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Can Monetary Policy Lean against Housing Bubbles?

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Can monetary policy lean against housing bubbles?

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Abstract

This paper investigates whether the counter-intuitive result of Gali and Gambetti (2015), where stock prices react positively to a monetary tightening, also holds for housing prices. Estimating a Bayesian VAR model based on an asset-pricing framework and allowing for rational bubbles for the United States, the United Kingdom and Canada, we find that housing prices respond negatively to a monetary policy shock, as common intuition would suggest. We also show, using a Markov Switching VAR model for the United States, that the response of housing prices to a monetary policy shock is not sensitive to the state of homebuyers sentiment. Hence, monetary policy can prove effective in fighting housing price bubbles. However, "leaning against the wind" has costs in terms of lost output while inflation becomes lower. Hence, before implementing such a policy, its relative effi-

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ciency and interactions with other policies, notably macro-prudential, need to be carefully considered.

Keywords: housing, bubbles, VAR, monetary policy

1. Introduction

The global financial crisis (GFC) of 2007-2008 and the associated recession, which followed the meltdown of the US subprime mortgage market, revived the debate on the impact of monetary policy on asset prices, and especially housing prices. The dominant view before the crisis was that monetary policy should react to asset price bubbles only insofar as they affect medium-term inflation prospects, even though some economists already advocated a more active role for monetary policy in preventing the development of bubbles, which can be costly in terms of future output and financial stability (e.g. Borio and Lowe (2002); Roubini (2006)). The reasoning behind the dominant position was essentially that it was difficult to detect bubbles in real time, that monetary policy was a crude tool to deal with bubbles, and that it would be easier to "clean up the mess" after a bubble burst by lowering interest rates and providing ample liquidity than to try to prevent it by "leaning against the wind", i.e. raising policy rates more than warranted on the basis of inflation and growth prospects alone (e.g. Kohn (2006); Posen (2006)). The high cost of the recession following the GFC prompted a reassessment of the role of monetary policy with respect to asset price bubbles (e.g. ECB (2010); Mishkin (2011)). In particular, the case for leaning against credit-driven bubbles was reinforced. In addition to entailing more risk for financial and economic stability, credit-driven bubbles are easier to identify than bubbles purely driven by over-optimistic expectations. Macro-prudential tools are generally considered as the best instruments to prevent the build up of credit-driven bubbles, notably because they can be tailored to address specific market failures, and many countries have expanded their macro-prudential toolkit in recent years (Cerutti et al. (2017)). Nevertheless, macro-prudential measures may not always be sufficient to prevent asset price bubbles, in particular because they may be difficult to design and implement and risk being circumvented. Hence, monetary policy may also have a role to play in dampening asset price booms, notably through its effect on risk appetite.

If one considers that monetary policy has a role to play in dampening asset price bubbles, a decisive question is to what extent a hike in interest rates would affect asset prices. In a recent article, Gali and Gambetti (2015) argue that a monetary tightening could, contrary to conventional wisdom, increase stock prices. This is because, although the fundamental component of asset prices reacts as expected, it is dominated by a rational bubble component, which responds in the opposite direction, i.e. rises after an interest rate hike. This result has been challenged on several grounds.

Caraiani and Calin (2018a) find that the response of stock prices to a monetary policy shock becomes negative when the shadow interest rate of Wu and Xia (2016), which takes into account unconventional monetary policy measures, is used instead of the federal funds rate. Paul (2017), using high-frequency surprises to identify structural monetary policy shocks, instead of the Christiano et al. (2005) procedure used by Gali and Gambetti (2015), finds that stock prices, as well as housing prices, decrease in response to a monetary tightening. While the former studies concentrated on the United States, Caraiani and Calin (2018b) extend the sample to 11 OECD countries. Their results are mixed, although in the majority of countries the stock price response to a monetary policy shock is negative in the medium run. Responses are also shown to depend on the level of financial development of the economy, business and consumer confidence, investor sentiment and liquidity.

