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Chapter 3

The Myth of Financial Innovation and the Great Moderation

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, in particular innovations in consumer credit and home mortgages, played a role in the "great moderation". This paper questions empirical evidence supporting this view. Especially the behavior of aggregate home mortgages changed less during the great moderation than is typically believed. A remarkable change we do find is that monetary tightenings became episodes during which financial institutions other than banks increased their mortgages holdings.[1]

3.1 Introduction

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.[2] The great moderation is the period from roughly the mid eighties until the start of the recent financial crisis during which business cycle fluctuations were small relative to the ones observed in previous decades. The basic idea underlying

[1] This chapter is joint work with Wouter den Haan.

[2] See, for example, Campbell and Hercowitz (2006), Cecchetti, Flores-Lagunes, and Krause (2006), Dynan, Elmendorf, and Sichel (2006), IMF (2006), Jermann and Quadrini (2006), Lacker (2006), Peek and Wilcox (2006), Wang (2006), Cecchetti (2008), Iacoviello and Pavan (2009), and de Blas-Pérez (2009), Guerron-Quintana (2009), Blanchard and Simon (2001), In Appendix 3.A, we provide several citations from policy makers, policy institutions, and academics.

theories that predict that financial innovation dampened business cycles is that financial innovation reduced frictions in lending and that this made it possible for financial intermediaries to continue to fulfil 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 the volumes of both mortgages and consumer credit has dropped enormously. This is a typical prediction of theories according to which financial innovation dampened business cycles.

Although it is now clear that the "innovated" financial sector could not protect the economy against a 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, financial innovation dampened the impact of the type of shocks observed during the great moderation, but magnified the type of shocks 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.

The objectives of this paper are (i) to carefully document the changes in the time series properties of key financial and macro variables and (ii) to discuss whether these are or are not consistent with the predictions of theories according to which financial innovation dampens business cycles. In this paper, we focus on consumer loans, that is, home mortgages and consumer credit. This choice is motivated by the fact that innovations in consumer lending have been a key element in the debate on the role of financial innovations on dampening business cycles. It would definitely be interesting to also include firm financing, but firm financing is very complex and is better treated separately.[3]

A proper evaluation of the changes in the time series properties requires a comprehensive set of statistics. We use the Impulse Response Functions (IRFs) of structural

[3] Using a methodology like the one proposed here, Lozej (2010) analyses changes in the cyclical behaviour of firm lending and finds results that are consistent with financial innovation.

Vector Autoregressive models (VARs) to provide such a set. To see whether the time series properties have changed, we estimate the VAR over an early sample (from 1954Q3 to 1978Q4) as well as over a later sample (from 1984Q1 to 2008Q1) and compare the results. The estimated IRFs also make it possible to analyze the reasons behind the drop in the comovement between real activity and consumer loans, which—as was mentioned above—is used in support of the view that financial innovation dampened business cycles.

The evidence that financial innovation is behind the great moderation turns out to be extremely weak. In particular, we find that the responses of real activity and consumer loans to several shocks have remained remarkably stable over time. The drop in the comovement is due to changes in the IRFs of the monetary policy shock and the real activity shocks. The changes in the responses following a monetary tightening are substantial, but we argue that these changes are not consistent with theories according to which financial innovation dampened business cycles. The observed changes in the responses following a real activity shock also offer no support for these theories. Moreover, the changes in the responses following a real activity shock are quite minor. The responses of both the real activity and the loan variables switch sign following a real activity shock. In that case minor shifts in the responses can have substantial effects on the comovement statistics.

We also investigate what type of financial institution holds consumer loans and whether there have been changes in the 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. One wonders whether it is beneficial for the whole economy that those institutions that know the least about the quality of the borrowers end up holding 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.

In Section 3.2, we explain our strategy to determine whether the data are consistent with the view that financial innovation moderated business cycles. In Section 3.3, we discuss the identification of the structural VAR and the data used to estimate it. In

Section 3.4, we discuss the trends in the variables considered and in Section 3.5 we discuss the cyclical behavior. In Section 3.6, we report and discuss the estimated IRFs and we also show how changes in the comovement can be related to the changes in the IRFs. Section 3.7 is our main section. In this section, we argue that the results are hard to reconcile with theories that predict that financial innovation dampened business cycles during the great moderation. The last section concludes.

3.2 What changes imply that financial innovation dampened business cycles?

The strong reduction in the unconditional correlation between the cyclical components of GDP and both consumer credit and mortgages is an argument in favour of the hypothesis that financial innovation played a role in the great moderation. For example, Campbell and Hercowitz (2006) develop a theory in which financial innovation generates a reduction in the volatility of real activity and in the comovement between consumer loans and real activity. But one can easily think of other reasons for the drop in the correlation. For example, the type of shocks that generates positive comovement could have become less important over time. Therefore, to properly assess whether financial innovation dampened business cycles during the great moderation one needs a much richer set of statistics than just unconditional correlation coefficients. At the core of our analysis are the IRFs of structural VARs estimated over different subsamples. Our 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 or due to fundamental changes in the IRFs.

Several of the responses are quite stable, which is in itself remarkable if financial innovation fundamentally changed business cycle properties. But some of the IRFs did change. The question is whether the observed changes are consistent with the view that financial innovation dampened business cycles during the great moderation. A set of observations

that would be easily explained by financial innovation consists of 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.

A particular set of empirical observations is unlikely to prove that financial innovation is behind the great moderation, because other theories may have the same set of implications. But a particular set of observations could be *in*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 output following a monetary tightening becomes *less* negative and that the response of loans becomes *more* negative or possibly does not change much. Such an observation is inconsistent with standard models in which financial innovation dampens business cycles. 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. We suspect that in a large class of models the consequence of financial innovation is not the combination of a less negative output response and an unchanged or stronger reduction in loans.[4] According to the data, however, this seems to be the case.

[4] The theory of Mertens (2008) seems to be an exception. In his model, the wage bill is constrained by the amount of available loans. Financial innovation is typically modelled as a relaxation of such constraints. In contrast, Mertens (2008) leaves this constraint untouched, but considers another type of financial innovation, namely the abolishment of Regulation Q. If the response of the real wage rate following a monetary tightening drops by more after the abolishment of Regulation Q, then this would lower the demand for loans making it possible to have a smaller reduction in output and a larger reduction in loans. The question arises whether it is plausible that there are such strong increases in the reduction of the real wage rate response when the reductions in real activity have become smaller.

3.3 Data and methodology

In this section, we describe the data and the methodology to construct IRFs and comovement statistics.[5]

3.3.1 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.[6] 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).[7]

The fraction of loans owned by banks has become smaller over time. One reason is that it has become easy for banks to initiate a loan and then sell it so that the loan ends up on the balance sheet of another (financial) institution.[8] 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".[9] 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

[5] For more details see online Appendix B.

[6] For 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.

[7] Of 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.

[8] Throughout this paper, banks consist of U.S.-chartered commercial banks, savings institutions, and credit unions.

[9] At the end of 2005, $609 billion of the $2.3 trillion in consumer credit was held in pools of securitized assets.

mortgages,[10] we can determine the amount of mortgages held by banks, both directly (which we refer to as *regular* bank mortgages) and indirectly 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.[11] There are many similarities between total and home mortgages, but also some differences. In online Appendix F, we argue that none of the results depend on which series is used when both are available.

Subsamples. Our main focus is on comparing business cycle properties for the 1954Q3-1978Q4 subsample with those of the 1984Q1-2008Q1 subsample. Thus, our sample ends before the complete collapse of financial markets following the bankruptcy of Lehman Brothers in September 2008.

There is wide agreement in the literature that somewhere close to 1980 a trend break did occur. The literature often uses formal econometric tests to split a sample in two, but it is not always that easy to determine the exact break point.[12] Our approach consists of excluding several years of data around the possible dates indicated as candidates for the break point in the literature. This makes it unlikely that the actual break point is not included. More importantly, we would think that the volatile transition period when Paul Volcker started the disinflation process is different from both the period before and after and so can better be excluded. Similarly, we exclude the most recent observations because the large fluctuations observed during the recent crisis are clearly not typical for

[10] 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.

[11] Namely, 76% in 2008Q1.

[12] Boivin and Giannoni (2002) try to find the date at which the great moderation started and conclude that no robust breakpoint is found.

the last couple of decades.

The question arises whether the VAR specifications are constant in the subsamples.[13] There are reasons to believe that they are not; using rolling windows, we find that the correlations between HP-filtered GDP and HP-filtered home mortgages as well as HP-filtered consumer credit have *gradually* declined since the early eighties. We suspect that these types of changes are likely to be the norm not the exception in macroeconomic time series analysis. The implication is that one should be careful in interpreting the results. One obviously cannot expect the IRFs to be equally valid at the beginning and the end of the sample used. The best way to interpret them would be to think of the estimated IRFs as *average* responses over the sample.

3.3.2 Identifying 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:[14,15]

$$Z_t = B_1 Z_{t-1} + \cdots + B_4 Z_{t-4} + u_t. \tag{3.1}$$

The relationship between the reduced-form error terms, u_t, and the structural shocks, ε_t, is given by

$$u_t = \overline{A}\varepsilon_t, \tag{3.2}$$

where $\overline{A}$ is a (7×7) matrix of coefficients and $\mathrm{E}[\varepsilon_t \varepsilon_t']$ is the identity matrix. We follow Bernanke and Blinder (1992) and many others by assuming that the federal funds rate is the relevant monetary instrument. In particular, we use the average of daily rates

[13] Given the size of the subsamples, we could not consider further splits.

[14] 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, as is shown in Appendix E.

[15] We use four lags since this is common practice when using quarterly data. Model selection criteria indicate that a shorter lag may be better, but as documented in online Appendix E the results are robust to using a smaller number of lags.

during the *last* month of the quarter. When using the federal funds rate at the end of the quarter,[16] it makes sense to assume (i) that the Board of Governors of the Federal Reserve (FED) can respond to the contemporaneous realizations of the structural shocks and (ii) that the other variables in the system cannot respond to the monetary policy shock within the period.[17]

The variable Z_t consists of the federal funds rate, the log of real GDP, the log of the GDP deflator, the log of real durable expenditures, the log of real residential investment, the log of consumer credit deflated with the GDP deflator, and the log of home mortgages deflated with the GDP deflator. Thus, we could in principle identify six more shocks in addition to the monetary policy shock. To identify these, we use the Cholesky decomposition and order the remaining variables so that those variables that are likely to have the slowest response are ordered first.[18]

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.

3.3.3 Comovement decomposition

As an alternative to measuring comovement with the correlation coefficients of HP-filtered time series, we use the comovement statistics of den Haan (2000) constructed using the estimated VAR. With these correlation coefficients we obtain results that closely resemble

[16] We could have taken the last daily observation of the quarter, but daily observations of the federal funds rate are at times very volatile.

[17] This implies that $\overline{A}$ has a *block*-triangular structure. Christiano, Eichenbaum, and Evans (1999) show that this is enough to identify the monetary policy shock. That is, one does not have to take a stand on the relationship between the remaining structural shocks and reduced-form error terms as is done when the Cholesky decomposition of the variance-covariance matrix of u_t is used.

[18] The ordering of the variables is as follows: price level, residential investment, durable expenditures, GDP, home mortgages, consumer credit, and federal funds rate.

those found using the standard correlation coefficients based on HP-filtered series.

The reason for including these alternative measures is not so much to document robustness. The main reason is that they allow us to determine the source(s) behind changes in comovement. More precisely, we can decompose the correlation between two variables into the contributions of the structural shocks of our empirical model. In particular, the covariance between the Kth-period ahead forecast errors of x_t and y_t, $COV(x_t, y_t; K)$, is equal to

$$COV(x_t, y_t; K) = \sum_{m=1}^{M} COV(x_t, y_t; K, m) \text{ with } COV(x_t, y_t; K, m) = \sum_{k=1}^{K} x_k^{imp,m} y_k^{imp,m}, \tag{3.3}$$

where $x_k^{imp,m}$ and $y_k^{imp,m}$ are the kth-period responses of variables x and y, respectively, to a one-standard-deviation innovation of the mth structural shock. The total covariance is simply the sum of the accumulated cross products for all possible shocks and does *not* depend on how the shocks are identified.

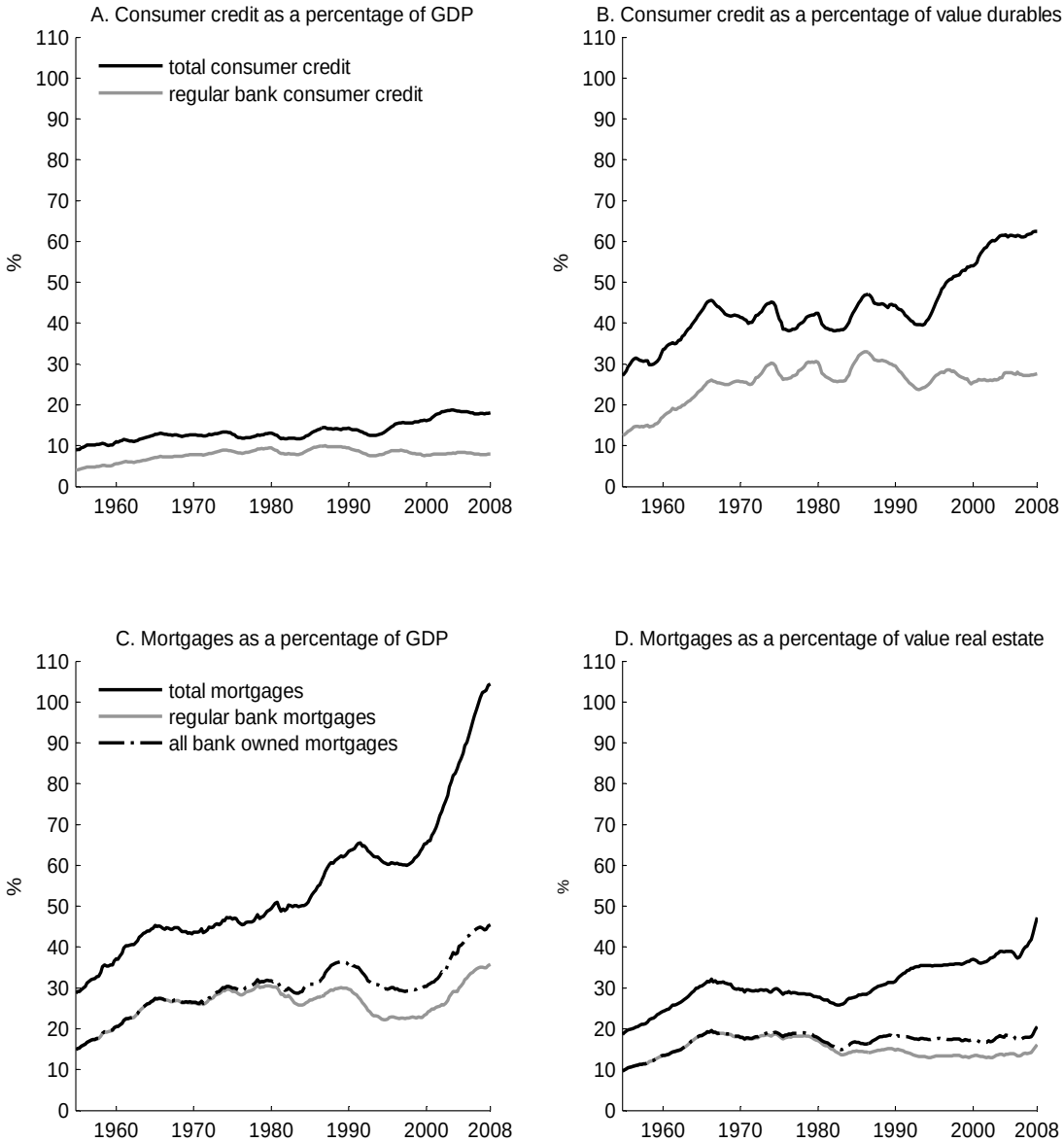
To decompose the correlation coefficient, we use

$$\begin{gathered} COR(x_t, y_t; K) = \textstyle\sum_{m=1}^{M} COR(x_t, y_t; K, m) \\ \text{with} \\ COR(x_t, y_t; K, m) = \frac{\sum_{k=1}^{K} x_k^{imp,m} y_k^{imp,m}}{SD(x_t;K)SD(y_t;K)}, \end{gathered} \tag{3.4}$$

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

In the denominator, we use the *total* standard deviations of the Kth-period ahead forecast error (and not the standard deviations due to the mth-shock) to ensure that the sum of all the scaled covariances is equal to the total correlation coefficient.

Figure 3·1: Consumer credit and mortgages; scaled by GDP or value underlying asset



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.

3.4 Trends

The panels on the left-hand side of Figure 3·1 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%.[19] The panels on the right-hand side of Figure 3·1 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.[20] 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 1970Q1 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

[19] For home mortgages, these numbers are 18.9% and 79.4%.

[20] For home mortgages relative to the value of household-owned real estate, these numbers are 19.5% and 50.9%.

factor, the sustained and sharp acceleration starting around 2000 is no longer present. The 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. As a percentage of the value of real estate, mortgages display 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. We do not know how much consumer credit banks indirectly hold on their balance sheets. Fortunately, for mortgages we do. Figure 3·1 displays the trends in the amount of consumer credit and mortgages that banks hold directly on their balance sheets, which we refer to as regular bank loans. For mortgages, it also plots the total amount of bank-owned mortgages (directly and indirectly held).

The amount of mortgages (home plus non-home) held directly on the banks' balance sheets (which we refer to as regular bank mortgages) was equal to 51.7% of total mortgages in 1954Q3 and 34.1% in 2008Q1. Asset-Backed Securities (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",[21] 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

[21] 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).

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%.

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 (from 9.2% to 18.3% of GDP) is not just due to an increase in regular bank consumer credit. For consumer credit, the most important new type of owner is the 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.

