Bank Loan Portfolios and the Canadian Monetary Transmission Mechanism*

Wouter J. DEN HAAN,† Steven W. SUMNER,‡ Guy M. YAMASHIRO§

May 29, 2008

Abstract

Following a monetary tightening, bank loans to consumers decrease. This is true both for mortgage and non-mortgage loans, and it is true for a tightening by the Bank of Canada that is, and is not, a response to a tightening by the Federal Reserve System. In contrast, business loans typically *in*crease following a monetary tightening. We argue that the "perverse" response of business loans cannot be explained by an increase in the demand for funds due to a reduction in real activity. The reason for this is that we find no evidence that business loans increase during a non-monetary downturn, in which real activity falls and real interest rates do not increase. These results are consistent with a change in bank portfolio behavior in favor of business loans in response to an unexpected increase in interest rates.

*The authors would like to thank Francisco Covas and Nicolas Raymond for assistance with obtaining the Canadian data and Craig Burnside, Zhiwei Zhang and two anonymous referees for useful comments.

†Department of Economics, University of Amsterdam, Amsterdam, The Netherlands and CEPR, UK. E-mail: wdenhaan@uva.nl.

‡Department of Economics, School of Business, University of San Diego, San Diego, USA. E-mail: sumner@sandiego.edu.

§Department of Economics, California State University, Long Beach, USA. E-mail: gyamashi@csulb.edu.

1 Introduction

There is a large empirical literature documenting that monetary policy shocks affect economic activity.[1] In particular, empirical studies estimated over different time periods and using data from different countries indicate that an unexpected monetary tightening is followed by a (delayed) reduction in real activity.[2] Understanding the transmission mechanism remains a challenge, however, and in particular, the importance of the banking system in accentuating the transmission to the real economy is still unclear.

Proponents of a "bank-lending channel" hold that a monetary tightening should be followed by a decline in the supply of bank loans, which exacerbates the economic downturn. It is our position that examining the role of the banking system in the transmission mechanism requires understanding the portfolio behavior of banks. In particular, additional insights can be gained by looking at the behavior of bank loan components as opposed to looking at just total bank loans. In Den Haan, Sumner, and Yamashiro (2007), we find support for this position using U.S. data. Our specific findings are as follows. First, the behavior of total loans is consistent with that of a bank-lending and/or interest-rate channel. That is, total loans decrease more during a downturn caused by a monetary tightening than during downturns of comparable magnitude that are not triggered by a monetary policy shock. Second, following a monetary tightening there is a strong shift out of real estate and consumer loans and into commercial and industrial (business) loans resulting in an *increase* in commercial and industrial loans. During non-monetary downturns of comparable magnitude, however, we find no such increases in commercial and industrial (C&I) loans, which suggests that the increase in C&I loans is not due to an increase in the demand for such loans because of the drop in real activity. Our findings, therefore, support the existence of a bank-lending channel, but only in relation to consumer and real estate loans. In fact, the results suggest that the shift out of these types of loans following

[1] See Bernanke and Gertler (1995) and Christiano, Eichenbaum, and Evans (1999) for detailed discussions on how economic variables respond following a monetary policy shock. See Duguay (1994) for a discussion on the monetary transmission mechanism in Canada.

[2] Cecchetti (1999), for example, documents that output decreases in all of the eleven OECD countries considered.

a monetary tightening allows for an increase in the supply of commercial and industrial loans.

That business loans may increase following a monetary tightening is also documented in Gertler and Gilchrist (1993). Moreover, Bernanke and Gertler (1995) argue that the "perverse response" can be explained by an increase in the demand for these loans. Our results indicate, however, that the observed increase is more likely the result of an increase in the supply. The idea that the supply of commercial and industrial loans increases following a monetary tightening is clearly a contentious finding. While the theoretical literature in support of the bank-lending channel typically focuses on the supply of loans to firms,[3] we find no empirical evidence of the bank-lending channel operating through this type of loan. Our empirical results do, however, provide support for the recent upsurge in theoretical papers emphasizing the role of financing imperfections in the consumer loan market in business cycle analysis.[4]

The obvious question is whether our surprising findings are specific to the U.S., or whether they are found in other countries as well. In this paper, we seek to answer this question by investigating whether the portfolio behavior of Canadian banks following a monetary tightening is the same as that of U.S. banks. Using data for the Canadian economy is especially revealing because the Canadian economy and banking system differ in fundamental aspects from the U.S. economy and banking system. In particular, the Canadian economy is much more open than the U.S. economy, and the Canadian banking system is comprised of only a handful of large banks, whereas the U.S. system includes more than 7,000 banks including many smaller banks. Despite these differences, we find that the results for Canadian bank loans are remarkably similar to those found using U.S. data.

This study differs in the following two aspects from Den Haan, Sumner, and Yamashiro (2007) in which we use U.S. data. First, in our Canadian data set, real estate lending is broken down into loans to businesses (commercial real estate) and loans to consumers (residential real estate). This distinction is not made in the U.S. data. This is important

[3] See, for example, Fisher (1999) and Repullo and Suarez (2000).

[4] See, for example, Campbell and Hercowitz (2004) and Iacoviello (2005).

because it sheds light on whether the change in the banks' loan portfolios is one mainly out of real estate (or long-term) loans into short-term loans, or whether it is a shift from loans to consumers to loans to businesses. Our results suggest it is the latter. The second difference with Den Haan, Sumner, and Yamashiro (2007) is that we consider two types of monetary downturns. The first monetary downturn is a tightening by the Bank of Canada (BoC) that *is not* a response to a tightening by the Federal Reserve System (FED) and the second monetary downturn is a tightening by the Bank of Canada that *is* a response to a FED tightening

The remainder of the paper is organized as follows. Section 2 highlights the similarities and differences in the financial systems of the U.S. and Canada. Section 3 discusses the data used and the empirical methodology. Section 4 presents the results and the last section concludes.

2 U.S. and Canadian financial systems

While there are many similarities between the financial systems in the United States and Canada there are also many differences. It is, therefore, interesting to see whether the remarkable results found with U.S. data are present in Canadian data as well. Monetary policy in both countries focuses on the economic and financial well-being of the country with a primary goal of maintaining price stability. Both countries currently target a short-term interest rate representing the rate at which financial institutions can borrow and lend funds with one another. Furthermore, to promote transparency in monetary policy, both countries have eight "fixed" dates at which they make announcements regarding the target policy variable.[5] The main difference between the countries in terms of monetary policy is that the Bank of Canada maintains an explicit operating target range for inflation of 1-3% per year based on total CPI (since 1991), whereas the Board of Governors of the Federal Reserve System does not.

Low-frequency changes in the composition of banks' loan portfolios are also similar in the two countries. Figure 1 plots the shares of the four loan series for Canada over

[5] This began in Canada in 2001 and in the U.S. in 1996.

our sample from the fourth quarter of 1972 to the third quarter of 2007. It shows that consumer real estate loans have become relatively more important, growing from 19% in the first ten years of the sample to just over 50% of total loans in the last ten years of the sample. In contrast, the share of business loans has decreased sharply from 54% in the first ten years to 24% in the last ten years. Consumer loans have remained fairly constant. Real estate loans to firms are only a small part of the banks' loan portfolio, but their share has grown substantially, from less than 1% to around 3%. The data for U.S. loan components display similar (but not identical) trends. As in Canada, commercial and industrial loans start out as the most important loan component but is overtaken by real estate loans. In the U.S. this happens in 1987, just a couple years before the same thing happened in Canada.[6] One difference is that in the U.S. the fraction of consumer loans displays a gradual drop from 25% to 16% of total loans.

Despite these similarities there are also some important differences that could affect the responses of the different loan components following a monetary tightening. The U.S. banking system consists of many small- and medium-sized commercial banks, whereas the Canadian banking system is dominated by a few large commercial banks. In particular, as of January 2008 there are over 7000 commercial banks operating in the U.S. and only 20 domestic banks in Canada.[7] Canadian banks compete, however, with other financial companies such as life insurance companies and mutual fund companies that themselves face tough competition in their primary market.[8] In the U.S. these various financial services are dominated by a few large nationwide companies. Moreover, Canadian banks have been less restricted, not only with respect to the setting of interest rates,[9] but they also had a wider business scope and the ability to branch nationwide throughout the sample. The larger number of smaller banks and the historical obstacles to nationwide

[6] Based on H.8 data downloaded from the website of the Federal Reserve System.

[7] From the website of the Canadian Banking Association.

[8] Allen and Engert (2007) summarize differences in performance of Canadian and U.S. banks and discuss the amount of competition in the Canadian banking market.

[9] Canada did not have an interest rate ceiling on deposits, while in the U.S. interest rate ceilings on deposits and savings accounts (Regulation Q) were only abolished in the 1980s.

banking in the U.S. have fostered relationship lending.[10] Relationship lending may affect the desire and ability of banks to protect their customers during a monetary tightening when their own source of funds are becoming scarcer and more expensive.

We discuss two additional reasons why U.S. banks may be better capable of sheltering their business customers from the negative effects of monetary tightening. The first reason is related to the mortgage market. Courchane and Giles (2002), report that even though home ownerships rates are similar (67% in the U.S. and 64% in Canada in 2000), differences in public policy objectives resulted in differences in housing and mortgage markets. Canada's policies have focused more on direct schemes to acquire and retain housing, whereas in the U.S., the focus has been on ensuring a supply of funds for mortgage lending. As a result, until recently, the variety of mortgages offered in the U.S. was greater than that being offered in Canada. In general terms, Canada had mortgages with shorter maturities, lower loan-to-value ratios, and interest rates that were not tax deductible.[11] Long-term mortgages are not attractive when interest rates rise, for example, because they put current-profit margins under pressure, which, in turn, makes it more difficult to have a sufficiently high capital adequacy ratio. This means that banks with long-term mortgages, i.e. U.S. banks, may want to substitute out of mortgages, which would free up resources to lend to firms. The public policy objectives pursued in the U.S. resulted in a strong secondary market for mortgages. Freedman (1998) documents that securitization of mortgages started much earlier in the U.S. and is of much less importance in Canada. The presence of a strong secondary market for mortgages would make it easier for U.S. banks to unload mortgages.

The second reason relates to composition of banks' loan portfolios. Although the qualitative trends in the banks' portfolio composition has been similar there are important differences in the levels. In particular, Canadian (non-mortgage) business loans dropped from 57% of total loans in 1972Q4 to 19% in 2007Q3, whereas U.S. (non-mortgage) business loans dropped from 42% to 25%. Faced with stronger long-term shifts out of business loans it may be less important for Canadian banks to safeguard business loans when interest

[10] See, for example, Berger and Udell (1995) and Petersen and Rajan (1994,1995).

[11] See Courchane and Giles (2002).

rates increase.

Above we provided three reasons why it could be more important and/or easier for U.S. banks not to reduce business loans during a monetary tightening. But there is one reason why business loans should fall by less in Canada. Because Canadian firms are more dependent on bank loans, a reduction in bank lending has the potential to be much more harmful. Freedman (1998) documents that the share of business credit raised through bonds is roughly half that raised through bank loans. In the U.S., the fraction of corporate bonds and commercial paper to bank loans and (bank and non-bank) mortgages was equal to 90% in 2003.[12] But if it is harder for Canadian banks to get funds from other types of financial institutions then demand factors may prevent bank loans from dropping in Canada following a monetary tightening.

3 Data and empirical methodology

In this section, we discuss the data and the empirical methods used. In particular, we show how to estimate the behavior of variables during a monetary downturn (in Section 3.3) and during a non-monetary downturn (in Section 3.4).

3.1 Data sources

All data used are from Statistics Canada. Because not all of the data is available on a monthly basis, we use quarterly data over a sample period, which begins with the fourth quarter of 1972 and extends through the third quarter of 2007. The four bank loan series are: non-mortgage consumer loans, residential mortgages (consumer mortgages), non-mortgage business loans, and non-residential mortgages (business mortgages). We focus attention only on loans held by domestic banks. As of January 2005, domestic banks held 94% of mortgages, 93% of non-mortgage loans, and 93% of total assets (OFSI website, author calculation). We augment this data with the Bank of Canada bank rate, taken to

[12] Using data from Table L.101 of the Flow of Funds for non-financial business.

be the indicator of the monetary authority,[13] the consumer price index, and gross domestic product. A more detailed description of the data is provided in the Appendix.

3.2 Behavior of the loan components

In this section, we describe the time series behavior of the loan components. Each panel of Figure 2 plots detrended real GDP, the interest rate, and the indicated loan component. There are five episodes in which the interest rate clearly reaches (local) peaks. Those are the seventies, early eighties, early nineties, mid nineties, and the beginning of the millennium. The figure documents that each episode (indicated in the graph with a vertical line) is followed by a period in which GDP is below its trend value, although after the interest rate hike of the mid nineties the cyclical component of GDP is only slightly negative. The different loan components behave differently in the periods following these interest rate hikes. Panel A documents that the cyclical component of non-mortgage consumer loans—like the cyclical component of GDP—is negative for some time following an interest rate hike, although after the interest rate hike of the mid nineties only with some delay. As documented in Panel B, the behavior for consumer mortgages is similar. Again, there are five periods of negative detrended values, each corresponding to an interest rate hike. The correlation between the cyclical component of GDP and non-mortgage consumer loans is equal to 0.71 and with consumer mortgages it is slightly less, equal to 0.59.

Results are very different for business loans. First, consider the behavior of non-mortgage business loans in Panel C. In order to associate the periods in which the detrended loan series are negative with interest rate hikes one would have to use long and

[13] Following the explicit targeting of a short-term interest rate by central banks, the recent literature typically only considers an interest rate as the monetary policy indicator even though interest-rate targeting may not have been in place throughout the entire sample. The appropriate interest rate to use as the monetary policy instrument for Canada would be the call loan (or overnight) rate. We use the bank rate, however, because it is available for a longer period and its behavior follows the overnight rate closely when both are available. Racette and Raynauld (1992) and Racette, Raynauld, and Sigouin (1994) use the prime corporate paper rate as the relevant policy instrument. Reestimation of our system using the prime corporate rate as well as reestimation over the shorter sample using the call loan rate leads to very similar results.

variable delays. An easier way to describe the comovement of interest rates and non-mortgage business loans is the following. At the start of each of the five interest rate hikes, non-mortgage business loans are at a trough (relative to its trend values), but then *increase* together with the interest rate and decline (possibly with some delay) when the interest rate declines. The behavior during the early eighties is especially remarkable in that non-mortgage business loans even follows the temporary loosening of monetary policy in the middle of 1980. The correlation of the detrended loan component and GDP is only 0.08.

Panel D plots the results for mortgage business loans. This loan component is only a small fraction of total bank lending but it grew rapidly over the sample period. Some of the rapid growth bursts that took place in the first half of the sample are not taken out by the filter. Thus, one should be careful when interpreting these results. Nevertheless, some interesting lessons can be drawn. In particular, following the sharp monetary tightening of the eighties, real estate lending to firms sharply increased. It is possible that this sharp increase (which was not reversed in the unfiltered data) is better modeled as a change in the trend. Whether the increase is due to a change in the trend or a change in the cyclical component, it is still remarkable that it occurred following a monetary tightening, a period after which—at least according to the conventional view—the supply of bank loans should decrease.

The discussion in this section simply points at some comovements during particular episodes. Below, we show that this informal discussion is confirmed with the results obtained using the empirical methodology described in the remainder of this section.

3.3 Two types of monetary downturns

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]

$$Z_t = B_1 Z_{t-1} + \cdots + B_q Z_{t-q} + D_0 r_t^{ffr} + \cdots + D_q r_{t-q}^{ffr} + u_t, \tag{1}$$

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

$$u_t = A\varepsilon_t, \tag{2}$$

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

$$E\left[u_t u_t'\right] = AA'. \tag{3}$$

When we replace $E\left[u_t u_t'\right]$ by its sample analogue, we obtain $k(k+1)/2$ conditions on the coefficients in A. Since A has k^2 elements, $k(k-1)/2$ additional restrictions are needed to estimate all elements of A. A standard procedure is to obtain the additional $k(k-1)/2$ restrictions by assuming that A is a lower-triangular matrix. Christiano, Eichenbaum, and Evans (1999), however, show that to determine the effects of a monetary policy shock one can work with the less-restrictive assumption that A has the following *block*-triangular structure:

$$A = \begin{bmatrix} A_{11} & 0_{k_1 \times 1} & 0_{k_1 \times k_1} \\ A_{21} & A_{22} & 0_{1 \times k_2} \\ A_{31} & A_{32} & A_{33} \end{bmatrix}, \tag{4}$$

[14] To simplify the expressions we do not display constants, trend terms, and seasonal dummies that are included in the empirical implementation.

where A_{11} is a $(k_1 \times k_1)$, A_{21} is a $(1 \times k_1)$ matrix, A_{31} is a $(k_2 \times k_1)$, A_{22} is a scalar, A_{32} is a $(k_2 \times 1)$, A_{33} is a $(k_2 \times k_2)$, and $0_{i \times j}$ is a matrix with zero elements. Note that this structure is consistent with the assumption made above about the information set of the central bank.

Our benchmark specification is based on the assumption that X_{2t} is empty and that all other elements are, thus, in X_{1t}. Intuitively, X_{2t} being empty means that the central bank responds to contemporaneous innovations in all of the variables of the system.[15] It also means that none of the variables can respond contemporaneously to monetary policy shocks. We impose the same restriction on changes in the federal funds rate. That is, all elements of the $(k \times 1)$ vector D are assumed to be equal to zero except the element corresponding to the Canadian bank rate. In other words, we allow the Canadian central bank to respond contemporaneously to unexpected changes in the federal funds rate. This structure allows us to consider two different types of monetary downturns.

FED initiated monetary downturn. The first type of monetary downturn is a monetary downturn that is initiated by the FED. We use the impulse response function of the federal funds rate from Den Haan, Sumner, and Yamashiro (2007), which is obtained by estimating a VAR with U.S. data, to pin down the size of the shock and the time path along which the federal funds rate returns back to normal. An increase in the federal funds rate leads to an increase in the Canadian bank rate in the same period, but affects other Canadian variables only in the next period.

Bank of Canada initiated monetary downturn. The second type of monetary downturn is initiated by the Bank of Canada. This is a response to the $(k_1 + 1)^{\text{th}}$ element of ε. Since the equation of the Canadian bank rate includes both the contemporaneous and lagged values of the federal funds rate, this change in the Canadian bank rate is *not* a response to a FED change in the interest rate.

[15] The results are similar under the alternative assumption that the monetary authority does not respond to contemporaneous innovations of the other variables in the system.

3.4 Non-monetary downturns

The impulse response functions for the monetary downturns not only reflect the direct responses of the variables to an increase in the interest rate, but also the indirect responses to changes in the other variables and, in particular, to the decline in real activity. This makes it difficult to understand what is going on, especially since a decline in real activity could increase or decrease the demand for bank loans.[16] For example, an increase in a loan component during a monetary downturn could still be consistent with a credit crunch, if the decline in real activity strongly increases the demand for that loan component. Thus, without the credit crunch this loan component would have increased even more. To filter out this indirect effect of real activity, we compare the behavior of loan components during a monetary downturn with their behavior during a non-monetary downturn of equal magnitude. While a monetary downturn is caused by a monetary tightening, a non-monetary downturn is caused by one or more output shocks.