The focus on stock market bubbles is understandable, as consistent data are more readily available for the stock market than for housing. Nevertheless, recessions following housing markets meltdowns tend to be deeper and more protracted than those following stock market crashes (e.g. Reinhart and Rogoff (2008); Jorda et al. (2015)). As noted above, a key argument for taking into account asset prices in monetary policy decisions is the potential economic cost associated with future meltdowns. From that perspective, focusing on housing bubbles seems warranted. In addition, the housing market plays a major role in the transmission of monetary policy, notably through housing equity withdrawal (Catte et al. (2005); Mishkin (2007)). Hence, assessing the impact of monetary policy shocks on housing prices and the role of housing bubbles is crucial for policymakers.

The aim of this paper is to investigate whether the counter-intuitive result found by Gali and Gambetti (2015) regarding the impact of a monetary policy shock on stock prices also holds for housing prices. We estimate VAR models for the United States, the United Kingdom and Canada. The United States is an obvious choice to allow comparisons with the results from Gali and Gambetti (2015) and related literature. But it is also useful to investigate whether similar results can be obtained for other countries. The choice of Canada and the United Kingdom derives from three considerations. First, imputed rent time series, which are more consistent with housing price series than actual rent series, are available over a relatively long time span for these countries. Reliable long imputed rent series are only available for a limited set of countries. In many countries a large share of the rental stock consists of social or other forms of subsidized housing and even private sector rents are often tightly regulated. Hence, rents are not primarily market driven. This makes it difficult to find consistent housing price and rent series and reduces the relevance of the asset-pricing model used to separate fundamental from bubble components. Second, despite some differences, Canada and the United Kingdom's housing systems are relatively close to that of United States, in particular with a high share of homeownership, relatively light rental regulations and sophisticated mortgage markets. Third, the three countries run independent monetary policies, contrary to countries belonging to a currency union or committed to maintaining a currency peg.

Like Gali and Gambetti (2015), we use the Christiano et al. (2005) procedure to identify monetary policy shocks. Like Caraiani and Calin (2018a), we use a shadow interest rate as the monetary policy instrument to account for unconventional monetary policy measures (e.g. quantitative easing) in the United States and the United Kingdom. For Canada, which has not used unconventional monetary policy during the estimation period, the policy rate is used.

One of the difficulties involved in estimating a rational bubble model for housing is that the underlying asset-pricing model is less reliable for housing than for stocks. In theory, an asset-pricing model of the owner-occupied housing market can be developed in a similar way as for stocks, replacing dividends by imputed rents and introducing some modifications to the discount rate to account for depreciation, maintenance costs and taxes (Poterba (1984)). However, while it is possible to match a stock price index with the corresponding dividend flow, no fully consistent housing price and rent series are available. The stock of owner-occupied dwellings may differ significantly from the rental stock in terms of location and quality. In this paper, we use imputed rents for owner-occupiers to minimize the mismatch between housing price and rent series. Nevertheless, robustness checks are also carried out using actual rents. One should also bear in mind that arbitrage is imperfect in housing markets (Glaeser and Gyourko (2007)), which may delay or weaken responses to policy measures.

A crucial issue for the conduct of monetary policy is whether the response of asset prices to a policy rate hike varies with investor sentiment. It is conceivable that once asset prices have gathered momentum and sentiment is bullish, a monetary tightening could have less impact on asset prices than in periods of bearish or neutral sentiment. It is often argued that the policy rate hike that would be needed to tame a housing price boom would be very large and hence would have a sizable negative impact on output. To investigate the influence of sentiment on housing price responses to monetary policy shocks, we use a Markov switching autoregressive (MS-AR) model, with two states, respectively bullish and bearish or neutral for the United

States. The states are determined using the new index of housing sentiment from Bork et al. (2017). A similar analysis cannot be carried out for Canada and the United Kingdom, as comparable housing sentiment series are not available.