3.5 Cyclical behavior

In this section, we document the changes that have occurred in the cyclical behavior of GDP, consumer credit, home mortgages, and the two components of consumer expenditures that often require financing: durable expenditures and residential investment. Regarding the consumer loan variables, we first consider the total series, i.e., bank and non-bank loans. Next we analyze whether the results are different for different owners.

Volatility. Table 3.1 reports the standard deviations of our key variables over the two subsamples.[22] 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.[23] Similar declines are found for durable expenditures and residential investment.

The standard deviations of the cyclical components of consumer credit and mortgages have also declined. Comparing the two subsamples, we find that the drop in volatility is

[22] Throughout this paper, we use the HP filter with a smoothing coefficient of $1,600$ to calculate cyclical components.

[23] When we extend the recent subsample up to 2009Q1, then the standard deviation in the second subsample is equal to 0.99% instead of 0.89%.

Table 3.1: Standard Deviations (in %)

	'54Q3-'78Q4	'84Q1-'08Q1	change
	standard deviations		
Real activity			
GDP	1.75	0.89	-49%
Durable expenditures (DE)	5.21	2.83	-46%
Residential investment (RI)	10.73	6.33	-41.%
Consumer credit			
Total (T)	3.59	2.85	-21%
Regular bank consumer credit (RB)	3.75	3.73	-1%
(T) - (RB)	3.71	2.95	-21%
Mortgages			
Total (T)	1.94	1.27	-35%
Regular bank mortgages (RB)	2.85	2.63	-8%
All bank-owned mortgages (B)	2.84	2.23	-22%
(T) - (RB)	1.32	1.58	20%
(T) - (B)	1.46	2.12	45%
	correlation with GDP		
Real activity			
Durable expenditures (DE)	0.87	0.63	-27%
Residential investment (RI)	0.59	0.48	-20%
Consumer credit			
Total (T)	0.74	0.19	-75%
Regular bank consumer credit (RB)	0.76	0.29	-61%
(T) - (RB)	0.57	-0.10	-118%
Mortgages			
Total (T)	0.76	0.32	-58%
Regular bank mortgages (RB)	0.78	0.51	-34%
All bank-owned mortgages (B)	0.79	0.42	-46%
(T) - (RB)	0.26	-0.22	-184%
(T) - (B)	0.19	-0.14	-175%

Notes: The table reports statistics for 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. "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.

larger for mortgages than for consumer credit, namely 35% versus 21%. Both reductions are less than the 49% drop in volatility observed for GDP.[24]

Comovement. Table 3.1 also documents the correlation between the cyclical component of GDP and the cyclical components of the other variables. The sharp reductions in the correlation between GDP and the loan variables are at least as striking as the reduction in volatilities. The correlation between consumer credit and GDP fell from 0.74 to 0.19 and the correlation between the cyclical components of mortgages and GDP fell 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. For home mortgages, the correlation dropped by more, namely from 0.80 to 0.13.

There are two aspects to the decline in the comovement between consumer loans and GDP. First, there is a reduction in the correlation between consumer lending and the associated spending component. The other part of the story seems to be that the correlation between GDP and the spending components has become smaller. For example, the correlation between consumer credit and durable expenditures falls from 0.65 to 0.31. This reduction is clearly not as spectacular as the drop in the correlation with GDP. The correlation between durable expenditures and GDP fell from 0.87 to 0.63. The results for mortgages and residential investment are similar.

The decline in the positive correlation between consumer loans and GDP is—as argued by Campbell and Hercowitz (2006)—consistent with the hypothesis that financial innovation makes 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.[25]

[24] For home mortgages the drop in volatility equals 30% and for non-home mortgages it equals 4%.

[25] For example, unconditional correlation coefficients change when the relative importance of different shocks changes, even if all IRFs remain unchanged.

Graphical presentation. To understand better what is behind the unconditional volatility and comovement statistics, we plot in Figure 3·2 the cyclical component of GDP together with the cyclical components of the two loan variables. The figure clearly illustrates the change in the pattern of comovement. In the beginning of the sample, there is a very close connection between the movements of the cyclical components of GDP and both loan components.

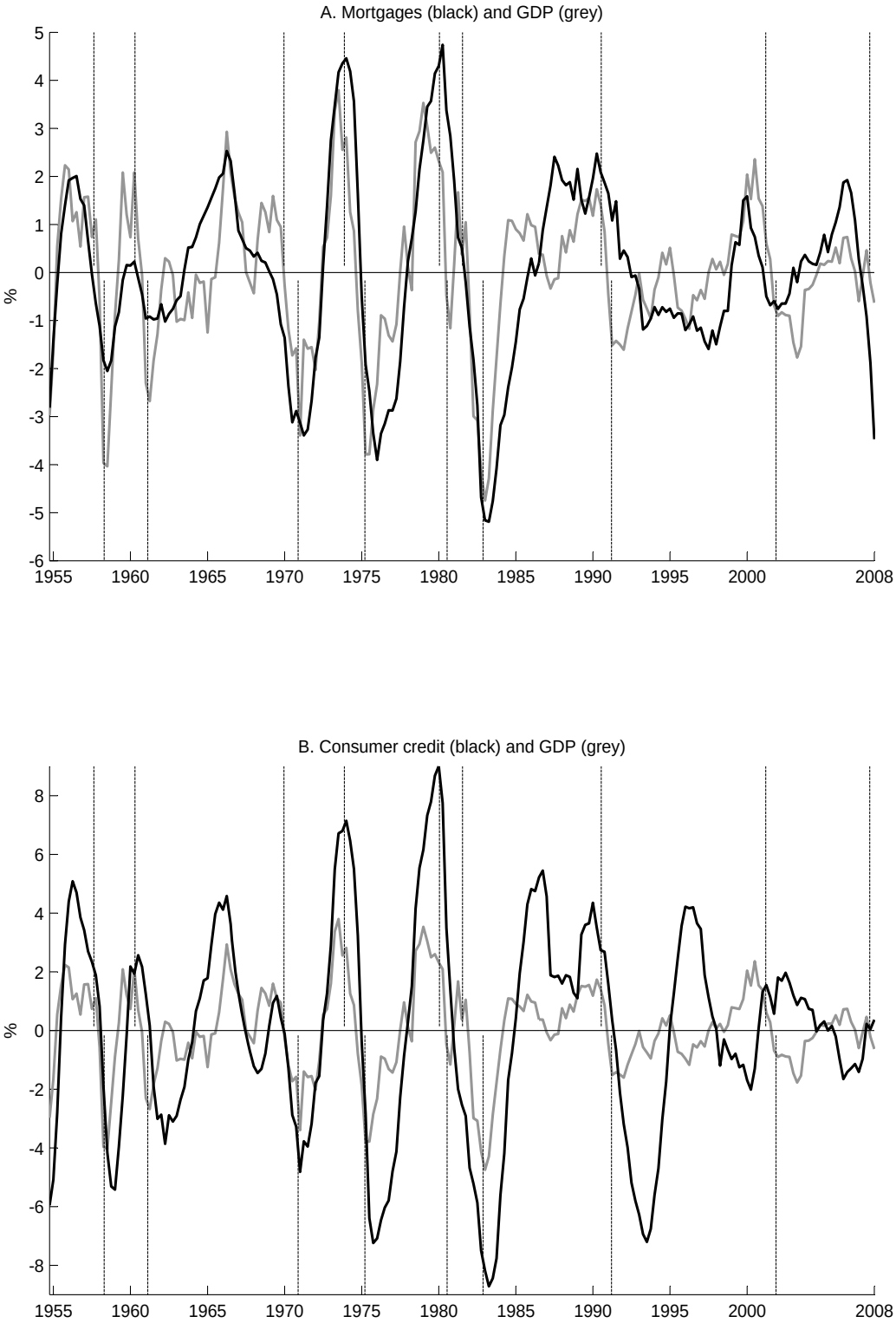
For mortgages, this link is much weaker in the second half of the sample. But there are still substantial "business-cycle" type fluctuations and one full cycle during the nineties with large swings. There are three minor booms in the mortgage series, namely before the 1990-91, before the 2001 and before 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.[26]

To understand the post 1983 sample period better, it is insightful to look at Panel C of Figure 3·1 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 3·1 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.

[26] The graph for cyclical residential investment is given in Den Haan and Sterk (2009).

Figure 3·2: Cyclical components consumer loans



Notes: The panels plot the HP-filtered residual of the indicated loan series and the HP-filtered residual of GDP. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs).

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.

The bottom panel of Figure 3·2 documents that the changes in the cyclical behavior are even more pronounced for consumer credit. Since the mid-nineties, consumer credit even seems to move in the opposite direction to both GDP and durable expenditures. In contrast to the results for mortgages, the changes in consumer credit do not seem an artefact of the filtering procedure. For example, Panel A of Figure 3·1 makes clear that during the 2001 recession the *unfiltered* ratio of consumer credit to GDP is also increasing.

Cyclical behavior of bank versus non-bank loans. Table 3.1 documents that the reductions in the standard deviations of both consumer credit and mortgages for the different types of owners do not add up to the reduction in the standard deviation for the total. For example, the drop for all mortgages is equal to 35%, but the drop is only 22% for bank mortgages and we find an *increase* in the volatility for non-bank mortgages equal to 45%. The reason is that there is a strong reduction in the correlation of the loans held by different institutions. For example, the correlation between bank mortgages and non-bank mortgages drops from 0.23 to -0.29. Similarly, the correlation between regular bank consumer credit and consumer credit not directly held on banks' balance sheets drops from 0.75 to 0.32.[27] The rapid emergence of the "originate and distribute" practice, which allows loans to be financed by a much wider group of investors is likely to be responsible for the lower and in some cases even negative correlation between the consumer loans held by different types of institutions.

Next we address the question whether the observed drop in the correlation between consumer loans and GDP depends on ownership. For example, the correlation between GDP and all mortgages dropped from 0.76 to 0.32, but the correlation between GDP and

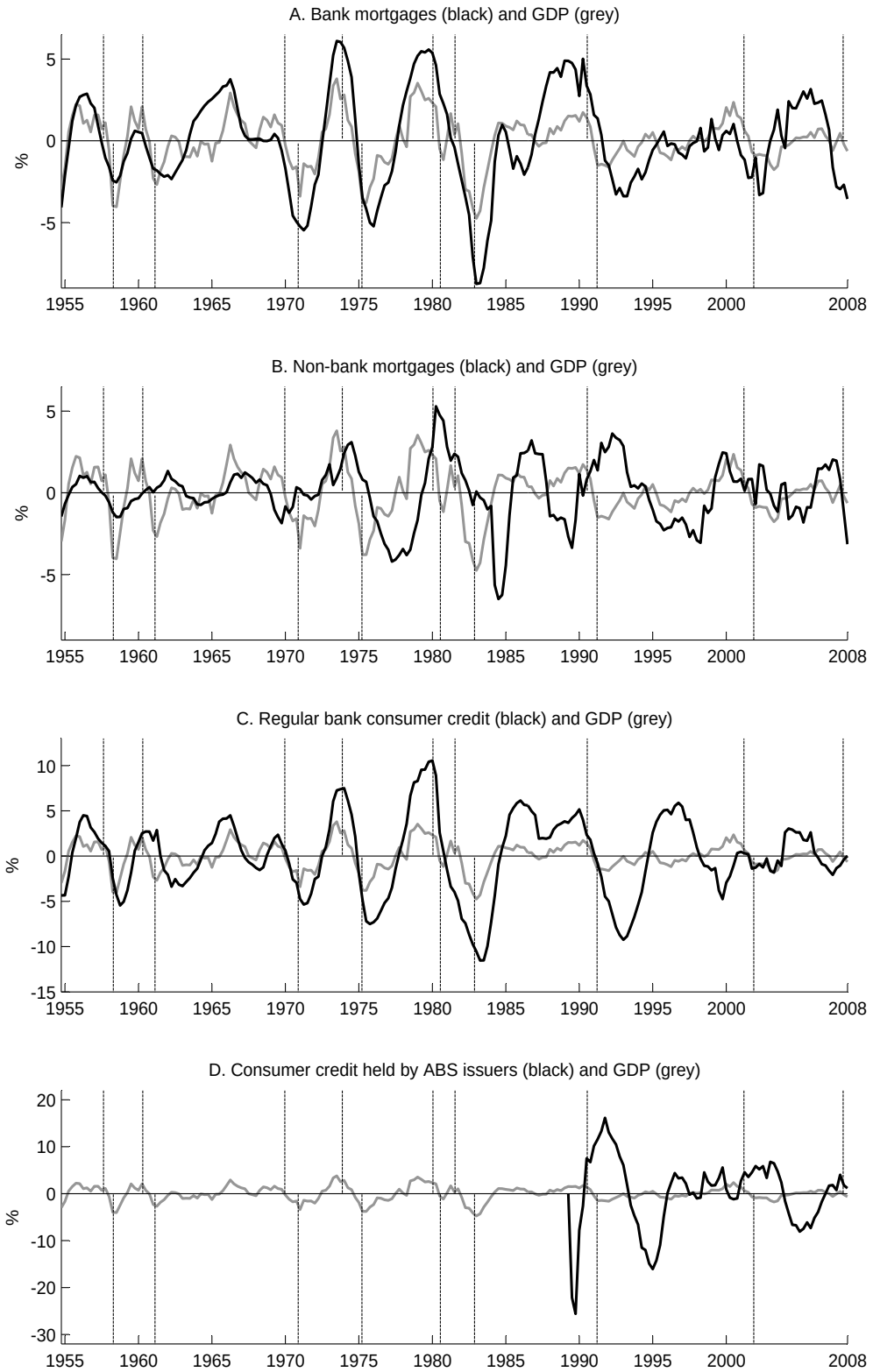
[27] These numbers and more detailed information on the correlation for series by ownership can be found in Den Haan and Sterk (2009).

regular bank mortgages dropped from 0.78 to only 0.51. Interestingly, the correlation between GDP and mortgages not held directly on the banks' balance sheets even turned negative.

Figure 3·3 plots the cyclical components of the loan component by owner. It also illustrates that the observed changes in the cyclical components of the total are not uniformly observed for the components. Consider for example Panels A and B that plot the cyclical components of bank mortgages and non-bank mortgages, respectively. 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 negative, but much less negative than the values taken on during the earlier downturns. 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.

For consumer credit the graph also makes clear that it is important to consider ownership. The 2001 recession is a good example. In Figure 3·2 it was shown that the cyclical component of total consumer credit was positive during this downturn. Now consider Panel C of Figure 3·3 that plots 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 although not as negative. 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.

Figure 3·3: Cyclical components consumer loans (bank versus nonbank)



Notes: The panels plot the HP-filtered residual of the indicated loan series and the HP-filtered residual of GDP. The vertical lines above (below) the x-axis correspond to NBER peaks (troughs). To be able to distinquish between "bank" and "non-bank" mortgages we use "all" instead of "home" mortgages for this graph.

3.6 Impulse response functions

In this section, we discuss the important IRFs, their changes, and relate these changes to the observed drop in the comovement.[28]

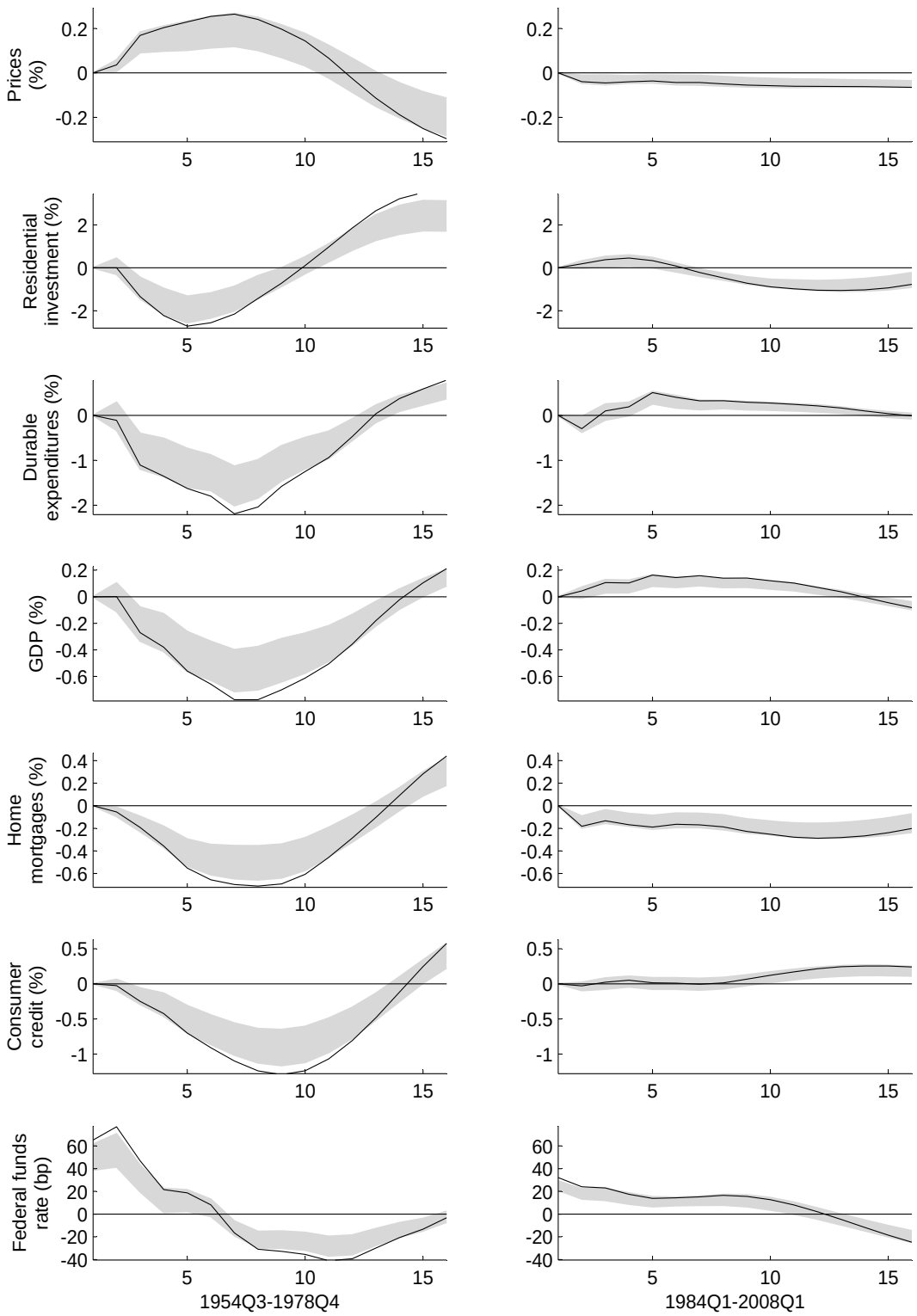
Which structural shocks to consider? There are seven structural shocks in our empirical model. The IRFs of the three real activity shocks turn out to be quite similar so we can condense the discussion by focusing on the IRF that corresponds to the total responses when the innovation of *each* of the three variables is equal to one standard deviation. Online Appendix C 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.

