The Myth of Financial Innovation  
and the Great Moderation

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Abstract

Financial innovation is widely believed to be at least partly responsible for the recent financial crisis. At the same time, there are empirical and theoretical arguments that support the view that changes in financial markets played a role in the "great moderation". If both are true, then the price for reducing the likelihood of another crisis, e.g., through new regulation, could be giving up another episode of sustained growth and low volatility. However, this paper questions empirical evidence supporting the view that innovation in consumer credit and home mortgages reduced cyclical variations of key economic variables. We find that especially the behavior of aggregate home mortgages changed less during the great moderation than is typically believed. For example, aggregate home mortgages declined during monetary tightenings, both before and during the great moderation. A remarkable change we do find is that monetary tightenings became episodes during which financial institutions other than banks increased their holdings in mortgages. One can question the desirability of such strong substitutions of ownerships during economic downturns.

Key Words: Consumer credit, Mortgages, Impulse Response Functions

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1 Introduction

The recent financial crisis has triggered a heated debate on necessary reforms of financial markets and in particular on how to improve regulation. Virtually everybody agrees that some changes are needed, but there is strong disagreement on how far these changes need to go. Proponents of modest reforms argue that—although new regulation should take care of the excesses of the current system—it is important not to alter the system too much in order to safeguard the benefits that financial innovation is believed to have brought.\footnote{Trichet (2009) says about these benefits the following: *To be clear, I do not deny that financial liberalisation and financial innovation over the past two decades have made important contributions to the overall productivity of our economies. For example, the securitisation of assets—the transformation of bilateral loans into tradable credit instruments—had tremendous potential for the diversification and efficient management of economic risk.*} After all, before the current crisis we experienced a sustained period of growth with only very moderate fluctuations, i.e., the period of the great moderation.

In fact, there are both empirical and theoretical arguments that support the view that the changes that reshaped financial markets during the last couple of decades were partly responsible for the great moderation. The basic idea behind the theory is that financial innovation reduced frictions in lending and that this made it possible for financial intermediaries to fulfill their role efficiently during an economic downturn. One important piece of evidence presented in the literature—and confirmed in this paper—is the empirical finding that the comovement between real activity and both mortgages and consumer credit has dropped enormously. This is exactly what business cycle theories about financial innovation would predict.

Although it is now clear that the "innovated" financial sector could not prevent the economy from the current severe downturn and is—at least to some extent—responsible, it may still be the case that financial innovation is also behind the great moderation. Financial innovation can be responsible for both the great moderation and the financial crisis if, for example, the excesses in lending practices only started later in the sample or if financial innovation \emph{did} dampen the impact of the type of shocks observed during

\footnote{Trichet (2009) says about these benefits the following: *To be clear, I do not deny that financial liberalisation and financial innovation over the past two decades have made important contributions to the overall productivity of our economies. For example, the securitisation of assets—the transformation of bilateral loans into tradable credit instruments—had tremendous potential for the diversification and efficient management of economic risk.*}
the great moderation, but magnified the type of shocks that were observed recently, like reductions in house prices that were unique in terms of how correlated they were across U.S. regions and even across borders.

In the literature, there is a lot of support for the view that financial innovation played a role in the great moderation.² If it is really true that financial innovation is at least partly responsible for the great moderation, then this is an important piece of information for the debate on how to restructure financial markets.

The objectives of this paper are (i) to carefully document the changes in the time series properties of key financial and macro variables, (ii) to discuss whether these are or are not consistent with financial innovation, and (iii) to discuss whether these changes are consistent with alternative explanations. Whereas the literature often focuses on a very limited set of statistics to evaluate theories that try to explain the great moderation, we will present a very detailed set of results. Presenting a rich set of empirical findings may at times overwhelm the reader. But with a comprehensive analysis one obtains a good idea about what is and what is not likely to have been causing the changes. In this paper, we show that the evidence that financial innovation is behind the great moderation is extremely weak. Especially the changes in the behavior of home mortgages are difficult to reconcile with theories in which financial innovation dampens business cycles. Moreover, by looking more carefully at what caused the drop in the comovement between real activity and consumer credit and mortgages, we discover that these changes are not likely to be the result of financial innovation.

At the core of our empirical analysis are Vector AutoRegressive time series models (VARs), estimated over an early sample, characterizing the period before the great moderation, and a later sample, characterizing the great moderation. With the VARs we can generate Impulse Response Functions (IRFs), i.e., dynamic time paths to different types

of shocks. The IRFs provide much more information than the unconditional correlation statistics typically used to characterize the comovement between loans and real activity; not only do they condition on the shock, they also provide information about the dynamic aspects of the comovement. The empirical analysis makes it possible (i) to answer the question which IRFs have changed and which have not and (ii) to answer the question whether the reduction in the comovement is simply due to some shocks becoming less important.

The detailed information provided by the VAR makes it easier to answer the question whether the changes in the IRFs that did occur are likely to be due to financial innovation or not. One finding that is particularly difficult to reconcile with the view that financial innovation is behind the great moderation is that following a monetary tightening the reductions in both home mortgages and consumer credit are not smaller during the great moderation if one corrects for the fact that the magnitudes of the responses in the federal funds and GDP also became smaller. This contradicts standard theories on the effects of financial innovation on business cycles, because these theories predict that financial innovation reduces the downward pressure on consumer borrowing during economic downturns.

Our finding that financial innovation is not likely to have been important in driving the great moderation has two important implications. First, in terms of thinking about new regulation to avoid future crises, there is less reason to think that new regulation will undo any favorable effects that financial innovation has had on volatility during normal times, because those favorable effects were never there.³ Second, if new financial regulation cannot undo positive effects that financial innovation has had on volatility, then this takes away one reason why there should not be another period with low volatility. That is, if the great moderation was never caused by financial innovation, then why should the great moderation not continue when the current crisis has ended? All that is needed is that the actual reasons for the great moderation—possibly improved monetary policy, more

³Note that here we are only referring to any favorable effects that financial innovation may have had on business cycle properties.
flexible labor markets, and/or improved inventory control—remain operative.

We also look at what type of financial institution holds consumer loans and whether there have been changes in the cyclical behavior of who finances what when. A striking finding is that following a monetary tightening bank mortgages decline in both the earlier and the later subsample, but that mortgages held by other institutions actually increased in the later subsample. Such shifts in ownership between financial institutions may be very attractive for the financial sector, but one wonders whether it is beneficial for the whole economy that those institutions that know the least about the quality of the borrowers choose to hold more mortgages during an economic downturn, especially if—as we find to be the case—it does not affect the total amount of mortgages consumers obtain. Perhaps this should have been a warning sign.

In Section 2, we discuss the predictions of standard business cycle theories of financial innovation and in Section 3 we discuss the data used and the empirical methodology. Section 4 discusses some trends in the variables considered. The next three sections discuss changes in business cycle properties and whether these changes can be explained by financial innovation. Section 5 discusses the results for durable expenditures, residential investment, and GDP, Section 6 discusses the results for consumer credit, and Section 7 discusses the results for mortgages. The last section concludes.

2 What is and what is not consistent with financial innovation?

In this section, we discuss what kind of empirical patterns are—according to standard theories—consistent with the effects of financial innovation on business cycle properties, what kind of observations are strongly suggestive of financial innovation, and what kind of changes are not very likely the result of financial innovation.

It is beyond dispute, that financial markets have changed considerably during the last several decades. It is also clear, that for a sustained period business cycles were moderate and several key correlations were different than before. As discussed in the introduction,
many authors have argued that financial innovation is at least partly responsible for the "great moderation". The financial crisis does not necessarily refute this hypothesis; it is very well possible that changes in financial markets played a role in dampening business cycles during normal times and that the same or other changes in financial markets also put the economy at risk of facing a large downturn.

An important argument in favor of the hypothesis that financial innovation played a role in the great moderation is that there has been a strong reduction in the correlation between the cyclical component of GDP and both consumer credit and mortgages. As pointed out by, for example, Campbell and Hercowitz (2006)—a reduction in the volatility of real activity and these correlation coefficients are consistent with some theories about financial innovation. That said, it may still be the case that financial innovation did not play a role in the great moderation and that the reduction in the volatility of real activity as well as the changes in correlation coefficients are driven by other factors.

One of the objectives of this paper is to discuss whether it is plausible that financial innovation is at least partly responsible for the observed changes in the business cycle behavior of the main macro variables during the great moderation. This may seem like a daunting task, because there is no universal theory on the effects of financial innovation on business cycle properties. Nevertheless, we think that there are some types of changes in business cycle behavior that can easily be explained by financial innovation, whereas for other types of changes alternative explanations are more plausible, such as, a monetary policy with a stronger emphasis on low inflation, a shift towards services, increased product market competition, and/or better inventory control.

A set of observations that can easily be explained by financial innovation is the following: (i) reductions in loans have negative effects on output, (ii) before financial innovation, consumer credit and home mortgages drop during an economic downturn, (iii) after financial innovation, loans decrease by less or even increase, and (iv) the reduction in output is larger before than after financial innovation has taken place. The idea would be that financial innovation makes it possible to dampen the reduction in lending during an economic downturn, which in turn dampens the reduction in real activity.
It is hard to imagine that a set of empirical observations could prove that financial innovation is behind the great moderation, because other theories may have the same set of implications. It is easier to imagine that a set of empirical observations is not consistent with particular, or possibly even a broad range of, theories about financial innovation. For example, suppose that one would observe that the response of loans following a monetary tightening becomes more negative over time and the response of output less negative. Such an observation is inconsistent with standard models in which financial innovations play a role in explaining the great moderation. In standard models, there is a financial friction which limits borrowing and typically this friction worsens during economic downturns. Financial innovation would alleviate this friction making it easier to keep on borrowing during an economic downturn. The creative reader may prove us wrong, but we suspect that in a large class of models the consequence of financial innovation is not the combination of a more negative loan response and a less negative output response. Nevertheless, there is evidence that this is what happened.

3 Data & Methodology

3.1 Data

U.S. data for home mortgages and consumer credit are from the Flow of Funds data set and cover the sample from 1954Q3 to 2008Q1. For the household sector, home mortgages and consumer credit are the two largest liabilities. For example, in 2005, home mortgages were 72% of total liabilities and consumer credit was 18%. Home mortgages not only include first and second mortgages, but also loans taken out under home equity lines of credit. Consumer credit consists of revolving credit (credit cards) and nonrevolving credit (e.g., automobile loans).

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4For some data series from the Flow of Funds, there is no seasonally adjusted version available. To take out any possible seasonality in these series, we include quarterly dummies when we use them in a VAR and we first filter them with X12-ARIMA when we calculate business cycle statistics.

5Of the $2.3 trillion in consumer credit outstanding at the end of 2005, $830 billion was in the form of revolving credit and $1.5 trillion in the form of nonrevolving loans.
The fraction of loans owned by banks has become smaller over time. These days, loans that are initiated by banks often end up on the balance sheet of other (financial) institutions.\footnote{Throughout this paper, banks consist of U.S.-chartered commercial banks, savings institutions, and credit unions.} Important for the increased incidence of ownership transition (both between different types of financial institutions and between banks) has been the emergence of "special-purpose vehicles".\footnote{At the end of 2005, $609 billion of the $2.3 trillion in consumer credit was held in pools of securitized assets.} The securities issued to finance the purchase of these pools may be held by banks or other institutions.