There are two schemes to construct non-monetary downturns. In the first scheme, the structural shock is simply the innovation to output from the reduced-form VAR. For our purposes, it is not that important to interpret the nature of this structural shock. The key feature, however, is that while this shock decreases real activity it does not lead to an increase in interest rates.[17] It, therefore, distinguishes itself from a monetary shock in a fundamental way. We mainly focus on a second scheme that is similar to the first but ensures that the behavior of output during a non-monetary downturn is identical to that observed during a monetary downturn. This makes it convenient to quantitatively compare the responses during the two types of downturns. According to this second scheme, a non-monetary downturn is caused by a sequence of output shocks such that output follows the exact same path as it does during a monetary downturn. As documented in the appendix,

[16] On one hand, the reduction in real activity would reduce investment and, thus, the need for loans, while on the other hand the reduction in internal cash flow could increase the demand for loans. The latter would especially manifest itself if production cannot easily be scaled down so that a reduction in sales leads to an increase in inventories.

[17] We find that output shocks lead to reductions in the interest rate but they are quantitatively very small.

the responses of the loan components following a single output shock tell a story that is very similar to that implied by the loan components responses during a non-monetary downturn (following a sequence of output shocks).[18]

With output declining during both downturns the key difference between the two is the behavior of the interest rate. Thus, the difference between the impulse response functions for the loan variables of the monetary and the non-monetary downturn can be interpreted as the effect of the increase in the interest rate holding real activity constant. That is, by comparing the behavior of the loan variables during a monetary downturn with that observed during a non-monetary downturn, we filter out the changes in demand and supply that are caused by the reduction in output. Obviously, there are pitfalls to this comparison, but we think that they provide a useful set of contrasting empirical results.

3.5 Specification of the VARs and standard errors

Each VAR includes one year of lagged variables, a constant, a linear trend, and quarterly dummies to adjust the data for seasonality.[19] The coefficients are estimated with ordinary least squares (OLS) and the significance levels are established using a Monte Carlo procedure with 5,000 replications in which data are generated by bootstrapping the estimated residuals. To avoid clutter we do not report confidence bands in the graphs but instead use open and solid squares to indicate that an estimate is significant at the 10% and 5% level, respectively.[20]

[18] Implementing these exercises requires us to make an additional assumption on A. In particular, we assume that the only shock that affects real activity is this "output" shock. That is, the matrix A_{11} also has a block-triangular structure. Note that the block-triangular structure imposed in Equation 4 already made the assumption that any structural shock, including the monetary shock, could have an effect on the monetary policy variable, but that the monetary shock only had an immediate effect on the monetary policy variable.

[19] We include seasonal dummies because non-residential mortgages are not seasonally adjusted.

[20] Significance levels are for one-sided tests.

4 Results

FED initiated monetary downturn. In this section, we examine a monetary tightening that is induced by the FED. In particular, we consider the responses of Canadian variables (including the bank rate) when the federal funds rate increases and then follows the time path indicated by the estimated impulse response function of Den Haan, Sumner, and Yamashiro (2007). Panels A through C of Figure 3 plot the responses of the bank rate, the price level, and real GDP following this FED tightening. The bank rate closely follows the federal funds rate but increases by a smaller amount. The peak increase in the federal funds rate is equal to 81 basis points, whereas the peak response in the bank rate is equal to 61 basis points. It is typically assumed that at least part of the increase in the nominal rate is due to an increase in the real rate. Bhuiyan and Lucas (2007) document—using Canadian data—that this is indeed the case. In particular, they show that an increase in the overnight target rate by 22 basis points leads to an increase in the ex ante real rate (of a one-year bond) by 18 basis points and a decrease in the expected inflation rate by 5 basis points. Real GDP drops significantly for over a year reaching its maximum decline of 0.58% after approximately 2 years. The response of the price level indicates that our results suffer from the price puzzle, but the puzzle is much smaller here than in other papers; the price level experiences a small (but significant) increase during the first few years, after which it displays a more substantial (but insignificant) decline below its original level.[21] Moreover, as documented below we do not face the price puzzle when we consider a tightening that is not initiated by the FED, and for alternative specifications discussed in the appendix the price puzzle is even less apparent than it is in Figure 3.[22] Fung and Kasumovich (1998) resolve the price puzzle for several countries including Canada using long-run restrictions. Barth and Ramey (2001) and Gaiotti and Secchi (2004) argue, however, that an increase in the price level is not a puzzle, because

[21] In contrast, Den Haan, Sumner, and Yamashiro (2007) find using U.S. data a strong significant increase in the price level that is not followed by a substantial decline.

[22] Fung and Gupta (1997) find using Canadian data a strong significant increase in the price level when monetary tightenings are identified as negative innovations to a liquidity variable, but their price response is similar to ours when monetary shocks are identified as innovations to an interest rate.

increases in the interest rate could lead to an increase in the price level through a cost channel. Given that there are reasons why the price level should not fall following a monetary innovation, and since we only face a modest price puzzle, we would rather not search for that particular specification, which delivers the desired result for prices.

Figures 3A and 3B also plot the behavior of the bank rate and the price level during a non-monetary downturn in which the changes in output are identical to those observed following a monetary tightening (Figure 3C), but are instead caused by a sequence of output shocks. The figure shows that interest rates decrease somewhat in response to the negative output shocks, but that the reduction is very small. Prices display a moderate drop during a non-monetary downturn.

Panels D through G of Figure 3 plot the responses of the four loan components after a positive innovation in the federal funds rate. The key observation is that—as is the case for the loan components of U.S. banks—the components behave very differently. Non-mortgage consumer loans and consumer mortgages display a gradual and persistent decline. The decline in these two loan components follow the drop in output but their declines last longer. The magnitudes are also larger. The maximum drop of non-mortgage consumer loans is equal to 1.78% and the maximum drop of consumer mortgages is equal to 2.23%, more than triple the fall of output. Results not shown indicate that consumer loans behave similarly to total loans.

Both types of business loans behave differently from consumer loans. Following a monetary tightening, both display sharp increases that are significant at the 10% level in the first quarter and significant at the 5% level for several subsequent quarters. Non-mortgage business loans return to their original level roughly four years following the shock after which they display a moderate but significant decline. Business mortgages remain high for an even longer time period.

Non-monetary downturn (corresponding to FED initiated downturn). To shed some light on the question of how the downturn in real activity, following the monetary contraction, affects the loan components, we also analyze the responses of the loan components during a non-monetary downturn in which the path of output is exactly as it

is during the monetary downturn. Recall that interest rates barely move during such a downturn.

Non-mortgage consumer loans decline in response to output shocks but the decline during the non-monetary downturn is roughly half that of the decline during a comparable monetary downturn. For consumer mortgages the difference is even greater. Whereas consumer mortgages sharply decline during a monetary tightening, they are virtually flat during a non-monetary downturn. How the non-monetary downturn is constructed is not important, since the same qualitative results are found when responses following a single output shock are considered.[23]

The behavior of both types of consumer loans during a monetary, thus, fits the textbook story of a monetary tightening. That is, loans decrease and they decrease by more than what can be explained by the reduction in real activity. In contrast, the behavior of both types of business loans does not fit the textbook story about the monetary transmission mechanism. Consider the behavior of non-mortgage loans to firms. Above we mentioned that this type of loan displays a sharp increase during a monetary downturn. During a non-monetary downturn, however, they display a significant decline although the decline is modest (roughly half the drop in output). Similarly, business mortgages, while increasing during a monetary downturn, are basically unchanged during a non-monetary downturn. Since a reduction in real activity could lead to either a decrease in the demand for loans (since investment decreases) or an increase (since internal financing decreases), the observed reduction in business loans following the negative output shocks is not that surprising. But if a reduction in real activity leads to a reduction in loans during a non-monetary downturn, then why do loans to businesses *increase* during a monetary downturn? We return to this question in the last section.

Bank of Canada initiated monetary downturn In this section, we consider an increase in the Bank of Canada bank rate that is not a response to an increase in the federal funds rate. The correlation between the bank and the federal funds rate is high, namely 88% for our quarterly data, but even when we allow the federal funds rate to

[23] See the appendix.

affect the bank rate contemporaneously, we find substantial innovations to the bank rate. The results are given in Figure 4. Panel A documents that the monetary tightening that is initiated by the Bank of Canada corresponds to increases in the bank rate that are similar to those that are observed when the increases are in response to a FED tightening. The same is true for the drop in output. The response for the price level is somewhat different and the price puzzle now has clearly disappeared. The price level is basically flat for roughly two years after which it displays a gradual and persistent decline, that is significant at the 5% level.

We now turn to the responses of the loan components. Qualitatively the responses of the two types of consumer loans following a tightening initiated by the Bank of Canada are very similar to those observed when the downturn is initiated by the FED. Quantitatively, however, the drops are much smaller. This suggests that Canadian banks may be better able to shelter their portfolio of consumer loans when interest rates only increase in Canada and not the United States.

Whether the interest rate increase is due to a tightening initiated by the FED or the Bank of Canada also does not matter for the qualitative results for business mortgages, although, it does matter for non-mortgages business loans. When the increase in the interest rate is due to a tightening initiated by the FED, non-mortgage business loans display a sharp and persistent increase. When the increase is initiated by the Bank of Canada, we find a similar initial increase after which the impulse response function becomes negative but insignificant.[24] The explanation for this result may be related to the one given to explain the smaller responses in consumer loans. In the last section, we argue that it is very well possible that the sharp reductions in consumer mortgages and other consumer loans that are observed when interest rates increase in both Canada and the U.S. occur because these loans are less attractive to banks when interest rates increase. This substitution out of consumer loans frees up resources that can be used to increase business loans. But if Canadian banks can obtain funding for their loans in the U.S. at lower rates, then consumer loans may not be as unattractive. Therefore, if consumer loans decrease

[24] There are some significant values after five years but these should probably not be taken seriously.

by less then there is less room for business loans to increase. An alternative explanation is that demand for business loans is lower during a monetary downturn initiated by the Bank of Canada, because Canadian firms would rather borrow from U.S. lenders than from Canadian lenders when the interest differential between Canadian and U.S. rates increases.

Non-monetary downturn (corresponding to BoC initiated downturn). Since the output decline following a tightening initiated by the Bank of Canada is very similar to the output decline following a FED tightening, it is also the case that the responses during the two non-monetary downturns are very similar. But since quantitatively (and for non-mortgage business loans also qualitatively) the results are different during the two monetary downturns it will be useful to do another comparison.

Although the decline in consumer mortgages is milder when the increase in the interest rate is due to an independent tightening by the Bank of Canada, the response during non-monetary downturns is flat, which means that the behavior of these loans is still consistent with the textbook description of a monetary tightening. The smaller decline in non-mortgage consumer loans does change the interpretation since consumer loans do decrease during a non-monetary downturn. In fact, as documented in Panel D of Figure 4, the declines in non-mortgage consumer loans during a monetary and a non-monetary downturn are now quite similar. These results are consistent with the hypothesis that when interest rates increase in Canada but not in the U.S., the reduction in non-mortgage consumer loans is due to the drop in real activity and not to the increase in the interest rate.

Business mortgages also increase during a monetary downturn initiated by the Bank of Canada. Since they do not increase during a non-monetary downturn, they clearly do not fit the standard textbook story. Finally, we discuss non-mortgage business loans. The significant initial increase in non-mortgage business loans clearly cannot be explained by the decline in real activity. Interestingly, except for this initial decrease non-mortgage business loans closely follow the behavior of non-mortgage business loans during a non-monetary downturn, which is exactly what we found for non-mortgage consumer loans.

To summarize, when interest rates increase in Canada but not in the U.S., the behavior of non-mortgage loans (both business and consumer loans) is very similar to that observed during downturns of equal magnitude caused by a series of output shocks instead of a monetary shock. For mortgage loans, it is less important whether the tightening is initiated by the FED and followed by the Bank of Canada or whether the tightening only occurs in Canada.

Robustness Exercises. In the appendix, we show that the results are robust to several modifications. In particular, we do the following. We calculate the impulse response functions using a standard VAR that does not distinguish between a tightening initiated by the Bank of Canada and a FED tightening. The results are basically an average of the ones reported here for the two types of monetary downturns. We also show that the results are robust to adding the exchange rate, U.S. GDP, and business inventories to the VAR. When we add inventories we generate the non-monetary downturn using output and inventory shocks so that we match both the response of output and inventories observed during the monetary downturn. We also reestimate the VAR using only more recent data and find similar responses for most variables. Finally, we document that the responses for the non-monetary downturns (which are based on a sequence of output shocks) are qualitatively similar to the responses observed after a single output shock.

We also tried alternative assumptions about the number of lags and trend specifications and found that the results are robust.[25]

5 Concluding comments

The responses of Canadian loans to a monetary tightening initiated by the FED—and followed by the bank of Canada—are remarkably similar to those found for the U.S. economy. In particular, both types of consumer loans decrease during a monetary downturn and they decrease by much more than during a comparable non-monetary downturn. In

[25] These results can be found through the link "robustness: different trend & lag structures" on http://www1.fee.uva.nl/toe/content/people/content/denhaan/papers.html.

contrast, business loans increase following the increase in interest rates while we do not observe such an increase during a non-monetary downturn.

The responses following a tightening initiated by the Bank of Canada, which leaves U.S. interest rates unchanged, are similar but there are also some differences. The decline in real activity is almost identical across the two types of monetary downturns. Although consumer loans decrease during both monetary downturns, the decrease in non-mortgage consumer loans during a tightening initiated by the Bank of Canada can be fully explained by the reduction in real activity. Except for the initial rise, the same is true for non-mortgage business loans. For mortgages, however, the rise in Canadian interest rates clearly has an effect that is not explained by the decline in real activity independent of which central bank initiates the tightening.

Given that business loans do not increase following a series of negative output shocks, the increase in business loans following a monetary tightening is unlikely to be caused by the reduction of real activity. It is not impossible that an increase in interest rates leads to an increase in the demand for loans if the higher burden of interest payments can only be met by increased borrowing. But if firms are in such dire need of extra funds, the question arises as to why banks are willing to supply the extra funds.

There are several reasons why banks may want to adjust their loan portfolio following a monetary tightening. One possibility is that the risk of loans to consumers increases by far more than the risk of loans to firms. This would shift the portfolio towards business loans, and if the portfolio shift is strong enough then the supply of business loans could even increase. Minetti (2007) develops a model in which banks affect the risk of their firm loans with the amount they lend out. In such an environment banks may want to give priority to business lending because a reduction in the amount lent to a firm may increase the risk and lower expected returns.[26] Another possibility considered is a shift from long-term (i.e., real estate) loans towards short-term loans. The idea is that the increase in the short-term rate decreases the current-period profit margin on long-term loans. If banks

[26] But note that this motivation should only be present during a monetary downturn because we do not see during a non-monetary downturn.

worry about the book value of their equity position then such a reduction in bank profits may induce banks to move out of long-term loans into short-term loans.[27]

With our U.S. data set we were unable to distinguish between real estate loans to consumers and firms. Using Canadian data, our empirical finding that both types of business loans (mortgages and non-mortgage loans) increase when interest rates increase in both Canada and the U.S., suggests that it is the type of borrower and not so much the type of loan that matters. That is, our results suggest that consumers are more likely than firms to be constrained during a monetary downturn. The conclusion that consumers and not businesses are credit constrained is consistent with the results of Safaei and Cameron (2003).[28] Although the theoretical literature on agency costs in financing has typically focused on loans to firms, there are now several papers that build dynamic business cycle models in which frictions associated with lending to consumers play a crucial role.[29] Our empirical results document that especially following a monetary tightening consumers are more likely than firms to be constrained and, thus, make clear the importance of theoretical work that emphasizes frictions in consumer finance.

Another aspect of our results that deserve more attention is the following. Our empirical work focuses on banks' loan portfolios following a monetary tightening. We do not address what happens to other types of funding[30] and whether these changes in the

[27] One such reason could be regulation such as the Basel accord. Den Haan, Sumner, and Yamashiro (2007) argue that even before the Basel accord was implemented there were reasons for banks to safeguard their equity position.

[28] They find in response to a monetary policy shock, a positive comovement between output and credit, both when credit to businesses and when credit to persons is used. In response to a positive "credit supply shock," however, output increases when bank credit to persons is used but output decreases when bank credit to businesses is used. The latter is consistent with the pattern we find during a monetary downturn. Note that while we do not separately identify a credit supply shock—which requires a complex set of restrictions—it is possible that our monetary policy shock captures, in part, a credit supply shock like the one identified in Safaei and Cameron (2003).

[29] See, for example, Campbell and Hercowitz (2004) and Iacoviello (2005).

[30] It is possible that the increase in bank funding makes up for a decline in funding from other sources. This raises the question why banks are not fulfilling this role during a non-monetary downturn while they are capable of doing it following a monetary tightening.

bank loan portfolios are important in magnifying or propagating the effects of the monetary tightening. Whether, for example, the observed reduction in consumer mortgages is important in affecting investment in real estate depends on alternative financing possibilities. This is obviously a difficult question, but Iacoviello and Minetti (2007) make progress on this issue by investigating whether shocks to the ratio of non-bank mortgages to bank mortgages affect house prices. Using data for Finland, Germany, Norway, and the U.K. they find mixed results and they argue that the differences can be explained by differences in the mortgage markets such as the depth of the funding system, the presence of a diversified range of mortgage lenders, and the ability to share credit risk.

A Appendix

A.1 Data Sources

All Canadian data series are from Statistics Canada, while U.S. data series are from the St. Louis FED FRED database.

- Bank rate (v122530). Quarterly series are constructed using the average of the monthly observations.
- Total Consumer Price Index (v735319). Quarterly series are constructed using the average of the monthly observations.
- (Non-mortgage) business loans (v122645). Quarterly series are constructed using the average of the monthly observations.
- Business mortgages (v122656). Quarterly series are constructed using the average of the monthly observations.
- (Non-mortgage) consumer loans (v122709). Quarterly series are constructed using the average of the monthly observations.
- Consumer mortgages (v122748). Quarterly series are constructed using the average of the monthly observations.

- Gross Domestic product (v499686). Quarterly data.
- Federal funds rate. Quarterly series are constructed using the average of the monthly observations.

B Robustness

We performed the following robustness exercises.

1. Estimate a standard VAR that does not distinguish between a monetary tightening initiated by the FED and the bank of Canada.
2. Report the results to a single output shock.
3. Add the exchange rate to the VAR.
4. Add U.S. GDP to the VAR.
5. Reestimate the results using only the more recent data.
6. Add inventories to the VAR and consider a non-monetary downturn in which output and inventory shocks are such that the implied response for output *and* the implied response for inventories is identical to the one observed during a monetary downturn.

The data sources for the additional data are the following.

- Inventories (v1992058), Statistics Canada. Quarterly level series are constructed using the quarterly change series.
- Exchange rate, FRED. Quarterly series are constructed using the average of the monthly observations.
- U.S. GDP, FRED. Quarterly data.

Results using a standard VAR. Figure A.1 plots the results when we use a standard VAR in which we do not include the federal funds rate. In this specification, an innovation in the bank rate captures both a response to a change in the federal funds rate as well as an independent tightening by the Bank of Canada. The results are similar to those reported in the main text for a tightening initiated by the FED. But quantitatively they are actually somewhat smaller, that is, they are best described as an average of the downturns initiated by the FED and the Bank of Canada. The only thing that is somewhat different is that during a non-monetary downturn consumer mortgages actually display a significant increase. This is also found by Den Haan, Sumner, and Yamashiro (2007) and only increases the gap between the response during a monetary and a non-monetary downturn.