We focus on this real activity shock and the monetary policy shock for two reasons. First, the changes in these two IRFs are responsible for the drop in the comovement between real activity variables and consumer loan variables, a drop that has played an important role in the debate on whether financial innovation dampened business cycles. Second, a cursory evaluation of the changes in the IRFs of a monetary policy and a real activity shock does seem to provide support for the hypothesis that financial innovation dampened business cycles. This view is misleading, however, and we will present evidence that there are aspects of the data that are problematic for this hypothesis, but this does require a bit of work. In contrast, the results for the other shocks are even more problematic for the theories that predict that financial innovation dampened business cycles, because the changes in the IRFs are not impressive and several of the changes that do occur are even the opposite of what such theories would predict. The responses to the other shocks are given and discussed in online Appendix D.

Monetary tightening. Figure 3·4 plots the IRFs following an unexpected monetary tightening. In the early subsample, all three real activity measures considered (GDP, res-

[28] As pointed out by a referee, our analysis is based on a linear framework. Consequently, there are no nonlinearities and no interactions between the shocks.

Figure 3·4: IRFs following a monetary tightening



Notes: Responses to a one-standard-deviation shock in the federal funds rate.

idential investment, and durable expenditures) display sizeable and significant decreases. 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). The response of residential investment has become smaller, but is still significantly negative.[29] 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.

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. For all VAR specifications considered, we find a sizeable reduction in home mortgages. As discussed in online Appendix E, there are even VARs for which the responses of home mortgages are larger in the second subsample when the responses are rescaled for the size of the shock in the federal funds rate. 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.

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 online Appendix E, we document that some VARs generate reductions in consumer credit and that it is even possible to obtain

[29] 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 online Appendix E, 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.

a reduction that, scaled for the size of the shock, exceeds the reduction observed in the first subsample.

Price responses during a monetary tightening. The only response not yet discussed is the price level response. 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. The occurrence of the price puzzle is a common feature of VARs. An initial increase in the price level may happen if the innovation in the federal funds rate is not fully unexpected, but in part a response to higher inflation expectations. Motivated by the analysis of Castelnuovo and Surico (2009), we included a measure of inflation expectations, namely the Greenbook forecast. This reduced the price puzzle in the first subsample somewhat, but clearly did not eliminate it as is documented in online Appendix E.3. The appendix also shows that the other results are not affected when this expectations measure is included.

We could search for the magic variable that eliminates the price puzzle for our analysis. We do not think that our interpretation of the results is hampered much, however, by the fact that the increase in the federal funds rate is in part a response to inflationary pressure. It is possible that the initial inflationary pressure observed in our first subsample was caused by events that would have continued to push up real activity and lending if the monetary tightening would not have taken place. In this case, we underestimate the real activity and lending responses in the first subsample. But given that all three real activity variables and both lending variables decrease almost immediately, it is not clear that there was much upward pressure left.

Bank versus non-bank lending during a monetary tightening. Given that securitization has been one of the important changes in the market for consumer loans, the question arises whether the upward shifts in the responses of consumer credit and home

mortgages are found for bank as well as non-bank lending.

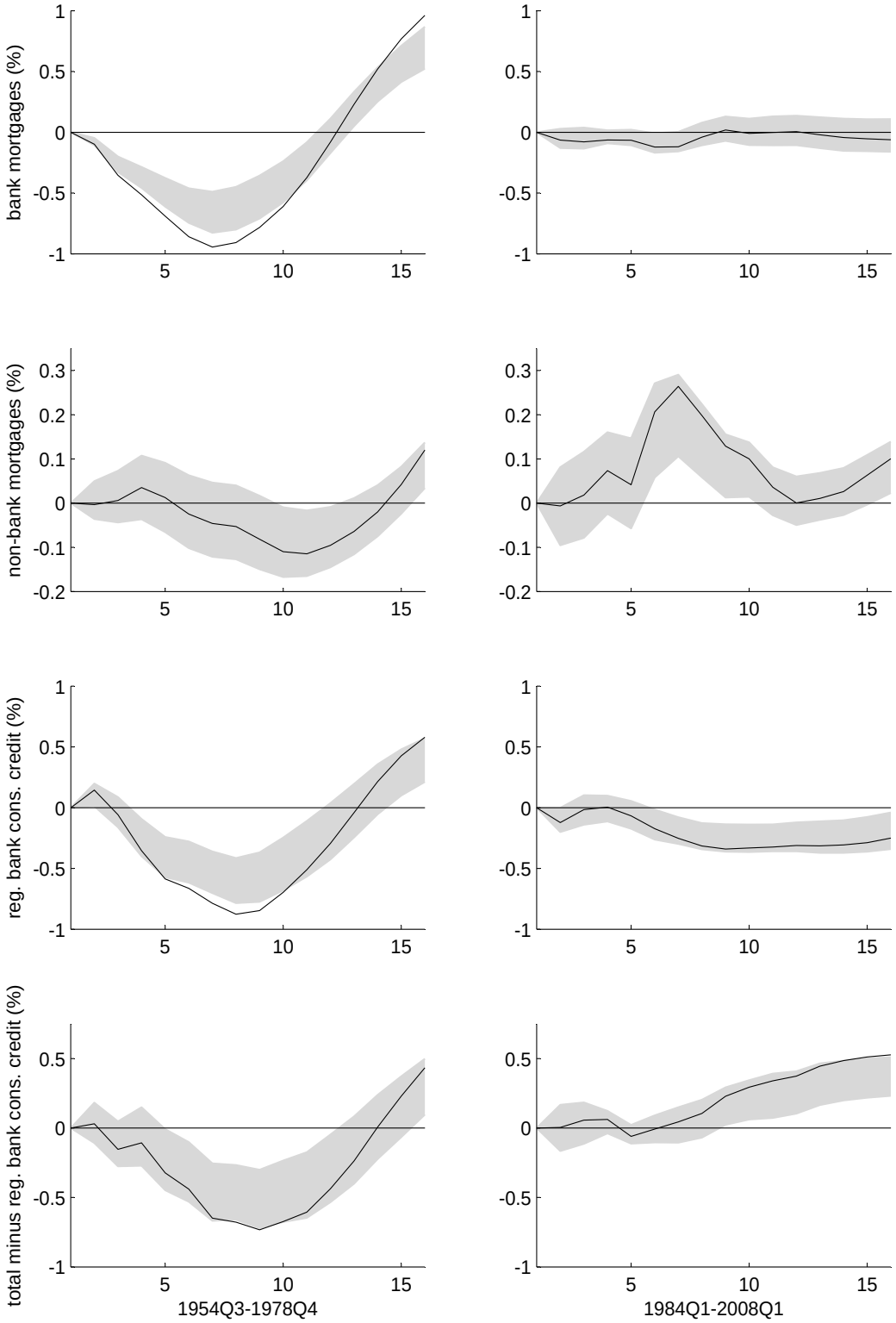
In Figure 3·5, we plot therefore the responses of bank and non-bank mortgages and the responses for regular bank consumer credit and other types of consumer credit.[30] In the first subsample, the IRF of bank mortgages initially declines sharply and remains negative for up to three years, that is, it basically has the same shape as the IRF for home mortgages held by all institutions. In contrast, the IRF for non-bank mortgages only displays a very small decline. In the second subsample, the responses of bank mortgages are still negative, but the decline is much smaller than the decline observed in the first subsample and insignificant. In the second subsample, the responses of non-bank mortgages hover initially around zero, but after roughly a year take on quite large positive values. So the responses of both bank and non-bank mortgages shift up, consistent with the upward shift observed for total mortgages. But the finding that following a monetary downturn non-bank mortgages actually increase is the most intriguing.

For consumer credit, we find the IRF of regular bank consumer credit and the IRF for other consumer credit to be very similar in the first subsample and to resemble the IRF of total consumer credit. As for mortgages, both IRFs shift up. Figure 3·5 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 they are significantly positive after roughly two and a half years.

Thus, if the changes in the IRFs for consumer credit and mortgages related to a monetary tightening are due to financial innovation, then the main cause does *not* seem to lie in a change in the behavior of consumer bank loans.

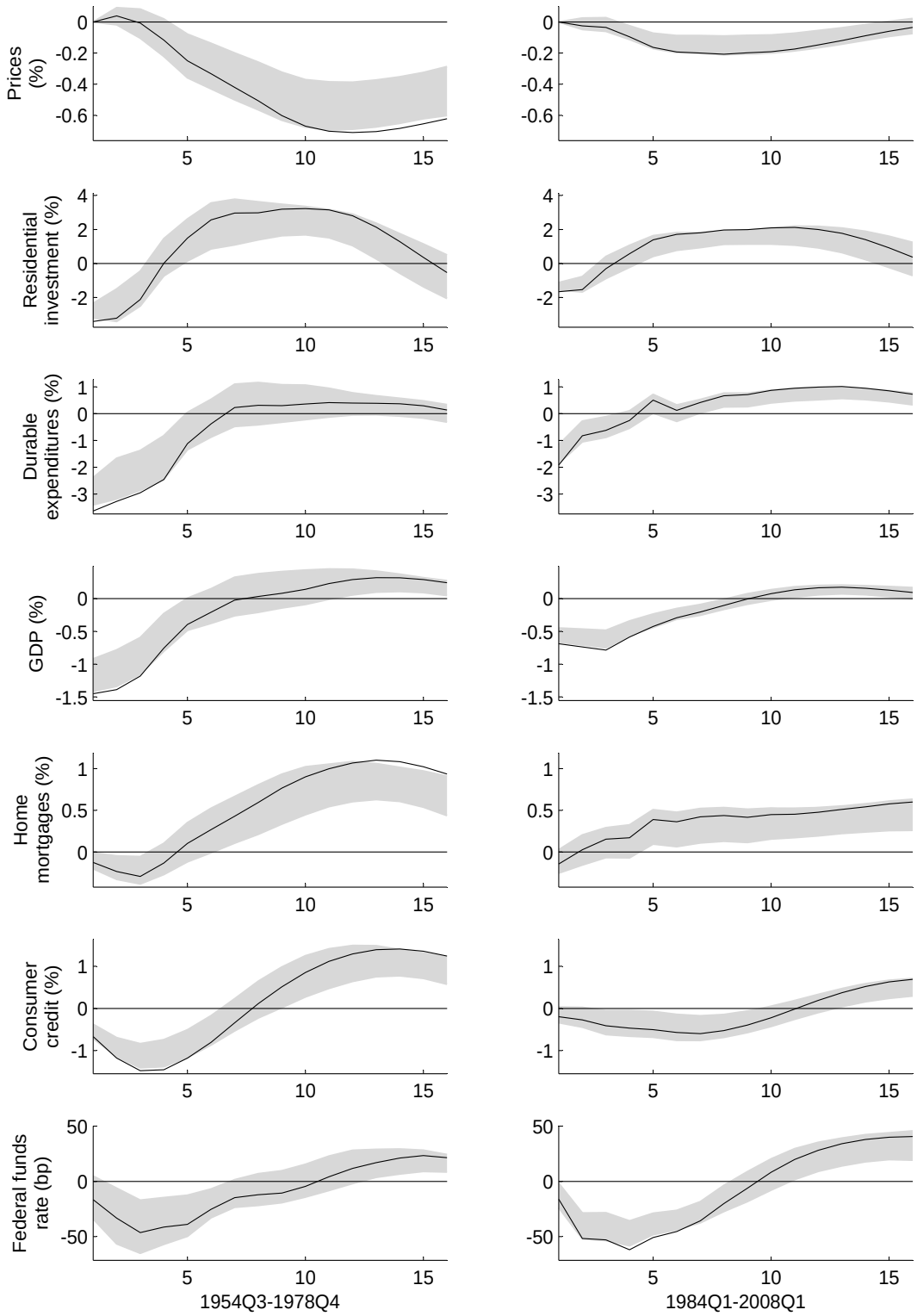
[30] Recall that bank mortgages include mortgages held directly and indirectly by banks, but that *regular* bank consumer credit only includes consumer credit held directly on the banks' balance sheets.

Figure 3·5: IRFs following a monetary tightening; bank versus non-bank



Notes: Responses to a one-standard-deviation shock in the federal funds rate. "regular" bank loans are those directly held on the banks' balance sheets and not in the form of asset-backed securities.

Figure 3·6: IRFs following a real activity shock



Notes: Responses to a simulatenous one-standard-deviation shock in residential investment, durable expenditures and GDP.

Real activity shock. Figure 3·6 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. This is true in both subsamples. In fact, the shapes of the IRFs are remarkably similar across subsamples. However, there are some changes in the magnitudes of the responses and the locations of the turning points. Although these gradual shifts do not seem very important, they turn out to matter quite a bit for the correlation between real activity and consumer loans.

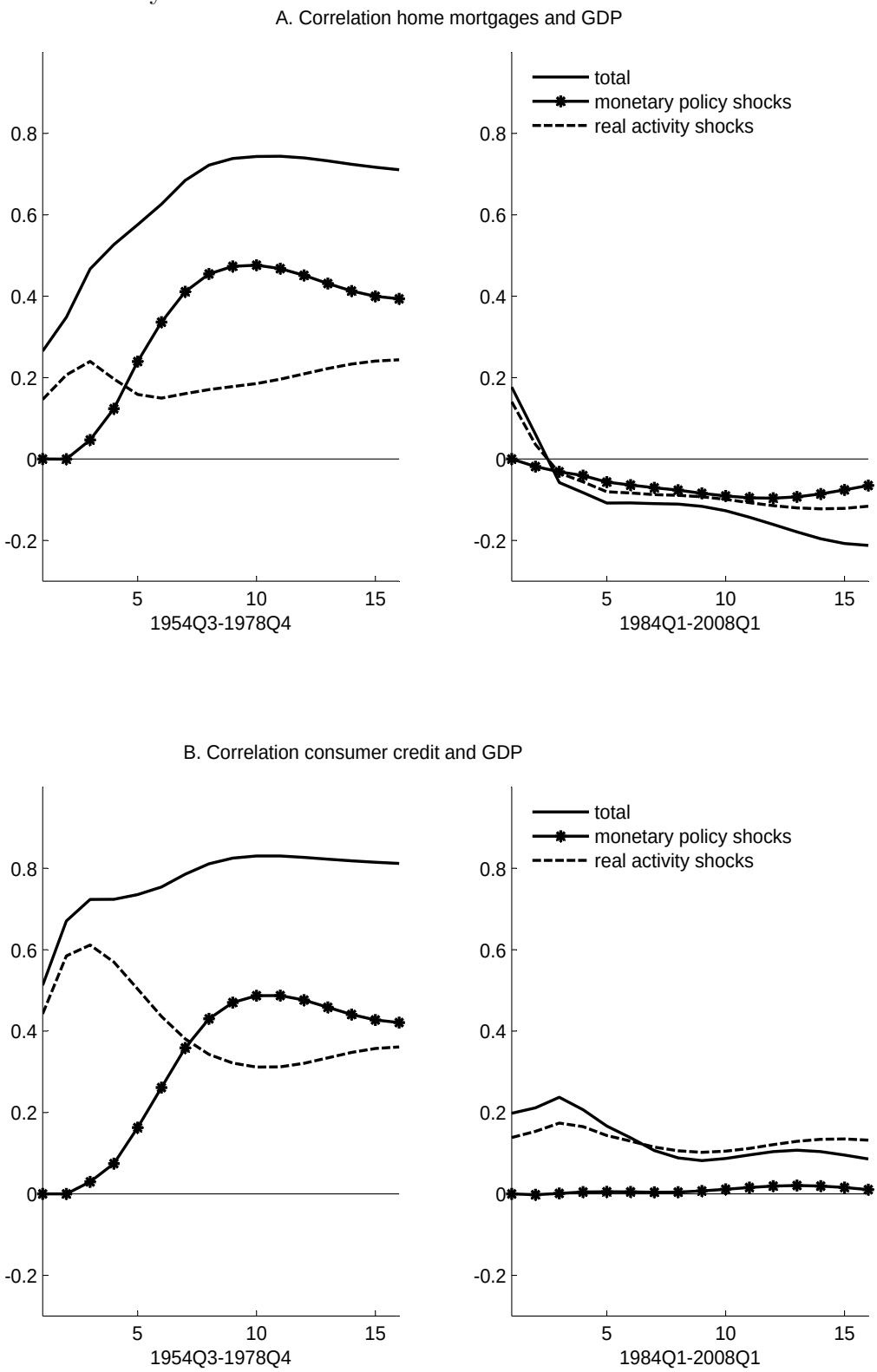
The IRFs of home mortgages and consumer credit follow the same pattern as those of the real activity variables. For mortgages, however, we find that the initial decrease is smaller than the subsequent upturn. This is true in both subsamples, but the initial decrease has become very small in the second subsample and the IRF changes sign quicker. In contrast, for consumer credit the sign switch occurs at a later date in the second subsample. Except for this shift in the location of the sign switch, the pattern is similar across the two subsamples.