The rest of the paper is organized as follows: section 2 describes the econometric framework; section 3 describes the data; section 4 details the results; section 5 discusses their policy implications and section 6 concludes.

2. Econometric Framework

2.1. A Bayesian Time-Varying VAR Approach

We investigate the effects of monetary policy shocks on bubbles by using a time-varying Bayesian VAR based on the previous contributions of Primiceri (2005) and Del Negro and Primiceri (2015). Following the logic of Gali and Gambetti (2015), we incorporate the identification procedure constructed by Christiano et al. (2005). Therefore, the model can be expressed as:

$$x_t = A_{0,t} + A_{1,t}x_{t-1} + ... + A_{p,t}x_{t-p} + u_t \tag{1}$$

In the above equation, $A_{0,t}$ represents a vector of time-varying intercepts. The $A_{i,t}$ matrices consists in the time-varying coefficients, while the innovation vector u_t is a white noise Gaussian process, having zero mean and Σ_t covariance matrix. We treat the reduced form innovations as linear transformations of structural shocks and consider that $u_t = S_t\epsilon_t$, where $E\{\epsilon_t\epsilon_t'\} = I$, $E\{\epsilon_t\epsilon_{t-k}'\} = 0$ and $S_tS_t' = \Sigma_t$.

2.2. A Markov Switching Autoregressive Model

Markov switching models are widely used econometric models in which one takes into account regime switches in the mean and slope of the regression. The initial contributions, e.g. Hamilton (1989), aimed at modeling nonstationary time series. He has shown that such models can capture in a relevant manner the asymmetric behavior of macroeconomic time series in the recession and boom periods. This is the reason for which these models have become very popular in analyzing business cycles (though their use has been extended to many other topics and fields).

In this paper, we use a Markov Switching AR (MS-AR) model to capture changes in the housing market sentiments. To achieve this, we consider the following MS-AR regression which assumes switches in the autoregressive coefficients:

$$x_t = \mu_{s_t} + \sum_{i=1}^{4} \phi^i_{s_t} x_{t-i} + \epsilon_t \tag{2}$$

Here x_t is the housing sentiment variable, μ is the state-dependent mean, $\phi^i_{s_t}$ are the state-dependent autoregressive coefficients while ϵ_t is the residual. We employ s_t to denote the state. We use a model with two states, i.e. a state corresponding to a bullish sentiment in the housing market and a state corresponding to a bearish sentiment in the housing market. We also utilize four autoregressive coefficients for each state.

3. Data

We use quarterly data over the period 1975:1-2018:1 for the United States, 1985:1-2018:1 for the United Kingdom and 1975:1-2018:1 for Canada. Housing prices were extracted from the OECD Housing prices database and correspond to the Federal Housing Finance Agency (FHFA) House Price Index for the United States, the House Price Index produced by the Office for National Statistics (ONS) under the framework of the Owner-Occupied Housing project coordinated by Eurostat for the United Kingdom and the Teranet-National Bank National Composite House Price Index for Canada (with data prior to 1999:2 from the Department of Finance). Robustness checks are carried out using the S&P/Case-Shiller U.S. National Home Price Index for the United States (starting in 1987) and the Nationwide House Price Index for the United Kingdom (starting in 1991). Real housing prices are obtained using the GDP deflator.

As explained above, we use imputed rents to match housing prices as closely as possible. For the United States, the owner rent equivalent component of the Consumer Price Index (CPI) for All Urban Consumers from the Federal Reserve Economic Data (FRED) database starts in 1983. We extended the series back to 1970 using data provided by the Lincoln Institute of Land Policy. For the United Kingdom, we use the implicit deflator of imputed rentals of owner-occupiers provided by the ONS. For Canada, we use the owned accommodation component of the CPI from Statistics Canada. The corresponding actual rent series extracted from the same sources are used for robustness checks. Real rents are obtained using the GDP deflator.