Part of this project is to investigate whether the cyclical properties of the loans owned by different entities differ and whether this has played a role in the changing time series behavior of the aggregate loan series. For total mortgages, i.e., home plus non-home mortgages,\footnote{Home mortgages are mortgages on 1-4 family properties, including mortgages on farm houses (but not on farms). Non-home mortgages consist of mortgages on multi-family homes, commercial mortgages, and farm mortgages.} we can determine the amount of mortgages held by banks, both directly (which we refer to as regular bank mortgages) and indirectly held through the ownership of asset-backed securities. For home mortgages, we can observe regular bank home mortgages, but not the amount of home mortgages indirectly held by banks. We are mainly interested in consumer loans and, thus, home mortgages, but throughout this paper we will also report results on total mortgages, because it allows us to be more precise on the amount held by banks. Note that home mortgages are by far the largest component of total mortgages.\footnote{Namely, 76\% in 2008Q1. Although there are some differences between the behavior of aggregate home and aggregate total mortgages, their behavior is quite similar. This is discussed in more detail in Section 7.1.}

### 3.2 Identifying monetary shocks

The standard procedure to study the impact of monetary policy on economic variables is to estimate a structural VAR using a limited set of variables. Consider the following
VAR.\textsuperscript{10}

\[ Z_t = B_1 Z_{t-1} + \cdots + B_q Z_{t-q} + u_t, \]  

(1)

where \( Z_t' = [X_{1t}', r_t, X_{2t}'] \), \( X_{1t} \) is a \((k_1 \times 1)\) vector with elements whose contemporaneous values are in the information set of the central bank, \( r_t \) is the federal funds rate, \( X_{2t} \) is a \((k_2 \times 1)\) vector with elements whose contemporaneous values are not in the information set of the central bank, and \( u_t \) is a \((k \times 1)\) vector of residual terms with \( k = k_1 + 1 + k_2 \). All lagged values are assumed to be in the information set of the central bank. In order to proceed, one has to assume that there is a relationship between the reduced-form error terms, \( u_t \), and the fundamental or structural shocks to the economy, \( \varepsilon_t \). This relationship is assumed to be given by:

\[ u_t = \overline{A} \varepsilon_t, \]  

(2)

where \( \overline{A} \) is a \((k \times k)\) matrix of coefficients and \( \varepsilon_t \) is a \((k \times 1)\) vector of fundamental uncorrelated shocks, each with a unit standard deviation. Thus,

\[ E[u_t u_t'] = \overline{A} \overline{A}'. \]  

(3)

When \( E[u_t u_t'] \) is replaced by its sample analogue, one obtains \( k(k + 1)/2 \) conditions on the coefficients in \( \overline{A} \). Since \( \overline{A} \) has \( k^2 \) elements, \( k(k - 1)/2 \) additional restrictions are needed to estimate all elements of \( \overline{A} \). Christiano, Eichenbaum, and Evans (1999) show that to determine the effects of a monetary policy shock it is sufficient to assume that \( \overline{A} \) has the following block-triangular structure:

\[ \overline{A} = \begin{bmatrix} \overline{A}_{11} & 0_{k_1 \times 1} & 0_{k_1 \times k_2} \\ \overline{A}_{21} & \overline{A}_{22} & 0_{1 \times k_2} \\ \overline{A}_{31} & \overline{A}_{32} & \overline{A}_{33} \end{bmatrix} \]  

(4)

\textsuperscript{10}To simplify the notation, we do not display the constant, the linear trend term, and the quarterly dummies that are also included. The estimated trend is allowed to differ across samples. As a robustness check, we used data that are detrended using one trend specification for the complete sample. This leads to very similar results. The results are also robust to including no trend and robust to including a quadratic trend.
where $A_{11}$ is a $(k_1 \times k_1)$ matrix, $A_{21}$ is a $(1 \times k_1)$ matrix, $A_{31}$ is a $(k_2 \times k_1)$ matrix, $A_{22}$ is a $(1 \times 1)$ matrix, $A_{32}$ is a $(k_2 \times 1)$ matrix, $A_{33}$ is a $(k_2 \times k_2)$ matrix, and $0_{i \times j}$ is a $(i \times j)$ matrix with zero elements. Note that this structure is consistent with the assumption made above about the information set of the central bank.

We follow Bernanke and Blinder (1992) and many others by assuming that the federal funds rate is the relevant monetary instrument. Our benchmark specification is based on the assumption that $X_{2t}$ is empty and that all other elements are, thus, in $X_{1t}$. Intuitively, $X_{2t}$ being empty means that the Board of Governors of the Federal Reserve (FED) can respond to contemporaneous innovations in any of the variables of the system, which seems plausible given that we use quarterly data.\(^{11}\)

Besides the federal funds rate, the VAR includes real GDP, the GDP deflator, real durable expenditures, real residential investment, consumer credit deflated with the GDP deflator, and mortgages deflated with the GDP deflator.

### 3.3 Real activity shock

There are seven variables in our VAR and one could in principle identify six more shocks in addition to the monetary policy shock. We use the Cholesky decomposition and ordered the remaining variables so that those variables that are likely to have the slowest response are ordered first.\(^{12}\) Although this is not an implausible assumption, it would be fair to question whether the identified shocks are truly structural. For our purpose, it is not strictly necessary that the shocks are structural. For example, we show that several aspects of the driving process, as represented by the IRFs of the VAR, have remained quite stable over time even though there also have been large changes in volatility and correlations. This is an interesting finding, independent of whether the shocks have a structural interpretation or not.

The three real activity variables are GDP, durable expenditures, and residential in-

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\(^{11}\)For the quarterly federal funds rate, we use the average of daily rates during the last month of the quarter.

\(^{12}\)The ordering of the variables is as follows: price level, residential investment, durable expenditures, GDP, home mortgages, consumer credit, and federal funds rate.
vestment. The IRFs of the three corresponding shocks turn out to be quite similar. For example, all three lead to a reduction in GDP and lead to—as predicted by the Taylor rule—a reduction in the federal funds rate. To streamline the discussion, we focus on the IRF that corresponds to the total responses when the innovation of each of the three variables is equal to one standard deviation. Appendix D discusses the IRFs for the individual shocks and documents that the main conclusions of this paper do not depend on looking at a joint shock.

3.4 Comovement decomposition

We also use the comovement statistics of Den Haan (2000) to characterize the correlation of different variables. Advantages of this procedure are that it captures the dynamic aspects of the comovement and that it determines the importance of the different shocks for the magnitude of the correlation coefficient.

Den Haan (2000) shows that the covariance between the $K$th-period ahead forecast errors of $x_t$ and $y_t$, $COV(x_t, y_t; K)$, is equal to

$$ COV(x_t, y_t; K) = \sum_{m=1}^{M} COV(x_t, y_t; K, m) \text{ with } COV(x_t, y_t; K, m) = \sum_{k=1}^{K} x_{imp}^{m,k} y_{imp}^{m,k}, $$

where $x_{imp}^{m,k}$ and $y_{imp}^{m,k}$ are the $k$th-period responses of variables $x$ and $y$, respectively, to a one-standard-deviation innovation of the $m$th shock. The cross product $x_{imp}^{m,k} y_{imp}^{m,k}$ indicates whether variables $x$ and $y$ move in the same or in opposite direction after an innovation in the $m$th shock. The total covariance is simply the sum of the accumulated cross products for all possible shocks. There are seven variables in our VAR, so there are also seven shocks, that is, $M = 7$. To decompose the correlation coefficient, we use

$$ COR(x_t, y_t; K) = \sum_{m=1}^{M} COR(x_t, y_t; K, m) \text{ with } COR(x_t, y_t; K, m) = \sum_{k=1}^{K} \frac{x_{imp}^{m,k} y_{imp}^{m,k}}{SD(x_t; K)SD(y_t; K)}, $$

where $SD(z_t; K) = \left( \sum_{m=1}^{M} COV(z_t, z_t; K, m) \right)^{1/2}$ for $z_t = x_t, y_t$. 

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In the denominator, we use the \textit{total} standard deviations of the $K^{th}$-period ahead forecast error (and not the standard deviations due to the $m^{th}$-shock) to ensure that the sum of all the scaled covariances is equal to the total correlation coefficient.

3.5 Subsamples

The great moderation is generally believed to have started in the early eighties and Figure 2, discussed below, supports this view. Our main focus is on comparing business cycle properties for the 1954Q3-1978Q4 subsample with those of the 1984Q1-2008Q1 subsample. We exclude the highly volatile transition period when Paul Volcker started the disinflation process. This period is too different to be part of either subsample. For completeness and to ease comparison with the literature, we also report results for the complete sample, which does include the transition period.

4 Trends

The panels on the left-hand side of Figure 1 document how consumer credit and mortgages have grown as a fraction of GDP. Both consumer credit and mortgages have increased substantially as a fraction of GDP, but mortgages have increased at a much sharper rate. From 1954Q3 to 2008Q1, consumer credit increased from 9.2% of GDP to 18.3% of GDP and mortgages from 28.8% to 104.2%.\footnote{For home mortgages these numbers are 18.9% and 79.4%.

14 These numbers are 19.5% and 50.9% for home mortgages relative to the value of household owned real estate.} The observed increases do not necessarily imply that debt levels increased relative to the value of the underlying asset. It may be the case that the values of durables and real estate increased faster than GDP or that the quantities of durables and housing relative to GDP increased. The panels on the right-hand side of Figure 1 plot the two liabilities scaled by the value of the associated asset. Scaled by the value of all real estate, total mortgages increased from 18.7% in 1954Q3 to 47.1% in 2008Q1.\footnote{These numbers are 19.5% and 50.9% for home mortgages relative to the value of household owned real estate.} This is clearly less than the increase of mortgages relative to GDP, but still quite substantial. As a fraction of the replacement value of durables, consumer
credit doubles, namely from 27.9% to 63.5%, just like it did as a fraction of GDP.

The increases in mortgages and consumer credit have not been uniform over the sample period. First consider consumer credit. As a fraction of GDP, consumer credit has displayed a steady increase. As a fraction of durables, a different picture emerges. A large part of the growth occurs in the beginning of the sample. Consumer credit increased to 41.9% of durables in 1970 and then displayed no growth for over two decades. In the early nineties, the ratio started to increase again.

Now consider mortgages. As a fraction of GDP, mortgages have displayed quite an intriguing growth process. Throughout the sample, there are several periods during which the growth rate of mortgages as a fraction of GDP sharply increases, but the sustained increase in the growth rate of mortgages relative to GDP that started around the beginning of the new millennium is without precedent. As a fraction of the value of real estate, however, the growth pattern is a bit different. In particular, there is a sharp increase in the fifties and early sixties followed by a period of no growth, and starting in the early eighties a renewed steady increase. Interestingly, using real estate as the scaling’s factor, the sustained and sharp acceleration starting around 2000 is no longer present. This acceleration of mortgages relative to GDP can, thus, for a large part be attributed to a sharp increase in the value of the stock of housing relative to GDP. Interestingly, mortgages as a percentage of the value of real estate displays a substantial increase at the very end of the sample, which is not surprising given the recent drop in the value of real estate.

**Loans owned by different institutions.** Securitization has obviously changed financial markets enormously. It makes it possible for a financial institution to issue consumer credit and mortgages, but then sell them so that another institution ends up holding them.

The amount of consumer credit held directly on the banks’ balance sheets (which we refer to as regular bank consumer credit) was equal to 4.2% of GDP in 1954Q3 and equal to 7.9% in 2008Q1. Consequently, the increase in total consumer credit is not just due to an increase in regular bank consumer credit. This is documented in Panels A and B of Figure 1.
For consumer credit, the most important new type of owner is the Asset-Backed Securities (ABS) issuer. Although these issuers are virtually nonexistent in the eighties, they hold roughly 26.9% of total consumer credit at the end of our sample. One of the key questions we want to address is whether the cyclical behavior of total as well as bank consumer financing has changed. Ideally, we would use data on both the part held by banks directly and the part held through asset-backed securities. We do not know how much consumer credit banks indirectly hold on their balance sheets. Fortunately, for mortgages we do.

The share of total mortgages (home plus non-home) held directly on the banks’ balance sheets (regular bank mortgages) was equal to 51.7% in 1954Q3 and 34.1% in 2008Q1. As for consumer credit, ABS issuers started to become owners of mortgages at the end of the eighties and 19.6% of all mortgages is owned by them in 2008Q1. Mortgages are also held in "Agency and GSE-backed mortgage pools",\textsuperscript{15} which began buying mortgages in the late sixties and then gradually expanded; in 2008Q1 they held 31.3% of all mortgages. For total mortgages (home plus non-home), we can calculate the ownership of banks in the bonds issued by these two types of special purpose vehicles. Combining the direct ownership with the indirect ownership, we find that banks held 51.8% of all mortgages in 1954Q3 and 43.6% in 2008Q1. Banks participated in the precipitous increase in mortgages that started at the beginning of the millennium, but not as much as other financial institutions. That is, from 2000Q1 to 2008Q1 the share of mortgages held by banks (both directly and indirectly) declined from 46.8% to 43.6%.

\textsuperscript{15}These are entities that hold pools of mortgages having similar features. These pools issue securities known as mortgage-pool securities, which are their liabilities. These pools are created by the government-sponsored enterprises (GSEs) Fannie Mae, Freddie Mac, and the Federal Agricultural Mortgage Corporation, by the government agency Ginnie Mae, and by the government agency formerly known as Farmers Home Administration (now part of the Farm Service Agency).
5 Cyclical behavior of real activity

In this section, we document the changes that have occurred in the cyclical behavior of GDP and the two components of consumer expenditures that often require financing: durable expenditures and residential investment.