IRFs and changes in comovement. Using standard business cycle statistics, we found a strong drop in the comovement between real activity and both consumer credit and mortgages. In this section, we will show that the same result is found using the correlation of forecast errors as implied by the VAR. Moreover, we will relate the observed drop in the comovement to the observed changes in the IRFs. This is a straightforward exercise when the comovement is measured using the correlation of VAR forecast errors.[31]

Figure 3·7 plots the correlation coefficients for the forecast errors of mortgages and GDP as well as the correlation coefficients for the forecast errors of consumer credit and GDP as implied by the VAR. It also plots the parts of the correlation coefficients that are due to the monetary policy and the real activity shock. It turns out that these two shocks are responsible for a very large part of the observed correlation coefficients and for why the correlation coefficients dropped so sharply.

[31] See Equation 3.4.

Figure 3·7: Decomposition of comovement between consumer loans and real activity



Notes: Correlation of forecast errors according to the benchmark VAR. The graph also indicates which part of the correlation is due to monetary policy and real activity shocks.

The two panels in the top row of the figure plot the results for mortgages and they show that the drop in this measure of comovement is at least as dramatic as the drop observed using standard business cycle statistics. The figure also shows that the monetary policy shock and the real activity shock imply a positive correlation in the first subsample, together being basically responsible for all of the observed comovement. In the second subsample, these two shocks do no longer generate a positive comovement. In fact, they generate a slight negative comovement. Since none of the other shocks generate a substantial comovement (either positive or negative), total comovement is slightly negative as well.

The results for the comovement between consumer credit and GDP are very similar to those for mortgages, except that real activity shocks still generate a modest positive comovement in the second subsample. These are displayed in the bottom two panels of the figure.

Recall that the sharp drop in the unconditional correlation between loan variables and GDP has been used to support theories that financial innovation played a role in the great moderation. The results in Figure 3·7 make clear that the drop in the comovement is due to changes in the IRFs of a monetary policy shock and the IRFs of a real activity shock. The advantage of the IRFs is that they provide more information than the unconditional correlation coefficients. In the next section, we will address the question whether the particular changes in the IRFs are indeed consistent with the hypothesis that financial innovation dampened the magnitudes of business cycles.

3.7 Financial innovation and the great moderation

In this section, we address the question whether the empirical evidence is consistent with the hypothesis that financial innovation reduced the magnitudes of cyclical fluctuations in variables like GDP, durable expenditures, and residential investment.

3.7.1 Preliminary evaluation

At first glance, the results presented in the previous two sections seem favorable to the hypothesis that financial innovation played a role in moderating business cycles. Consider the responses for consumer credit and home mortgages following a monetary tightening and a negative real activity shock, two not unimportant shocks. We find that the reductions in both types of consumer loans are smaller in the second than in the first subsample. These findings are consistent with the view that financial innovation has made it easier for financial intermediation to fulfil its role in the presence of adverse aggregate shocks, resulting in smaller drops in consumer lending, which in turn dampen the downturn. The sharp reductions in the observed comovement between real activity and consumer loans is also consistent with the view that financial innovation dampened business cycles.

In the next subsection, we express a series of arguments that cast doubt on this way of thinking about what the data tell us.

3.7.2 Doubts about financial innovation having dampened business cycles

In this section, we give reasons that made us doubt the validity of the hypothesis that financial innovation dampened business cycles during the great moderation. The organization of our arguments is the following. In Sections 3.7.2 and 3.7.2, we look more closely at the IRFs of a monetary policy and a real activity shock, respectively and argue (i) that the IRFs actually have not changed that much and (ii) that a close look at the changes reveals that they do not fit the standard story about financial innovation moderating business cycles that well. In Section 3.7.2, we take a closer look at the drop in the comovement between consumer loans and real activity. Our structural VAR makes it possible to link changes in the unconditional correlation coefficient to changes in the IRFs. We will show that the types of changes in the IRFs responsible for the drop in the correlation coefficient are not convincing evidence for the view that financial innovation dampened business cycles. In Section 3.7.2, we will show that the data do not

reveal much support for the hypothesis that the amount of loans issued actually has an important impact on real activity, an important ingredient for theories that predict that financial innovation dampens business cycles. Finally, we argue in Section 3.7.2 that there is a very simple alternative explanation for the observed changes in the IRFs.

Financial innovation and changes in monetary IRFs

Figure 3·4 displayed substantial differences between the IRFs in the first and second subsample. We want to argue, however, that the changes are not as large as they look. Moreover, we will argue that there are reasons to believe that mortgages dropped by *more* in the second subsample, not by less.

Using the right scaling. 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. In particular, following a monetary tightening, the maximum reduction in home mortgages relative to GDP is equal to 0.19% in the first subsample and is actually somewhat larger, 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.

Measured relative to GDP or residential investment the drop in mortgages has become bigger in the second subsample *even though* the drop in the federal funds rate has become much smaller. We now turn to this issue.

Comparing similar changes in the federal funds rate. 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 is likely to correspond with a larger underlying structural shock.[32] 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.

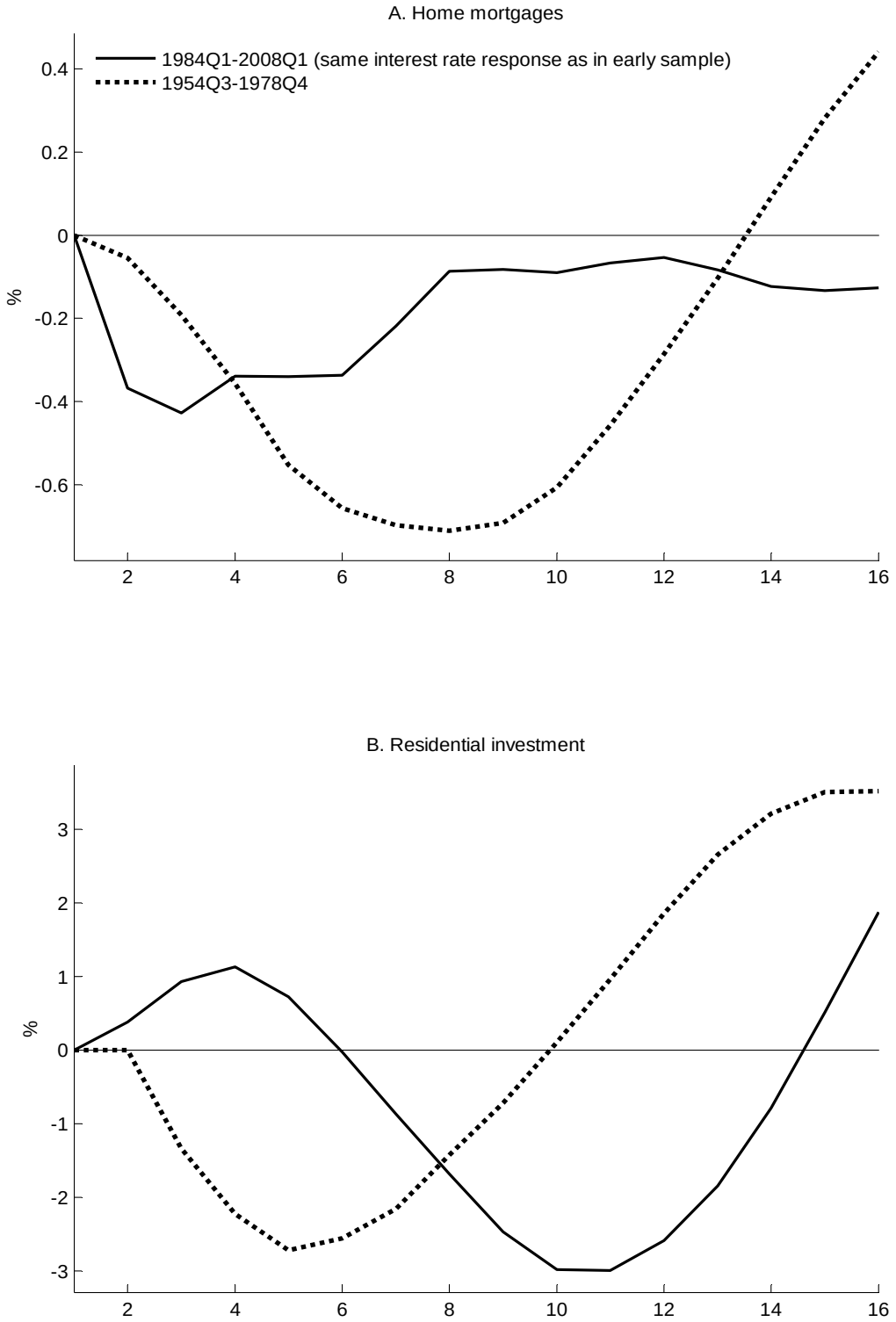
The magnitude of a monetary policy shock used to construct the subsample IRFs in Figure 3·4 is equal to the standard deviation of the shock in the subsample. The reduction in the standard deviation of the shock is at least partly responsible for the smaller responses. To facilitate the comparison of the responses in the face of the different time paths of the federal funds rate, we plot in Figure 3·8 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 results 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. Note, however that the response of home mortgages is initially actually *larger* in the second subsample.[33]

If financial innovation—through an eventually 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

[32] This is not necessarily the case. Mertens (2008) develops a model in which monetary policy becomes more effective after the removal of Regulation Q in the early eighties. His model predicts that a smaller increase in the interest rate is needed to obtain the same drop in inflation after the removal of Regulation Q. See footnote 4 for a related discussion on the model of Mertens (2008).

[33] The home mortgage response is also initially larger when the federal funds rate responses in the second subperiod are not rescaled to match those of the first subsample. But this initial decrease is much more pronounced when we do rescale the federal funds rate.

Figure 3·8: IRFs following a monetary tightening (with same interest rate response as in early sample)



Notes: This figure plots the IRF of the indicated variable in the first sample following a monetary tightening and the IRF of the indicated variable 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 during a monetary tightening in the first subsample.

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.

The rescaling of monetary policy shocks does not affect the interpretation of the changes in the IRFs of consumer credit. The reason is that the responses of consumer credit are so close to zero in the second subsample that with or without rescaling one would conclude that the drop in consumer credit following a monetary tightening has disappeared in the second subsample, at least for the IRFs of the benchmark VAR.

Robustness. In online Appendix E.2, we show that there are other sensible VAR specifications in which the responses of home mortgages and consumer credit are much more similar in the two subsamples. In fact, we report two VAR specifications in which the maximum reduction in the second subsample is close to the one for the first subsample even for the much smaller increase in the federal funds rate used to generate the IRFs for the second subsample and even when we look at the percentage change in the loan series, not to the change relative to GDP.

Financial innovation and changes in non-monetary IRFs

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. Even if we take a close look, then there are only some minor noticeable changes in the shapes.

In the first subsample, the three real activity variables as well as consumer credit and home mortgages display an initial decrease followed by a quite substantial recovery. During this 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 GDP turns positive somewhat later, the reduction in consumer credit has become more persistent, durable expenditures turn positive earlier,

and home mortgages and residential investment turn positive earlier as well.

An increase in the persistence of GDP and consumer credit is not consistent with the standard story that financial innovation has dampened the effect of shocks. The shortening of the downturn for durable expenditures 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 shorten the period during which durable expenditures remain suppressed. The shortening of the downturn in residential investment is consistent with the observed shortening in the downturn of home mortgages. But these shifts in turning points 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.

In online Appendix D, we report the IRFs for the other shocks. The striking result is that the changes in these other IRFs are quite small. It is not unusual 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 of these other shocks.

Financial innovation and the drop in comovement

In Section 3.6, it was shown that the positive correlation coefficients between the two consumer loan series and real activity in the first subsample were due to the responses following monetary policy and real activity shocks. The reason the correlation coefficients dropped was that the responses following those two shocks changed.

As discussed in Section 3.7.2, the changes in the responses following a monetary policy shock are not trivial, but are not the type of changes that are convincing evidence for the view that financial innovation dampened business cycles.

As shown in Figure 3·6 and discussed above, the changes in the responses following a real activity shock are minor. The changes consist of small shifts. Although these IRFs do not change that much, these changes turn out to be quantitatively important for the

correlation coefficient. The reason is that the IRFs change sign. In the first subsample, the points at which the responses of home mortgages and GDP switch from negative to positive are not that far apart. This leads to a strong positive correlation. In the second subsample, home mortgages turn positive earlier and GDP turns positive later. Although the shifts are not that spectacular, they still imply that there is now a period in which the loan and the real activity responses have the opposite sign. This offsets the positive correlation at short and long forecast horizons.

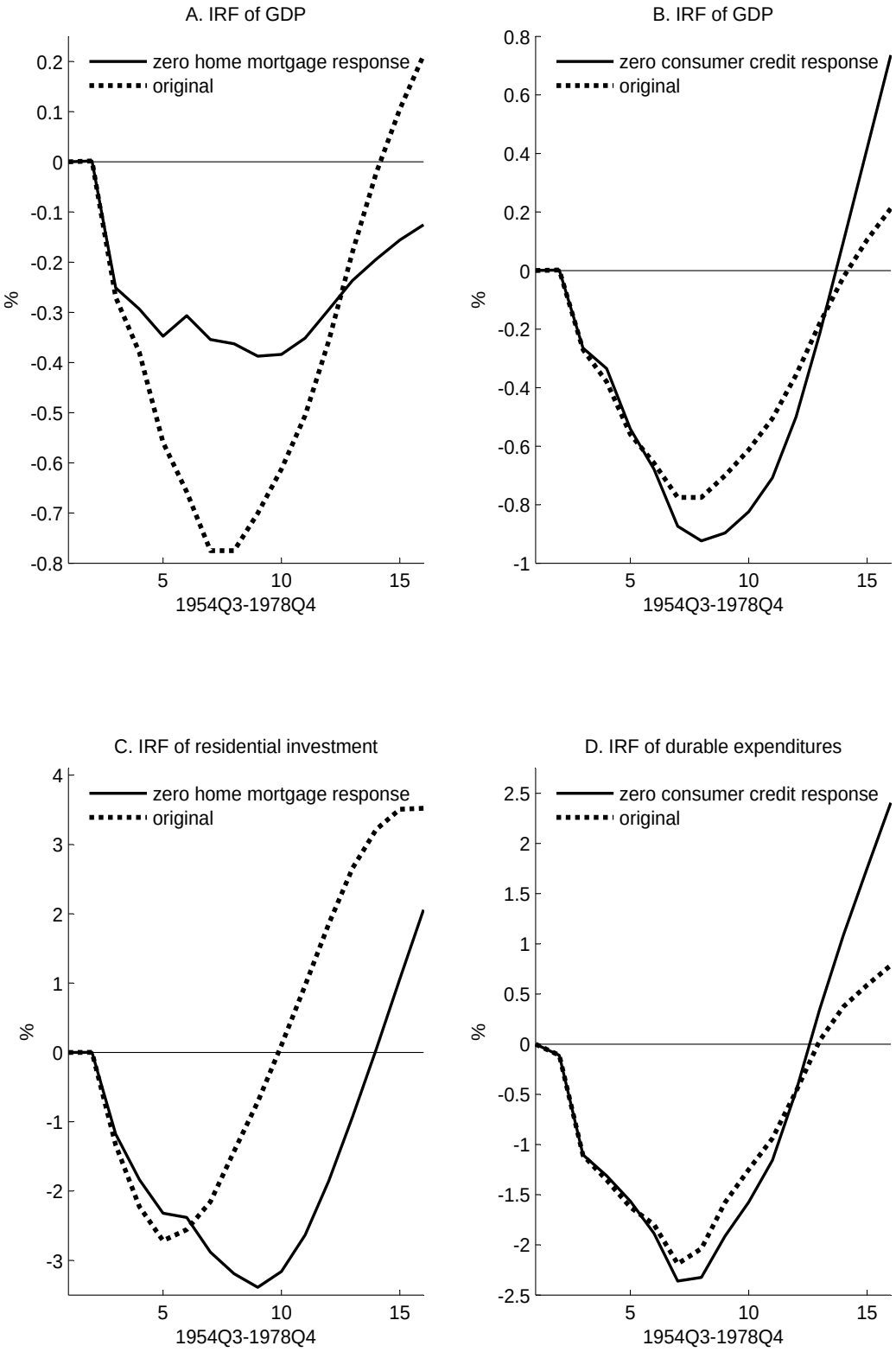
The evidence presented here is not only interesting in terms of what it reveals about financial innovation, it is also informative about the usefulness of using changes in business cycle statistics like covariances as evidence. The comovement between consumer loans and real activity generated by real activity shocks displays a substantial drop that could easily be interpreted as a sign of an important change in the economy. But the observed changes in the IRFs make clear that this drop in comovement is caused by minor shifts.

Financial innovation and effect of loans

If business cycle fluctuations became smaller, because it became easier for financial intermediaries to continue lending during economic downturns, then consumer loans should of course have an impact on real activity. That is, we would like to know whether real activity would have dropped by less in the first subsample if loans would have dropped by less. To shed some light on this question, we recalculate the IRFs keeping the loan responses equal to zero. Figure 3·9 plots the original and the recalculated responses. The two panels on the left report the results when the home mortgage responses are kept equal to zero and the two on the right when the consumer credit responses are kept equal to zero. The top panels report the results for GDP and the bottom panels for the spending component most associated with the loan variable.

For consumer credit, we find that loans have virtually no effect on real activity. Lending activity in the mortgage market does seem to affect real activity. The impact of a monetary tightening on GDP is less than half as large if the mortgage response is set equal

Figure 3·9: Responses of real activity variables following a monetary tightening
(consumer loans remain constant)



Notes: IRFs in the right (left) column are constructed by setting the response of home mortgages (consumer credit) equal to zero each period.

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.

