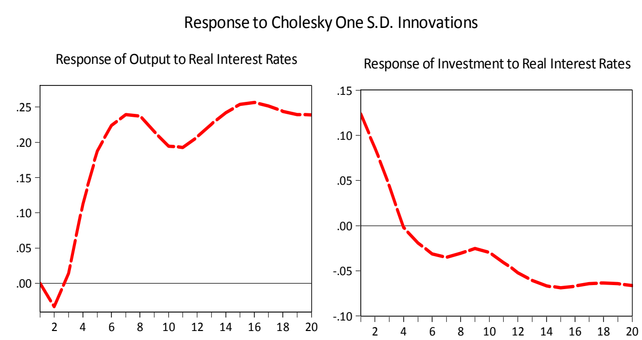
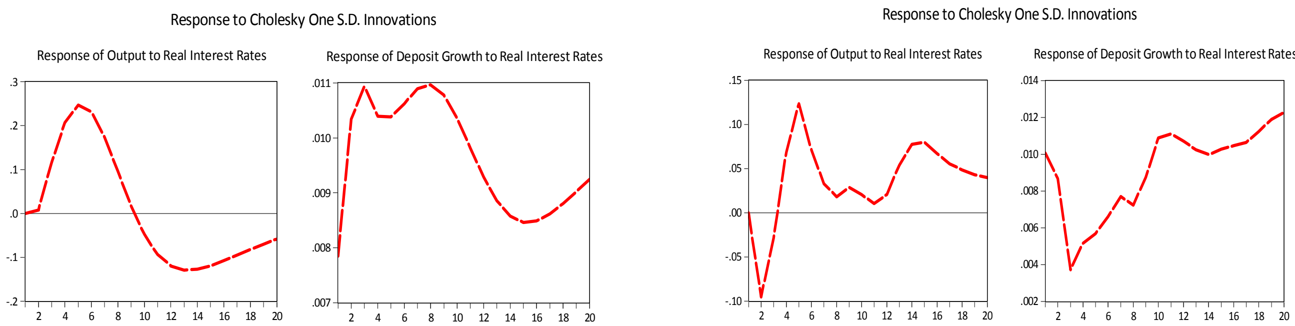


Figure 9. South Africa—Impulse-Response Graphs of Interest Rate Elasticity: VECM(3,2) Simultaneous Equation Model of Balance Sheet Effects (with Bank Deposits as Bank Balance Sheet Variable) with and without Control for Securitization (1987–2006 and 2002–2006)

Total Sample (1987Q3–2006Q4) | Sample with Securitization (2002Q4–2006Q4)



Specification of VECM(3,2) for testing the balance sheet effect in South Africa

In order to measure the degree of interest rate elasticity in the presence of securitization activity for the South African case, we consider the three-dimensional VECM(3,2) specifications

$$\{X_{k,t}\}_{k=1-3} = C + \Lambda\left(y_t - \alpha - \beta_k \begin{Bmatrix} \Delta deposit_t \\ \Delta invest_t \\ \Delta loans_t \end{Bmatrix}_{k=1-3} \right) + \sum_{j=1}^{p} \Phi_t X_{t-j} + \Xi_t Z_t + \{\mathrm{E}_{k,t}\}_{k=1-3} \quad (15)$$

and

$$\{X_{k,t}\}_{k=1-3} = C + \Lambda\left((\bar{i}_t - \bar{\pi}_t) - \alpha - \beta_k \begin{Bmatrix} \Delta deposit_t \\ \Delta invest_t \\ \Delta loans_t \end{Bmatrix}_{k=1-3} \right) + \sum_{j=1}^{p} \Phi_t X_{t-j} + \Xi_t Z_t + \{\mathrm{E}_{k,t}\}_{k=1-3} \quad (16)$$

of vectors $X_{1,t} = (\Delta y_t, \Delta r_t, \Delta deposit_t)'$, $X_{2,t} = (\Delta y_t, \Delta r_t, \Delta invest_t)'$ or $X_{3,t} = (\Delta y_t, \Delta r_t, \Delta loans_t)'$ of difference stationary series and a choice of two cointegrating vectors comprised of the corresponding balance sheet variable (deposits, bank investments, or loans) and either output gap or real interest rates at rank order one. These possible linear combinations of the three level series of vector $X_{k,t}$