5.1 Summary statistics for real activity

Panels A and B of Figure 2 display the cyclical components of durable expenditures and residential investment, together with the cyclical component of GDP.\textsuperscript{16} It visualizes the well-known fact that in the early eighties a sustained period with very moderate fluctuations in key real activity variables began. In particular, the incidence of large swings in the cyclical component of GDP has been reduced in the later sample (fewer recessions) and the amplitude of the fluctuations has become smaller. This is also true for residential investment and durables, although both spending components still sharply decreased during the recession of the early nineties. Moreover, residential investment also seems to have started a sharp decrease during the recent financial crisis. It is too early to tell how large the current downturn will be, but it is interesting to note that the boom in residential investment that preceded the current slump does not reach the same magnitude as the highest peaks attained in the first subsample.

Table 1 reports the standard deviations of these three variables over the whole sample and the two subsamples. Whereas the standard deviation of the cyclical component of GDP is equal to 1.75% during the 1954Q3-1978Q4 sample, it is equal to 0.89% during the 1984Q1-2008Q1 sample, a 49% decline. Similar declines are found for durable expenditures and residential investment.\textsuperscript{17}

\textsuperscript{16}Throughout this paper, we use the HP filter with a smoothing coefficient of 1,600 to calculate cyclical components.

\textsuperscript{17}When we extend the recent subsample up to 2009Q1 then the standard deviation increases to 0.99%. 
5.2 Impulse response functions for non-financial variables

Figure 3 plots the IRFs following an unexpected monetary tightening. In this section, we discuss the non-financial variables. The responses of the two loan variables will discussed in Sections 6.2 and 7.2.

In the early subsample, all three real activity measures considered (GDP, residential investment, and durable expenditures) display sizeable and significant decreases following a monetary tightening. Results are quite different in the later subsample. There is no longer a reduction in GDP and durable expenditures, which is consistent with the results reported in Boivin and Giannoni (2002, 2006).\textsuperscript{18} The response of residential investment has become smaller, but is still significantly negative. Also, this response has become much more delayed and more persistent. This pattern for the response of residential investment is also found by McCarthy and Peach (2002). The maximum drop in residential investment (during the first five years) is equal to 2.7% in the early subsample and only 1.1% in the later subsample. But the maximum increase in the federal funds rate has also dropped, namely from 77 to 32 basis points.

In the early sample, the IRF of the price level suffers from the price puzzle in that there is a significant increase during the first two years. In the second subsample, there is a small and quite rapid reduction in the price level. Over the whole sample, there is virtually no price puzzle and prices follow the textbook response, that is, flat initially and then a reduction.

Figure 4 plots the IRFs following a real activity shock. GDP, residential investment, and durable expenditures all decline for some time after which all increase. That is, the initial losses are later on partly recovered. The shapes of the IRFs are remarkably similar in both the first and the second subsample. However, there are some changes in the magnitudes of the responses and the locations of the turning points. Although these

\textsuperscript{18}For this specification of the VAR, we actually find a small marginally significant increase in GDP. This increase is, however, not robust. As documented in Appendix C, it is possible to get a significant decline of GDP in the second subsample. Boivin and Giannoni (2006) also report IRFs with positive and negative responses for GDP over a similar sample. In contrast, the negative response in residential investment for the second subsample is quite robust.
gradual shifts do not seem very important, they turn out to matter quite a bit for the correlation between real activity and consumer loans. The responses to the other shocks turn out to be not that interesting and are discussed in Appendix E.

Considered in isolation, the disappearance of negative responses of GDP and durable expenditures following a monetary tightening is consistent with financial innovation. For example, the ability of financial institutions to attract different types of funding could make it easier to keep on lending during a monetary contraction, which in turn would diminish the negative effect on real activity. In subsequent sections, we will investigate whether the behavior of consumer credit and mortgages has changed in a way that is consistent with this hypothesis.

6 Cyclical behavior of consumer credit

This section starts with a discussion of some summary statistics regarding the cyclical behavior of consumer credit. Next, Section 6.2 discusses the IRFs for consumer credit, Section 6.3 discusses how the results differ across the different institutions that hold consumer credit, and Section 6.4 discusses whether financial innovation is a plausible candidate for the observed changes.

6.1 Summary statistics for consumer credit

This subsection discusses the cyclical properties of total consumer credit as well as the cyclical properties of consumer credit by financial institution.

Cyclical properties of total consumer credit. Table 1 documents that the volatility of the cyclical component of consumer credit has declined, but the reduction is much smaller than the reduction observed for both GDP and durable expenditures. In particular, the standard deviation of consumer credit in the 1984Q1-2008Q1 sample is only 21% below the standard deviation in the 1954Q3-1978Q4 sample. Panel C of Figure 2 plots the cyclical component of consumer credit. It makes clear that consumer credit may have
been relatively smooth in the last ten years of the sample, but during the nineties there still is a full cycle with large fluctuations.

Table 2 reports the correlation coefficients for the cyclical components. This table, as well as Figure 2, documents another change that occurred that is at least as striking as the reduction in volatilities. This is the sharp reduction in the correlation between the cyclical component of GDP and the cyclical component of consumer credit. The correlation between consumer credit and GDP drops from 0.74 to 0.19. The change in the pattern of comovement is also clearly visible in Figure 2. In the beginning of the sample, there is a very close connection between the movements of the cyclical components of GDP and consumer credit, a link that seems to have virtually disappeared in the later half of the sample. Consumer credit even seems to move in the opposite direction to both GDP and durable expenditures since the mid-nineties.\textsuperscript{19} We will delve deeper into possible reasons behind this reduction in comovement throughout this paper.

The results in Table 2 suggest that there are two aspects to the drop in the comovement between consumer credit and GDP. First, there is a drop in the correlation between consumer credit and durable expenditures. This correlation drops from 0.65 to 0.31 and is clearly not as spectacular as the drop in the correlation with GDP. The other part of the story seems to be that the correlation between GDP and the spending components has dropped. The correlation between durable expenditures and GDP has dropped from 0.87 to 0.63.

The drop in the positive correlation between consumer loans and GDP is—as argued by Campbell and Hercowitz (2006)—consistent with the hypothesis that financial innovations make it easier for consumers to keep on borrowing during an economic downturn. It is intriguing that the correlation between consumer credit and durables dropped by so much less than the correlation between consumer credit and GDP. But changes in unconditional correlation coefficients are open to several interpretations; the IRFs discussed below are better suited to understand how comovement patterns have changed.\textsuperscript{20}

\textsuperscript{19}Panel A of Figure 1 makes clear that during the 2001 recession the unfiltered ratio of consumer credit to GDP is also increasing.

\textsuperscript{20}For example, unconditional correlation coefficients change when the relative importance of different
**Cyclical properties of consumer credit by financial institution.** Table 1 also reports the standard deviation of the cyclical component of consumer credit by institution. For consumer credit, we cannot determine the amount of consumer credit that banks hold indirectly through the ownership of the bonds issued by ABS issuers to purchase consumer credit. Nevertheless, some interesting observations can be made.

The amount of consumer credit that shows up directly on the banks’ balance sheets has remained equally volatile and consumer credit held by finance companies has become even more volatile. In the first subsample, ABS issuers did not yet hold consumer credit, but note that the volatility of consumer credit held by this group in the second subsample is enormous. So why did the volatility of total consumer credit decline? An important factor is that the correlations between the components strongly declined. Table 2 shows that the correlation coefficient between regular bank consumer credit and consumer credit held by other institutions dropped substantially, namely from 0.75 to 0.32. The correlation between regular bank consumer credit and consumer credit held by ABS issuers is even negative in the second subsample, namely -0.41.

The 2001 NBER recession is a good example of the different behavior of consumer credit in the second subsample. Figure 2 documents that the cyclical component of total consumer credit was positive during this downturn. To understand what is behind this increase in consumer credit, we plot in Figure 8 the cyclical components of regular bank consumer credit and consumer credit held by ABS issuers. During the 2001 recession, the cyclical component of regular bank consumer credit is negative, just as it was in other post-war recessions. In contrast, the cyclical component of consumer credit held by ABS issuers is positive during this period; it turns negative as the economy recovers and the cyclical component of regular bank consumer credit turns positive. Thus, if one wants to argue that changes in financial markets made it possible to have easy access to consumer credit during the 2001 downturn, then one should focus on ABS issuers.

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shocks changes, even if all IRFs remain unchanged.
6.2 Consumer credit IRFs

This subsection discusses the IRFs of consumer credit following a monetary tightening and a real activity shock. The most interesting observations can be made for these two shocks; for completeness, we discuss the IRFs of the other shocks in Appendix E.

Monetary tightening. We find that the negative responses of consumer credit, like the negative responses for durable expenditures, have disappeared. Although we find this for several alternative VAR specifications, it is not a robust result; in Appendix C.1, we document that some VARs generate reductions in consumer credit and that it is even possible to obtain a reduction that, scaled for the size of the shock, exceeds the reduction observed in the first subsample.

Real activity shock. The shapes of the IRFs of consumer credit are similar in the two subsamples, but the magnitudes of the responses and the significance levels have become smaller. In particular, the drop in the magnitudes of the responses for consumer credit resembles the drop in the magnitudes for the real activity variables.

6.3 Consumer credit IRFs by financial institution

The question arises whether the disappearance of the negative response of consumer credit following a monetary tightening is found for the consumer credit held by each of the financial institutions. To check this, we estimated the IRF for regular bank consumer credit and the IRF for all consumer credit minus regular bank consumer credit.\footnote{We also calculate the IRF for consumer credit held by finance companies. The changes resemble the changes in the IRF for total consumer credit minus regular bank consumer credit. Recall that regular bank consumer credit is consumer credit that banks hold directly on their balance sheets, i.e., not in the form of asset-backed securities.} These two IRFs are reported in Figure 9. We find that the responses to a monetary tightening have shifted up for both series, although there are some differences. The figure documents that the responses for regular bank consumer credit have shifted up much less. In fact, the responses for regular bank consumer credit are still negative and several responses...
are significant. In contrast, the responses for total consumer credit minus regular bank credit are almost all positive and after roughly two and a half year they are significantly positive. Thus, if the disappearance of the negative response of consumer credit following a monetary tightening is due to financial innovation, then the main cause does not lie in a change in the behavior of regular bank consumer credit.

When we look at a real activity shock, then we find that the negative responses of consumer credit are smaller in the second subsample for all financial institutions. Again, there are differences; the largest upward shift is found for finance companies.

6.4 Financial innovation and cyclical behavior of consumer credit

In Sections 6.1 and 6.2, we documented that the values of several standard deviations and correlation coefficients as well as some IRFs related to consumer credit and real activity have changed over time. We now address the question whether it is possible to reconcile these changes with prevailing views on how financial innovation affects consumer credit and real activity over the business cycle. In particular, we discuss whether financial innovation could be an important factor behind the reduction in the volatility of real activity and the reduction in the covariance between consumer credit and GDP.

6.4.1 Innovation in the market for consumer credit and the monetary IRF

The IRFs corresponding to a monetary policy shock have an important advantage that the other IRFs do not have and that is that the instantaneous response of the federal funds rate can be taken as a reasonable measure of the size of the shock. That is, a larger unexpected change in the federal funds rate corresponds with a larger underlying structural shock. For the other shocks this is not so clear-cut, because the first-period responses provide not only a measure of the magnitude of the underlying structural shock, but also of the magnitude of the instantaneous response.

A striking observation is that the negative (and significant) response of consumer credit following a monetary tightening observed in the first subsample has disappeared in the second subsample. The same is true for the negative responses of GDP and durable
expenditures. In Appendix C.1, we show that these results are not robust; for several VAR specifications, we find that the responses for both consumer credit and all three real activity variables are negative in both the first and the second subsample. Although there are VAR specifications according to which there are no changes in these IRFs, one can safely argue that the negative responses for consumer credit and real activity variables have at least become less robust.

So, although there are reasons to question that the changes found with our benchmark VAR really occurred, we now take the results that the negative responses for both consumer credit and real activity variables have disappeared seriously and ask the question whether these changes are consistent with the hypothesis that financial innovation is behind the great moderation. At first glance, these changes fit the standard financial innovation story quite well. That is, it seems that it has become easier for financial intermediaries to keep on extending credit when interest rates increase, which in turn results in a smaller economic downturn. One possible reason for the continued access to consumer credit is the rapid emergence of the "originate and distribute" practice, which allows loans to be financed by a much wider group of investors.

For innovation in markets for consumer credit to be behind the vanishing negative responses in consumer credit, durable expenditures, and GDP during a monetary downturn it also must be the case that consumer credit actually matters for economic activity, i.e., the first element of the typical financial innovation story discussed on page 5. An alternative explanation is that the responses of several expenditure components to a monetary policy shock have become smaller, because, for example, prices have become less sticky. The response of consumer credit is then smaller, because the smaller reduction in expenditure components corresponds to a smaller reduction in the demand for consumer credit and faced with a smaller economic downturn financial institutions see less reason to reduce the supply of credit.