Real GDP and GDP deflator series originate from the OECD Economic Outlook database and the non-energy commodity price index comes from the World Bank. All variables are in log-differences multiplied by 100, except interest rates. We use the shadow interest rate of Wu and Xia (2016) instead of the policy rate as the monetary policy instrument for the United States and the United Kingdom, to account for the use of unconventional monetary policy in recent years. The shadow interest rate equals the policy rate as long as the latter is higher than the zero lower bound (ZLB). Once the policy rate hits the ZLB and unconventional monetary policy is implemented, the shadow interest rate is derived from a term structure model using forward rates. Importantly, the shadow interest rate is a measure of the monetary policy stance which spans the period preceding the use of unconventional monetary policy and the following period without breaks, which makes it very relevant for the estimation of time series models. For Canada, which has not used unconventional monetary policy during the estimation period, we use the target for the overnight rate.

To determine the states of sentiment in the MS-AR model for the United States, we use the new index of housing sentiment of Bork et al. (2017), which builds on University of Michigan household survey responses about conditions for buying houses. The data end in 2014:3, which shortens our sample slightly.

4. Results

This section first presents the impulse responses obtained with our baseline Bayesian VAR model for the United States, the United Kingdom and Canada. Then results from the MS-AR model for the United States, which allows impulse responses to differ according to the sentiment of homebuyers are displayed. Finally, we report the results of robustness checks using in turn alternative housing price indices and alternative rent series.

4.1. Bayesian VAR Estimates

To estimate the Bayesian time-varying coefficients model, we build on the previous work by Primiceri (2005), Del Negro and Primiceri (2015) as well as Gali and Gambetti (2015). We employ a Gibbs sampling approach to the estimation. The prior is set following these papers: the covariance matrices Ω, Ξ, Ψ as well as the initial states $\theta_0, \phi_0, log\sigma_0$ are set as independent, the priors for initial states use the normal distributions, and for $\Omega^{-1}, \Xi^{-1}, \Psi^{-1}$ we employ Wishart distributions. In a formal sense, the equations below describe the assumptions about the prior:

1. $\theta_0 \sim N(\hat{\theta}, 4\hat{V}_\theta)$
2. $log\sigma_0 \sim N(log\hat{\sigma}_0, I_n)$
3. $\phi_{i0} \sim N(\hat{\phi}_i, \hat{V}_{\phi_i})$

4. $\Omega^{-1} \sim W(\underline{\Omega}^{-1}, \underline{\rho}_1)$
5. $\Xi^{-1} \sim W(\underline{\Xi}^{-1}, \underline{\rho}_2)$
6. $\Psi_i^{-1} \sim W(\underline{\Psi}_i^{-1}, \underline{\rho}_{3i})$

For the normal distributions, the mean and variances priors are fixed by employing the classical fixed coefficient VAR on a sub-sample. As in Gali and Gambetti (2015), we run 22000 draws, while discarding the first 20000, to ensure convergence is reached.

4.2. Time-Varying IRFs

Fig. A1 displays the response up to 20 quarters of US housing prices to a one standard deviation shock to the shadow interest rate. Since the Bayesian VAR model's impulse responses vary over time, a third dimension is added to show how the responses evolved during the sample period. Housing prices start declining on impact and are between about 1% and 3% lower after 20 quarters, depending on the time of the shock (Figure A.1). The response has strengthened in the 2000s. The short-term response of the bubble component of housing prices is positive and has strengthened over time (Figure A.2). However, the bubble effect is relatively short-lived and turns negative at a longer horizon. The long term (20 quarter) effect varies slightly with the housing cycle and has been strongest in the last downturn. This short-term positive bubble effect, which is consistent with the thesis of Gali and Gambetti (2015), is more than offset by the fundamental component's response and the overall response of housing prices to a monetary policy shock is negative on impact. The increase in the magnitude of the negative response of the fundamental component over time is consistent with the trend decline of interest rates over the sample period and the non-linear relation between interest rate and asset prices, with a stronger impact of a given interest rate change on asset prices at lower levels of interest rates. As time passes, the bubble component's response also turns negative and contributes to the dampening effect of the monetary tightening on housing prices. The fact that the impact of the monetary policy shock has remained strong after the GFC suggests that unconventional policies, including the purchase of mortgage bonds by the federal reserve, have contributed to stabilizing the housing market.