Responses following a single output shock. As discussed in Section 3.4, the responses of variables during a non-monetary downturn are the responses to a series of output shocks (this made it possible to get an identical output response during the two different downturns). The responses of the variables during a non-monetary downturn are, however, qualitatively very similar to the responses to a single output shock. This is documented in Figure A.2, which plots the responses of output and the loan components following a one-time negative output shock.

First, note that following an output shock the initial output response is larger than the one constructed for the non-monetary downturn in Figure A.1, but the dynamic path is not that different. It still has a slight hump shape, and after roughly three years it has returned back to its original level. As was observed during a non-monetary downturn, non-mortgage consumer loans decline and consumer mortgages increase. Business loans also move in the same direction as observed during a non-monetary downturn, except that in response to a single output shock business mortgages initially display an (insignificant) increase.

Adding the exchange rate. As documented in Figure A.3 the results are very similar when we add the exchange rate to the VAR.

Adding U.S. GDP. As documented in Figure A.4 the results are very similar when we add U.S. GDP to the VAR.

1984-2007 sample. Figure A.5 reports the results when we reestimate the VAR using only data from 1984 to the end of the sample. The results are similar to those reported in Figure A.1, although there are a few differences. First, although the response of the bank rate is only slightly smaller for this subsample (60 basis points versus 80 basis points for the whole sample), the response of output is much smaller. In particular, whereas we find a maximum drop of around 0.6% for the VAR estimated using the complete sample we only find a maximum drop of around 0.15% for this subsample. The price puzzle worsens in that the drop in the price level is now smaller and not significant. The responses of non-mortgage business loans are similar to those discussed in the main text except that the magnitudes are smaller. In particular, the response during a monetary downturn lies consistently above the response during a non-monetary downturn. The response for business mortgages now displays wild swings. Given the volatility of this series and the shortness of the sample it is not clear how serious to take these results, but it is clear that the pattern does not provide evidence of a bank-lending channel. Consumer mortgages still display a sharp reduction during a monetary downturn in the subsample even though the magnitude is now somewhat smaller. It is also still the case that consumer mortgages during a monetary tightening are substantially below the responses during a non-monetary downturn. The only substantial difference is the response for consumer non-mortgage loans. For the whole sample we find that consumer loans decrease during both a monetary and a non-monetary downturn, but more so during a monetary downturn. In the subsample, we find that they increase during a monetary downturn although none of the values of the IRFs are significant.

Adding inventories. One possible reason why companies might need more funds during a downturn is that the drop in sales leads to less internal funds especially if production (costs) cannot be easily adjusted downwards. If inventories increase more during a monetary than a non-monetary downturn then this would be consistent with a larger increase in

the demand for business loans after a monetary than a non-monetary downturn. To check this hypothesis we add the change in inventories to our VAR and redefine a non-monetary downturn as a downturn caused by output and inventory shocks such that the responses of output and inventories are identical to those observed after a monetary tightening.

Adding inventories to the VAR leaves the impulse response functions of a monetary tightening reported in Figure A.1 almost unaffected. Only the response of business loans is a little bit lower. When we look at an inventory shock then we find—in contrast to our results for the U.S.—that inventories decrease following a monetary downturn. Since business loans drop following a negative inventory shock, this means that business loans drop even more during a non-monetary downturn, when a non-monetary downturn is defined as a downturn in which output and investment shocks generate a time path for output and inventories identical to that observed during a monetary downturn. These findings are documented in Figure A.6 that plot the response of non-mortgage business loans during both a monetary and a non-monetary downturn.

References

[22] Allen, Jason, and Walter Engert, 2007, Efficiency and competition in Canadian Banking, *Bank of Canada Review* Summer, 33-45.

[22] Barth, Marvin J., and Valerie A. Ramey, 2001, The cost channel of monetary transmission, *NBER Macroeconomics Annual* 16, 199-239.

[22] Berger, Allen N., and Gregory F. Udell, 1995, Relationship lending and lines of credit in small firm finance. *Journal of Business* 63, 351-381.

[4] Bernanke, Ben S., and Mark Gertler, 1995, Inside the black box: The credit channel of monetary policy transmission, *Journal of Economic Perspectives* 9, 27-48.

[5] Bhuiyan, Rokon, and Robert F. Lucas, 2007, Real and nominal effects of monetary policy shocks, *Canadian Journal of Economics* 40, 679-702.

[6] Campbell, Jeffrey R., and Zvi Hercowitz, 2004, The role of collateralized household debt in macroeconomic stabilization, Federal Reserve Bank of Chicago working paper WP 2004-24.

[7] Cecchetti, Stephen G., 1999, Legal structure, financial structure, and the monetary policy transmission mechanism, *FRBNY Economic Policy Review* July, 9-28.

[8] Christiano, Lawrence J., Martin Eichenbaum, and Charles Evans, 1999, Monetary policy shocks: What have we learned and to what end?, in *Handbook of Macroeconomics*, John B. Taylor and Michael Woodford (eds.), North Holland, Amsterdam.

[9] Courchane, Marsha J., and Judith A. Giles, 2002, A comparison of U.S. and Canadian residential mortgage markets, *Property Management* 20, 326-368.

[22] Den Haan, Wouter J., Steven W. Sumner, and Guy M. Yamashiro, 2007, Bank loan portfolios and the monetary transmission mechanism, *Journal of Monetary Economics* 54, 904-924.

[11] Duguay, Pierre, 1994, Empirical evidence on the strength of the monetary transmission mechanism in Canada, *Journal of Monetary Economics* 33, 39-61.

[12] Fisher, Jonas D.M., 1999, Credit market imperfections and the heterogeneous response of firms to monetary shocks, *Journal of Money, Credit and Banking* 31, 187-211.

[22] Freedman, Charles, 1998, The Canadian banking system, Bank of Canada Technical Report 81.

[14] Fung, Benedict S.C., and Rohit Gupta, 1997, Cash setting, the call loan rate, and the liquidity effect in Canada, *Canadian Journal of Economics* 30, 1057-1082.

[22] Fung, Ben Siu-cheong Fung, and Marcel Kasumovich, 1998, Monetary shocks in the G-6 countries: Is there a puzzle? *Journal of Monetary Economics* 42, 575-592.

[22] Gaiotii, Eugenio, and Alessandro Secchi, 1996, Is there a cost channel of monetary policy transmission? An investigation into the pricing behavior of 2,000 firms, *Journal of Money, Credit, and Banking* 38, 2013-2037.

[17] Gertler, Mark, and Simon Gilchrist, 1993, The role of credit market imperfections in the monetary transmission mechanism: Arguments and evidence, *Scandinavian Journal of Economics* 95, 43-64.

[18] Iacoviello, Matteo, 2005, House prices, borrowing constraints and monetary policy in the business cycle, *American Economic Review* 95, 739-764.

[19] Iacoviello, Matteo, and Raoul Minetti, 2007, The credit channel of monetary policy: evidence from the housing market, forthcoming in *Journal of Macroeconomics*.

[22] Minetti, Raoul, 2007, Bank capital, firm liquidity, and project quality, *Journal of Monetary Economics* 54, 2584-2594.

[22] Petersen, Mitchell A., and Raghuram G. Rajan, 1994, The benefits of lending relationships: evidence from small business data, *Journal of Finance* 49, 3-37.

[22] Petersen, Mitchell A., and Raghuram G. Rajan, 1995, The effect of credit market competition on lending relationships, *Quarterly Journal of Economics* 110, 407-443.

[23] Racette, Daniel, and Jacques Raynauld, 1992, Canadian monetary policy: will the check-list approach ever get us to price stability?, *Canadian Journal of Economics* 25, 819-838.

[24] Racette, Daniel, Jacques Raynauld, and Christian Sigouin, 1994, An up-to-date and improved BVAR model of the Canadian economy, Working paper WP-94-4, Bank of Canada, Ottawa.

[25] Repullo, Rafael, and Javier Suarez, 2000, Entrepreneurial moral hazard and bank monitoring: A model of the credit channel, *European Economic Review* 44, 1931-1950.

[26] Safaei, Jalil, and Norman E. Cameron, 2003, Credit channel and credit shocks in Canadian macrodynamics – a structural VAR approach, *Applied Financial Economics* 13, 267-277.

Figure 1: Loan components as a fraction of total loans

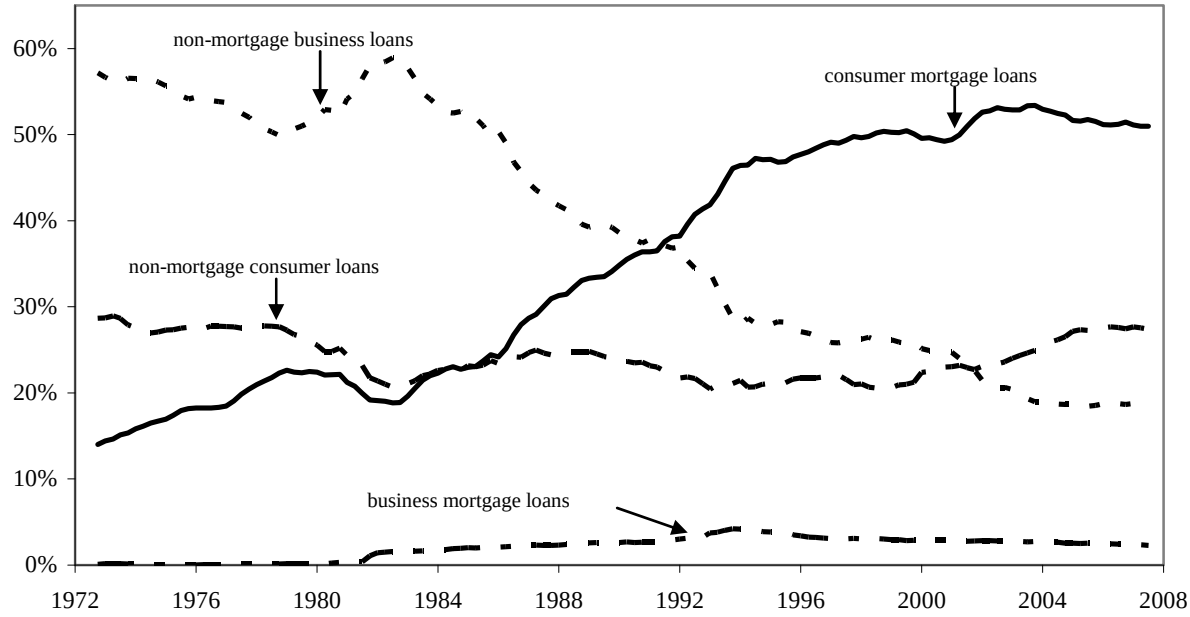
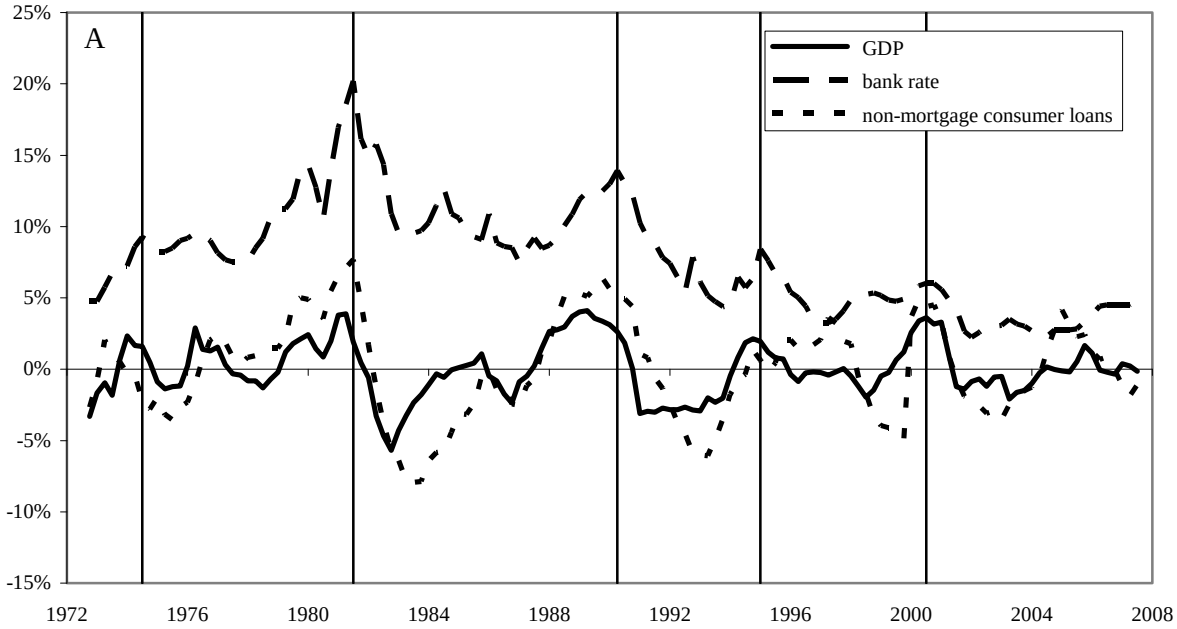
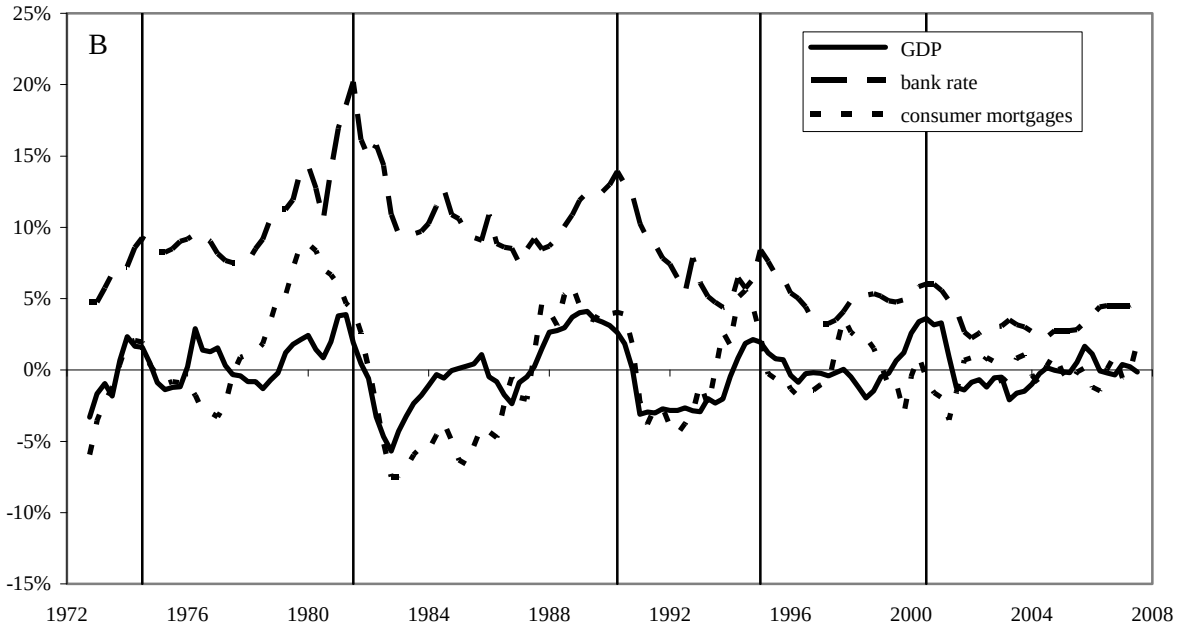
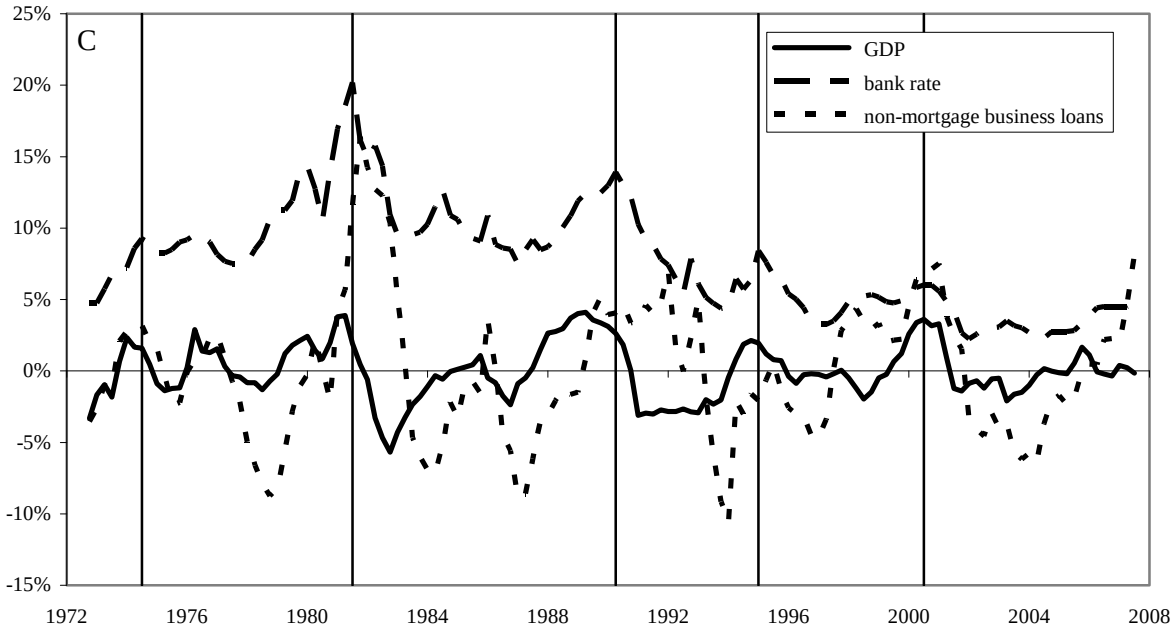
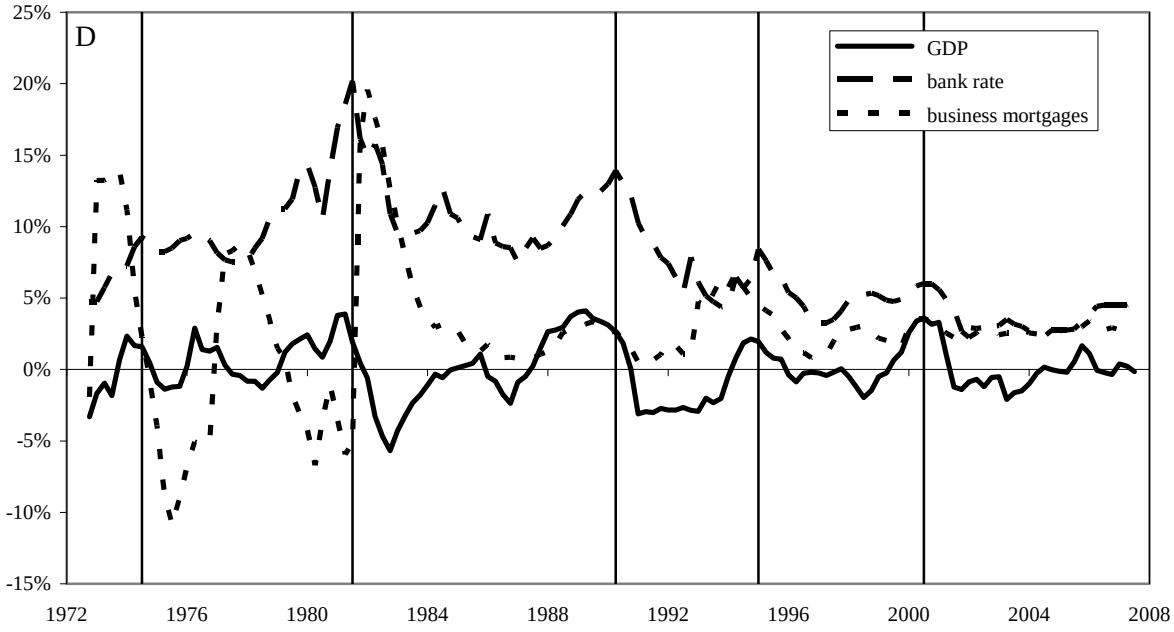