To shed light on these issues, we perform the following two experiments. In the first experiment, we recalculate the IRFs to a monetary tightening in the first subsample, but reset the negative loan responses equal to zero in each period following the shock.
If loans are important for real activity, then resetting negative loan responses to zero, should dampen the negative responses of real activity. The results are reported in Figure 10. The graph makes clear that consumer credit has basically no effect on either durable expenditures or GDP, at least not when this effect is measured by the effect of consumer credit in the VAR equations.\textsuperscript{22}

In the second experiment, we feed the VAR of the second subsample a sequence of monetary policy and real activity shocks such that the time paths of residential investment, durable expenditures, GDP, and the federal funds rate are identical to the time paths observed in the first subsample. The results are reported in Figure 11. For this set of shocks, we find that the predicted responses of consumer credit in the second subsample are stronger than the responses observed in the first subsample. This implies that in the second subsample consumer credit continues to decline whenever real activity declines.

6.4.2 Innovation in the market for consumer credit and non-monetary IRFs

The IRFs corresponding to the other shocks are plotted in Figures 4 through 7. A general observation is that the changes in these other IRFs are remarkably small. It is not unusual in empirical work that the IRFs of VARs are not robust at all in the sense that minor changes in, for example, the specification or the sample period lead to different outcomes. If financial innovation really did affect the business cycle behavior of the variables we consider, then one would have expected much larger changes in the IRFs.\textsuperscript{23}

Real activity shock. The general shapes of the IRFs following a real activity shock are quite similar across the two subsamples, except that the magnitudes are smaller in the second subsample. The simplest explanation is that the size of the real activity shock has become smaller and the IRF of consumer credit in the second subsample is scaled

\textsuperscript{22}One obtains only limited information from these exercises. The reason is that the coefficients of other variables in the GDP and durable expenditure equation, like the coefficient on the federal funds rate, may also capture the effect from the market for consumer credit on real activity. It is, however, quite striking that consumer credit has virtually no effect on either durable expenditures or GDP.

\textsuperscript{23}In Appendix E, we discuss whether the changes that do occur are consistent with financial innovation.
down accordingly. Even if we take a close look, then there are only some minor noticeable changes in the shape.

In the first subsample, the three real activity variables as well as consumer credit display an initial decrease followed by a quite substantial recovery. During the economic downturn, the federal funds rate drops by 50 basis points, which could be the reason for the subsequent expansion. In the second subsample, the observed pattern is very similar, except that the reduction in consumer credit has become more persistent, durable expenditures turn positive earlier, and GDP turns positive later.

An increase in the persistence of GDP and consumer credit is not consistent with the standard story that financial innovation has dampened the impact of shocks. The shortening of the downturn for durable expenditure is, but it seems strange that financial innovation would cause consumer credit to remain suppressed for a longer time period and at the same time would cause durable expenditures to remain suppressed for a shorter time period.

6.4.3 Innovation in the market for consumer credit and correlations

The literature has used the sharp drop in the unconditional correlation between the cyclical components of loan variables and real activity as support for the hypothesis that financial innovation played a role in the great moderation.24 We argue that unconditional correlation coefficients can change for many reasons and are not very useful to think about something like financial innovation. The IRFs provide a much more detailed set of statistics describing the comovement and are, thus, much more suitable to address the question whether observed changes in the time series properties of key economic variables are consistent with financial innovation being behind the great moderation.

Figure 12 plots the correlation coefficients of the consumer credit and GDP forecast errors (implied by the VAR) and the correlation coefficients of the consumer credit and durable expenditures forecast errors; in both cases we consider several forecast horizons to obtain information about the dynamics of the comovement. The figure documents a sharp

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24 See, for example, Campbell and Hercowitz (2006) and Iacoviello and Pavan (2008).
drop in the correlation coefficients at virtually all forecast horizons, which is consistent with the observed reductions in the unconditional correlation coefficients of the filtered series.\textsuperscript{25}

In the remainder of this section, we use the estimated IRFs to explain why the covariance has dropped and whether the underlying reasons for the drop are consistent with the hypothesis that financial innovation affected business cycle properties. Figure 13 decomposes the correlation between consumer credit and GDP (top panel) and between consumer credit and durable expenditures (bottom panel). In particular, this figure plots the parts of the comovement that are due to the monetary policy and the real activity shock and it makes clear that these two shocks are responsible for a very large part of the comovement and the observed changes.\textsuperscript{26}

At short forecast horizons, the correlation is virtually completely driven by the real activity shock. The second-subsample responses of consumer credit, durable expenditures, and GDP following a real activity shock at short forecast horizons are a scaled down version of those in the first subsample. The reason the correlation coefficients at these forecast horizons still drop is that real activity shocks have become less important relative to those shocks for which consumer credit and real activity variables do not move together in a systematic way.

At other forecast horizons, the real activity shock is not always the sole factor driving the correlation coefficients. In particular, the figure makes clear that monetary policy shocks were very important in explaining the positive correlation between consumer credit and real activity (both for GDP and durable expenditures) in the first subsample, except at short forecast horizons. In the second subsample, however, this role has completely disappeared. Monetary policy shocks have become much smaller, but more importantly, monetary shocks no longer predict a positive comovement. Similarly, whereas real activity

\textsuperscript{25}In Appendix C.1, we show that the drop in the covariance is not robust. In the main text, however, we argue that even when measures of comovement display a drop, they change in a way that is not consistent with financial innovation.

\textsuperscript{26}In Section 3.4, the comovement statistics of variables $x$ and $y$ are equal to the sum across all shocks of the (scaled) accumulated cross products of the IRFs of $x$ and $y$. 
shocks generate a substantial positive comovement in the first subsample, this is much less
the case in the second subsample, again except for the short forecast horizons.

Now that we know the sources of the drop in the correlation coefficients, we are in a
better position to evaluate the idea that the drop in the correlation coefficients is evidence
for the hypothesis that financial innovation is part of the explanation for the great moder-
eration. As discussed in Section 6.4.2, the changes in the IRFs following a real activity
shock are mainly shifts in the location of the point at which the IRFs change sign. These
are minor shifts, but because the IRFs change sign, they are important for the correlation
coefficients. Moreover, we argued that the way they shift is not consistent with financial
innovation. As discussed in Section 6.4.1, the changes in the IRFs following a monetary
tightening are consistent with standard stories about financial innovation except that the
VARs are not consistent with the view that consumer credit actually matters for real
activity.

6.5 Summary of consumer credit results

Does a close look at the data support the view that financial innovation played an impor-
tant role in the great moderation? Our findings suggest that the evidence is at best very
weak for the following reasons:

- The changes in the IRFs following a monetary tightening are consistent with stan-
dard views on how financial innovation can dampen business cycles, except that the
VARs do not provide evidence that consumer credit matters for real activity at all.
A more plausible explanation is that the smaller reduction in consumer credit is due
to the fact that the real activity responses have become smaller (for other reasons).
As documented in Appendix C.1, for some VAR specifications the negative responses
of consumer credit, durable expenditures, and GDP are still present in the second
subsample.

- The changes in the IRFs following a real activity shock are relatively minor. If
anything, consumer credit is negative for a longer and real activity is negative for

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a shorter time period, which is the opposite of predictions of standard theories in which financial innovation dampens business cycles. Although the shifts in the IRFs are minor, they are important for the comovement because the IRFs switch sign and the location of the turning point shifts.

- The correlation coefficients can be explained almost completely by the monetary policy and the real activity shocks. Given that the corresponding IRFs are not very supportive of the view that financial innovation is behind the great moderation, the sharp reduction in the correlation coefficients also cannot be used as evidence.

7 Cyclical behavior of mortgages

The main focus in this paper is on consumer loans, i.e., consumer credit and home mortgages. One drawback of using home mortgages is that it is not possible to measure the amount banks hold directly on their balance sheets and the amount banks hold indirectly through asset-backed securities. This is possible for the sum of home and non-home mortgages. We use the term "bank mortgages" to indicate the amount of mortgages held by banks directly and indirectly, while we use the term "regular bank mortgages" to indicate the amount that excludes mortgage-backed securities.27

Section 7.1 discusses summary statistics for the cyclical behavior of mortgages. It also documents that the cyclical behavior of home mortgages resembles that of total mortgages, although there are some differences.28 Section 7.2 discusses the IRFs, 7.3 discusses whether the IRFs are different for different types of financial institutions, and Section 7.4 discusses whether the results found are consistent with the view that financial innovation dampened business cycles during the great moderation.

27 Details on the construction of these series are provided in Appendix B.
28 Home mortgages are substantially larger than non-home mortgages; the share of home mortgages in total mortgages has increased from 66% in 1954Q3 to 76% in 2008Q1.
7.1 Summary statistics for mortgages

We start with a discussion of the cyclical properties of total mortgages (i.e., home plus non-home) aggregated across institutions and then discuss whether the properties differ across institutions. Finally, we discuss the differences between home and non-home mortgages.

Cyclical properties of total mortgages. Table 1 reports that the standard deviation of the cyclical component of mortgages has declined. Comparing the two subsamples, we find that the drop in volatility is larger for mortgages than for consumer credit, namely 35% versus 21%. Both reductions are less than the drop in volatility observed for GDP, which is equal to 49%.²⁹

The correlation between the cyclical components of mortgages and GDP dropped from 0.76 to 0.32, not quite as large as the drop in the correlation of consumer credit and GDP, but still quite substantial.³⁰ The drop in the correlation coefficient is smaller when residential investment is used instead of GDP, which resembles the results for consumer credit for which we also find a smaller drop in comovement when durables expenditures is used instead of GDP.³¹

Panel D of Figure 2 plots the cyclical component of total mortgages together with the cyclical component of GDP. Although the drop in the standard deviation and the reduction in the correlation with real activity are similar to the changes found for consumer credit, Figure 2 makes clear that there are some key differences between the changes for consumer credit and those for mortgages. For consumer credit there are still substantial "business-cycle" type fluctuations and one full cycle during the nineties with large swings. For mortgages there are three minor booms, namely before the 1990-91, before the 2001 and before the most recent recession, but neither the 1990-91 nor the 2001 recessions were accompanied by substantial negative cyclical components, whereas residential investment did display substantial drops during these two recessions, especially during the 1990-91 recession. Note that the cyclical component for mortgages actually takes on its third

²⁹ For home mortgages the drop in volatility equals 30% and for non-home mortgages it equals 4%.
³⁰ For home mortgages the the correlation drops by more, namely from 0.80 to 0.13.
³¹ This is true independent of whether total or home mortgages are used.
largest positive value during the 1990-91 recession.

To understand the post 1984 sample period better, it is insightful to look at Panel C of Figure 1 that plots the (unfiltered) ratio of mortgages to GDP. This picture makes clear that there is a sharp increase in the growth rate of mortgages in the mid eighties. During the 1990-91 recession there is a clear reversal, but the run-up before the 1990-91 recession had been so substantial that the cyclical component is still positive during the downturn. If a larger part of the increase in the second half of the eighties would have been allocated to the trend, then the cyclical component during this period would have been smaller. Thus, the observed positive cyclical component during the 1990-91 recession may be misleading.

Now consider the 2001 recession. Figure 1 shows that there is an acceleration of the growth rate around this recession. Since the HP filter is a two sided filter this will show up as a negative cyclical component, but neither the ratio of mortgages to GDP nor the unscaled data seem to indicate that this was a period in which mortgages were low. Thus, the large positive cyclical component during the 1990-91 recession may overestimate the true cyclical component, but the small negative cyclical component during the 2001 recession may underestimate the true cyclical component. These examples again highlight that there is only limited information in unconditional correlation coefficients of filtered data.

**Cyclical properties of total mortgages by financial institution.** The drop in the volatility of the cyclical component of bank mortgages is less than the drop for all mortgages, i.e., mortgages aggregated across all financial institutions. Whereas the drop for all mortgages is equal to 35%, the drop is only 22% for bank mortgages and if we restrict ourselves to mortgages directly held on banks' balance sheets, i.e., "regular" bank mortgages, then the drop in volatility is only 8%. Interestingly, for non-bank mortgages we find an increase in volatility. Similar to the results for consumer credit, we find that the reduction in the volatility of total mortgages is driven to a large extent by a reduction

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32Recall that bank mortgages include mortgage-backed securities, unless we refer to them as regular bank mortgages in which case they are excluded.
in the comovement between bank and non-bank mortgages. This is documented in Table 3. The correlation between the cyclical components of bank and non-bank mortgages is equal to 0.26 in the first subsample, but equal to -0.12 in the second subsample. If we restrict bank mortgages to be only those directly held, then we observe an even larger drop, namely from 0.32 to -0.22.