Simple alternative explanation

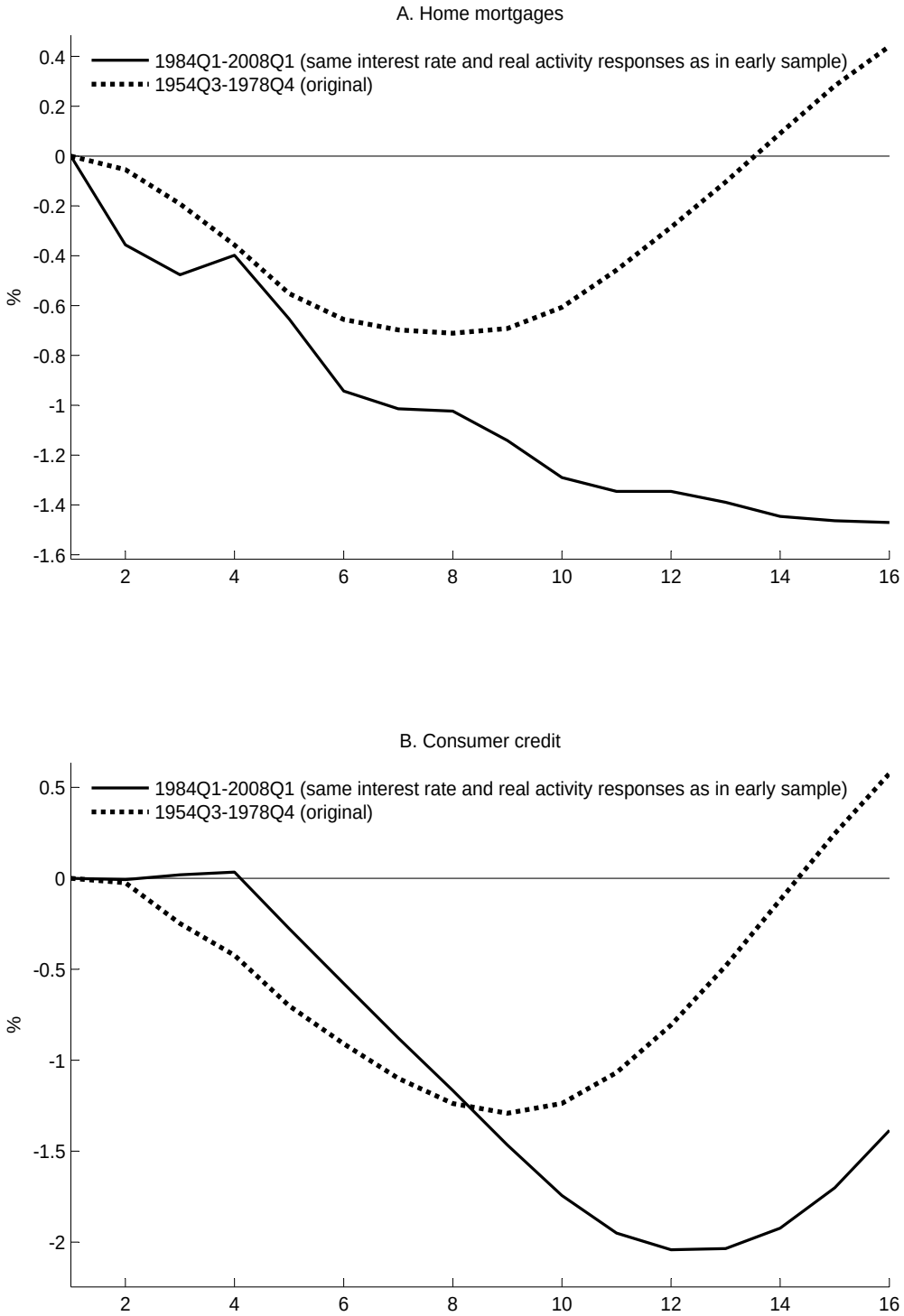
In this paper, we have focused on the hypothesis that financial innovation dampened business cycles during the period of the great moderation. To limit the scope of the paper, we do not address the question whether our empirical results are consistent with alternative hypotheses about the great moderation including those hypotheses according to which financial innovation *magnified* business cycle fluctuations, for example, because leverage was increased.[34]

Nevertheless, we would like to offer one alternative explanation for the observed changes in the responses following a monetary downturn which is so simple and obvious that it cannot be ignored. The alternative hypothesis is that loan responses are smaller because real activity responses are smaller and not the other way around.

To evaluate this hypothesis, we plot in Figure 3·10 the responses according to the VAR estimated using data from 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 responses following a monetary tightening in the first subsample. The graph shows that correcting for the magnitude of the economic downturn the loan responses are not smaller in the second sample at all. In fact, after some period they take on substantially larger values. That is, whereas in Section 3.7.2 we found that there is mixed evidence on whether consumer loans affect real activity, we find here that real activity does clearly have an effect on consumer loans.

[34] This can still be consistent with the great moderation if other factors are at play such as better fiscal and/or monetary policy.

Figure 3·10: Loan responses following a monetary tightening (with same interest rate and real activity responses as in early sample)



Notes: This figure plots the loan responses following a monetary tightening in the first subsample and what the responses according to the VAR of the second subsample would be when the economy faces a sequence of monetary policy and real activity shocks such that the time paths of the federal funds rate and the three real activity variables are identical to the ones observed during a monetary tightening in the first subsample.

3.8 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 a whole class of theories. Nevertheless, we believe that the empirical evidence presented provides little support for the view that innovation in the markets for consumer loans dampened business cycles during the great moderation.

This does not mean that financial innovation did not have an effect. In the first place, we showed that there were important changes in what type of financial institution finances consumer loans when. In particular, in the second subsample other financial institutions than banks seem to take over the role of financing consumer loans during downturns, where financing means holding the loans (or the underlying securities) on your balance sheet not originating the loan. One can expect the quality of consumer loans to deteriorate during economic downturns and the recent financial crisis suggests that the financial institutions that took these loans on their balance sheets were probably not fully aware of the quality of these loans.

There are other reasons why financial innovation could still have had an effect on the economy even though it did not dampen business cycles. By increasing leverage, financial innovation could have *magnified* business cycles. This is still consistent with the great moderation as long as there is a more powerful factor dampening business cycles like better monetary policy. Finally, we would like to point out that our analysis only considers aggregate series. It may still be the case that financial innovation affected the cross-sectional distribution. For example, financial innovation may have made it possible to spread the losses more equally during economic downturns.

Appendix 3.A The literature on financial innovation and the great moderation

In this section, we give citations to document widespread support for the view that financial innovation dampened business cycles during the great moderation among policy makers, policy institutions, and academics.[35] 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 is from the 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 intuition for this is straightforward at the level of an individual household, the effect of improved consumption-smoothing opportunities on aggregate volatility is not unambiguous. ... Nonetheless, a causal link between the great moderation and the simultaneous wave of financial innovation would seem to be a plausible conjecture.
>
> (Lacker, 2006, p.3)

The following two quotes are from the president of the European Central Bank:

> ..., 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.
>
> (Trichet, 2003, p.3)

[35] A more complete set of references is given in footnote 2.

> 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.
>
> (Trichet, 2009, p.2)

Policy institutions like the IMF also stressed the beneficial effects of financial innovation on stabilising the economic system. The April 2006 Global Financial Stability Report said the following:

> 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.
>
> (IMF, 2006, p.51)

The remaining quotes in this section are from academics.

> Our findings also suggest a role for improvements in financial markets in reducing consumption and investment volatility. ... 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.
>
> (Blanchard and Simon, 2001, p.163 and p.164)

> ..., 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.

(de Blas-Pérez, 2009, in abstract)

> 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.

(Guerron-Quintana, 2009, p.255)

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.

(Cecchetti, 2008, p.1)

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.

(Cecchetti, 2008, p.2)

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.

(Dynan, Elmendorf, and Sichel, 2006, p.123)

..., 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.

(Cecchetti, Flores-Lagunes, and Krause, 2006, p.2)

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.

(Peek and Wilcox, 2006, p.139)

Appendix 3.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.[36]

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

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

[36] Schedule RC-D provides information of assets held for trading, which are excluded in schedule RC-B.

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:[37]

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.

row 16 Mortgages

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,[38] but

[37] There are occasional changes in row numbers; our row numbers correspond to those of the March 2009 issue of the flow of funds.

[38] Namely Call Report series RCON 1733 and RCON 1735.

it also includes securities that are not related to mortgages.[39] 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.[40] 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.

Appendix 3.C 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 *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

[39] In particular, it includes other debt securities, RCON 1737 & RCON 1739, and foreign debt securities, RCON 1742 & RCON 1744.

[40] 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.

3·11, 3·12 and 3·13.

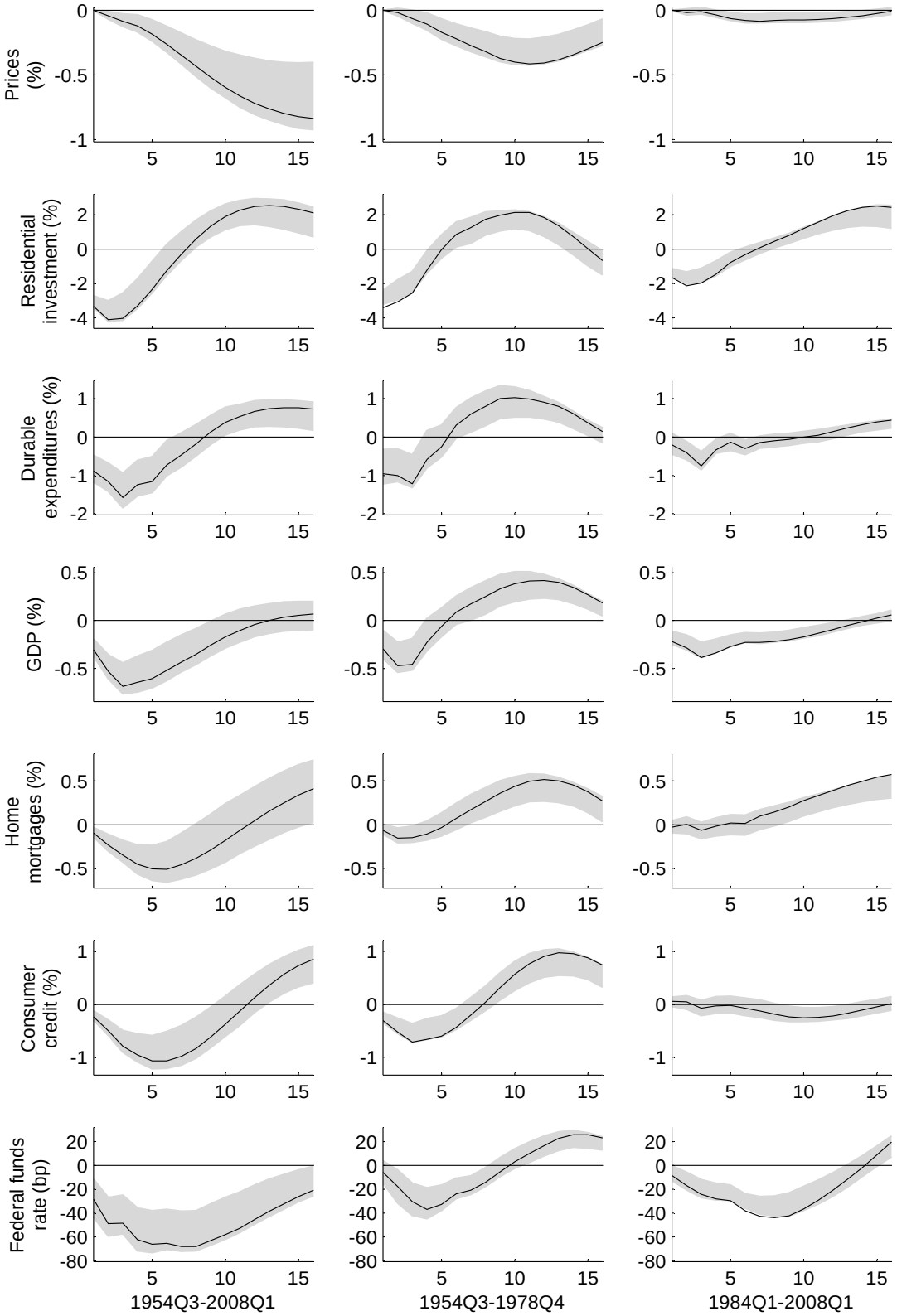
Residential investment shock. There are several similarities in the shapes of IRFs across the two subsamples. The main change seems to be that the magnitudes of the responses have declined, which resembles the results for a joint real activity shock.

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.

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.

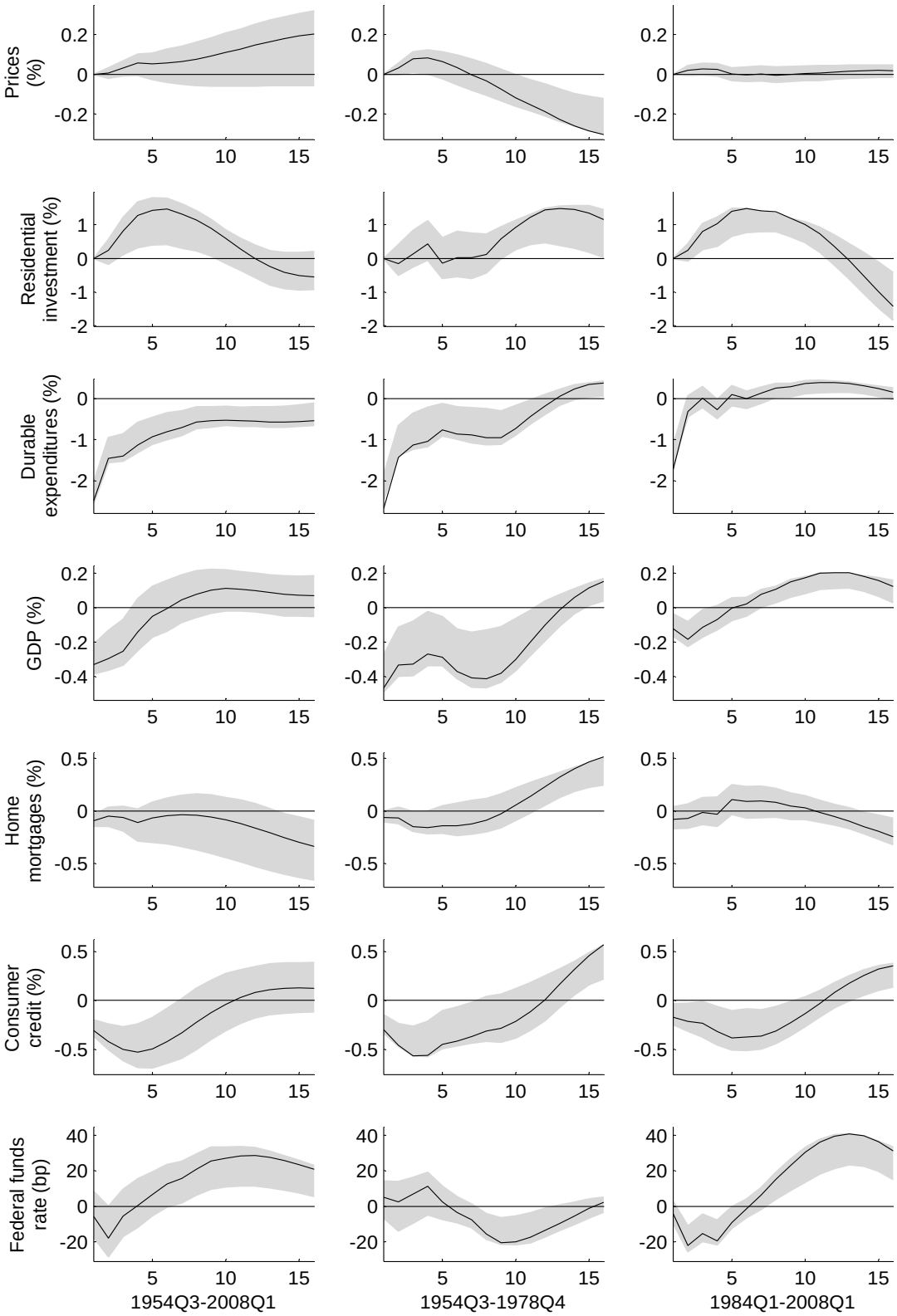
GDP shock. At first sight, the changes in the IRFs following a GDP shock do seem to support the view that financial innovation had a favorable impact on the transmission of

Figure 3·11: IRFs following a residential investment shock



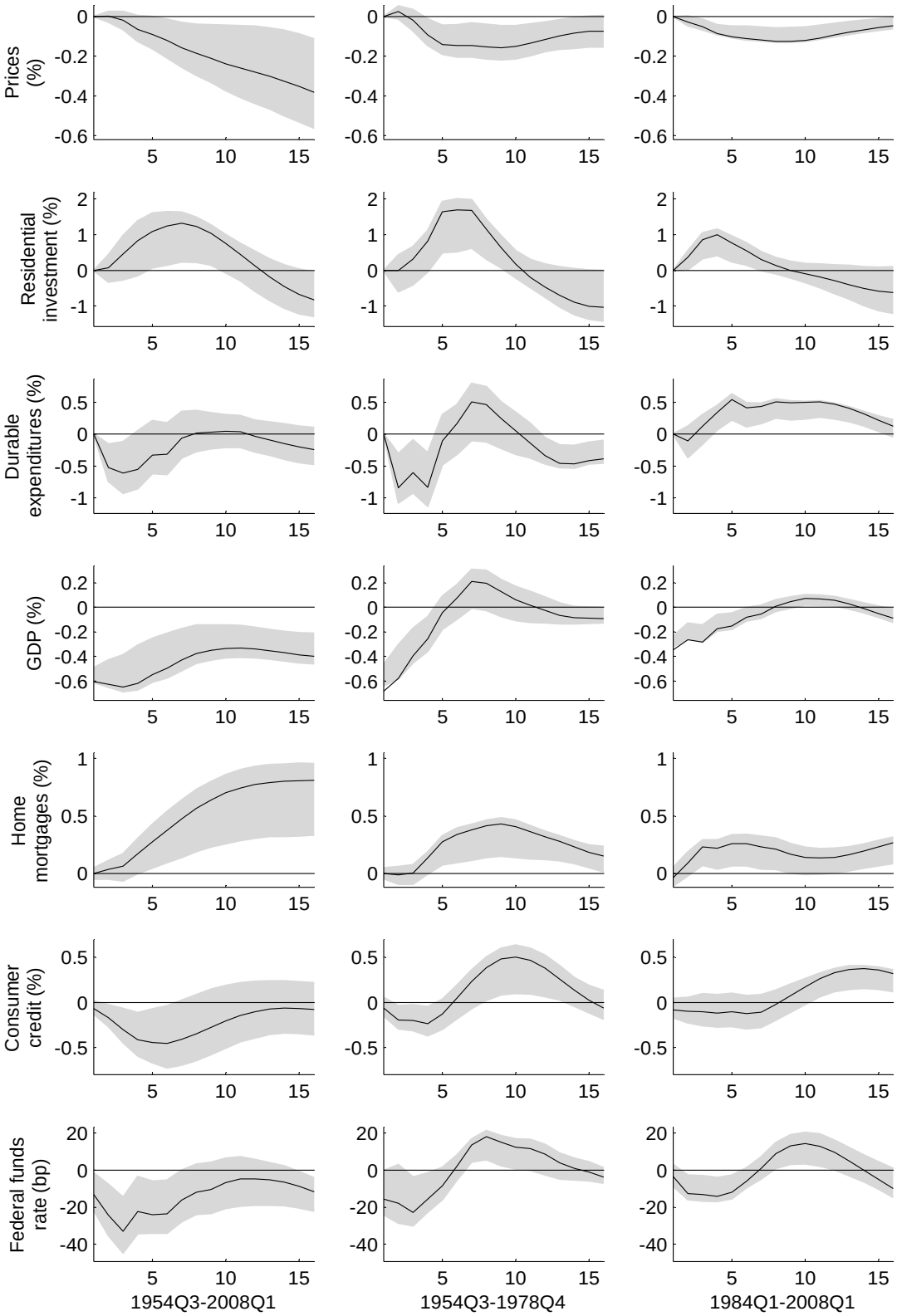
Notes: Responses to a one-standard-deviation shock in residential investment.