Figure 2: Interest rate and cyclical components of GDP and loan components



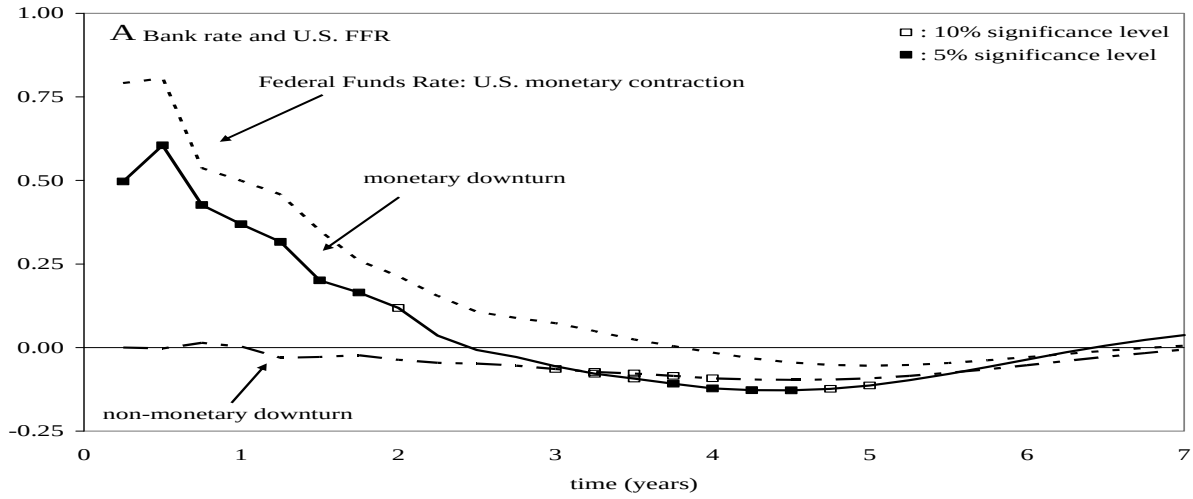


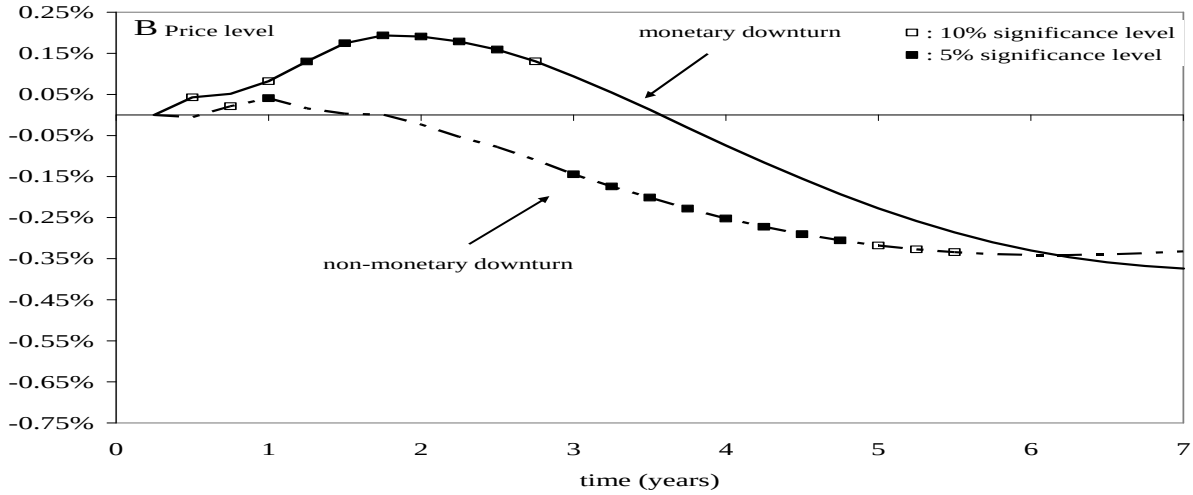


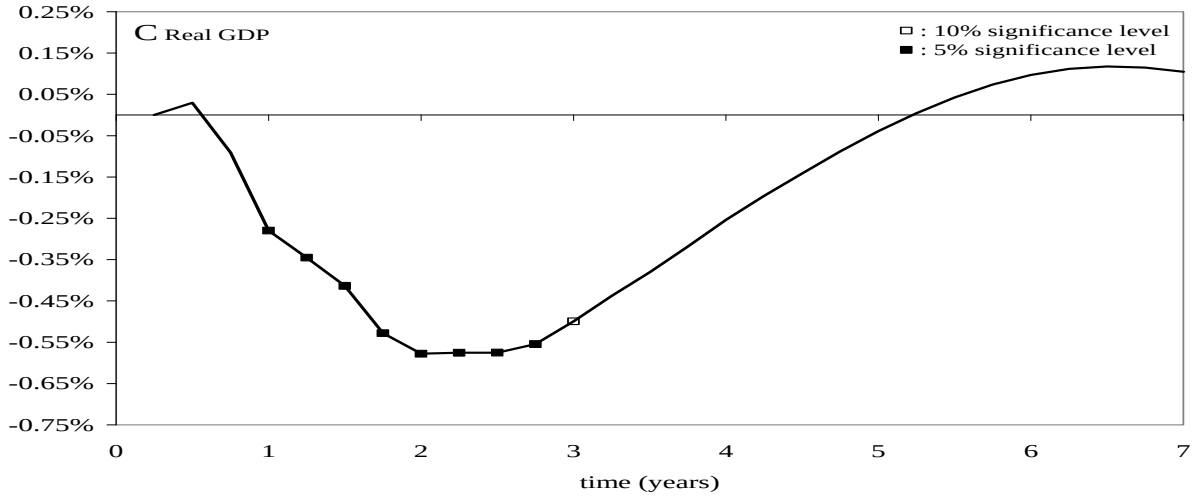


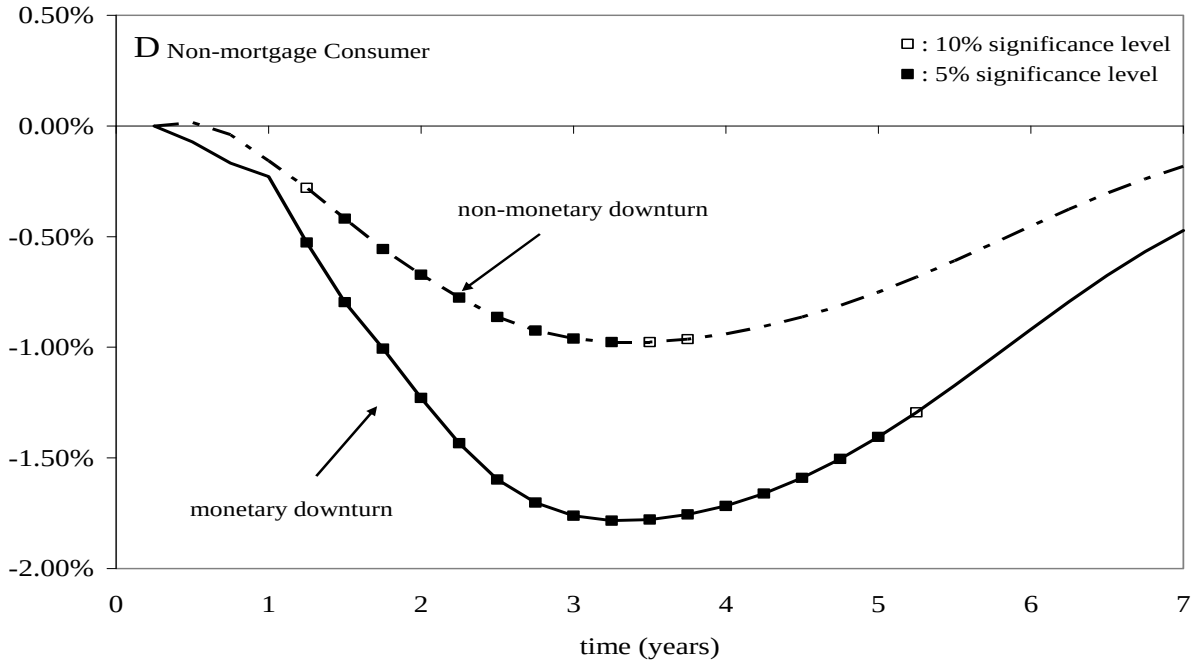
Note: These graphs plot the bank rate, the cyclical component of GDP, and the indicated cyclical component of the loan component. The vertical lines indicate peaks in the bank rate. Cyclical components are constructed using the HP filter.

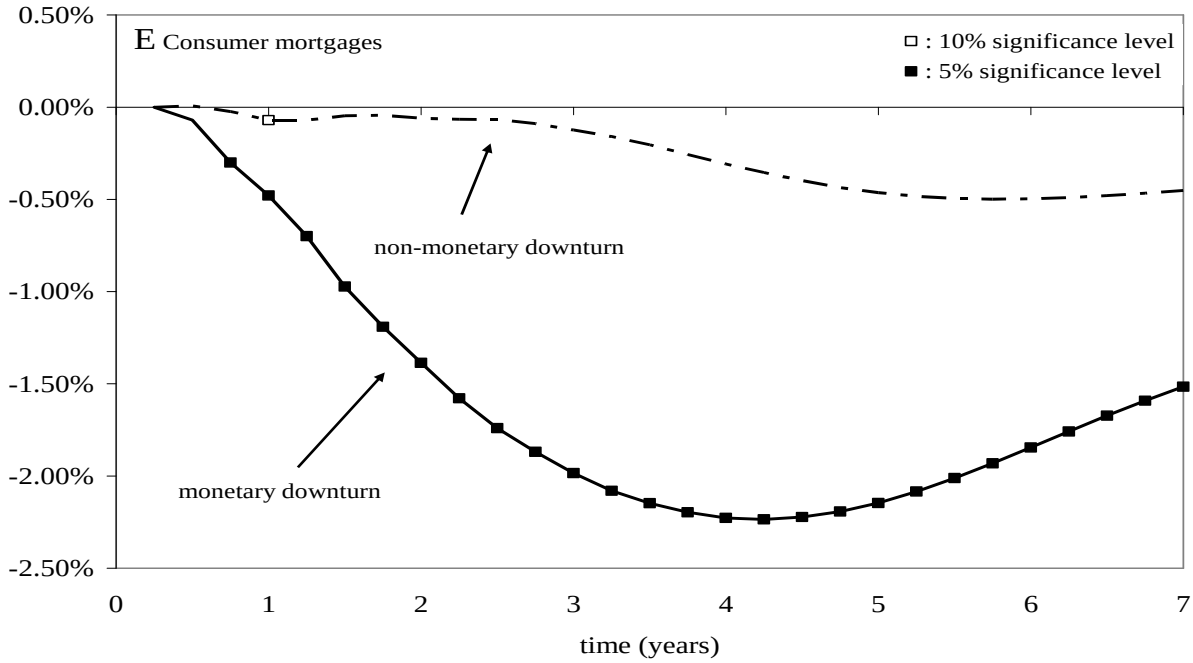
Figure 3: Responses during a monetary and a non-monetary downturn
Tightening initiated by the FED

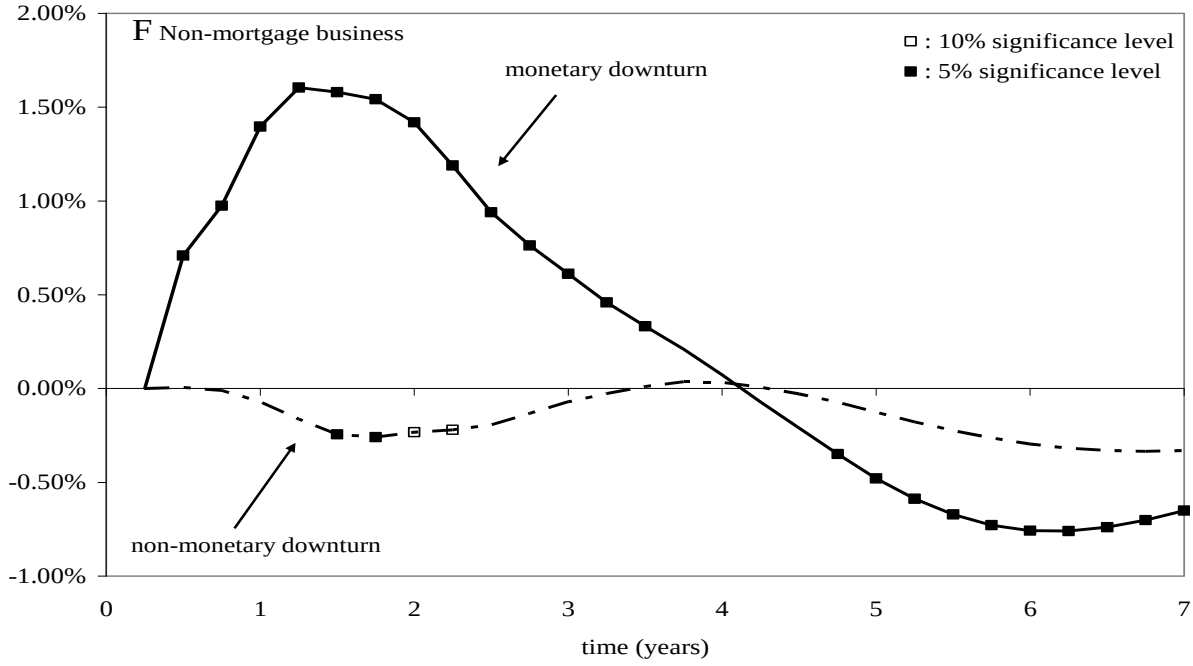


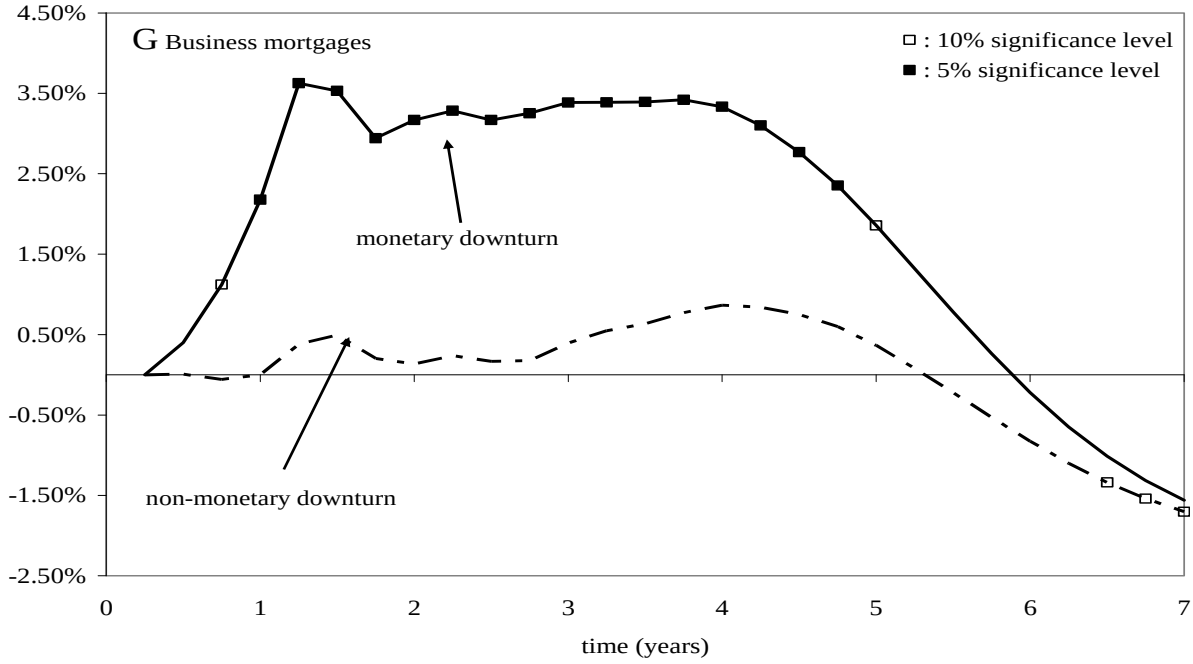





D Non-mortgage Consumer
□ : 10% significance level
■ : 5% significance level
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
non-monetary downturn
monetary downturn
0
1
2
3
4
5
6
7
time (years)

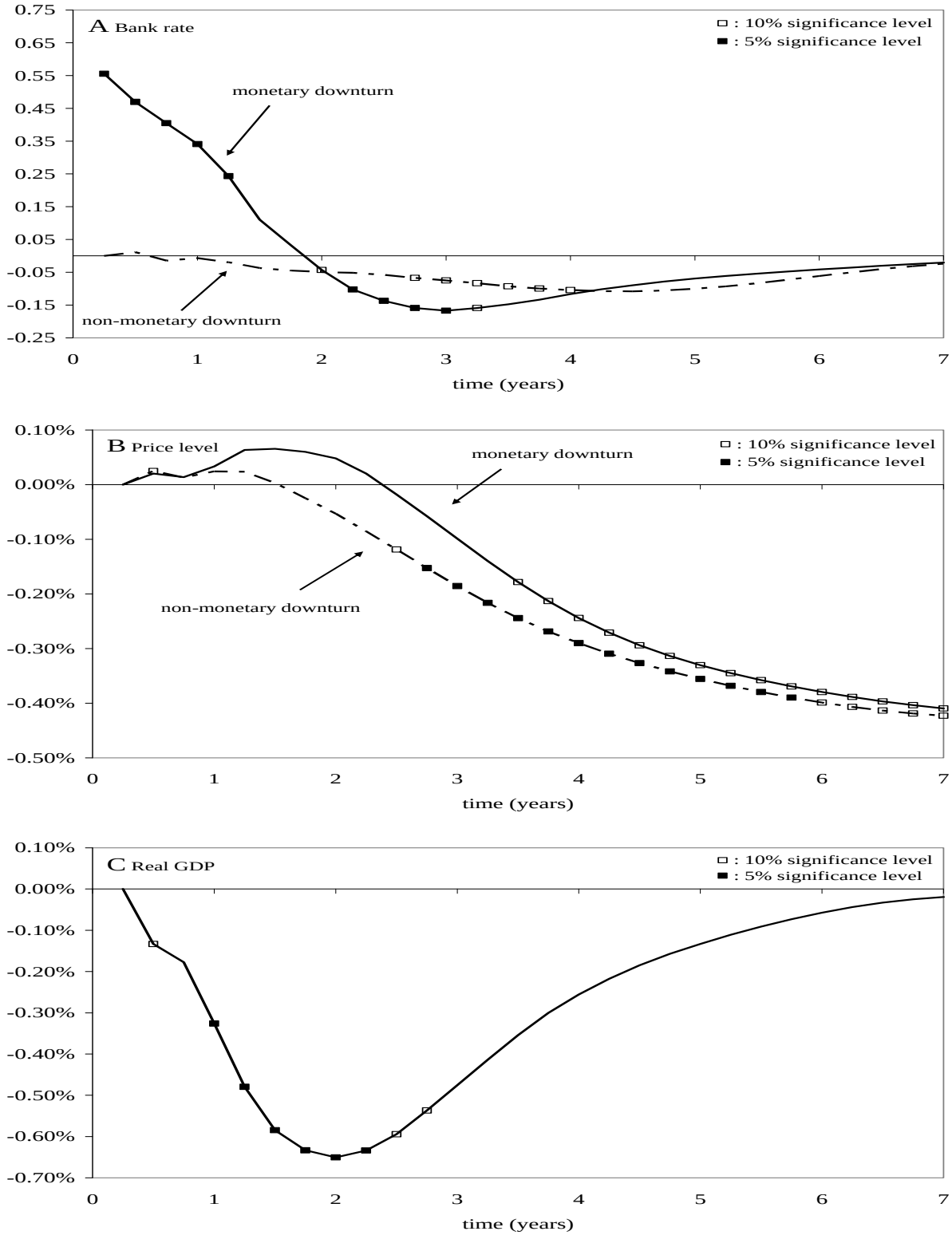

E Consumer mortgages
□ : 10% significance level
■ : 5% significance level
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
-2.50%
non-monetary downturn
monetary downturn
0
1
2
3
4
5
6
7
time (years)