The type of institution also seems to matter for the correlation between mortgages and real activity. When we aggregate across all institutions that hold mortgages, then we find that the correlation between the cyclical component of mortgages and GDP dropped from 0.76 to 0.32, but for bank mortgages the correlation dropped from 0.79 to 0.42 and if we restrict ourselves to regular bank mortgages, then the correlation dropped from 0.78 to 0.51. In contrast, the correlation between the cyclical components of non-bank mortgages and GDP dropped from 0.19 to -0.14. That is, non-bank mortgages are even countercyclical in the second subsample.

This is illustrated in Figure 14 that plots the cyclical components of bank mortgages (panel A) and non-bank mortgages (panel B). Recall from the discussion above that during the 1990-91 recession the cyclical component of mortgages aggregated across all institutions remained positive and during the 2001 recession it was barely negative. In contrast, the cyclical component of bank mortgages is negative in both recessions and in fact as negative as the cyclical component in the last observation of our sample, 2008Q1. For non-bank mortgages, we find in both recessions a large positive cyclical component; the cyclical component during the 1990-91 recession takes on its second largest positive value.

Considered in isolation, the changes in the summary statistics are consistent with standard stories about financial innovation. In particular, there is a strong drop in the cyclicality of mortgages suggesting that households can keep on borrowing during economic downturns. The additional data for mortgages by institution make it possible to be precise about the role that bank mortgages (both those directly and indirectly held) played in the observed changes in the behavior of all mortgages. A striking observation in this respect is the increase in the negative correlation between bank and non-bank mortgages. It seems that the reduction in the cyclicality of mortgages is due to other financial institutions
taking over lending from banks during economic downturns. Using the more detailed empirical evidence discussed below, we will question this interpretation.

**Home versus total mortgages.** Figure 15 plots the cyclical components of home mortgages and GDP (in panel A) and the cyclical components of non-home mortgages and GDP (in panel B). A comparison with Figure 2 makes clear that the cyclical behavior of home mortgages is very similar to that of total mortgages throughout the sample. In particular, the correlation of the cyclical components of home and total mortgages is equal to 0.97 in the first subsample and 0.92 in the second subsample. The correlation between home and non-home mortgages for the second subsample is clearly smaller than the correlation for the first subsample. This does not lead to a strong decrease in the correlation between home and total mortgages, because the share of home mortgages in total mortgages is substantially higher in the second subsample.

Figure 15 documents that the cyclical behavior of home mortgages often resembles that of non-home mortgages, but there are some important differences. In particular, the run-ups in mortgages before the 1990-91 and the 2001 recession are not as large for home mortgages as for non-home mortgages, whereas the run-up before the recent turmoil is substantially larger for home mortgages. We will discuss these differences in more detail below.

**7.2 Mortgage IRFs**

In this section, we focus on the IRFs following a monetary tightening and a real activity shock. The IRFs for the other shocks are discussed in Appendix E.

**Monetary tightening.** As documented in Figure 3, the responses of home mortgages are still negative in the second subsample and several are significant. The maximum decrease in home mortgages (during the first five years) did become smaller, it namely dropped from 0.71% to 0.29%, but relative to the size of the federal funds rate response this is only a minor reduction. Moreover, since home mortgages have increased sharply relative to GDP, the same percentage decrease in home mortgages implies a much larger
change in the amount of home mortgages relative to GDP. For all VAR specifications considered, we find a sizeable reduction in home mortgages. As documented in Appendix C.1, there are even VARs for which the responses in home mortgages are larger in the second subsample when the responses are rescaled for the size of the shock in the federal funds rate.

**Real activity shock.** A negative real activity shock leads to an immediate reduction in GDP, residential investment, and consumer credit, followed—after some time—by positive responses. The IRF of home mortgages also follows this pattern, but the initial decrease is smaller than the subsequent upturn. This is true in both subsamples, but the initial decrease has become very small in the second subsample and the IRF changes sign quicker. One possible interpretation is that borrowers were capable of limiting the reduction in mortgage lending during this type of downturn in the second subsample.

**Non-home mortgages.** In the first subsample, the IRFs of home, non-home, and total mortgages are all significantly negative. Panel A of Figure 16 plots the IRFs for these three series for the second subsample. As discussed above, the IRF for home mortgages following a monetary tightening is still significantly negative in the second subsample. The IRF for total mortgages, however, is basically flat and the IRF for non-home mortgages even displays a substantial increase. This is likely to be due to the boom and bust in commercial mortgages in the early nineties. As documented in Figure 15, the cyclical component of non-home mortgages increases at the end of the eighties and remains high for an unusually long time. In fact, it remains high even when the economy is going through a downturn. Note that there is a boom in home mortgages too, but of much smaller magnitude and this one ends much earlier. The boom in non-home mortgages is followed by a bust, also of an unusually long time. That is, non-home mortgage lending was buoyant following the increases in the federal funds rate in the second half of the eighties and suppressed following the reductions in the federal funds rate in the early nineties.
7.3 Mortgage IRFs by institution

Figure 17 plots the responses of both bank and non-bank mortgages following a monetary tightening. Bank mortgages not only include mortgages banks hold directly on their balance sheets, but also those they hold indirectly through asset-backed securities. The top panel of the figure plots the results for the first subsample and the bottom panel the results for the second subsample. In the first subsample, the IRF of bank mortgages initially declines sharply and remains negative for up to three years, that is, it basically has the same shape as the IRF for home mortgages held by all institutions. In contrast, the IRF for non-bank mortgages is basically flat.

In the second subsample, the responses of bank mortgages are still negative and in fact remain negative for a longer period than in the first subsample. In contrast, the responses of non-bank mortgages are initially slightly negative, but after roughly a year take on quite large positive values.

7.4 Financial innovation and cyclical behavior of mortgages

7.4.1 Innovation in the mortgage market and the monetary IRF

Monetary policy shocks are definitely smaller in the second subsample, but they are also more persistent, that is, the federal funds rate takes longer to return to its pre-shock value. To facilitate the comparison of the responses in the face of these different time paths of the federal funds rate, we plot in Figure 18 the IRFs of home mortgages and residential investment for the VAR of the second subsample when we feed the VAR a series of monetary policy shocks that result in a time path for the federal funds rate that is identical to the one observed in the first subsample. The figure also plots the IRFs of home mortgages and residential investment for the first subsample. The figure documents that the responses of residential investment are not smaller in the later subsample, only more delayed. The responses of home mortgages have become smaller. For changes in the federal funds rate that are as big as they are in the first subsample, the VAR estimated over the second subsample still generates responses for home mortgages that are less negative.
than the responses of the first-subsample VAR.

One possible story would be that financial innovation is behind the delay in the reduction of residential investment and the disappearance of the drop in GDP following a monetary tightening. For the following reasons, we doubt that this interpretation is correct.

1. The results from our benchmark VAR specification indicate that the negative response of home mortgages has become smaller, even if one feeds the VAR interest rate shocks that are as big as those observed in the first subsample. This is, however, not a robust result. For some VAR specifications the reduction in home mortgages in the second subsample exceeds those in the first subsample. Figure 3 documents that according to our benchmark VAR the reduction in home mortgages is initially larger in the second subsample. This is even true when the response of home mortgages is not scaled by the size of the monetary policy shock. Also, it is not clear whether the percentage change in home mortgages is the right measure, given that home mortgages have increased sharply relative to GDP and relative to the level of residential investment. That is, in the second subsample the same percentage reduction in home mortgages corresponds to a much larger drop in the amount of home mortgages relative to GDP. Scaled for the size and persistence of the federal funds rate responses, we find that the largest reductions for home mortgages are equal to 0.71% and 0.43% in the first and second subsample, respectively. In the second subsample, however, the ratio of average mortgages relative to average GDP is 193% higher than in the first subsample. Consequently, the maximum reduction in home mortgage relative to GDP is equal to 0.19% in the first subsample and equal to a somewhat larger drop, namely 0.22%, in the second subsample. If we calculate the drop in mortgages relative to the level of residential investment, then we find that the maximum reduction in home mortgages is equal to 3.95% in the first subsample and equal to a substantially larger reduction, namely 4.77% in the second subsample.

2. If financial innovation—through a smaller reduction in home mortgages—is behind
the smaller negative responses of GDP and possibly even the smaller negative responses in durable expenditures, then it is somewhat surprising that the drop in residential investment did not become smaller. It is not impossible of course. For example, financial innovation may have made it possible for households to face a smaller decrease in their home equity loans during a monetary tightening and this may have made it possible to have a lower reduction in durable expenditures, while at the same time their ability to use home mortgages to finance residential investment was still suppressed during this type of downturn.

3. An additional reason to believe that financial innovation in the market for mortgages is not behind the reduction in the response of GDP (and durable expenditures) and that is that there is a plausible alternative explanation. The alternative explanation is that home mortgages drop by less, because there is no longer a sharp immediate reduction in real activity. To check the validity of this story, we plot in Figure 19 the IRF of home mortgages for the second subsample when the economy faces a series of monetary policy and real activity shocks such that the time paths for the federal funds rate and the three real activity variables are identical to the IRFs observed in the first subsample. The figure also plots the original IRF of home mortgages during a monetary tightening in the first subsample. It documents that when the second-subsample response of home mortgages is corrected for the differences in the federal funds rate and GDP that the home mortgage response is a lot more negative in the second than in the first subsample.

4. In contrast to the results for consumer credit, there is some evidence that lending activity in the mortgage market affects real activity. For the VAR estimated over the first subsample, we find that the impact of a monetary tightening on GDP would be less than half as large if the mortgage response is set equal to zero. The evidence is mixed, however, because the impact on residential investment is actually somewhat larger if the mortgage response is set equal to zero.

As discussed above and documented in Figure 17, there has been a change in who
finances mortgages following a monetary tightening; whereas in the first subsample non-bank financial institutions did not reduce their mortgages, in the second subsample they strongly increased it. Since the IRF for home mortgages is still negative in the second subsample and—conditional on the behavior of the federal funds rate and GDP—even more negative (see Figure 19), this aggressive behavior of non-bank financial institutions apparently did not show up in the amount of mortgages that consumers got. That is, it resulted mainly in a substitution out of bank into non-bank mortgages. The question arises whether such a substitution is desirable.

7.4.2 Innovation in the mortgage market and non-monetary IRFs

One difference between the real-activity-shock IRFs for the first and the second subsample is that the expansion that follows the initial downturn in home mortgages occurs faster in the second subsample. Also, the downturn is smaller, not only for home mortgages, but for all three real activity variables. Although the changes are not spectacular, they fit the standard story that financial innovation has dampened the impact of shocks. The idea would be that because of financial innovation home mortgages only display a minor initial response and in fact quickly increase in response to this negative real activity shock. This upward shift of the response in home mortgages then dampens the economic downturn. What does not quite fit the story is that the response of GDP, although less negative, remains negative for a longer period.

Either way, these shifts in the IRFs are way too small to be used as support for a theory that argues that the great moderation came about by changes in the responses to shocks. Although the shifts in the IRFs are minor, they are in fact quantitatively important for the change in the covariance between the loan components and the real activity variables, a statistic that has received attention by papers that focus on financial innovation and changing business cycle behavior. The reason is that the IRFs switch sign. We will discuss this in more detail below, but note that the range of forecast horizons at which the home mortgage and the GDP responses have the opposite sign is larger in the second than in the first subsample.
The interpretation of the changes in the IRFs for the other non-monetary shocks is given in Appendix E.2.

7.4.3 **Innovation in the mortgage market and correlations**

In this section, we explain how minor shifts in the IRFs of mortgage lending are consistent with the observed strong reduction in the correlation between mortgages and real activity. Panels A and B of Figure 20 plot the correlation coefficients, calculated using VAR forecast errors, between home mortgages and GDP and residential investment, respectively. The correlations of VAR forecast errors for home mortgages and GDP are not only much lower in the second subsample, they even turn negative (but insignificantly so). For the unconditional correlation coefficients of the cyclical components of home mortgages and residential investment, we found a smaller drop than for the correlation coefficients of home mortgages and GDP. This is confirmed by the correlation coefficients of VAR forecast errors; moreover, the reduction in the comovement between home mortgages and residential investment seems almost completely due to a reduction in the correlation of short-term forecast errors.