Housing price impulse responses to a monetary policy shock in the United Kingdom (Figure D.1) are also negative. However, the response in recent years is more muted than in the United States and housing prices are back to the baseline after 20 quarters. The response to a one standard deviation shock on the policy rate was much stronger in the 1990s, when the fall in housing prices after 20 quarters was on average around 3%. The weakening response results from the strong and persistent increase in the bubble component, albeit with large cyclical variations, which are consistent with a generally more volatile housing market in the United Kingdom than in the United States (Figure D.2). The fact that the overall response of housing prices to a monetary policy shock remained negative despite the strength of the bubble component in recent years suggests that unconventional monetary policy has been effective in supporting housing prices.

Long-term housing price impulse responses to a monetary policy shock for Canada are broadly in line with those of the United States until the early 2000s, but did not show the same strengthening thereafter. The average response to a one standard deviation shock on the policy rate after 20 quarters has remained in the -1% to -1.5% range (Figure G.1). In addition, the response of house prices to the monetary policy shock is positive on impact towards the end of the sample. The positive response is small, with a peak around 0.5%, but it takes about seven quarters for the monetary policy tightening to start dampening house price increases. Except the beginning of the sample, the response of the bubble component is positive (Figure G.2).

To sum up, in all three countries, we find a positive response of the bubble component of housing prices to a monetary policy shock, which has tended to strengthen over time (for the case of the United States, the responses at 20 quarters become negative for the baseline model and partially negative for Case-Shiller series). This is in line with the thesis by Gali and Gambetti (2015). Nevertheless, except for an initial period of around six quarters in Canada, the response of the fundamental component of housing prices more than offsets the impact of the bubble component and housing prices fall following a monetary tightening, as common intuition would suggest.

4.3. Influence of housing sentiment on responses to shocks

The previous section has shown that the response of the bubble component of housing prices to a monetary policy shock has varied over time in all three countries. Part of these variations may reflect structural shifts in the economy, housing and mortgage markets. Another part looks more cyclical. In times when home buyers are very optimistic about future housing price developments, monetary policy's ability to influence housing price developments could be reduced. In that case, the interest rate hikes that would be needed to contain a housing boom might be very high and would be very damaging for economic growth and employment.

In this section, we analyze how housing price responses are affected by home buyers sentiment using the MS-VAR model described in Section 2.2. The state of sentiment is determined by the new index of housing sentiment of Bork et al. (2017). Based on the computed filtered probabilities, we derive the episodes (shown in shades) corresponding to a positive sentiment. We impose a threshold of 0.9 for the positive sentiment in the housing market (that is, the probability that the sentiment is positive is higher than 90%). This implies that we identify bullish versus neutral or bearish sentiment. Regime switches are shown in Figure I.1. Evolutions over time in the magnitude of the response of the bubble component of housing prices to the monetary policy shock in the short run – average over three quarters following the shock – and long run – average over the 20 quarters following the shock – are displayed in Figure I.2. The short run response has strengthened steadily over time, but no clear association with the state of sentiment appears. The long run response has remained more stable, but again without any clear association with the state of sentiment. This suggest that the latter has little effect on the impact of monetary policy on housing prices.

4.4. Robustness checks

We first replace the housing price series in the Bayesian VAR models for the United States and the United Kingdom by alternative series. No relevant alternative series is readily available for Canada. We use the S&P Case-Shiller U.S. National Home Price Index for the United States (starting in 1987). The results are broadly similar to the baseline case, although the housing price response to the monetary policy shock is somewhat deeper and more volatile (Figures B.1 and B.2). These results are consistent with the higher volatility of the S&P Case-Shiller compared to the FHFA index. For the United Kingdom, we introduce the Nationwide House Price Index. Again, the results are broadly similar to the baseline case. The bubble component increases over time, but the increase is not strong enough to dominate the impact of the fundamental component (Figures E.1, E.2).