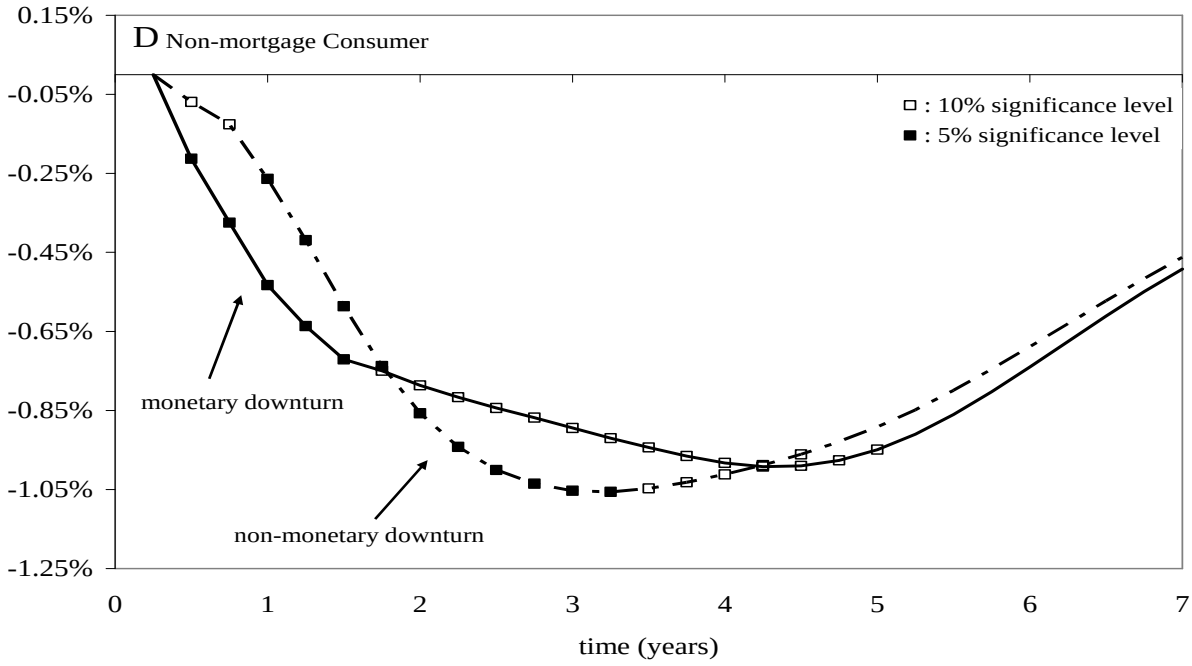


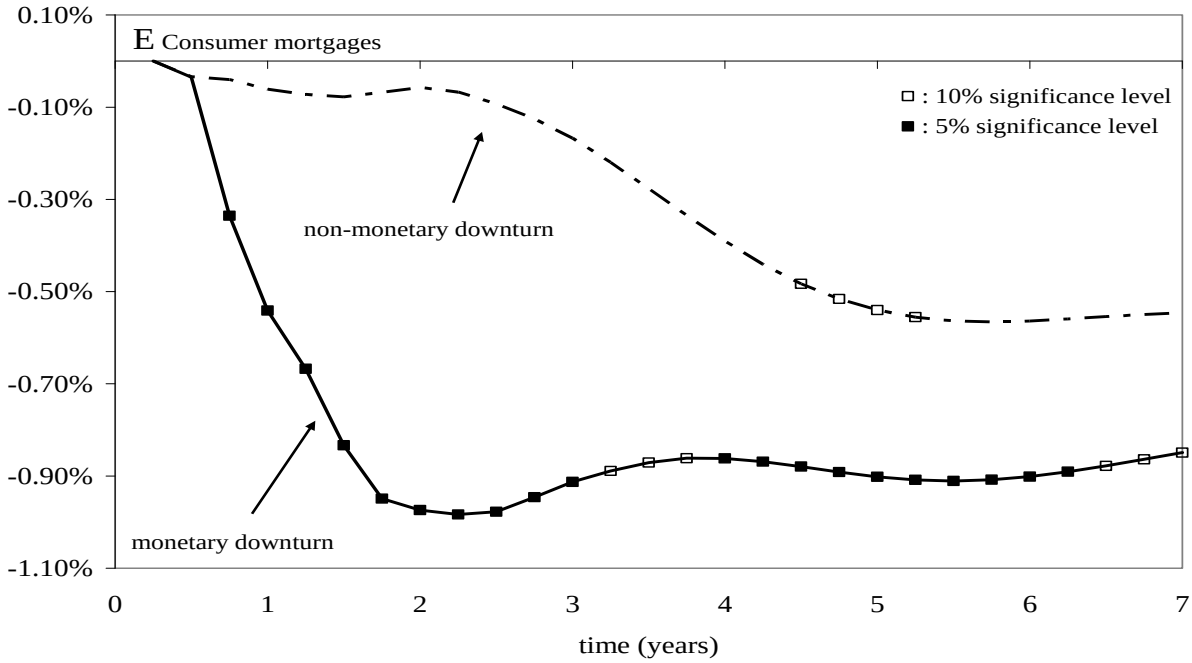


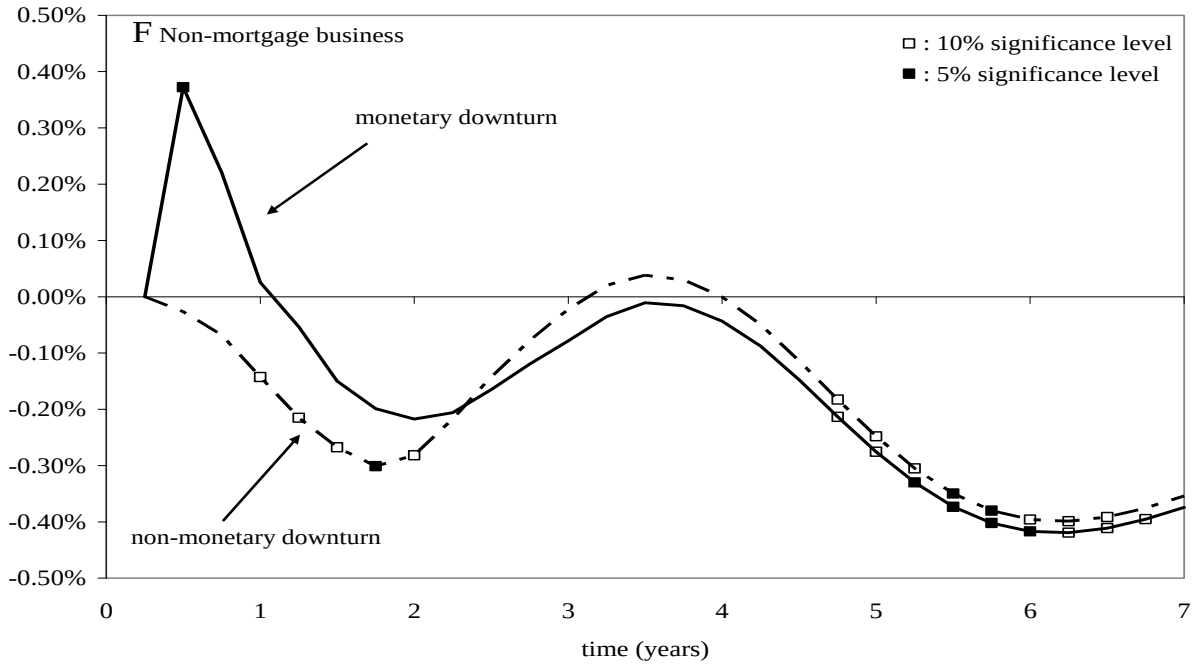
Note: The graphs plot the responses to a monetary policy shock of the FED (FED monetary downturn) and the responses to a sequence of output shocks that result in the same responses for real output (FED non-monetary downturn).

Figure 4: Responses during a monetary and a non-monetary downturn
Bank of Canada tightening that is not a response to FED tightening



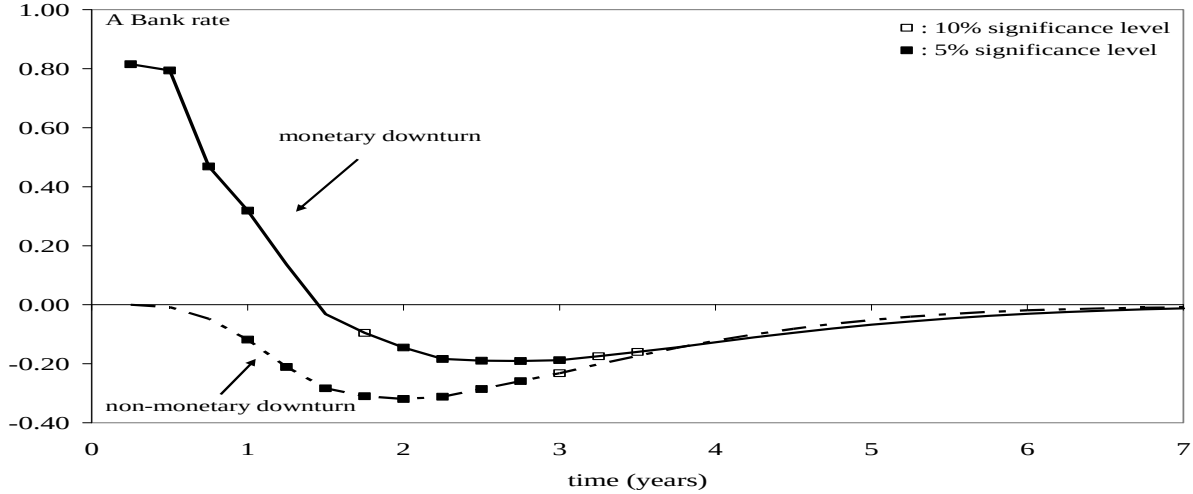

D Non-mortgage Consumer
□ : 10% significance level
■ : 5% significance level
monetary downturn
non-monetary downturn
0.15%
-0.05%
-0.25%
-0.45%
-0.65%
-0.85%
-1.05%
-1.25%
0
1
2
3
4
5
6
7
time (years)

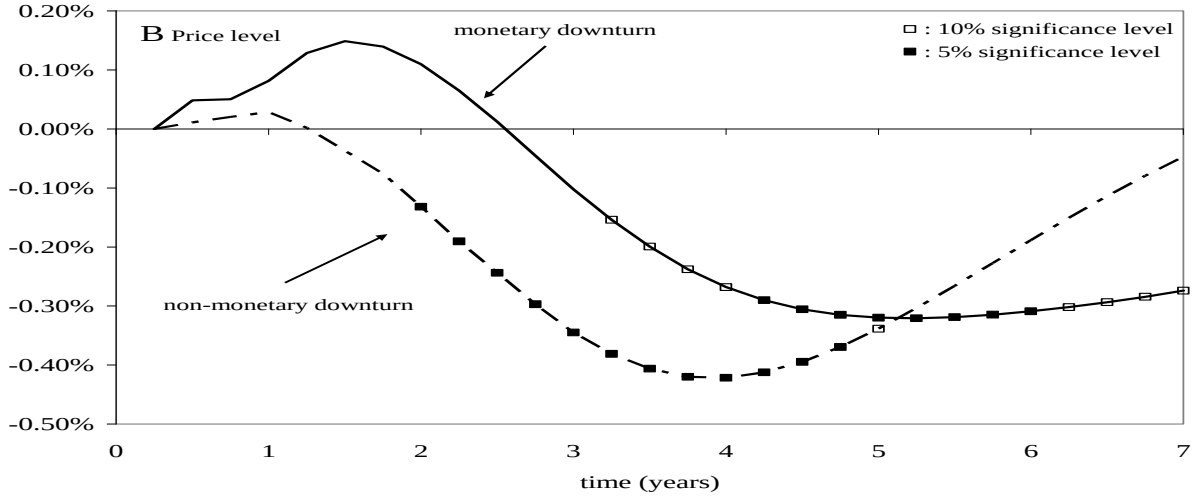

E Consumer mortgages
□ : 10% significance level
■ : 5% significance level
non-monetary downturn
monetary downturn
0.10%
-0.10%
-0.30%
-0.50%
-0.70%
-0.90%
-1.10%
0
1
2
3
4
5
6
7
time (years)

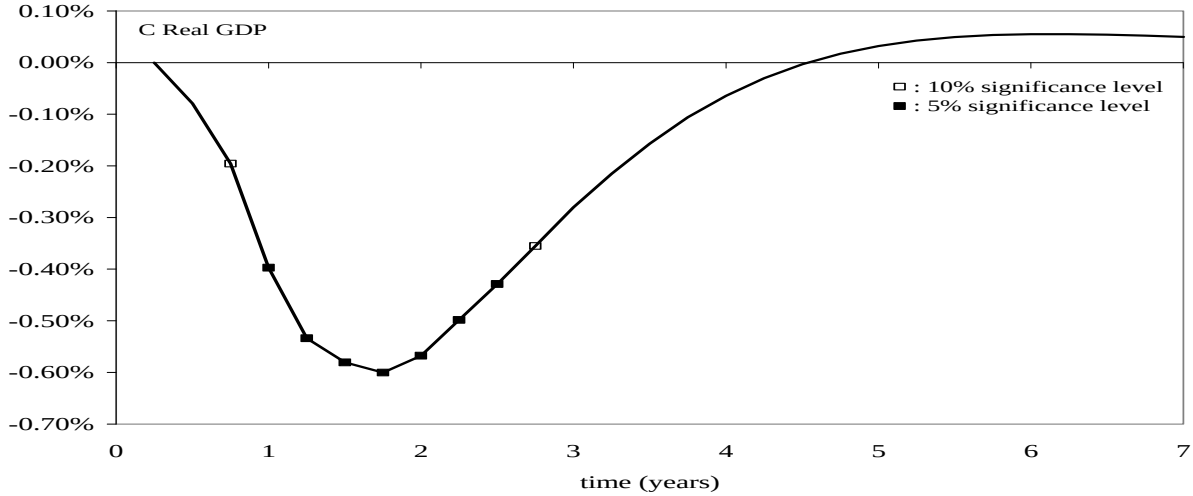


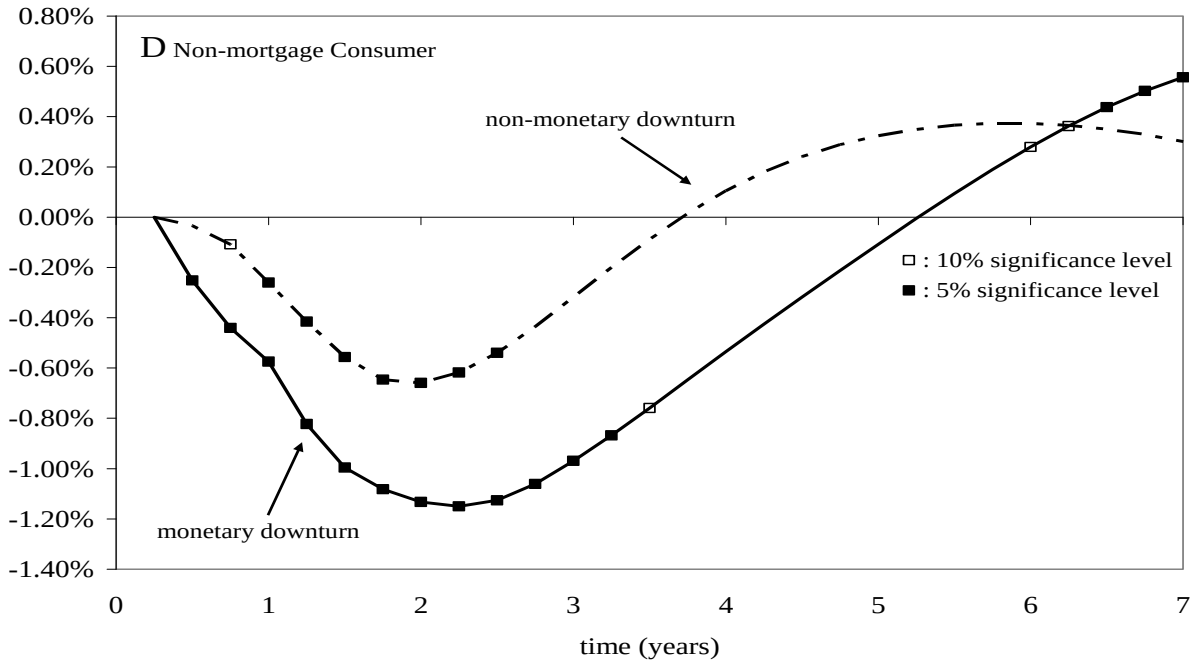
Note: The graphs plot the responses to a one-standard-deviation monetary policy shock of the Bank of Canada (BoC monetary downturn) and the responses to a sequence of output shocks that result in the same responses for real output (BoC non-monetary downturn).