Figure 3·12: IRFs following a durable expenditures shock



Notes: Responses to a one-standard-deviation shock in durable expenditures.

Figure 3·13: IRFs following a GDP shock



Notes: Responses to a one-standard-deviation shock in GDP.

this shock on the economy. That is, in response to a negative GDP shock home mortgages increase 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.

Appendix 3.D Other shocks

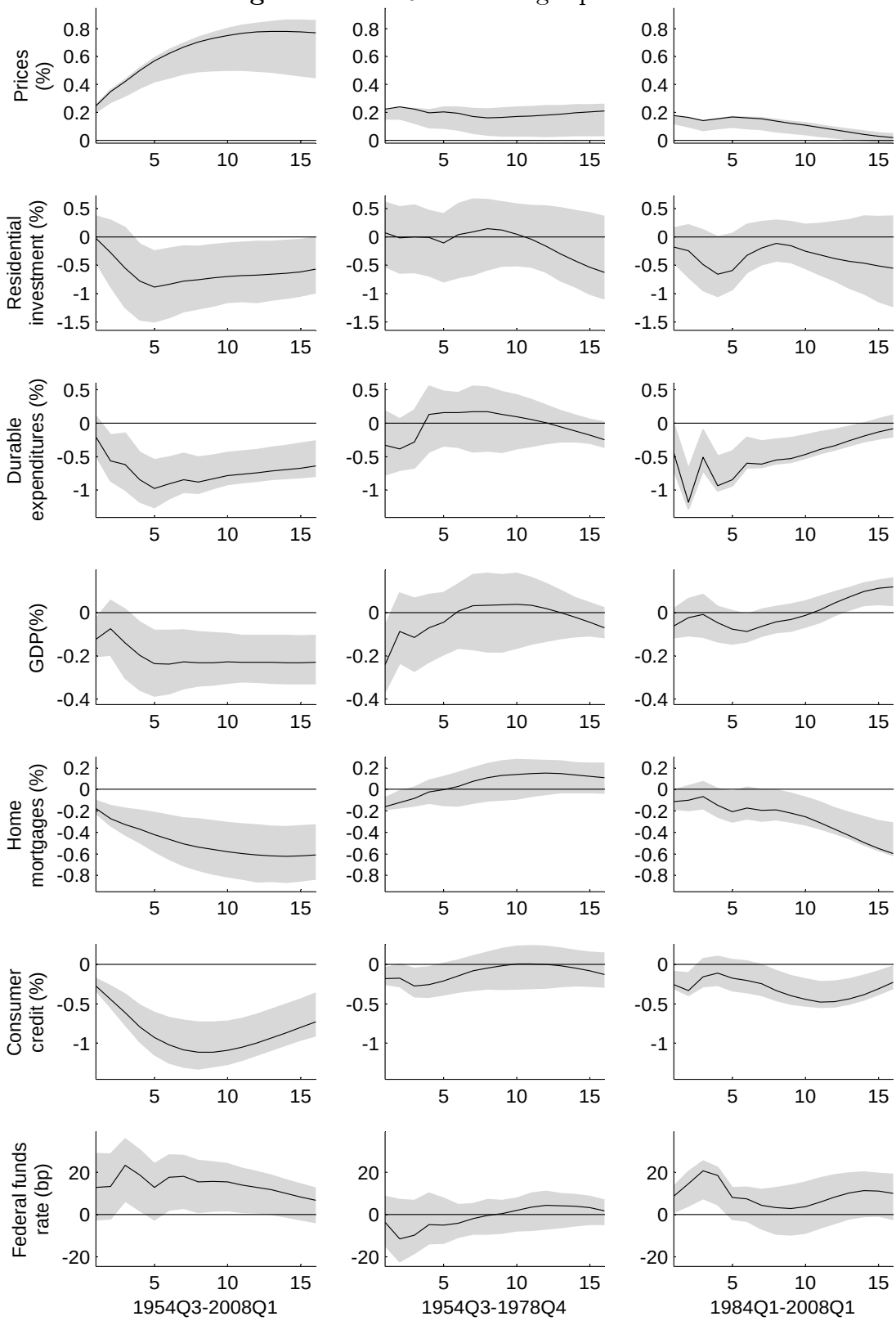
In the main text, we discussed the responses to a monetary tightening and a joint real activity shock. In this section, we discuss the responses to the other shocks. The IRFs are plotted in Figures 3·14, 3·15, and 3·16.

3.D.1 IRFs of Other Shocks

Price shock.

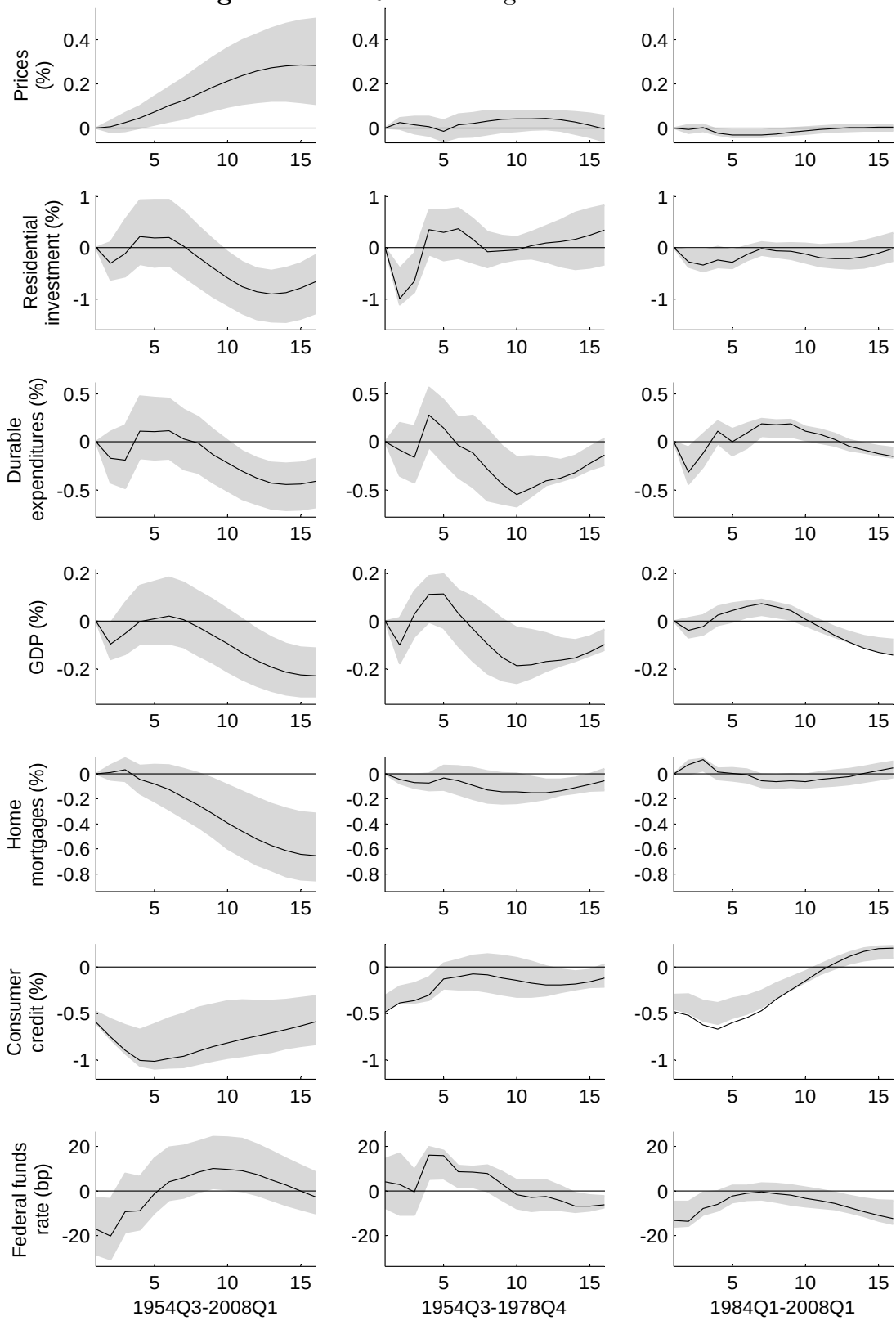
Most of the responses are insignificant in the subsamples. Interestingly, the responses are often significant over the complete sample, which also includes the period from 1979Q1 to 1983Q4 during which inflation was sharply reduced. None of the two subsamples include this period. One interesting observation 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.

Figure 3·14: IRFs following a price level shock



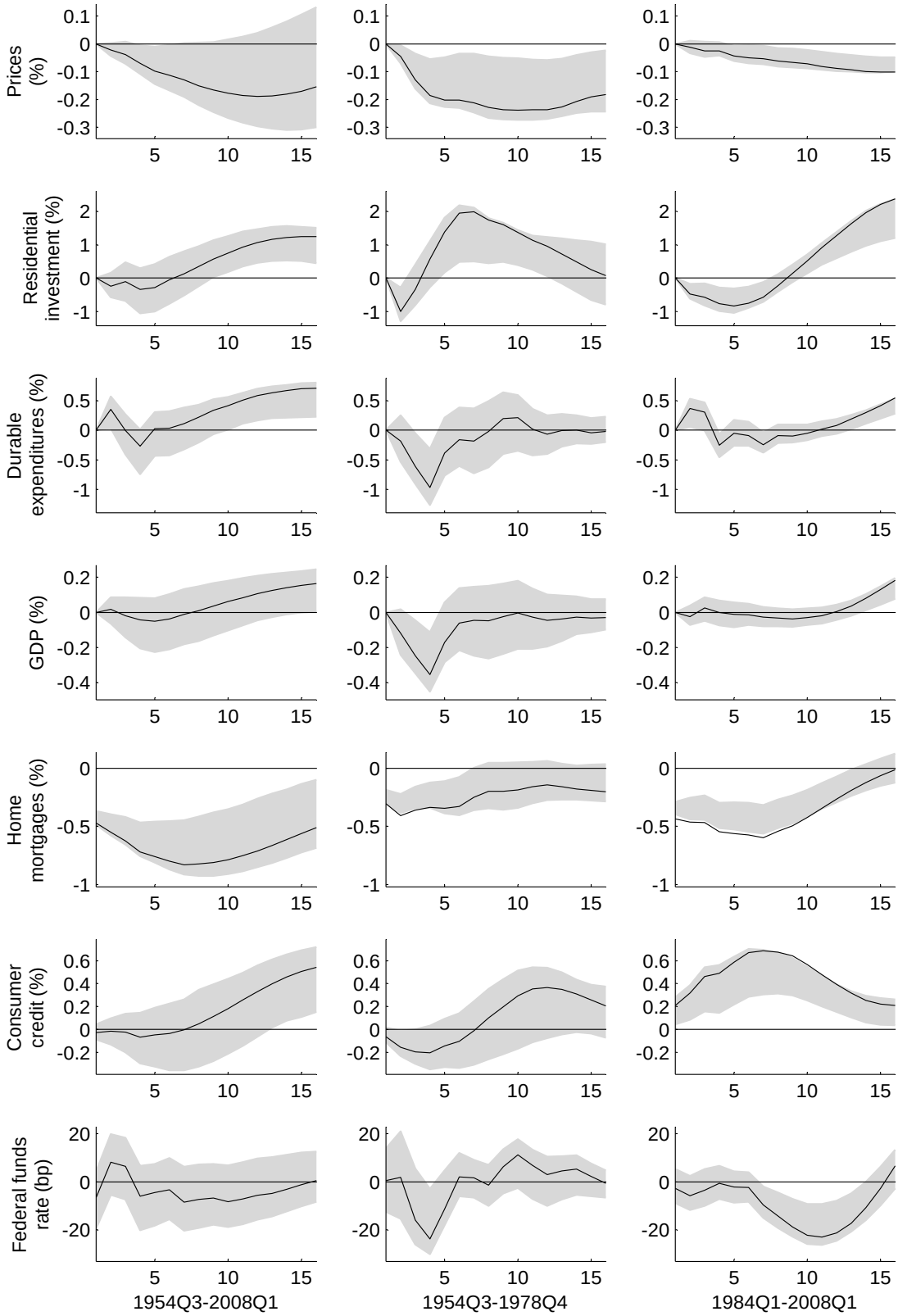
Notes: Responses to a one-standard-deviation shock in the price level.

Figure 3·15: IRFs following a consumer credit shock



Notes: Responses to a-one-standard deviation shock in consumer credit.

Figure 3·16: IRFs following a home mortgage shock



Notes: Responses to a one-standard-deviation shock in home mortgages.

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 gave rise to positive opportunities in other financial markets.

3.D.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 con-

sumer 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 portfolios 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.

Appendix 3.E Robustness

Alternative Filter to Calculate Business Cycle Statistics

Table 3.2 reports some key business cycle statistics when a band-pass filter instead of the HP filter is used. Our band-pass filter lets pass through that part of the time series associated with cycles with a period between 6 and 32 quarters.[41] The HP filter is an approximate band-pass filter that focuses on cycles with a period less than 32 quarters. Since short-term cycles may be quite noisy and for example be affected by measurement error, it is important to document that the results are robust to this alternative procedure to construct cyclical components.

The table documents that our results do not depend on which filter is used.

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 3·17 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 samples 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

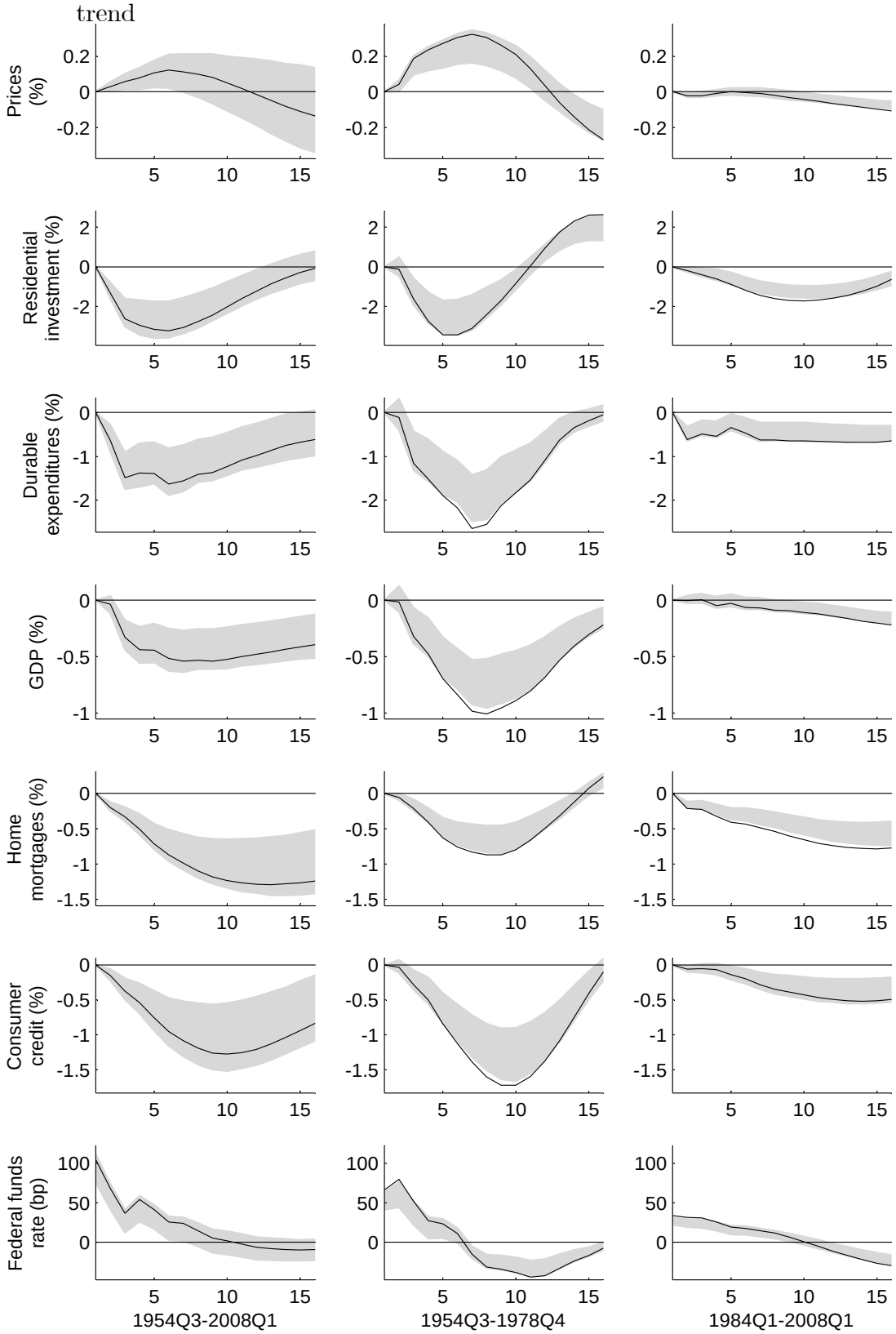
[41] The ideal band-pass filter is an infinite-order two-sided filter. To be able to implement the filter we truncate it at 8 quarters and then rescale the coefficients so that they still add up to zero. We experimented with alternative truncation choices and found the results to be similar.