Another robustness check is carried out by replacing imputed rents by actual rents in the baseline model. As explained above, imputed rents match the quality and location of the housing stock covered by broad housing price indices better than actual rents. However, actual rents have the advantage of being directly observable. Hence it is useful to assess the sensitivity of our analysis to the choice of the rent measure. For the United States, the results are fairly similar with both rent series (Figures C.1-C.2). In the case of actual rents, the bubble component is somewhat stronger and especially more persistent than with imputed rents. Even so, the overall response of housing prices to the monetary policy shock is negative at all horizons. For the United Kingdom, the housing price impulse responses obtained using actual rents vary much more over time than when using imputed rents (Figures F.1 - F.2). This reflects high volatility in the actual rent index. In particular, spikes in the bubble component in the late 1990s and especially in the late 2000s are more marked than when using imputed rents. Towards the end of the sample, the negative response of housing prices to the monetary policy shock is slightly stronger when actual rather than imputed rents are used. Discounting an outlier in the late 2000s, the robustness check confirms that housing prices respond negatively to a monetary policy shock in the United Kingdom. The results for Canada show a somewhat stronger and more persistent bubble component in recent years when using actual rather than imputed rents (Figures H.1 - H.2). This amplifies and prolongs slightly the initial positive response of housing prices to the monetary policy shock found in the baseline model. Nevertheless, the pattern is roughly similar and the longer run response is negative. To sum up, all our robustness checks show that our results are robust to the use of different housing price and rent series.

5. Policy Implications

Our analysis shows that housing prices respond negatively to a monetary policy shock. In similar settings as used by Gali and Gambetti (2015) to analyze the response of stock prices, we find that the rational housing bubble component reacts positively to a monetary policy shock. The bubble component, which partly offsets the fundamental response, has strengthened over time. However, lower interest rates have also strengthened the fundamental component, as the relation between interest rates and asset prices is nonlinear. The change in the overall response of housing prices to a monetary policy shock over time shows no clear pattern across countries. The impact of the monetary policy shock seems to have weakened in the United Kingdom after 2008, but strengthened in the United States since the early 2000s, and remained broadly stable in Canada. This suggest country-specific factors, such as structural changes in mortgage markets, may have affected monetary policy transmission mechanisms. While important, this issue is beyond the scope of this paper. Another interesting result of our research is that unconventional monetary policy in the United Kingdom and the United States after the GFC seems to have been as effective in supporting housing prices as traditional policy rate cuts.

The main takeaway from this paper is that the bubble component's response is always more than offset by the response of the fundamental component of housing prices, except for a relatively short period following impact in Canada in recent years. Hence, monetary policy has the ability to lean against the wind, contrary to what Gali and Gambetti (2015) suggested on the basis of their analysis of the reaction of stock prices to a monetary policy shock. If central banks raise interest rates in response to booming housing prices, their growth will slow. However, this does not mean that central banks should necessarily do so. Other instruments, notably macro-prudential policy may be more effective in fighting housing bubbles. In particular, by targeting a particular market or asset class, macro-prudential policy can avoid a wider negative effect on output and inflation. Indeed, our monetary policy shock reduces GDP on average after two years by 0.34% in the United States (Figures J.1) and by 0.62% in Canada (Figure L.1), while the GDP in UK is slightly positively affected by 0.05% (Figure K.1). Inflation generally falls, with the exception of Canada in recent years, where a negative response on impact is very short-lived (Figures J.2, K.2 and L.2).