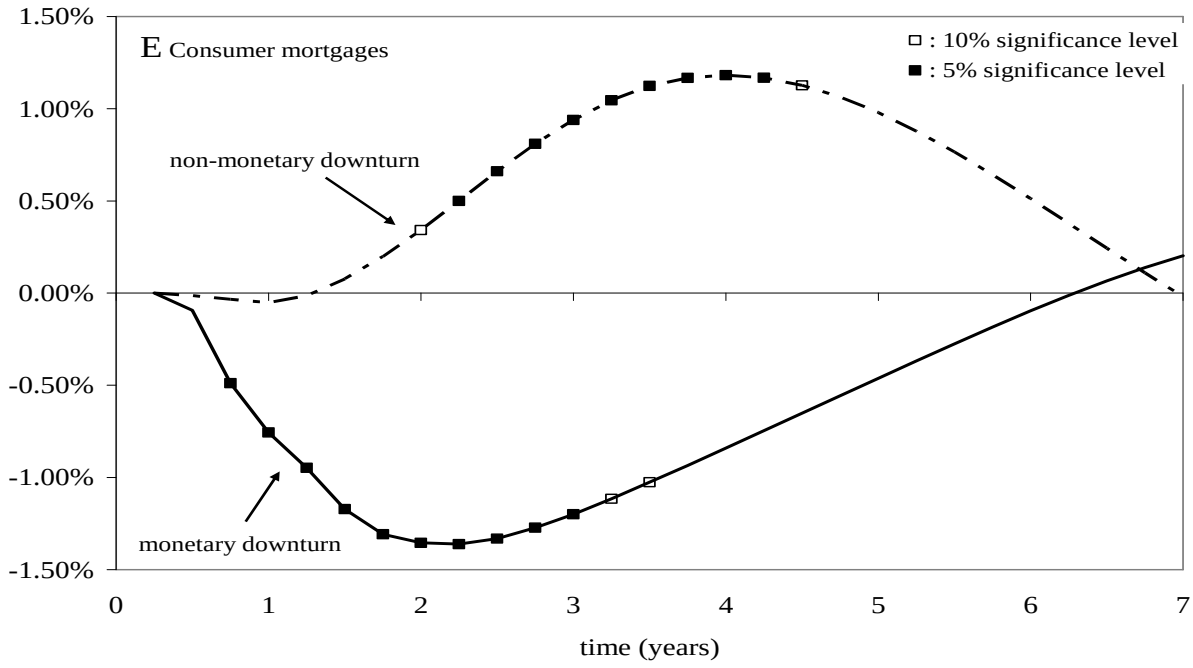
Figure A.1: Responses during a monetary and a non-monetary downturn
No distinction between Bank of Canada and FED tightening

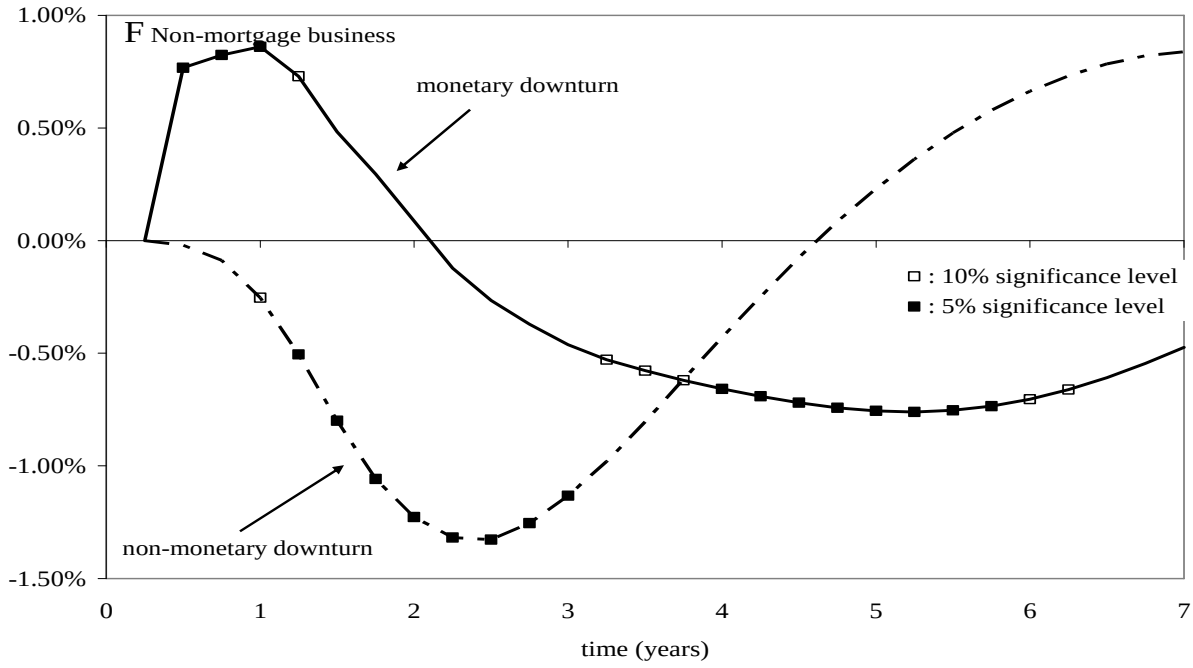


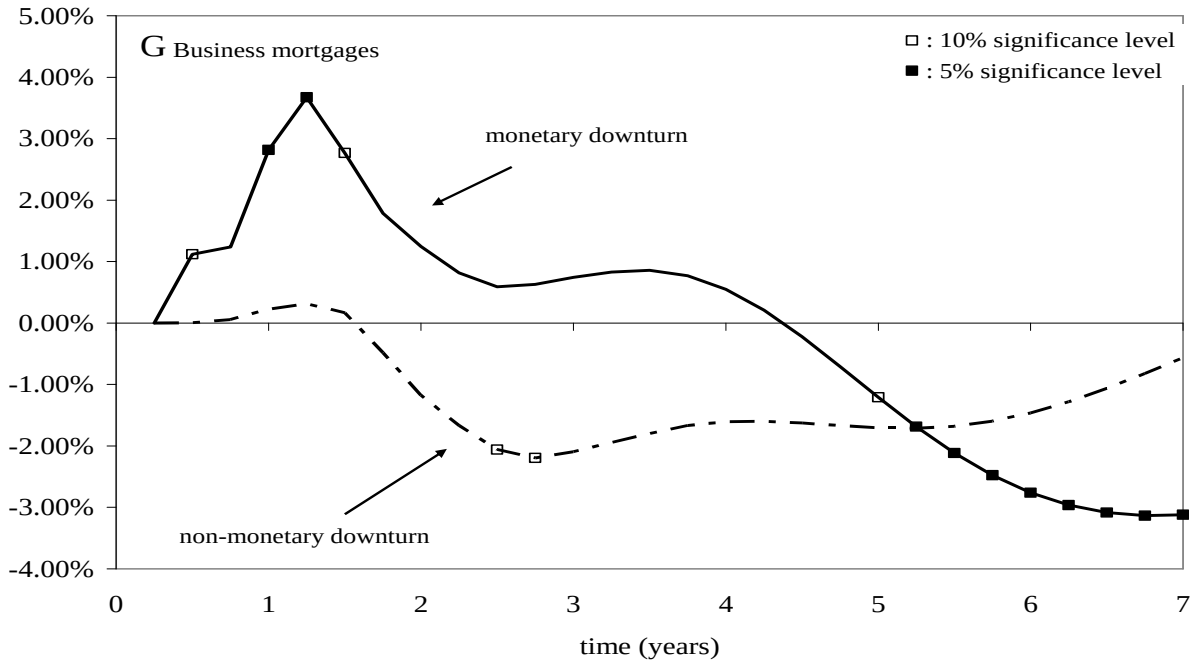





D Non-mortgage Consumer
non-monetary downturn
monetary downturn
□ : 10% significance level
■ : 5% significance level
0.80%
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
-1.20%
-1.40%
0
1
2
3
4
5
6
7
time (years)

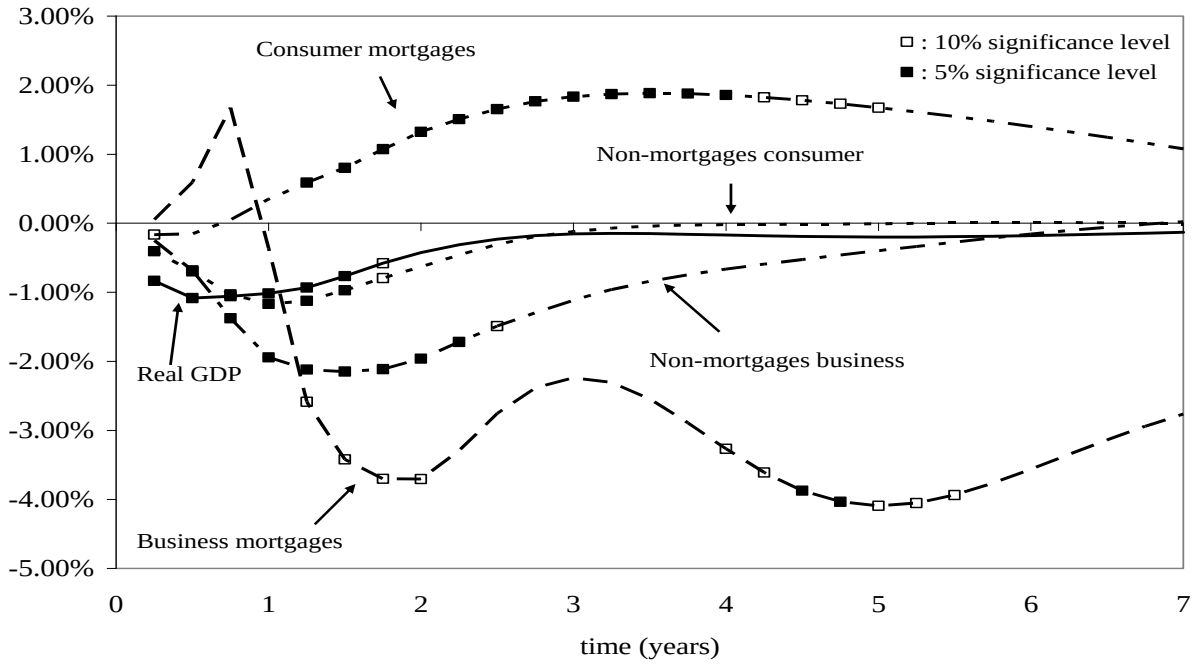

E Consumer mortgages
□ : 10% significance level
■ : 5% significance level
non-monetary downturn
monetary downturn
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
0
1
2
3
4
5
6
7
time (years)





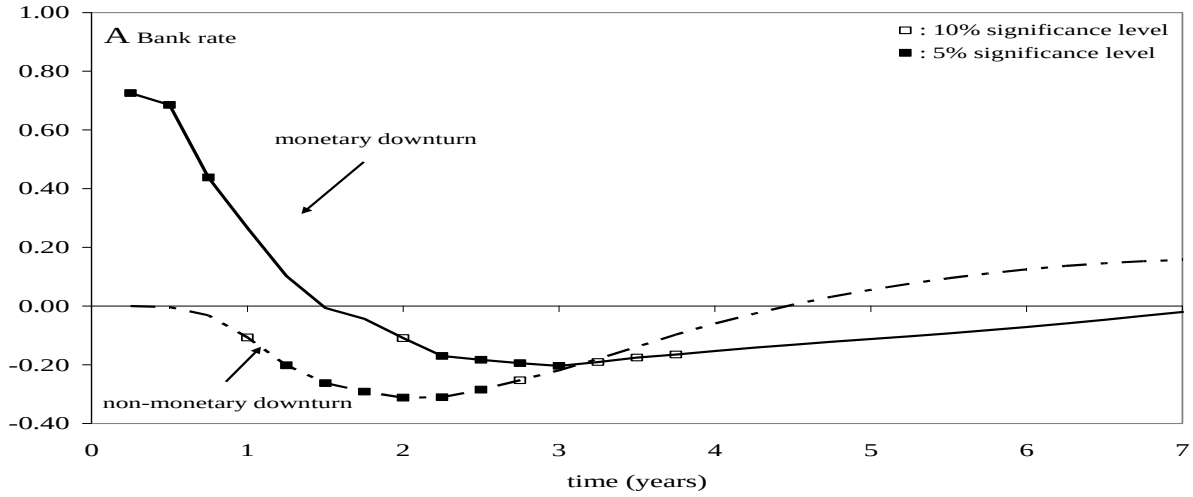
Note: The graphs plot the responses to a one-standard-deviation monetary policy shock (monetary downturn) and the responses to a sequence of output shocks that result in the same response for real output (non-monetary downturn).

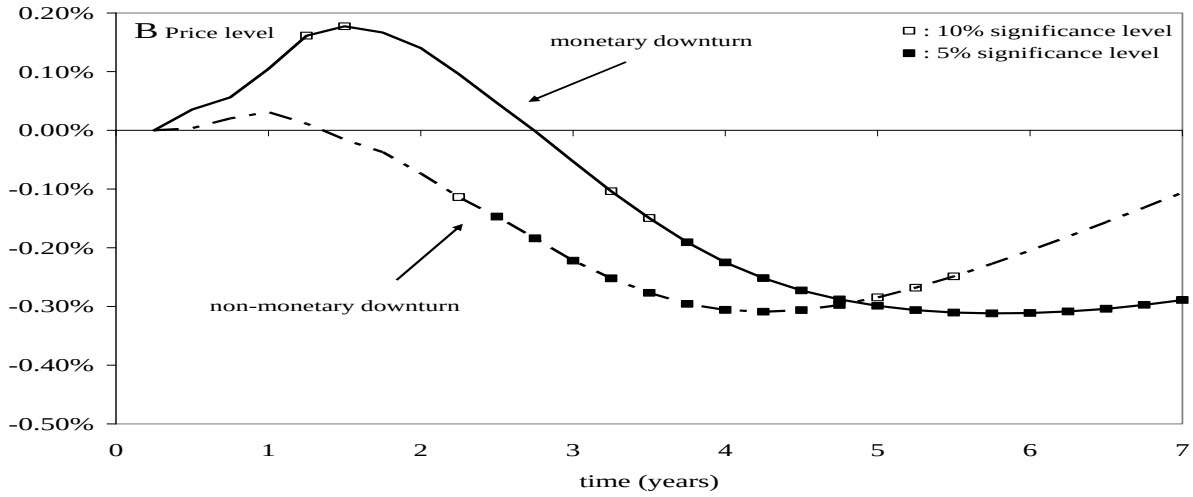
Figure A.2: Loan responses to a single non-monetary shock

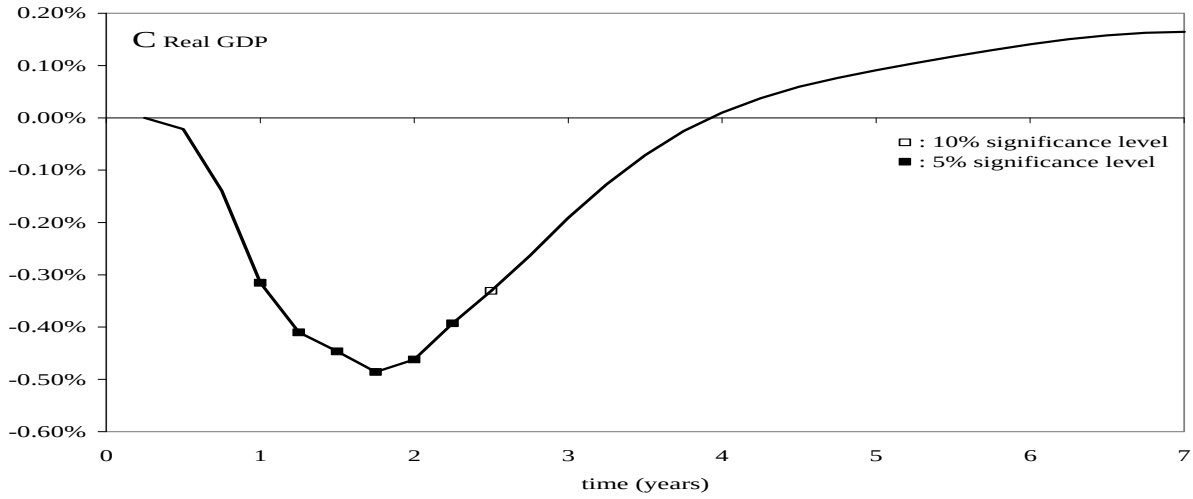


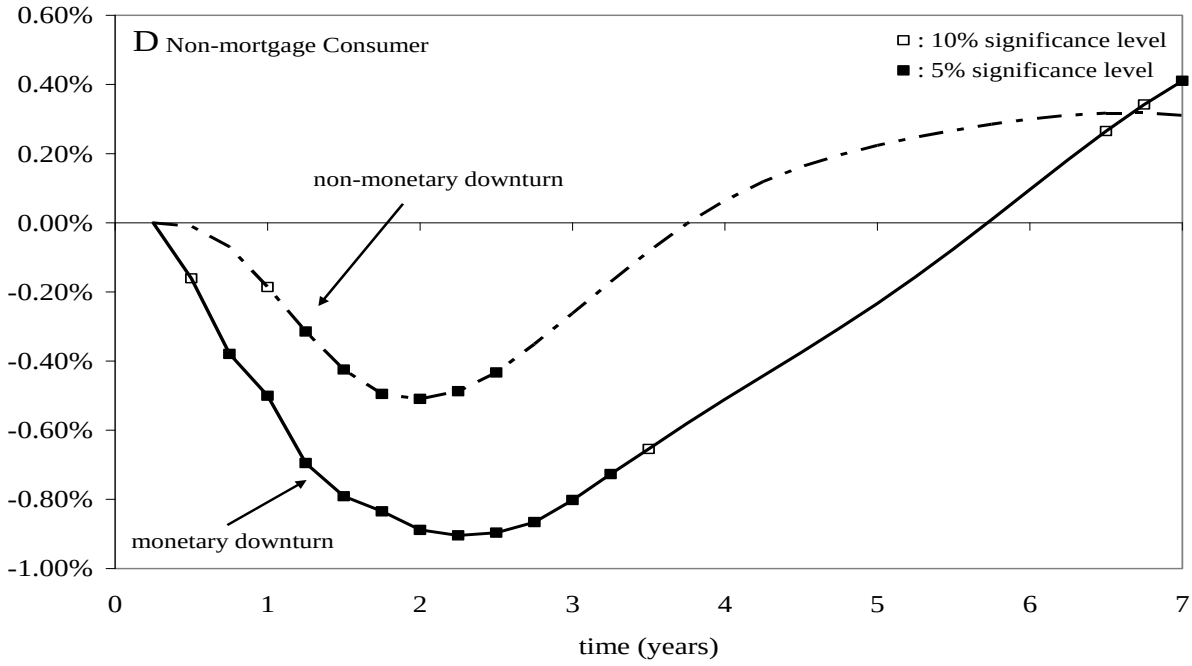
Note: The graph plots the responses to a one-standard-deviation output shock.