Table 3.2: Standard Deviations (in %) according to the band-pass filter

	'54Q3-'78Q4	'84Q1-'08Q1	change
	standard deviations		
Real activity			
GDP	1.38	0.63	-54%
Durable expenditures (DE)	3.75	1.71	-55%
Residential investment (RI)	7.68	3.94	-49.%
Consumer credit			
Total (T)	2.41	1.57	-35%
Regular bank consumer credit (RB)	2.59	2.04	-22%
(T) - (RB)	3.71	2.95	-21%
Mortgages			
Total (T)	1.21	0.68	-35%
Regular bank mortgages (RB)	1.83	1.52	-17%
All bank-owned mortgages (B)	1.84	1.30	-30%
(T) - (RB)	0.79	1.10	40%
(T) - (B)	0.88	1.43	63%
	correlation with GDP		
Real activity			
Durable expenditures (DE)	0.90	0.66	-26%
Residential investment (RI)	0.66	0.54	-18%
Consumer credit			
Total (T)	0.67	0.08	-88%
Regular bank consumer credit (RB)	0.68	0.32	-53%
(T) - (RB)	0.43	-0.26	-161%
Mortgages			
Total (T)	0.75	0.16	-78%
Regular bank mortgages (RB)	0.76	0.51	-34%
All bank-owned mortgages (B)	0.78	0.39	-50%
(T) - (RB)	0.21	-0.37	-278%
(T) - (B)	0.09	-0.29	-427%

Notes: The table reports statistics for the cyclical componentof the indicated variable. The cyclical component is calculated using a band-pass filter that let pass through the part of the series associated with cycles with a period in between 6 and 32 quarters. To implement the filter, which is an infinite-order two-sided filter, we truncate after 8 quarters and rescale the coefficients so that they still add up to zero. "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.

Figure 3·17: IRFs following a monetary tightening; no deterministic time trend



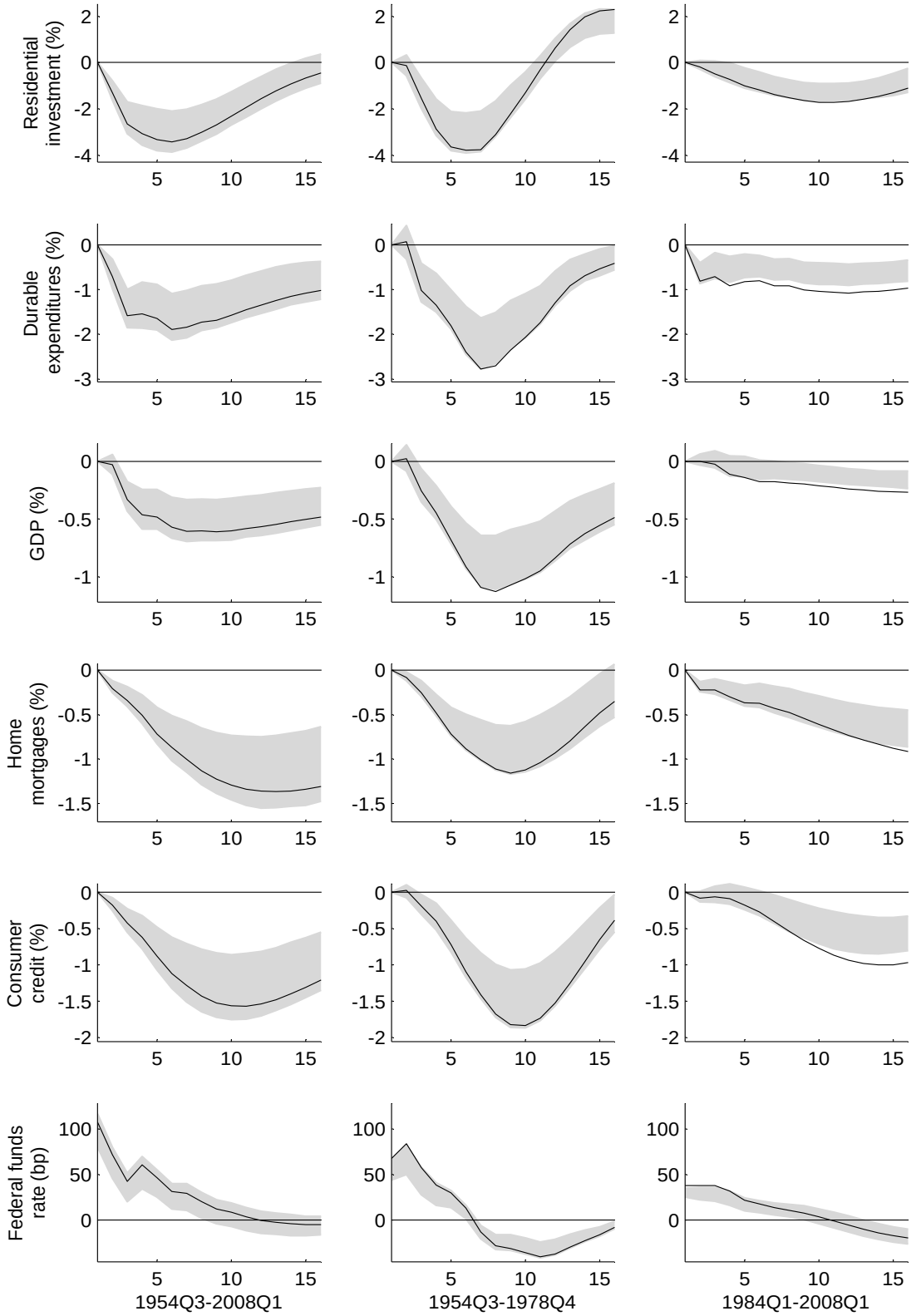
Notes: Responses to a one-standard-deviation shock in the federal funds rate. The IRFs are generated by a VAR with the same specification as the one used in the main text, except that no deterministic time trend is included.

innovation affecting business cycles. The results in Figure 3·18 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 conditional 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.

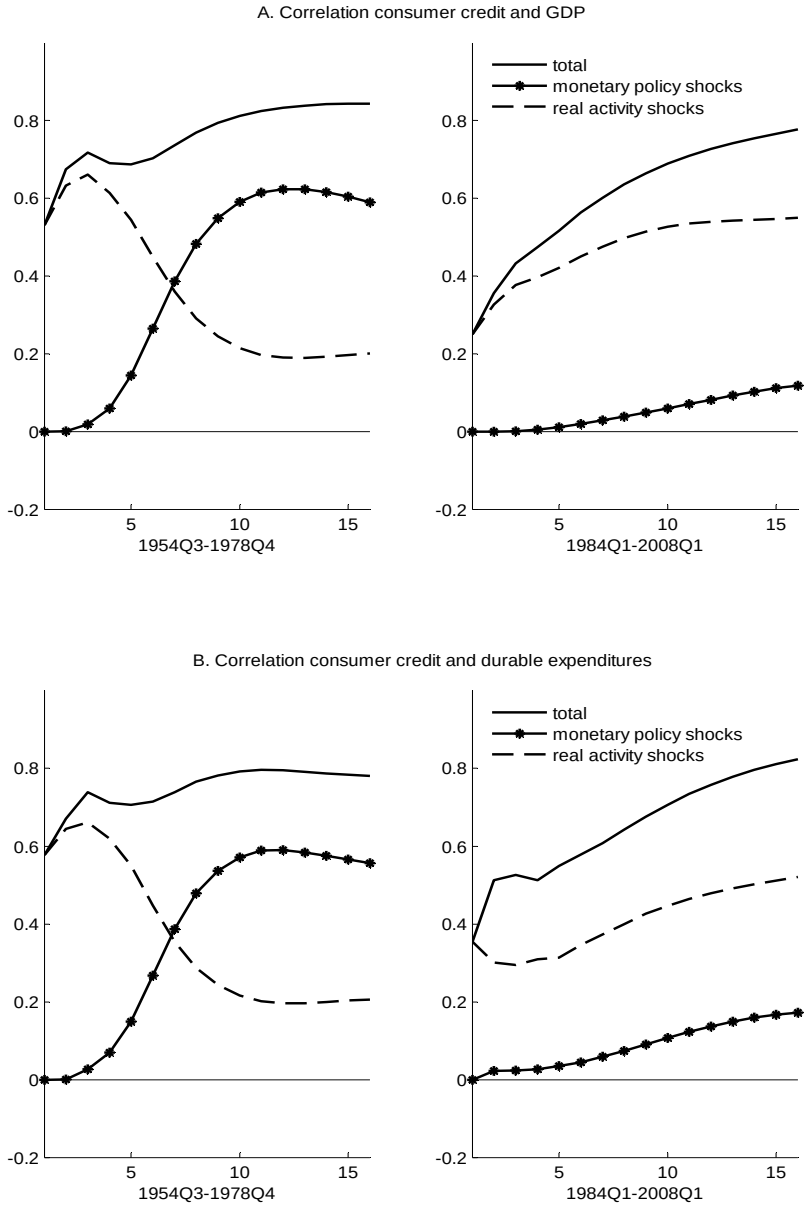
If consumer credit, durable expenditures, and GDP, all drop following a monetary tightening, as documented in Figure 3·18, then the question arises whether the correlation of the forecast errors still drops. The covariances according to the VAR underlying this figure are reported in Figure 3·19 together 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 for 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 the monetary policy shock and the delayed drop in consumer credit keeps the covariance due

Figure 3·18: 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 determinisitic time trend nor the deflator is included.

Figure 3·19: Decomposition of comovement between consumer credit and real activity;
no deterministic time trend and deflator



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 which part of the correlation is due to monetary policy and real activity shocks.

to monetary policy shocks low. Figure 3·19 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.

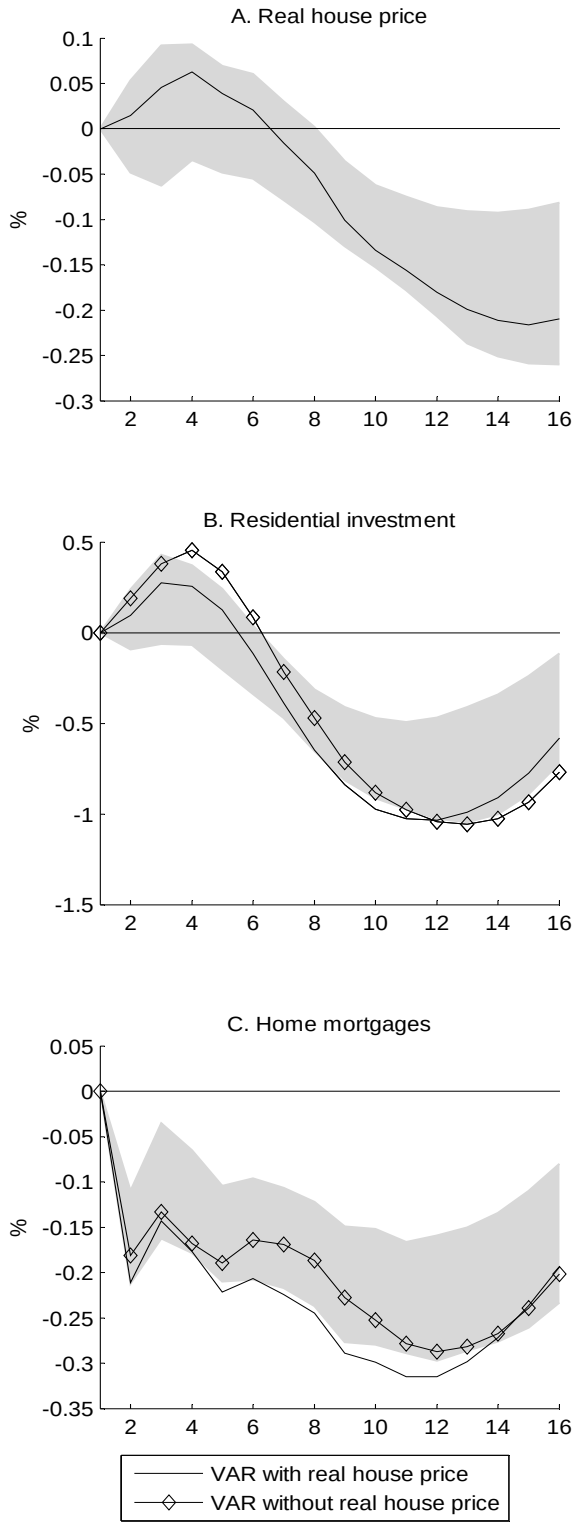
Alternative VAR Specifications

We found that our main results are robust to several changes in the specifications of the VAR. In particular, across specifications 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. In Section 3.E, we already discussed the results when no deterministic trend was included and when the price deflator was not included. In this section, we document the results for some of the alternative specifications considered.

Including house prices.

One obvious alternative to consider is a VAR that includes an index for house prices. Figure 3·20 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 IRFs from Figure 3·4. 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

Figure 3·20: IRFs following a monetary tightening; VAR with house price



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.

affected very much.[42]

Different number of lags.

Our benchmark VAR specification follows common practice and includes four lags of each variable. A smaller number of lags is preferred in several of the equations according to both AIC and BIC. To make sure that our results are robust to the number of lags, we report in Figure 3·21 the results for a monetary tightening when only two lags are included. The results are very similar except that with two lags the upward shift in the responses of residential investment is smaller. Since such an upward shift could be interpreted as evidence in favor of the hypothesis that financial innovation dampened business cycles, the smaller upward shift only strengthens our case.

Different ordering.

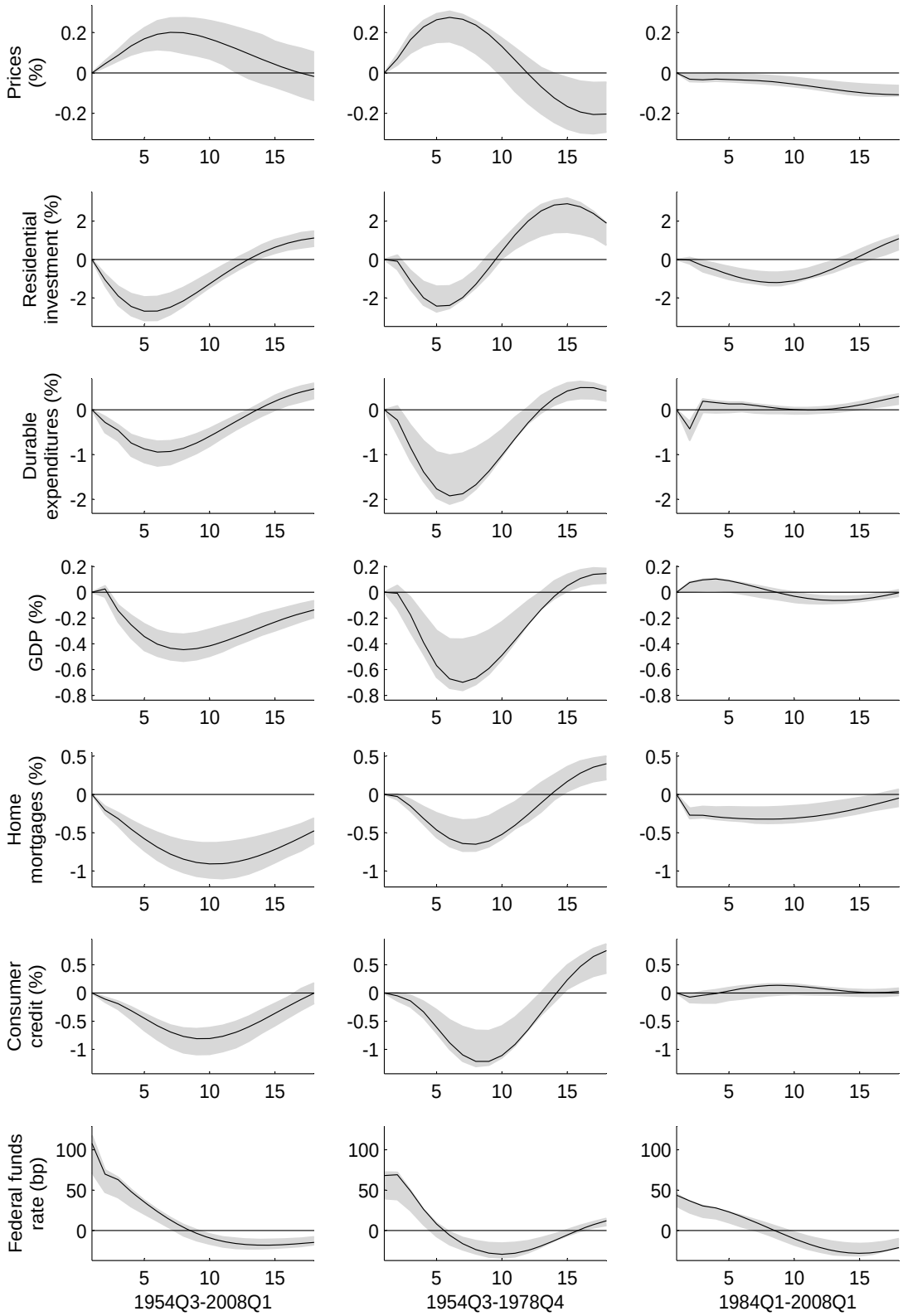
Our identification procedure relies on the assumption that variables do not respond to a monetary policy shock within the quarter is correct. To increase the plausibility of this hypothesis, we use the average daily federal funds rate during the *last* month of the quarter as our monetary policy instrument. To be on the safe side, we also consider an alternative identification assumption under which the two loan variables are able to respond within the quarter. The responses following a monetary tightening are shown in Figure 3·22. The figure documents that the results are very similar, except that the responses for consumer credit are now slightly positive instead of hovering around zero. These responses are insignificant, under both identification assumptions.