The comovement of home mortgages and GDP can almost completely be explained by only two shocks, namely the monetary policy shock and the real activity shock. This is not true for the comovement of home mortgages and residential investment in the second subsample, although it remains true that a large share of the comovement is explained by these two shocks. Figure 21 plots the correlation coefficients together with the contributions of the monetary policy shock and the real activity shock for the two subsamples.

First, consider the correlation with GDP. In the first subsample, the positive correlation between home mortgages and GDP is mainly due to monetary policy shocks. A significant part is also due to real activity shocks. At longer forecast horizons the real activity shocks explain roughly one third of the total correlation, but at shorter forecast horizons it is more. In the second subsample, the correlation coefficients have turned negative although the magnitudes are small. In itself, a reduction and certainly a change in the sign could very well be consistent with financial innovation. If financial innovation makes it possible
to increase mortgages following a monetary tightening and this in turn leads to a lower 
reduction in real activity, then this would make the correlation between the two variables 
negative. From the discussion above, however, we know that this is not what is behind the 
sign change for the comovement due to monetary policy shocks. This comovement has not 
turned negative because the responses of mortgages have become positive, but because the 
responses of GDP have turned slightly positive. The responses of home mortgages are still 
significantly negative and, as documented above, the magnitudes in the second subsample 
are comparable to those observed in the first subsample for a similar size federal funds 
rate shock.

One reason behind the drop in the comovement due to real activity shocks is that 
the responses of home mortgages turn positive earlier. As explained above, this could be 
consistent with financial innovation, but the shifts in the IRFs are not substantial. If the 
IRFs of two variables both change sign, then the covariance can change by just a change 
in the timing of the sign switches. The drop in the covariance is very weak evidence for 
the hypothesis that financial innovation has been part of the great moderation, given that 
the drop in the covariance is due to the kind of minor shifts in the IRFs as reported in 
Figures 3 and 4.

7.5 Summary of mortgage results

The changes in the cyclical behavior of (home) mortgages provides even less evidence that 
financial innovation played an important role in the great moderation than the changes 
for consumer credit for the following reasons.

- Although it is clear that durable expenditures and GDP have become less responsive 
to monetary policy shocks, residential investment still displays a significant decline 
of equal magnitude (for the same size shock).

- Corrected for the differences in the interest rate and real activity responses, the 
reductions in home mortgages following a monetary tightening are larger in the 
second than in the first subsample.\footnote{This does not take into account that—as discussed in Appendix C.1—in some VARs the reduction of}
construct a theory in which financial innovation affects the economy in such a way that following a monetary tightening consumers reduce their borrowing by more, while at the same time reduce the levels of durable expenditures and GDP by less.

- The IRFs following a real activity shock display only a minor shift. Although they move in a direction that is consistent with theories in which financial innovation dampen economic fluctuations, the shifts are too small to be seen as convincing evidence. These minor shifts are important for the correlation coefficients, however, because the IRFs change sign. This empirical finding is more useful in highlighting the limited evidence one can obtain from changes in unconditional correlation coefficients than in supporting a particular economic theory.

As for consumer credit, there have been interesting changes in who finances loans. Comparing the first with the second subsample, we find that following a monetary tightening there is a strong shift towards mortgages being financed by financial institutions other than banks. Such a shift may be important for several reasons. Given the difficulties in evaluating mortgage portfolios, it may not be beneficial for financial stability that the originate-and-distribute practice becomes more prevalent following a monetary tightening. An often expressed view is that this practice has been beneficial for business cycles by expanding the group of potential investors. Our results indicate, however, that in terms of the amount of mortgages actually received by consumers, there is no evidence that it actually dampened business cycles.

8 Concluding comments

There are limitations to a discussion like the one given in this paper that does not focus on a specific model about financial innovation, but tries to refute conventional views on how financial innovation affects business cycles. Consequently, one should be careful drawing mortgages in the second subsample is larger than the reduction in the first subsample (scaled for the size of the shock). It also does not take into account that mortgages have increased sharply relative to GDP, which means that the same percentage reduction corresponds to a larger reduction relative to GDP.
strong conclusions on the basis of such an analysis. Nevertheless, we believe that the empirical evidence presented provides little support for the view that innovation in the markets for consumer loans is behind the great moderation. This does not mean that financial innovation did not have an effect. Financial innovation obviously affected mean levels and we did provide evidence that there have been changes in what kind of financial institution finances what kind of loans when.

In terms of the cyclical behavior of key economic variables, we do not see any evidence that financial innovation has had a moderating influence, which is an important finding when thinking about how to structure new regulation following the financial crisis.

There is one important caveat to our analysis and that is that we have limited ourselves almost completely to consumer loans. It would be more difficult to do a similar exercise for commercial loans given that firms have many more ways in which they can finance themselves. Nevertheless, it definitely would be worthwhile to carefully document the changes in the cyclical behavior of firm financing.

A The literature on financial innovation and the great moderation

In this section we document the extent to which policy makers, policy institutions, and academics supported the view that financial innovation played a role in the great moderation.34 Recent events may have changed the views of some of these authors. But a Google search on "financial innovation" and "bath water" generates many commentaries on the benefits of financial innovation and that in designing future policies one should be careful not to throw the baby away with the bath water.

A striking quote of the belief of one policy maker is the following of Jeffrey Lacker, President of the Federal Reserve Bank of Richmond:

Financial innovation could contribute to growth, therefore, by reducing the volatility of consumption relative to income and expense shocks. While the

34A more complete set of references is given in footnote 2.
intuition for this is straightforward at the level of an individual household, the
effect of improved consumption-smoothing opportunities on aggregate volatil-
ity is not unambiguous. ... Nonetheless, a causal link between the great mod-
eration and the simultaneous wave of financial innovation would seem to be a
plausible conjecture.\textsuperscript{35}

Although not precisely focused on business cycles, the following quote by Jean-Claude
Trichet follows quite closely the arguments used by those that believe that financial inno-
vation dampened business cycles:

..., the reason why the latest episode of stock market adjustments did not
cause systemic problems could be attributed to the contribution of financial
innovation to the more even distribution of risk.\textsuperscript{36}

Policy institutions like the IMF also stressed the beneficial effects of financial innovation
on stabilizing the system. The April 2006 Global Financial Stability Report contains a
chapter on "The influence of credit derivatives and structured credit markets on financial
stability," which starts with the following sentence:

There is growing recognition that the dispersion of credit risk by banks to a
broader and more diverse group of investors, rather than warehousing such risk
on their balance sheets, has helped to make the banking and overall financial
system more resilient.\textsuperscript{37}

The remaining quotes in this section are from academics.
Blanchard and Simon (2001):

Our findings also suggest a role for improvements in financial markets in
reducing consumption and investment volatility.

In the same article, the following is mentioned:

\textsuperscript{35}In Lacker (2006).
\textsuperscript{36}In Trichet (2003).
\textsuperscript{37}See IMF (2006).
The decrease in output volatility appears sufficiently steady and broad based that a major reversal appears unlikely. This implies a much smaller likelihood of recessions.

de Blas-Pérez (2009):

..., the results are most consistent with a decline in shock variances which was reinforced by a decrease in financial frictions, making the economy less vulnerable to shocks.

Guerron-Quintana (2009):

When moving toward a more flexible portfolio, the model can account for almost one-third of the observed decline in the volatilities of output, consumption, and investment.

Cecchetti (2008):

There are a variety of possible explanations for this unprecedented stability. ... , the one that I put most weight behind is that financial innovation has allowed companies and individuals to smooth consumption and investment in the face of fluctuations in income and revenue. ... The result of the last 20 years of financial innovation is that we can insure virtually anything and engage in activities we would not have undertaken in the past. As a result growth has been more stable and business cycles have been less frequent and severe.


We employ a variety of simple empirical techniques to identify links between the observed moderation in economic activity and the influence of financial innovation on consumer spending, housing investment, and business fixed investment. Our results suggest that financial innovation should be added to the list of likely contributors to the mid-1980s stabilization.

..., we find that the volatility of output falls as a country’s financial system becomes more developed and its central bank becomes more independent. Volatility fell by more in countries where credit became more readily available.

Peek and Wilcox (2006):

Our results provide some evidence that the larger and more fully developed and integrated SMM [secondary mortgage market] tempers the responses of residential investment to income and to interest rates, and thereby lowers the volatility of residential investment.

B Constructing time series for bank mortgages

In the Flow of Funds data set, there is an item for bank mortgages, but this item only includes the mortgages banks hold directly on their balance sheets. Therefore, it only provides limited information, because banks hold a lot more mortgages on their balance sheets in the form of asset-backed securities. In this section, we explain how we calculate the amount of mortgages banks hold indirectly on their balance sheets.

To decide what should be included, we checked schedules RC-B & RC-D of the Call reports on which this part of the Flow of Funds is based and the Guide to the Flow of Funds Accounts published by the Board of Governors of the Federal Reserve System.\(^{38}\)

Schedule RC-B, item 4, mortgage-backed securities:

4.a. Pass-through securities

1. guaranteed by GNMA
2. issued by FNMA & FHLMC
3. other pass-through securities

\(^{38}\)Schedule RC-D provides information of assets held for trading, which are excluded in schedule RC-B.
4.b. Other mortgage-backed securities (CMOs, REMICs, & Stripped MBSs)

1. issued or guaranteed by FNMA, FHLMC, or GNMA
2. collateralized by MBSs issued or guaranteed by FNMA & FHLMC
3. other MBSs

Schedule RC-D, item 4, mortgage-backed securities:

4.a. Pass-through securities issued or guaranteed by FNMA, FHLMC, or GNMA
4.b. Other mortgage-backed securities issued or guaranteed by FNMA, FHLMC, or GNMA
4.c. All other mortgage-backed securities

For U.S.-chartered commercial banks, the Flow of Funds lists the following potentially relevant series in L.110:39

row 7 Agency- and GSE-backed securities: Mortgage and GSE-backed securities; this item consists of items 4.a.1 and 4.a.2 of schedule RC-B and item 4.a of schedule RC-D
row 8 Agency- and GSE-backed securities: CMOs and other structured MBS; this item consists of item 4.b.1 of Schedule RC-B and item 4.b of schedule RC-D.
row 9 Agency- and GSE-backed securities: Other; these include U.S. government agency obligations and MBSs are explicitly excluded.
row 12 Corporate and foreign bonds: Private mortgage pass-through securities; this item consists of item 4.a.3 of schedule RC-B and item 4.c of schedule RC-D.
row 13 Corporate and foreign bonds: Private CMOs and other structured MBS; this item consists of item 4.b.2 of schedule RC-B.
row 14 Corporate and foreign bonds: Other; this item consists of item 4.b.3 of schedule RC-B, but also of other items.

39There are occasional changes in row numbers; our row numbers correspond to those of the March 2009 issue of the flow of funds.
Obviously, we have to exclude row 9. Row 14 includes some MBSs, namely those that are not pass-through securities and not related to GNMA, FNMA, or FHLMC, but it also includes securities that are not related to mortgages. Row 14 is not trivial in magnitude. In 2006, it was equal to 6% of the sum of rows 7, 8, 12, 13, and 16 and 22.6% of the sum when row 16 is excluded. The largest part of row 14, however, is not related to mortgages. We obtained individual bank data from the Call Reports and aggregated them to obtain the six items that are part of row 14. At the end of our sample, roughly 40% of row 14 is related to mortgages. This means that the mortgage part of row 14 is roughly 1.5% of all U.S.-chartered mortgages and 9% of these banks MBSs. Therefore, our total mortgage measure for U.S.-chartered commercial banks consists of rows 7, 8, 12, 13, and 16.

For savings institutions, the listed series in L.114 of the Flow of Funds are identical to those of U.S.-chartered banks and we construct our total mortgage measure for savings institutions in the same way.

For credit unions, the Flow of Funds lists in L.115 only the total amount of pass-through securities and the total for other mortgage-backed securities. For credit unions we, therefore, only use home mortgages (row 10) and agency-and GSE-backed securities (row 8). We would miss the MBSs in corporate and foreign bonds (row 9), but this balance sheet item is very small relative to both the quantities in row 8 and row 10.