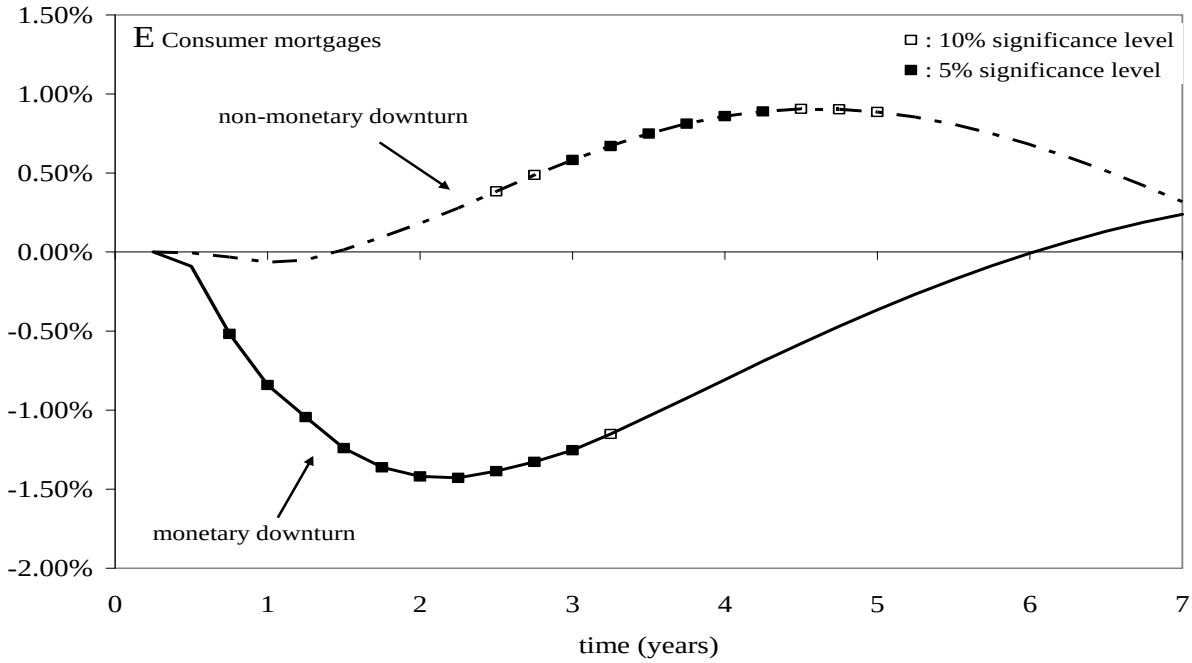
Figure A.3: Responses during a monetary and a non-monetary downturn
Adding the Exchange rate to the VAR

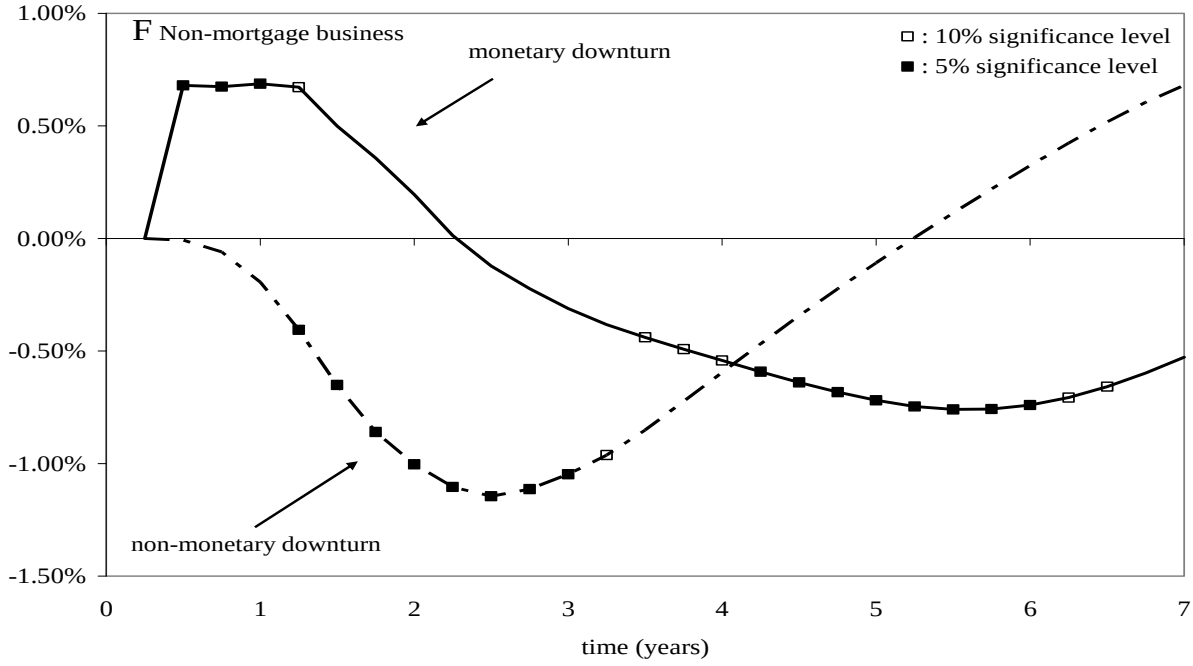


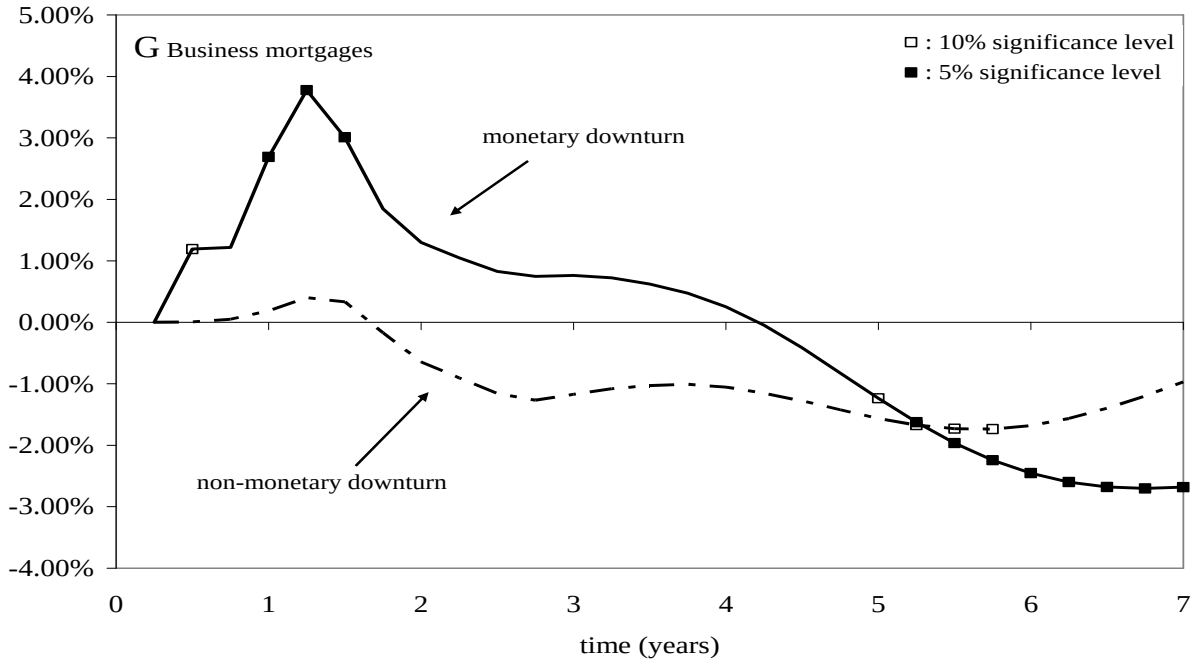





D Non-mortgage Consumer
□ : 10% significance level
■ : 5% significance level
non-monetary downturn
monetary downturn
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
0
1
2
3
4
5
6
7
time (years)

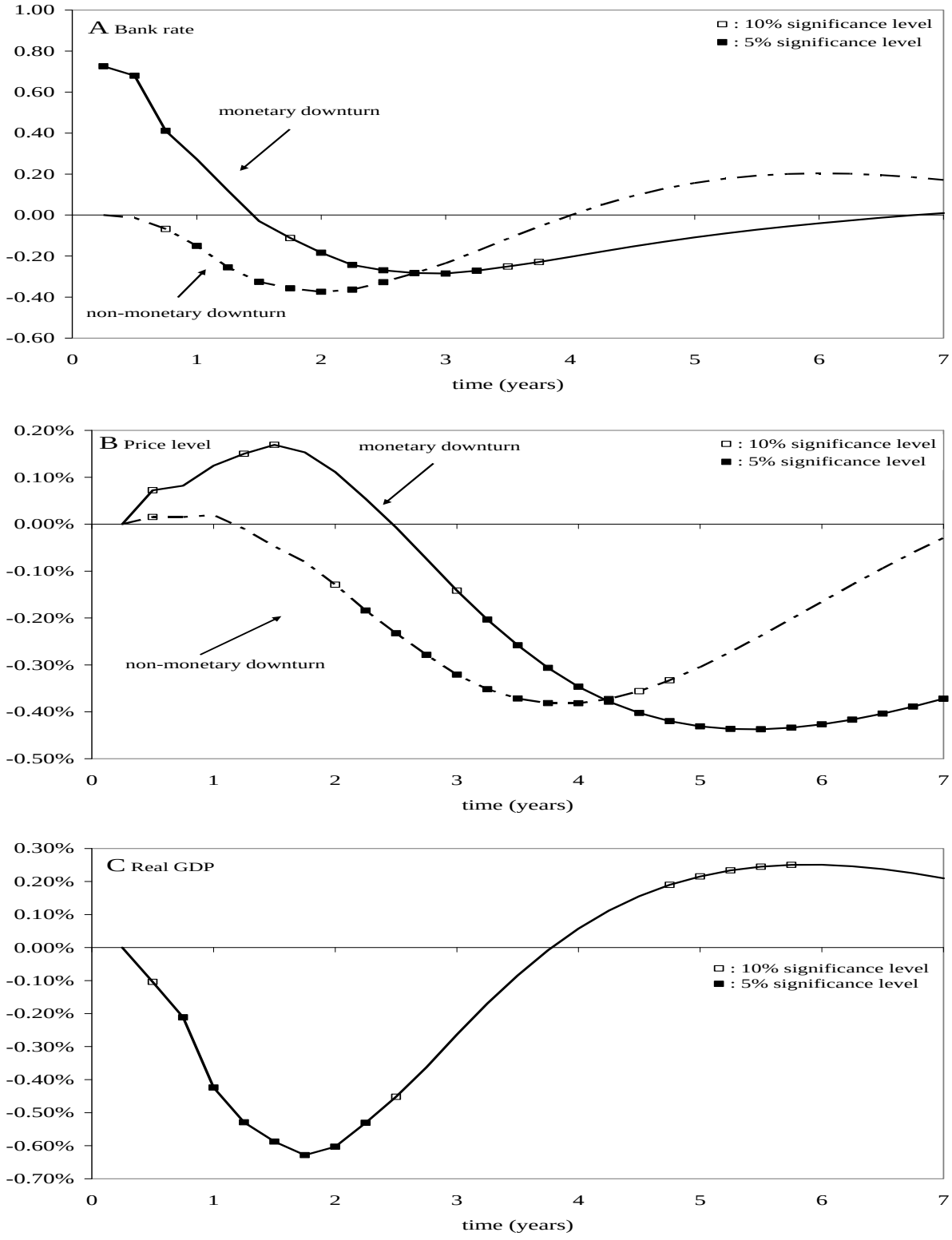

E Consumer mortgages
□ : 10% significance level
■ : 5% significance level
non-monetary downturn
monetary downturn
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
0
1
2
3
4
5
6
7
time (years)

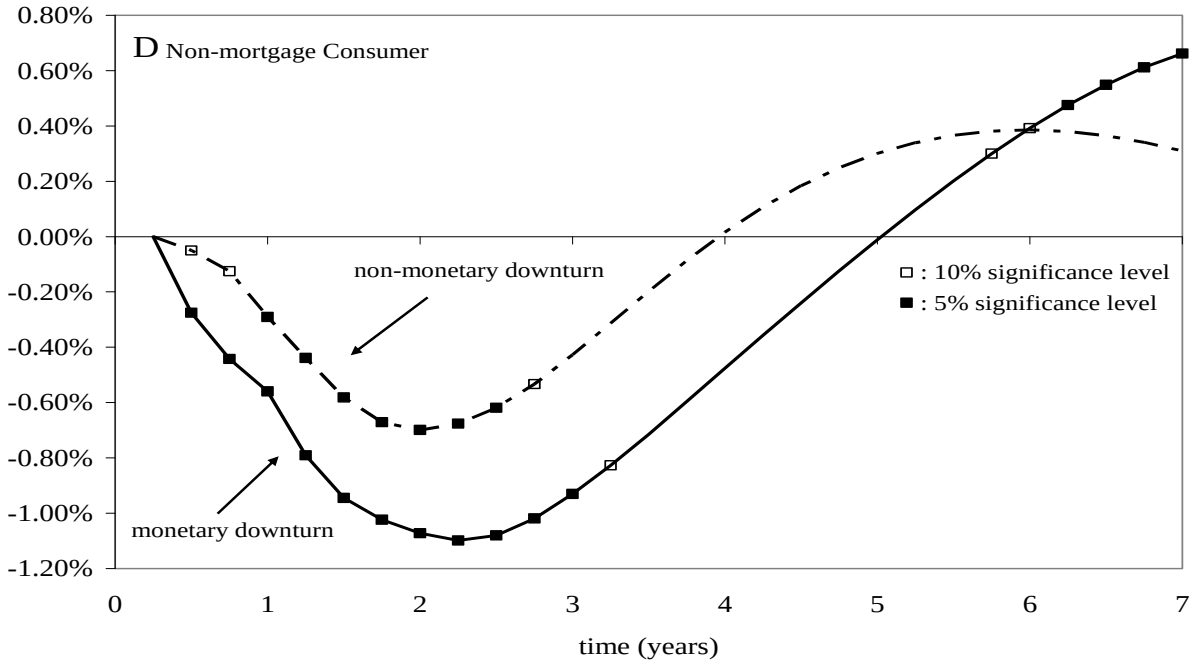


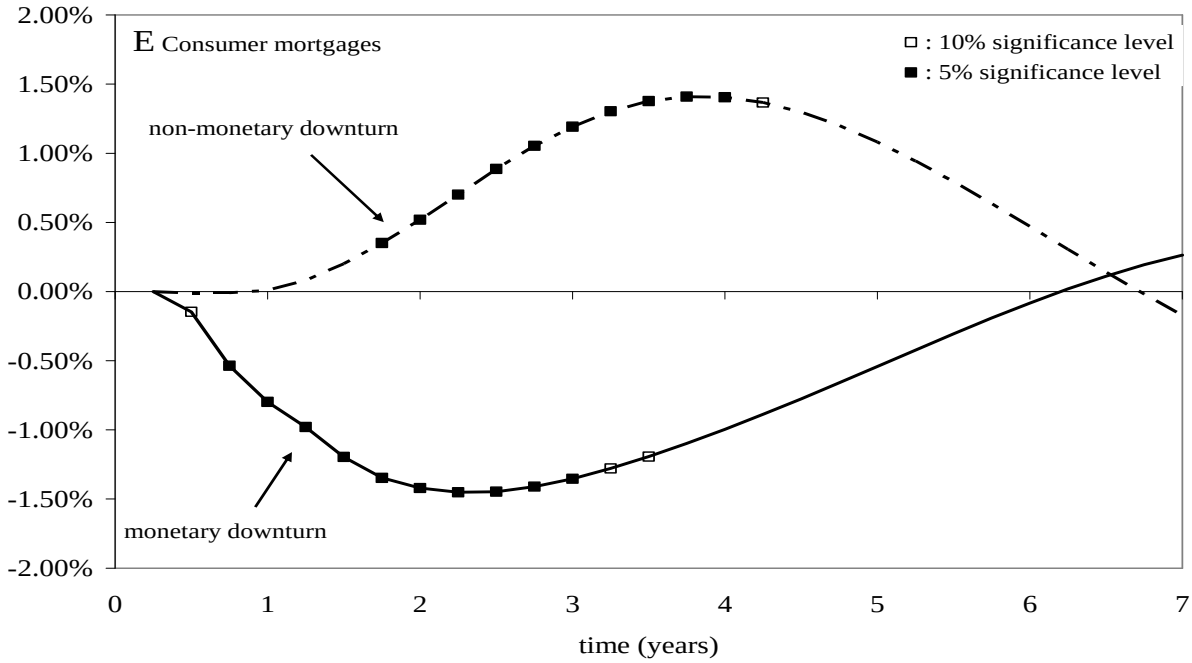


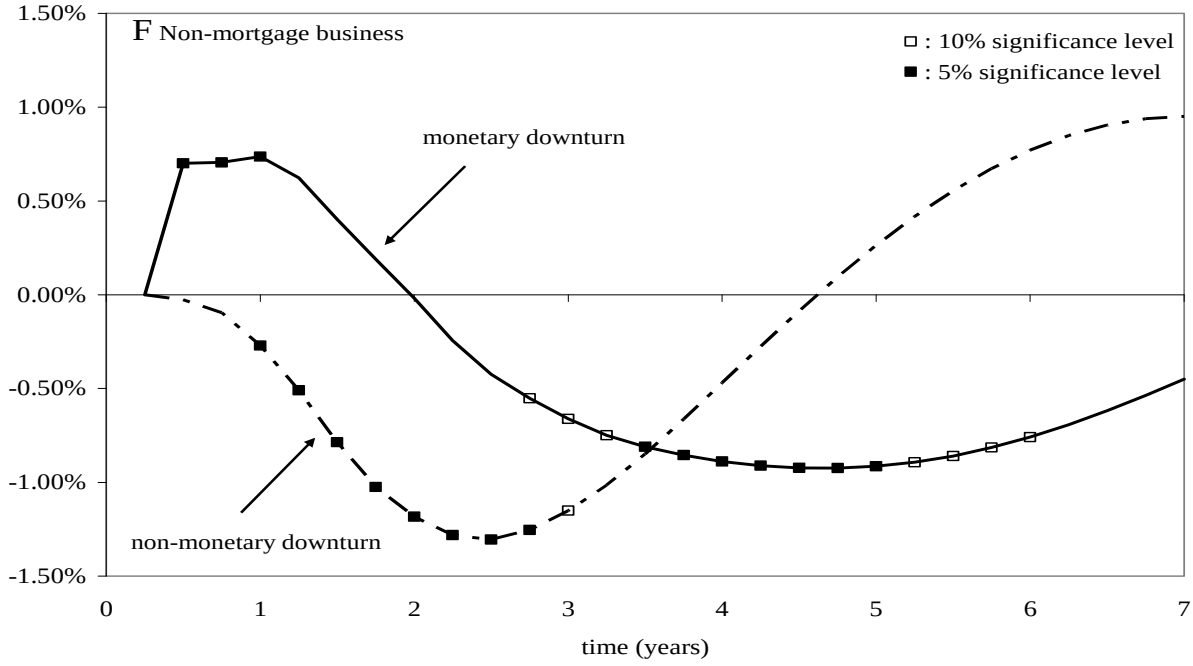
Note: The graphs plot the responses to a one-standard-deviation monetary policy shock (monetary downturn) and the responses to a sequence of output shocks that result in the same response for real output (non-monetary downturn).