Appendix 3.F Home versus total mortgages

For the exercises in the main text related to bank and non-bank mortgages we used total mortgages, because we could not distinguish between home and other mortgages. In this

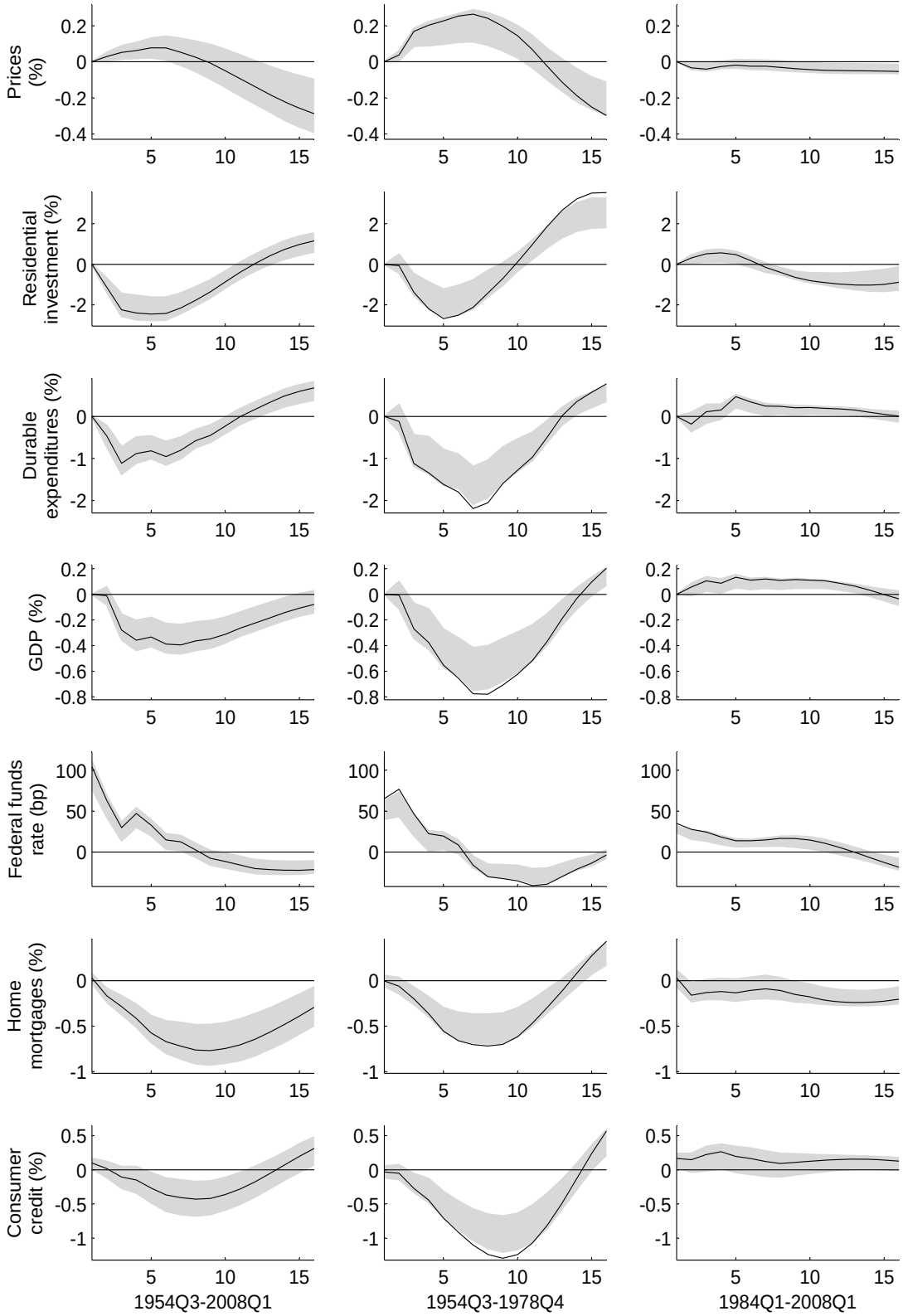
[42] The results for the other variables are quite similar to those reported in Figure 4.

Figure 3·21: IRFs following a monetary tightening; two instead of four lags



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 two instead of four lags are used as explanatory variables.

Figure 3·22: IRFs following a monetary tightening; different orderings



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 consumer loans can respond to our end-of-quarter policy shock within the quarter.

section, we discuss the similarities and differences between the different mortgage series at the aggregate level.

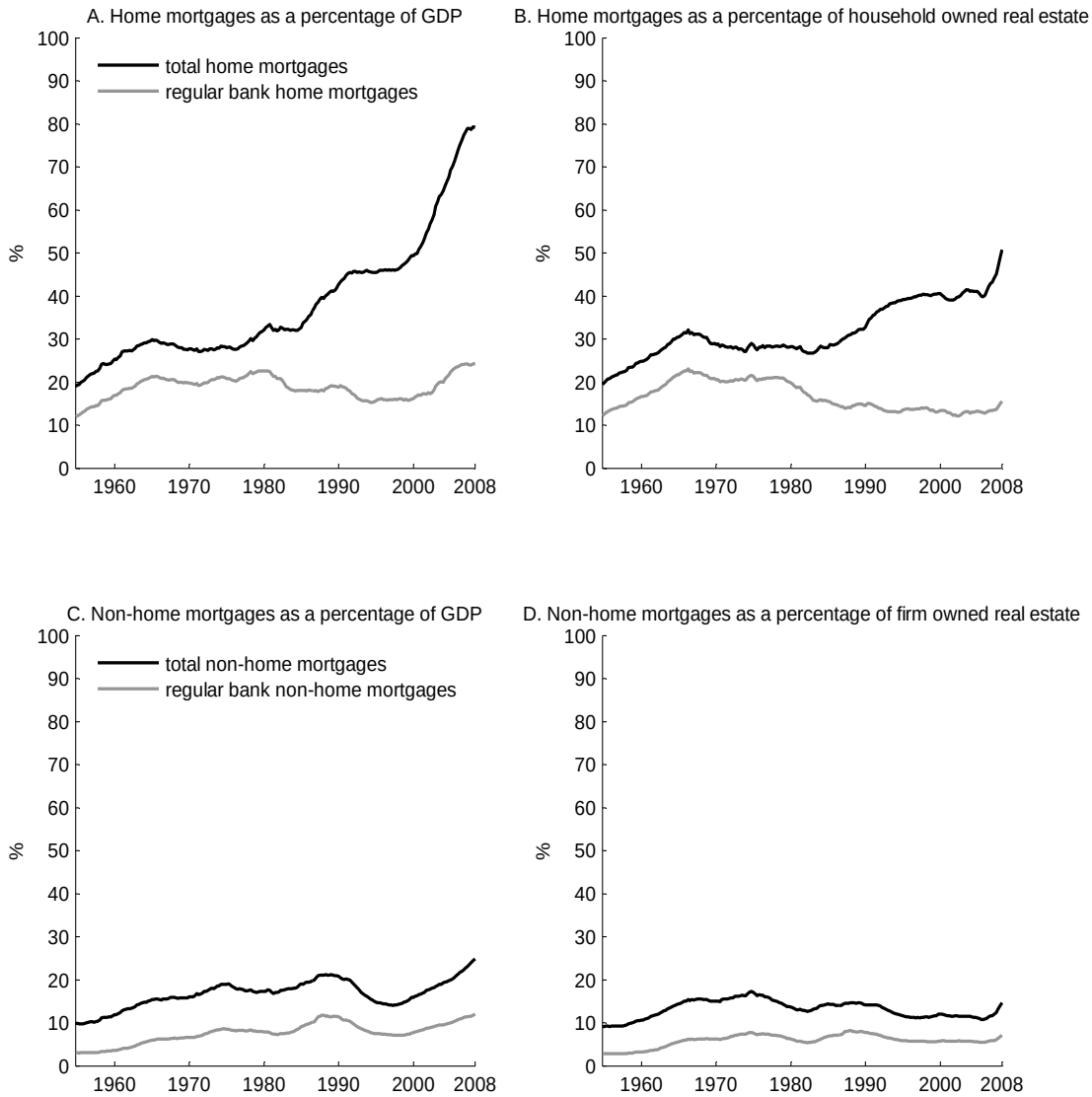
Trends. Figure 3·23 is the equivalent of Figure 3·1, but uses home and non-home mortgages instead of total mortgages.[43] The figure shows that most the long-term increase in total mortgages is clearly due to the increase in *home* mortgages. Similar to the results found for total mortgages, this increase in home mortgages is mainly due to an increase in mortgages that are not directly owned by banks.

Cyclical behavior. Figure 3·25 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 3·2 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 3·25 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.

[43] For these series we cannot determine all bank-owned mortgages. The series that are indicated as "regular bank mortgages" in the graphs only include mortgages banks hold directly on their balance sheets.

Figure 3·23: Home and Non-Home mortgages; scaled by GDP or value underlying asset

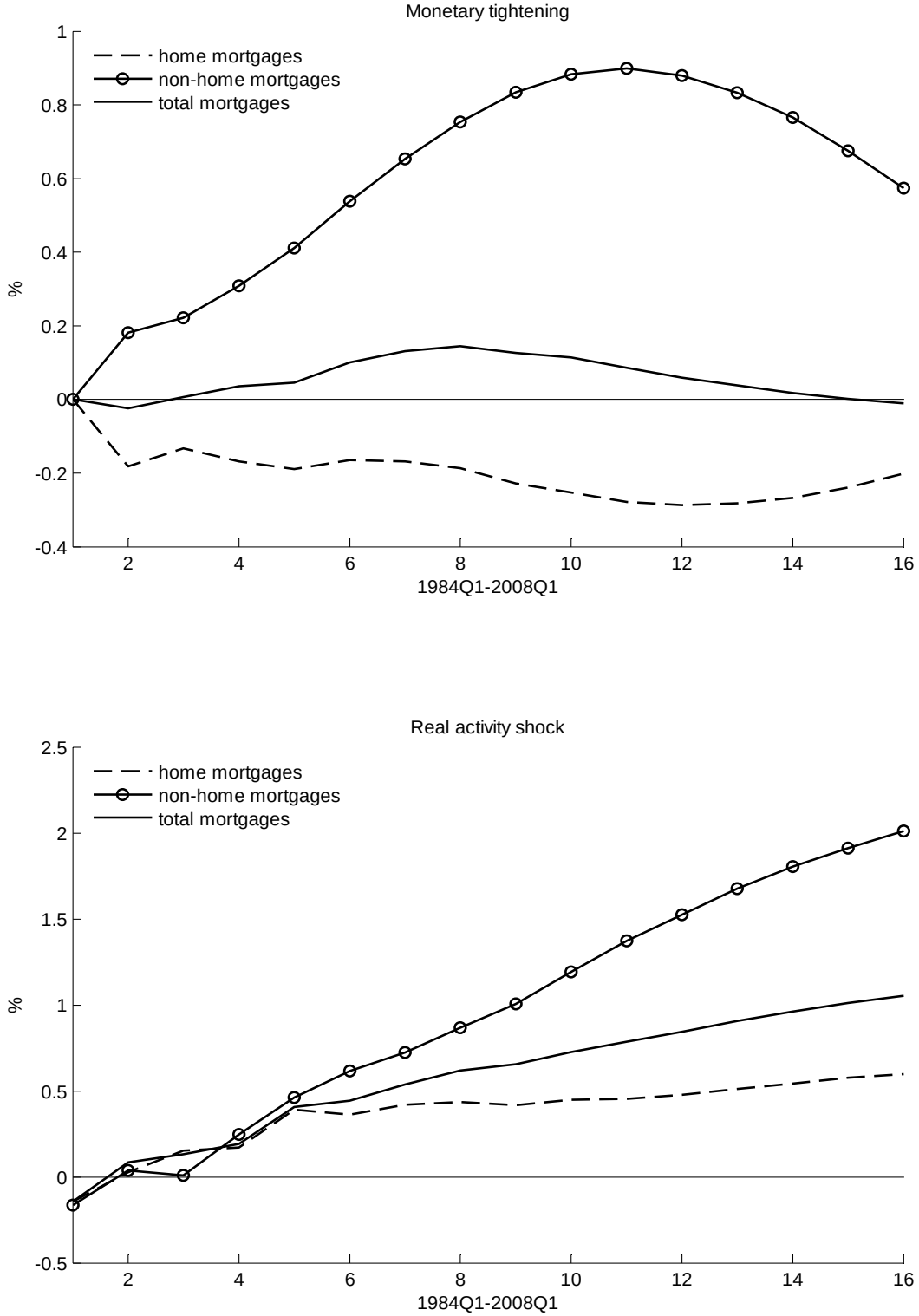


Notes: "Regular" bank mortgages are those directly held on the banks' balance sheets and not in the form of asset-backed securities and "total" bank mortgages include both. In the two panels on the right, the mortgage series is scaled with the market value of the associated real estate variable.

Impulse response functions. In the first subsample, the IRFs of home, non-home, and total mortgages are all significantly negative.

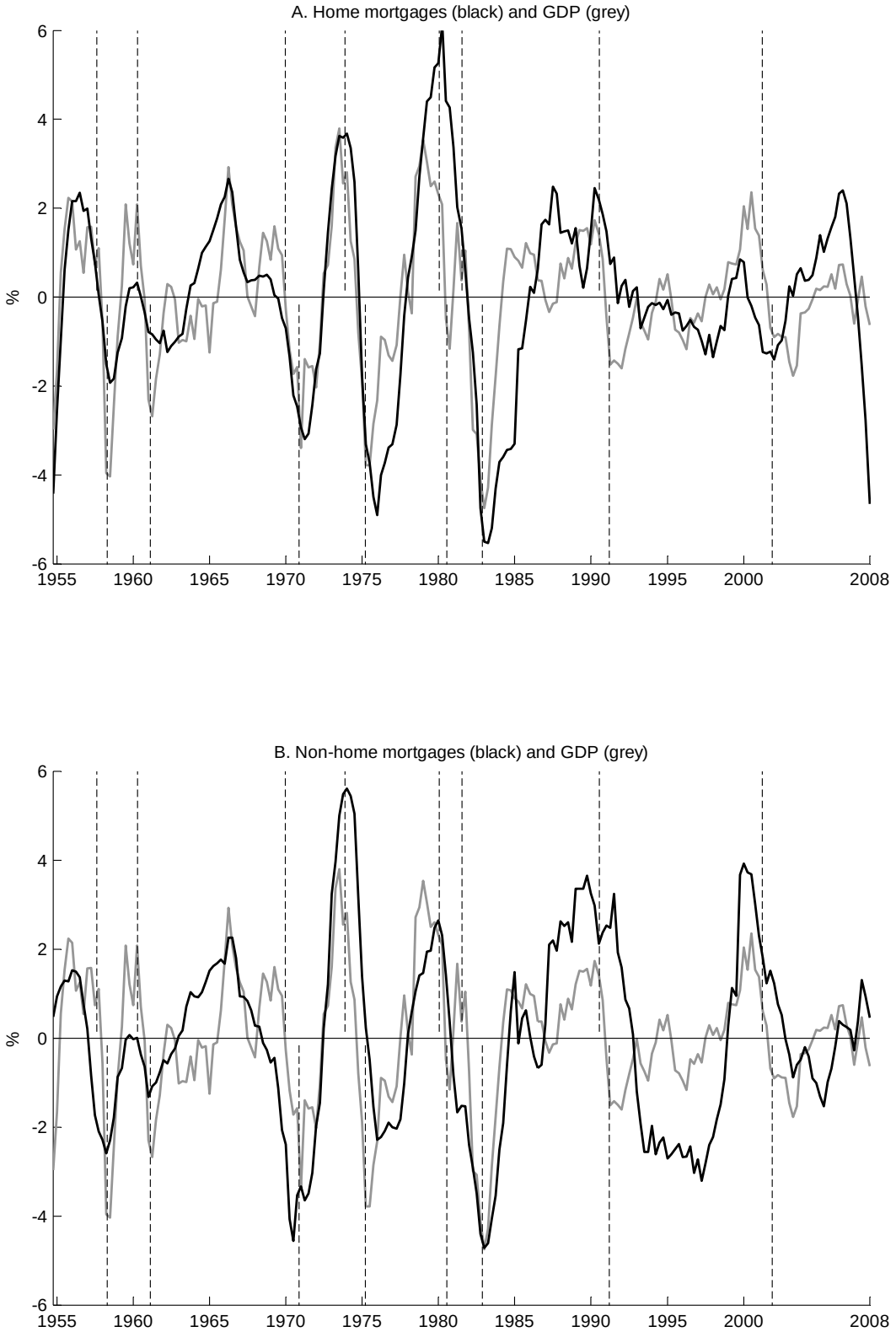
Panel A of Figure 3·24 plots the IRFs for these three series for the second subsample. As discussed above, the IRF for home mortgages following a monetary tightening is still significantly negative in the second subsample. The IRF for total mortgages, however, is basically flat and the IRF for non-home 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 3·25, 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.

Figure 3·24: IRFs for home, non-home, and total mortgages



Notes: IRFs for the indicated shocks.

Figure 3·25: 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).