\footnote{Namely Call Report series RCON1733 and RCON 1735.}

\footnote{In particular, it includes other debt securities, RCON1737 & RCON 1739), and foreign debt securities, RCON 1742 & RCON 1744.}

\footnote{It is not difficult to do such an exercise for one period, but it is to do it for a whole time series. The problem with the Call Reports is that it is not trivial to construct consistent time series because the definitions often change.}
C Robustness

C.1 Lack of robustness of second subsample GDP responses

In the second subsample, the response of GDP following a monetary tightening is slightly positive and significant. This is not a robust result. Alternative VAR specifications can give significantly negative responses. The results in Figure 26 are from a VAR identical to the one used in the main text, but without a deterministic trend. Excluding the deterministic time trend makes the responses across the two sample more similar, especially if we would equalize the size of the shock in the federal funds rate. GDP now starts to decrease in the first two quarters and the responses are significant after two years. The responses of durable expenditures as well as those for consumer credit are also significantly negative for this VAR specification. The negative response for home mortgages is stronger. The results generated by this VAR are even less in favor of financial innovation affecting business cycles. The results in Figure 27 are based on the same VAR except that the deflator is excluded. Now the negative responses of both the real activity and the consumer loan variables are even stronger. Scaled for the size of the federal funds rate shock, the drop in home mortgages would be much larger in the second than in the first subsample.

The finding that there are simple VAR specifications in which there are still sizeable drops in both real activity and consumer loans following a monetary tightening question the validity of the hypothesis that it has become easier for consumers to keep on borrowing during a monetary tightening and that in turn this reduced the magnitude of the economic downturn. Our interpretation of the empirical evidence is the following. In the second subsample, there is no robust evidence that real activity (except residential investment) declines following a monetary tightening. The comovement between real activity and consumer loans does not seem to have changed, however. That is, whenever a VAR generates a sizeable drop in real activity, it also generates a sizeable drop in the two consumer loans. If a VAR does not generate a sizeable drop in all real activity variables, it may also not generate a sizeable drop in both types of consumer loans.

If consumer credit, durable expenditures, and GDP, all drop following a monetary tightening,
tightening, as documented in Figure 27, then the question arises whether the correlation of the forecast errors still drops. The covariances according to the VAR underlying this figure are reported in Figure 28 together with the role of the monetary policy and the real activity shock. The covariance of consumer credit with both durable expenditures and GDP still drops, but clearly not as much as for the VAR used in the main text. That is, there are covariance measures between consumer credit and real activity that do not even drop, further weakening the evidence against the hypothesis that financial innovation played a role in the great moderation. Interestingly, the smaller drop in the correlation coefficients according to this VAR is not due to the IRFs of consumer credit and the real activity variables all dropping during a monetary tightening. The lesser importance of monetary policy shock and the delayed drop in consumer credit keeps the covariance due to monetary policy shocks low. Figure 28 shows that this comovement measure does not drop by this much because according to this VAR the comovement driven by real activity shocks does not drop by much and at higher forecast horizons even increases. This is not that surprising. In the main text, we documented that small changes in these IRFs could have large effects on the correlation between the forecast errors, because the IRFs switched sign and that the turning point moved over time, but differently for different variables. Then one can expect that the changes in the correlation coefficients are not that robust, which we show here is indeed the case.

C.2 Alternative VAR specifications

We found that our main results are robust to several changes in the specifications of the VAR, such as estimation in first differences or changing the number of lags. In particular, we find that there is a sizeable drop in home mortgages and residential investment following a monetary tightening in both the first and the second subsample and that real activity variables have a strong effect on loan variables, but not vice versa. One obvious alternative to consider is a VAR that includes an index for house prices. Figure 29 reports the IRFs for the real house price, residential investment, and home mortgages when the OFHEO house price index, deflated by the GDP deflator, is added to the VAR. The panels for residential
investment and home mortgages also plot the IRFs when the VAR does not include the house price index, that is, the results from Figure 3. Because of data limitations, we can only obtain these IRFs for the second subsample. The graph documents that a monetary tightening leads to a significant but small drop in house prices. Moreover, the IRFs of residential investment and home mortgages are not affected very much.\textsuperscript{43}

D Real activity shocks

Our VAR contains three real activity variables: residential investment, durable expenditures and GDP. For each of these variables, our Cholesky decomposition gives rise to an associated shock. In the main part of this paper, we analyze the IRFs when \textit{each} of the three innovations is equal to one standard deviation. In this appendix, we discuss the responses to the three individual shocks. The corresponding IRFs are shown in Figures 22, 23 and 24.

Residential investment shock. There are several similarities in the shapes of IRFs across the two subsamples. The main change seems to be that the magnitudes of the responses have declined, which resembles the results for a joint real activity shock.

In the first subsample, the three real activity variables as well as the two loan components display an initial decrease followed by a quite substantial increase. Similar to the change observed for the responses to a joint real activity shock, the responses of home mortgages to a residential investment shock seem to have shifted upward and turn positive earlier. In itself this is consistent with financial innovation, but comparing the IRFs for residential investment and GDP across the two samples indicates that there is not a substantial reduction in the economic downturn and that the drop in GDP even has become a lot more persistent. Relative to the IRFs reported in the main text for a real activity shock, these results provide less evidence in favor of the hypothesis that financial innovation is behind the reduction in the volatility of real activity.

\textsuperscript{43}The results for the other variables are quite similar to those reported in Figure 3.
**Durable expenditures shock.** When we compare the changes in the IRFs of durable expenditures and GDP to a durable expenditures shock with the changes in the IRFs to a real activity shock, then we find that the reduction of the negative responses are stronger for the first set. This would strengthen the case for financial innovation having had a favorable impact on business cycle behavior. When we compare the responses of consumer credit to a durable expenditures shock with the responses of consumer credit to a real activity shock, however, then we find that the responses to a durable expenditures shock are very similar across the two subsamples. With an almost equal reduction in consumer credit, it seems unlikely that financial innovation is behind the smaller reductions in real activity.

**GDP shock.** At first sight, the changes in the IRFs following a GDP shock do seem to support the view that financial innovation had a favorable impact on the transmission of this shock on the economy. That is, in response to a negative GDP shock the IRF of home mortgages increases faster in the second subsample and so does the IRF of residential investment; GDP and durable expenditures drop by less in the second subsample. In the second subsample, however, the negative drop in GDP leads to a more persistent drop in the federal funds rate and this could also be behind the observed changes in home mortgages and residential investment.

**E Other shocks**

In the main text, we discussed the responses to a monetary tightening and a joint real activity shocks. In this section, we discuss the responses to the other shocks. The IRFs are plotted in Figures 5, 6, and 7.

**E.1 IRFs of other shocks**

**Price shock.** Most of the responses are insignificant in the subsamples. Interestingly, the responses are often significant over the complete sample, which also includes the period from 1979Q1 to 1983Q4 during which inflation was sharply reduced. None of the
two subsamples include this period. One interesting observation is that in the second subsample there is a significant monetary tightening in response to a positive price shock, whereas in the first subsample, there is an insignificant decline of the federal funds rate. This observation is consistent with the hypothesis that keeping inflation low has become more important for policy makers. Although we found that in the second subsample an unexpected monetary tightening does not have a significant downward effect on durable expenditures, the increase in prices combined with a monetary tightening does still lead to a substantial reduction in durable expenditures.

**Consumer credit shock.** Except for the responses of consumer credit itself, almost none of the responses are significant, which is consistent with the result discussed in the main text that consumer credit does not seem to have a strong effect on the real economy.

**Home mortgage shock.** The responses to a home mortgage shock are also not significant that often (except for the responses of home mortgages itself), but there are still somewhat more significant responses for a home mortgage shock than for a consumer credit shock. One striking observation is that in the second subsample both the negative response of home mortgages itself and the negative response of residential investment have become more persistent. This is, of course, not very supportive of the view that financial innovation dampened economic fluctuations. It is interesting to note that a negative disturbance in home mortgages did correspond with a (short-lived) reduction in durable expenditures and GDP in the first subsample, but that the responses of these two variables are basically flat in the second subsample. A possibly related observation is that in the first subsample consumer credit decreases together with home mortgages, although the reduction is not significant. In contrast, in the second subsample there is a sharp and significant increase in consumer credit. One possible interpretation is that in the first subsample disturbances in the market for home mortgages spread across markets, but that in the second subsample reductions in home mortgages lead to positive opportunities in other financial markets.
E.2 IRFs of other shocks and financial innovation

**Price shock.** The changes in the IRFs after a price shock are close to the opposite of what one would expect if financial innovation had affected business cycle properties. In particular, the consumer credit response has become more negative and the GDP response has become less negative (although possibly more persistent). Moreover, the response of durable expenditures is small and insignificant in the first subsample, but more negative and significant in the second subsample. A much more straightforward explanation for this change is that the FED has become more responsive to inflationary pressure, which explains the upward shift of the response of the federal funds rate, which in turn explains the downward shift of the responses of consumer credit and durable expenditures. Although the responses are not significant, a similar set of results is found for mortgages and residential investment.

**Consumer credit shock.** The drop in consumer credit has only become larger and more persistent, whereas the IRFs of the three real activity variables have become more muted, which does not fit the standard story that better access to loans has dampened economic fluctuations. Given that the responses are typically not significant, however, there is little point in taking the changes seriously.

**Home mortgage shock.** The most interesting change is that in the second subsample there is a negative comovement between home mortgages and consumer credit. This substitution between different types of loans could be a sign of financial innovation. For example, financial institutions may have better substitution possibilities and channel funds towards consumer credit when there are disruptions in the market for home mortgages. This substitution could then very well amplify the downturn in home mortgages and the downturn in residential investment, which is consistent with the IRFs. Better possibilities for financial institutions to adjust their loan portfolio could be beneficial for financial institutions. It is not clear, however, how such substitutions between one type of consumer loan for another benefit consumers and this pattern does not correspond with the view
expressed in the literature that financial innovation made it easier for consumers to keep on borrowing during bad times.

References


Figure 1: Consumer credit and mortgages; scaled by GDP or value underlying asset

A. Consumer credit as a percentage of GDP

B. Consumer credit as a percentage of value durables

C. Mortgages as a percentage of GDP

D. Mortgages as a percentage of value real estate

Notes: "Regular" bank mortgages are those directly held on the banks’ balance sheets and not in the form of asset-backed securities and "all" bank mortgages include both. Mortgages include home and commercial mortgages. In Panel B consumer credit is scaled with the replacement cost of the stock of durables and in Panel D mortgages are scaled with the market value of the total stock of real estate.
Figure 2: Cyclical components

A. Durable expenditures (black) and GDP (grey)

B. Residential investment (black) and GDP (grey)

C. Consumer credit (black) and GDP (grey)

D. Mortgages (black) and GDP (grey)

E. Federal funds rate

Notes: The top four panels plot the HP-filtered residual of the indicated component and the HP-filtered residual of GDP. The federal funds rate, plotted in the bottom panel, is not filtered. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs).
Figure 3: IRFs following a monetary tightening

Notes: Responses to a one-standard-deviation shock in the federal funds rate.
Figure 4: IRFs following a real activity shock

Notes: Responses to a simultaneous one-standard-deviation shock in residential investment, durable expenditures and GDP.
Figure 5: IRFs following a price level shock

Notes: Responses to a one-standard-deviation shock in the price level.
Figure 6: IRFs following a consumer credit shock

Notes: Responses to a one-standard-deviation shock in consumer credit.
Figure 7: IRFs following a home mortgage shock

Notes: Responses to a one-standard-deviation shock in home mortgages.
Figure 8: Cyclical components of consumer credit by owner

Notes: "regular" bank loans are those directly held on the banks' balance sheets and not in the form of asset-backed securities. The graph plots the HP-filtered residuals of the indicated component. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs).
Notes: Responses to a one-standard-deviation shock in the federal funds rate. Regular bank consumer credit is consumer credit banks hold directly on their balance sheets and excludes asset-backed securities.
Figure 10: Monetary tightening and IRFs of durable expenditures and GDP (consumer credit remains constant)

A. IRF of GDP

B. IRF of durable expenditures

Notes: IRFs are constructed by setting the response of consumer credit equal to zero each period.
Figure 11: Monetary tightening and IRF of consumer credit in later sample (with same interest rate and real activity responses as in early sample)

Notes: This figure plots the IRF of consumer credit in the first subsample following a monetary tightening and the IRF of consumer credit in the second subsample, when the economy faces a sequence of monetary and real activity shocks such that the response of the federal funds rate and real activity variables are identical to those observed in the first sample during a monetary tightening.
Figure 12: Comovement between consumer credit and real activity

A. Correlation consumer credit and GDP

B. Correlation consumer credit and durable expenditures

Notes: Correlation of forecast errors at different forecast horizons according to the benchmark VAR.
Figure 13: Decomposition of comovement between consumer credit and real activity

A. Correlation consumer credit and GDP

B. Correlation consumer credit and durable expenditures

Notes: Correlation of forecast errors according to the benchmark VAR. The graph also indicates the role of monetary policy and real activity shocks.
Figure 14: Cyclical components of bank and non-bank mortgages

Notes: These two panels plot the HP-filtered residual of the indicated component and the HP-filtered residual of GDP. Bank mortgages also include mortgage-backed securities. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs).
Figure 15: Cyclical components of home and non-home mortgages

Notes: These two panels plot the HP-filtered residual of the indicated component and the HP-filtered residual of GDP. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs).
Figure 16: IRFs for home, non-home, and total mortgages

Notes: IRFs for the indicated shocks.
Figure 17: Monetary tightening and IRFs for bank and non-bank mortgages

Notes: Responses to a one-standard-deviation shock in the federal funds rate.
Figure 18: IRFs following a monetary tightening
(with same interest rate response as in early sample)

A. Home mortgages

B. Residential investment

Notes: This figure plots the IRF of the indicated variable in the first sample following a monetary tightening and the IRF of home mortgages in the second sample when the economy faces a sequence of monetary policy shocks such that the time path of the federal funds rate is identical to the one observed in the first subsample during a monetary tightening.
Figure 19: IRFs following a monetary tightening
(with same interest rate and real activity responses as in early sample)

Notes: This figure plots the IRF of home mortgages in the first subsample following a monetary tightening and the IRF of home mortgages in the second subsample when the economy faces a sequence of monetary and real activity shocks such that the time paths of the federal funds rate and real activity variables are identical to those observed in the first sample during a monetary tightening.
Figure 20: Comovement between home mortgages and real activity

A. Correlation home mortgages and GDP

B. Correlation home mortgages and residential investment

Notes: Correlation of forecast errors at different forecast horizons according to the benchmark VAR.
Figure 21: Decomposition of comovement between home mortgages and real activity.