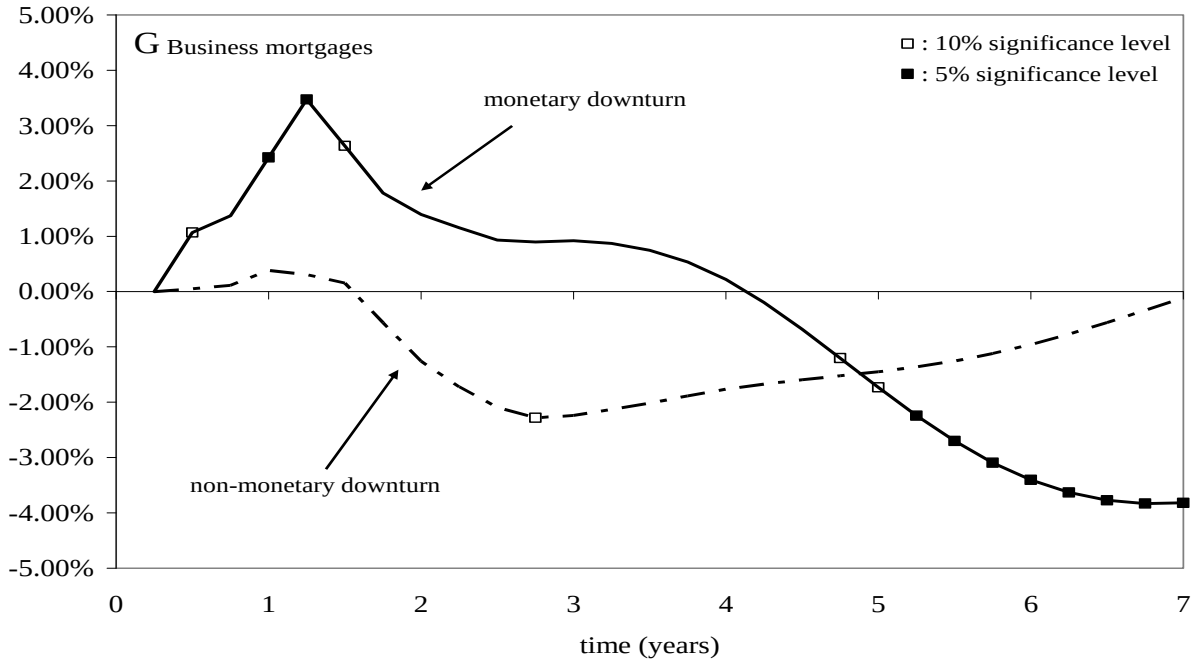
Figure A.4: Responses during a monetary and a non-monetary downturn
Adding U.S. GDP to the VAR




D Non-mortgage Consumer
0.80%
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
-1.20%
non-monetary downturn
monetary downturn
□ : 10% significance level
■ : 5% significance level
0
1
2
3
4
5
6
7
time (years)

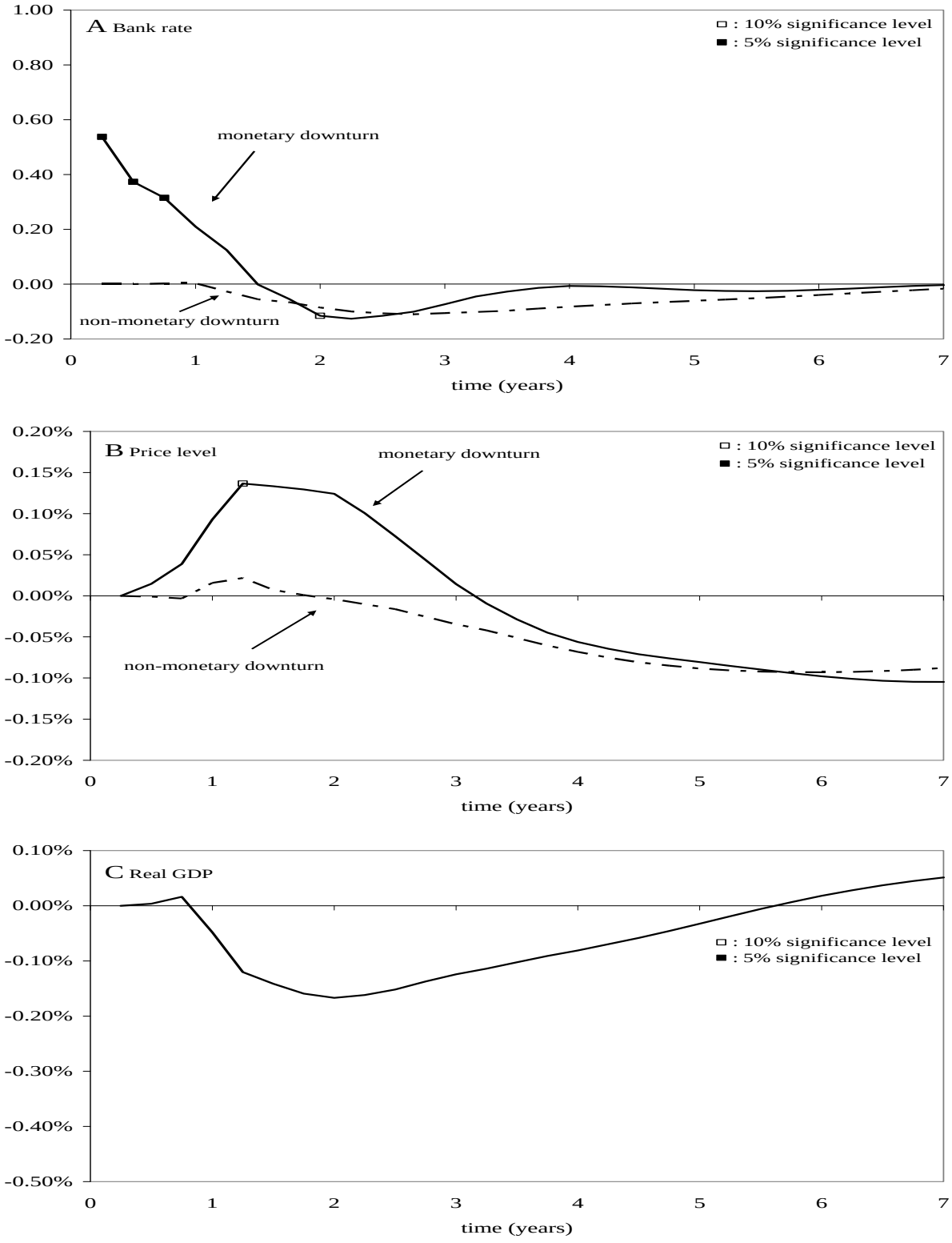

E Consumer mortgages
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
non-monetary downturn
monetary downturn
□ : 10% significance level
■ : 5% significance level
0
1
2
3
4
5
6
7
time (years)

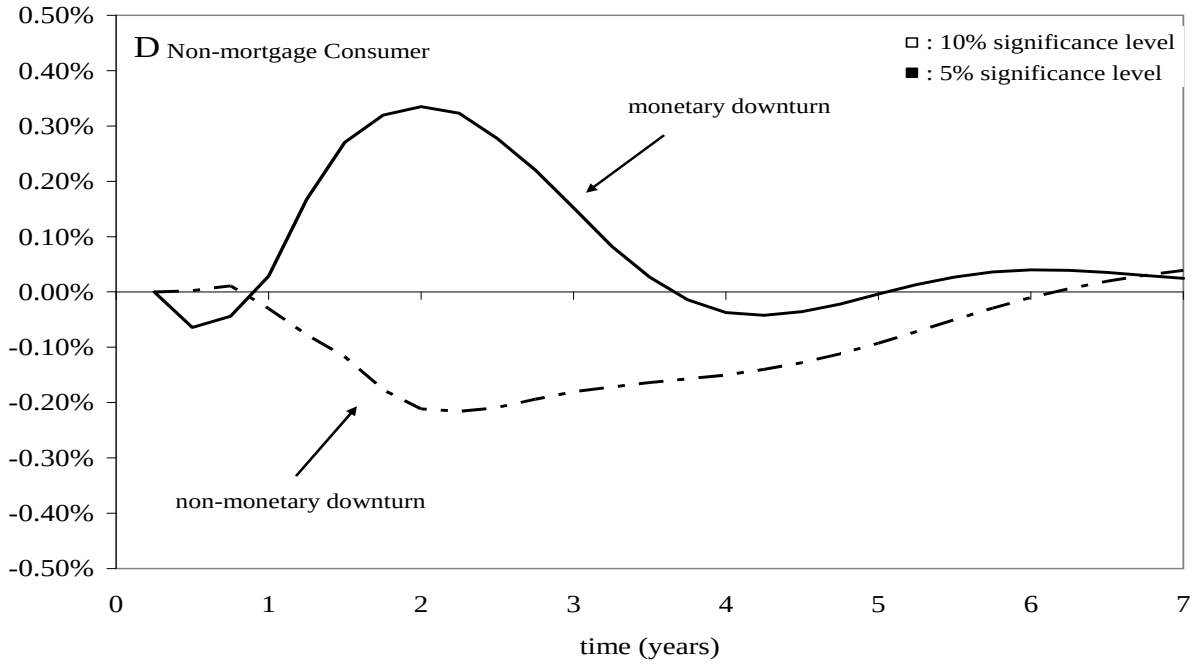


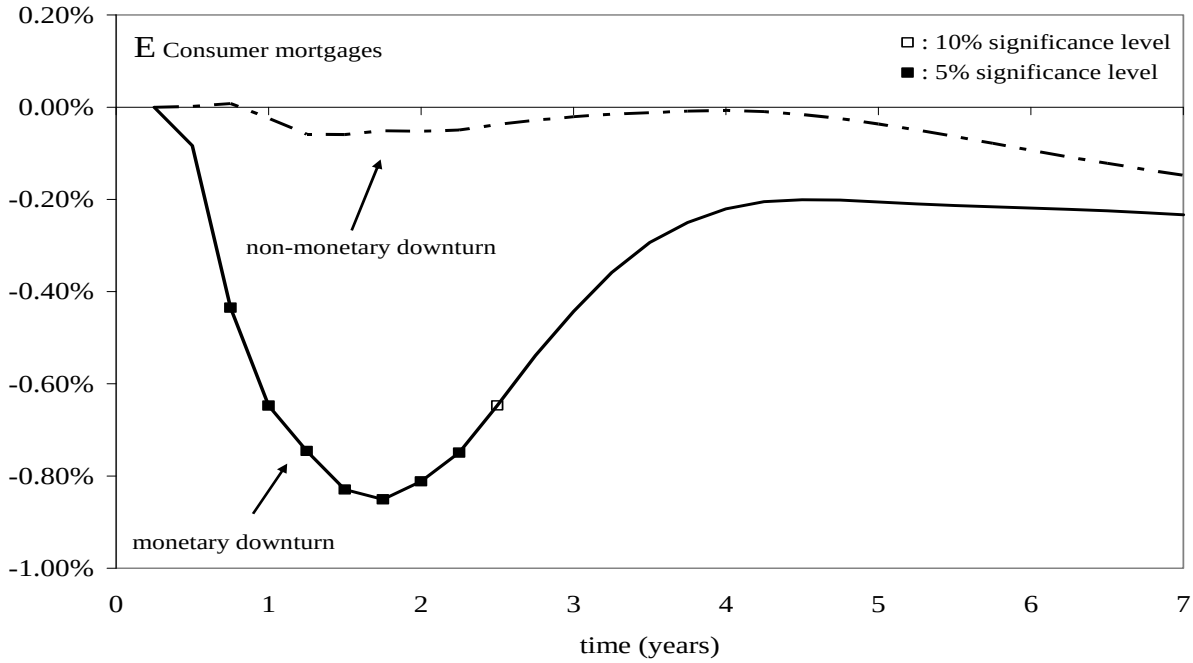


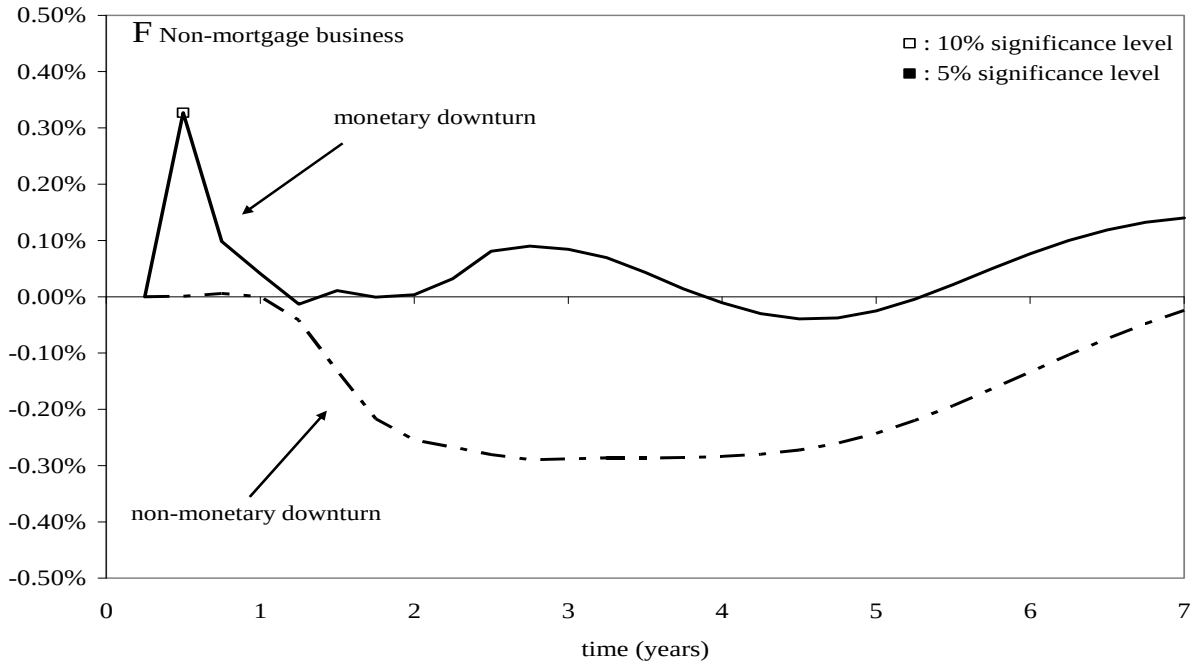
Note: The graphs plot the responses to a one-standard-deviation monetary policy shock (monetary downturn) and the responses to a sequence of output shocks that result in the same response for real output (non-monetary downturn).

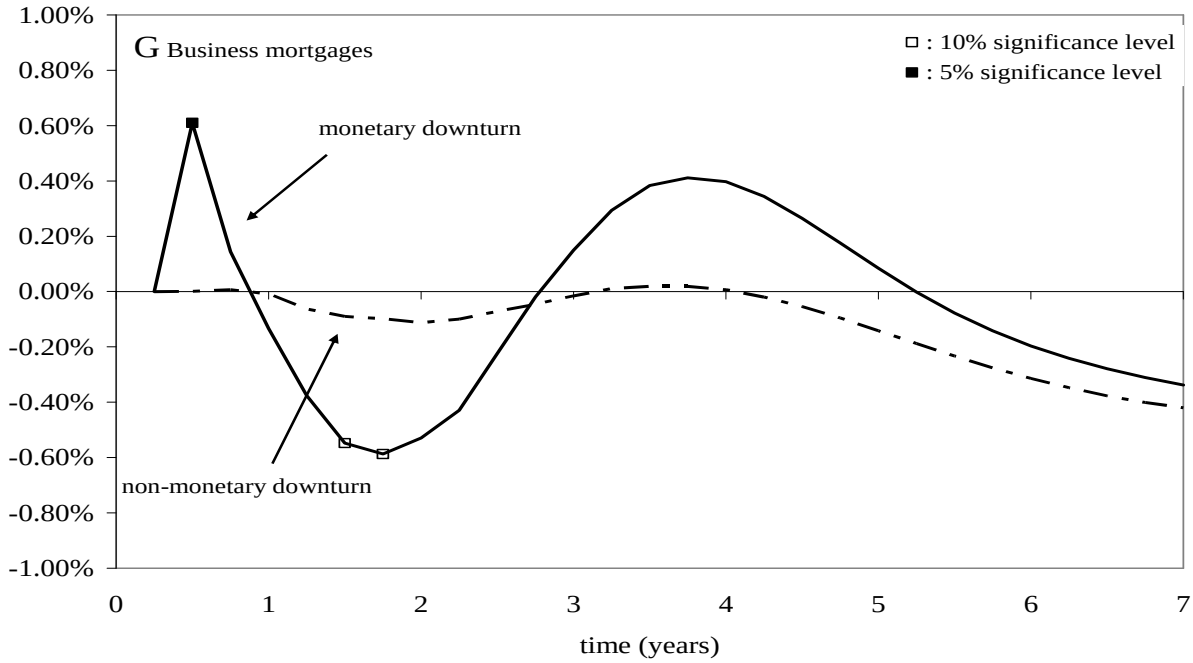
Figure A.5: Responses during a monetary and a non-monetary downturn
Shorter sample: 1984Q1 - 2007Q3




D Non-mortgage Consumer
□ : 10% significance level
■ : 5% significance level
monetary downturn
non-monetary downturn
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
-0.10%
-0.20%
-0.30%
-0.40%
-0.50%
0
1
2
3
4
5
6
7
time (years)

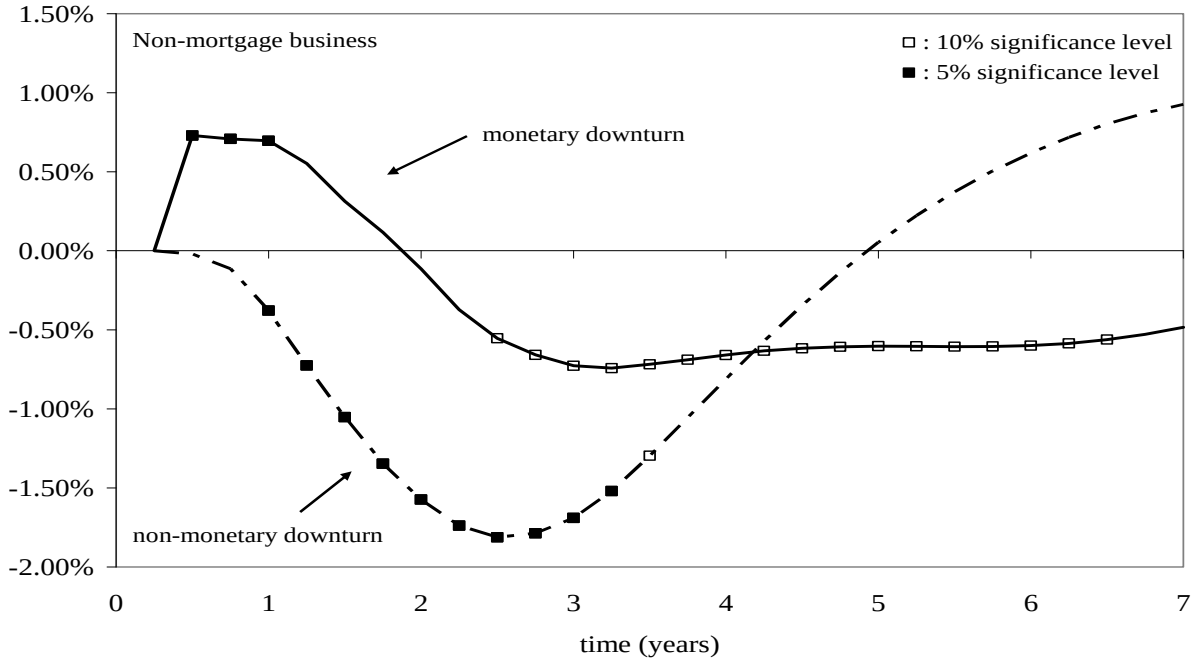

E Consumer mortgages
□ : 10% significance level
■ : 5% significance level
non-monetary downturn
monetary downturn
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
0
1
2
3
4
5
6
7
time (years)





Note: The graphs plot the responses to a one-standard-deviation monetary policy shock (monetary downturn) and the responses to a sequence of output shocks that result in the same response for real output (non-monetary downturn).

Figure A6: Responses during a monetary and a non-monetary downturn
Inventories are added to VAR and to the definition of a non-monetary downturn



Note: The graph plot the responses of non-mortgage business loans to a one-standard-deviation monetary policy shock (monetary downturn) and the responses to a sequence of output shocks and inventory shocks that result in the same response for real output and inventories (non-monetary downturn).