$$[\mathrm{CI}_1]\text{: } y_t = \alpha + \beta_k \begin{Bmatrix} \Delta deposit_t \\ \Delta invest_t \\ \Delta loans_t \end{Bmatrix}_{k=1-3} \quad (17)$$

and

$$[\mathrm{CI}_2]: \left(\bar{i}_t - \bar{\pi}_t\right) = \alpha + \beta_k \begin{Bmatrix} \Delta deposit_t \\ \Delta invest_t \\ \Delta loans_t \end{Bmatrix}_{k=1-3} \qquad (18)$$

constitute the "error correction terms" (or "cointegrating equations" CI_1 and CI_2), which indicate possible long-term consistency (with complete cointegration at $\alpha = 0$, $\beta = 1$). These cointegration terms account for (contemporaneous) price adjustment of I(1) cointegrated levels of $X_{k,t}$, where α and β are endogenously determined.

The endogenous variables are defined as the quarterly output gap $\Delta y_t = y_t - y_{t-1}$, the real interest rate $\Delta r_t = \left(\bar{i}_t - \bar{\pi}_t\right) - \left(\bar{i}_{t-1} - \bar{\pi}_{t-1}\right)$, and either one of the following three bank balance sheet variables (at first differences): (i) the change in outstanding bank deposits (deposit growth) $\Delta deposit_t = \ln\left(deposit_t / CPI_t\right) - \ln\left(deposit_{t-1} / CPI_{t-1}\right)$, (ii) the change in outstanding bank investments $\Delta invest_t = \ln\left(invest_t / CPI_t\right) - \ln\left(invest_{t-1} / CPI_{t-1}\right)$, or (iii) the change in outstanding mortgage and non-mortgage bank loans $\Delta loans_t = \ln\left(loans_t / CPI_t\right) - \ln\left(loans_{t-1} / CPI_{t-1}\right)$. $\bar{i}_{t-j}$ is the four-quarter average of current and lagged nominal money market rate, $\bar{\pi}_{t-j}$ is the annualized average inflation rate (based on quarterly reported CPI_t) over the same four quarters. The parameter coefficients of the short-term dynamics are estimated as (3x2) matrix vectors Φ_t of jointly dependent past $X_{k,t}$ values (and compounded by lag structure *p*=2 number of lags) over the entire sample time period. C is a (3x1) vector of constants c_1, c_2, and c_3, Ξ_t is the (3x1) parameter coefficient matrix of contemporaneous control vector Z_t for securitization ratio S_t (i.e., the ratio of securitized home mortgages to the value of all outstanding home mortgages), and $E_{k,t}$ is the (3x1) vector $\left(\varepsilon_t^{(\Delta y_t)}, \varepsilon_t^{(\Delta r_t)}, \varepsilon_t^{(deposit_t)}\right)'$, $\left(\varepsilon_t^{(\Delta y_t)}, \varepsilon_t^{(\Delta r_t)}, \varepsilon_t^{(invest_t)}\right)'$, or $\left(\varepsilon_t^{(\Delta y_t)}, \varepsilon_t^{(\Delta r_t)}, \varepsilon_t^{(loans_t)}\right)'$ of non-autoregressive i.i.d. residuals $\varepsilon_t \sim N(0, \Sigma)$ with variance-covariance matrix Σ (depending on the selection of the bank balance sheet variable). Λ is a (3x1) vector of adjustment coefficients λ_{1-3} of intertemporal error correction to establish covergence to the conintegration relations above. This vector consists of λ_1 ("Output (Gap) λ"), λ_2 ("Real Interest Rate λ") and λ_3 ("Deposit/Investment/Loan Origination λ") according to the rank ordering in equation (17) and λ_1 ("Deposit/Investment/Loan Origination λ"), λ_2 ("Real Interest Rate λ") and λ_3 ("Output (Gap) λ") analogous to the ordering of endogenous variables in equation (18). These adjustment coefficients indicate the degree of short term adjustment so as to correct discrepancies against a long-term trend of difference (covariance) stationarity.