A. Correlation home mortgages and GDP

B. Correlation home mortgages and residential investment

Notes: Correlation of forecast errors according to the benchmark VAR. The graph also indicates the role of monetary policy and real activity shocks.
Figure 22: IRFs following a residential investment shock

Notes: Responses to a one-standard-deviation shock in residential investment.
Figure 23: IRFs following a durable expenditures shock

Notes: Responses to a one-standard-deviation shock in durable expenditures.
Figure 24: IRFs following a GDP shock

Notes: Responses to a one-standard-deviation shock in GDP.
Figure 25: Home and non-home mortgages; scaled by GDP or value underlying asset

A. Home mortgages as a percentage of GDP

B. Home mortgages as a percentage of household owned real estate

C. Non-home mortgages as a percentage of GDP

D. Non-home mortgages as a percentage of firm owned real estate

Notes: "regular" bank loans are those directly held on the banks’ balance sheets and not in the form of asset-backed securities. In Panel B home mortgages are scaled with the market value of household-owned real estate and in Panel D non-home mortgages are scaled with the market value of commercial real estate.
Notes: Responses to a one-standard-deviation shock in the federal funds rate. The IRFs are generated by a VAR with the same specification as the one used in the main text, except that no deterministic time trend is included.
Figure 27: IRFs following a monetary tightening; no deterministic time trend and deflator.

Notes: Responses to a one-standard-deviation shock in the federal funds rate. The IRFs are generated by a VAR with the same specification as the one used in the main text, except that neither the deterministic time trend nor the deflator is included.
Figure 28: Decomposition of comovement between consumer credit and real activity; no deterministic time trend and deflator

A. Correlation consumer credit and GDP

B. Correlation consumer credit and durable expenditures

Notes: Correlation of forecast errors according to the VAR that is identical to the benchmark VAR, except that neither the deterministic time trend nor the deflator is included. The graph also indicates the role of monetary policy and real activity shocks.
Notes: Responses to a one-standard-deviation shock in the federal funds rate for the second subsample. The IRFs are generated by a VAR with the same specification as the one used in the main text, except that an index for house prices is included.
Table 1: Standard Deviations (in %)

<table>
<thead>
<tr>
<th>Real activity</th>
<th>'54Q3-'08Q1</th>
<th>'54Q3-'78Q4</th>
<th>'84Q1-'08Q1</th>
<th>change</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>1.53</td>
<td>1.75</td>
<td>0.89</td>
<td>-49%</td>
</tr>
<tr>
<td>Durable expenditures (DE)</td>
<td>4.48</td>
<td>5.21</td>
<td>2.83</td>
<td>-46%</td>
</tr>
<tr>
<td>Residential investment (RI)</td>
<td>9.75</td>
<td>10.73</td>
<td>6.33</td>
<td>-41.6%</td>
</tr>
</tbody>
</table>

| Consumer credit               |             |             |             |        |
| Total (T)                     | 3.65        | 3.59        | 2.85        | -21%   |
| Regular bank consumer credit (RB) | 4.36    | 3.75        | 3.73        | -1%    |
| ABS issuers (ABS)             | -           | -           | 7.89        | -      |
| Finance companies (FC)        | 4.99        | 4.88        | 5.20        | 7%     |
| (T) - (RB)                    | 3.32        | 3.71        | 2.95        | -21%   |

| Mortgages                     |             |             |             |        |
| Total (T)                     | 1.89        | 1.94        | 1.27        | -35%   |
| Regular bank mortgages (RB)   | 3.08        | 2.85        | 2.63        | -8%    |
| All bank mortgages (B)        | 2.89        | 2.84        | 2.23        | -22%   |
| GSEs (GSE)                    | 7.12        | 6.86        | 8.07        | 18%    |
| Agency- & GSE-backed (GSE*)   | 7.51        | 10.15       | 3.60        | -65%   |
| ABS issuers (ABS)             | -           | -           | 7.13        | -      |
| Finance companies (FC)        | 9.50        | 11.65       | 7.50        | -36%   |
| Other (O)                     | 2.27        | 1.30        | 2.98        | 128%   |
| (T) - (RB)                    | 1.50        | 1.32        | 1.58        | 20%    |
| (T) - (B)                     | 1.87        | 1.46        | 2.12        | 45%    |

Notes: The table reports the standard deviation of the cyclical component of the indicated variable. In each sample, the trend used to construct the cyclical component is obtained by applying the HP filter over the whole sample. GSEs are government sponsored enterprises and GSE* stands for agency and GSE-backed mortgage pools. "regular" bank loans are those directly held on the banks' balance sheets and not in the form of asset-backed securities. For mortgages the latter could be calculated and are included in "all" bank mortgages.
Table 2: Correlation coefficients for consumer credit and components

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>RB</th>
<th>ABS</th>
<th>FC</th>
<th>T-RB</th>
<th>GDP</th>
<th>DE</th>
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<tr>
<td><strong>'54Q3-'08Q1</strong></td>
<td></td>
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<tr>
<td>Total (T)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Regular bank loans (RB)</td>
<td>0.95</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ABS issuers (ABS)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Finance companies (FC)</td>
<td>0.73</td>
<td>0.68</td>
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</tr>
<tr>
<td>(T) - (RB)</td>
<td>0.77</td>
<td>0.55</td>
<td>-</td>
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<tr>
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<td>0.66</td>
<td>-</td>
<td>0.36</td>
<td>0.39</td>
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<tr>
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<tr>
<td>ABS issuers (ABS)</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Finance Companies (FC)</td>
<td>0.85</td>
<td>0.73</td>
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</tr>
<tr>
<td>(T) - (RB)</td>
<td>0.89</td>
<td>0.75</td>
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<td>0.94</td>
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<tr>
<td>Durable expenditures (DE)</td>
<td>0.65</td>
<td>0.66</td>
<td>-</td>
<td>0.34</td>
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<td>0.87</td>
<td>1</td>
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<tr>
<td><strong>'84Q1-'08Q1</strong></td>
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<tr>
<td>(T) - (RB)</td>
<td>0.68</td>
<td>0.32</td>
<td>0.47</td>
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<td>0.63</td>
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Notes: The table reports the correlation coefficients of the cyclical components of the indicated variables. In each sample, the trend used to construct the cyclical component is obtained by applying the HP filter over the whole sample. "regular" bank loans are those directly held on the banks’ balance sheets and not in the form of asset-backed securities. GSEs are government sponsored enterprises and GSE* stands for agency and GSE-backed mortgage pools.
Table 3: Correlation coefficients for mortgages and components

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>RB</th>
<th>B</th>
<th>GSE</th>
<th>GSE*</th>
<th>ABS</th>
<th>FC</th>
<th>T-RB</th>
<th>R-B</th>
<th>GDP</th>
<th>RI</th>
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<tr>
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<tr>
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<td>FC</td>
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<td>0.41</td>
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<td>-</td>
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<tr>
<td>T - RB</td>
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<td>0.15</td>
<td>0.20</td>
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<td>0.25</td>
<td>-</td>
<td>0.42</td>
<td>1</td>
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</tr>
<tr>
<td>T - B</td>
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<td>0.13</td>
<td>0.04</td>
<td>-0.03</td>
<td>0.12</td>
<td>-</td>
<td>0.44</td>
<td>0.86</td>
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<tr>
<td>GDP</td>
<td>0.71</td>
<td>0.73</td>
<td>0.74</td>
<td>-0.11</td>
<td>0.29</td>
<td>-</td>
<td>0.33</td>
<td>0.14</td>
<td>0.08</td>
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<tr>
<td>RI</td>
<td>0.45</td>
<td>0.46</td>
<td>0.55</td>
<td>-0.11</td>
<td>0.38</td>
<td>-</td>
<td>0.36</td>
<td>-0.01</td>
<td>-0.16</td>
<td>0.62</td>
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</table>

|          |      |      |      |      |      |      |       |       |       |       |      |
| '54Q3-'78Q4 |      |      |      |      |      |      |       |       |       |       |      |
| T        | 1    |      |      |      |      |      |       |       |       |       |      |
| RB       | 0.97 | 1    |      |      |      |      |       |       |       |       |      |
| B        | 0.96 | 1.00 | 1    |      |      |      |       |       |       |       |      |
| GSE      | -0.31| -0.44| -0.45| 1    |      |      |       |       |       |       |      |
| GSE*     | 0.42 | 0.42 | 0.43 | -0.17| 1    |      |       |       |       |       |      |
| ABS      | -    | -    | -    | -    | -    | -    | -     |       |       |       |      |
| FC       | 0.63 | 0.62 | 0.60 | -0.56| 0.32 | -    | 1     |       |       |       |      |
| T - RB   | 0.52 | 0.32 | 0.30 | 0.24 | 0.19 | -    | 0.38  | 1     |       |       |      |
| T - B    | 0.47 | 0.26 | 0.23 | 0.27 | 0.15 | -    | 0.39  | 0.93  | 1     |       |      |
| GDP      | 0.76 | 0.78 | 0.79 | -0.23| 0.39 | -    | 0.45  | 0.26  | 0.19  | 1     |      |
| RI       | 0.47 | 0.58 | 0.58 | -0.56| 0.44 | -    | 0.52  | -0.14 | -0.19 | 0.59  | 1    |

|          |      |      |      |      |      |      |       |       |       |       |      |
| '84Q1-'08Q1 |      |      |      |      |      |      |       |       |       |       |      |
| T        | 1    |      |      |      |      |      |       |       |       |       |      |
| RB       | 0.70 | 1    |      |      |      |      |       |       |       |       |      |
| B        | 0.69 | 0.88 | 1    |      |      |      |       |       |       |       |      |
| GSE      | -0.18| -0.14| 0.04 | 1    |      |      |       |       |       |       |      |
| GSE*     | 0.18 | -0.18| 0.01 | -0.22| 1    |      |       |       |       |       |      |
| ABS      | -0.03| -0.36| -0.36| 0.09 | -0.30| 1    |       |       |       |       |      |
| FC       | 0.44 | 0.14 | 0.05 | -0.07| -0.03| 0.11 | 1     |       |       |       |      |
| T - RB   | 0.53 | -0.22| -0.10| -0.10| 0.46 | 0.37 | 0.49  | 1     |       |       |      |
| T - B    | 0.48 | -0.12| -0.29| -0.23| 0.19 | 0.46 | 0.56  | 0.81  | 1     |       |      |
| GDP      | 0.32 | 0.51 | 0.42 | -0.01| -0.32| 0.06 | -0.06 | -0.22 | -0.14| 1     |      |
| RI       | 0.23 | 0.21 | 0.39 | 0.46 | -0.17| 0.25 | 0.04  | 0.01  | -0.19| 0.48  | 1    |

Notes: The table reports the correlation coefficients of the cyclical components of the indicated variables. In each sample, the trend used to construct the cyclical component is obtained by applying the HP filter over the whole sample. "regular" bank loans are those directly held on the banks' balance sheets and not in the form of asset-backed securities. GSEs are government sponsored enterprises and GSE* stands for agency and GSE-backed mortgage pools. Meaning of abbreviations can be found in Table 1.