In a situation where the economy is operating close to full capacity and inflation is above target, cooling the housing market through monetary tightening may be consistent with the stabilization objectives of monetary policy. However, if spare capacity and low inflation coincide with rapidly rising housing prices, using monetary policy to tame housing prices would have a significant cost for the economy. Such a situation occurred recently in countries like Australia, Canada, New Zealand and Sweden, where the authorities have implemented diverse macro-prudential policy measures to address housing market imbalances, while keeping policy rates low to support the economy.

Even when housing market and wider economic stabilization goals do not conflict, whether to lean against the wind depends on a number of considerations. As noted above, the GFC has drawn the attention to the cost of credit-driven bubbles, notably associated with soaring housing prices. Several studies have shown that strong credit growth and rapid increases in housing prices significantly increase the likelihood of recession (e.g. Sutherland and Hoeller (2012); Detken et al. (2014); Dreger and Kholodilin (2013)). In addition, housing price falls had the most devastating effects on the economy and the financial sector in countries where the pre-crisis housing price boom was accompanied by a construction boom, like Ireland, Spain and the United States. In sum, even though detecting a bubble in real time remains challenging, credit, housing prices and construction activity indicators provide fairly reliable indicators of mounting vulnerabilities.

Monetary policy can help dampening credit-driven booms, especially by affecting bank leverage and risk appetite. As demonstrated by Minsky (1986), lending and risk taking tend to be pro-cyclical, as economic agents become more confident and sometimes complacent in good economic times. Adrian and Shin (2008) show that financial intermediaries' balance sheet growth and leverage are closely related to the monetary policy stance. The credit cycle can be amplified by the financial accelerator. As credit growth lifts asset prices, more collateral becomes available for borrowing, fuelling an additional expansion of credit, lifting asset prices further and so on (Kiyotaki and Moore (1997); Bernanke et al. (1999); Aoki et al. (2002)). The mechanism works in reverse in a downturn, amplifying the recession. Monetary policy is not the only instrument to address a credit-driven housing boom. Capital requirements, including counter-cyclical capital buffers, dynamic provisioning and measures directly targeting mortgage lending, such as caps on loan-to-value and loan-to-income ratios or minimum risk weights on mortgages can also be used to tame the housing cycle. Nevertheless, these instruments also have some limitations, including design and implementation challenges (Mishkin (2011)) and risks of circumvention (Cerutti et al. (2017)). Furthermore, Bruno et al. (2017) show that macroprudential policies are more successful when they complement monetary policy by reinforcing monetary tightening, than when they act in opposite directions. Hence, leaning against the wind could be a sensible option in some circumstances.

6. Conclusion

In this paper, we have investigated whether the counter-intuitive result found by Gali and Gambetti (2015), which suggests that stock prices would react positively to a monetary policy shock, also holds for housing prices. We find that this is not the case. Even though a rational bubble component of housing prices reacts positively to a monetary policy shock, it is more than offset by the fundamental component, and the overall response of housing prices is negative, as conventional wisdom would suggest. This result holds for the United States, but also for the United Kingdom and Canada, even though in the latter case, the response is slightly delayed in recent years. Our results are robust to changes in the housing price series included in the model, as well as to the substitution of imputed with actual rents. We also estimated a MS-VAR model for the United States to assess whether the housing price response to the monetary policy shock was sensitive to the sentiment of home buyers, as measured by the new index of

Bork et al. (2017). The results suggest monetary policy remains effective, irrespective of the state of sentiment. We have used a shadow interest rate to take into account unconventional monetary policy in the United States and the United Kingdom after the GFC and we observe that housing prices have remained responsive to monetary policy shocks during that period. Altogether, we find robust evidence that housing prices respond negatively to a monetary tightening. This suggests that monetary policy has scope to lean against the wind during housing booms. Nevertheless, monetary policy is not the only instrument which can be used to dampen the housing cycle and potential conflicts with price and output stabilization objectives, the impact on output and employment, as well as the relative efficiency and interactions between different policy instruments also need to be taken into account before deciding to lean against the wind.

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Appendix A. The Impact of Monetary Policy Shocks on Bubbles for the US: baseline model

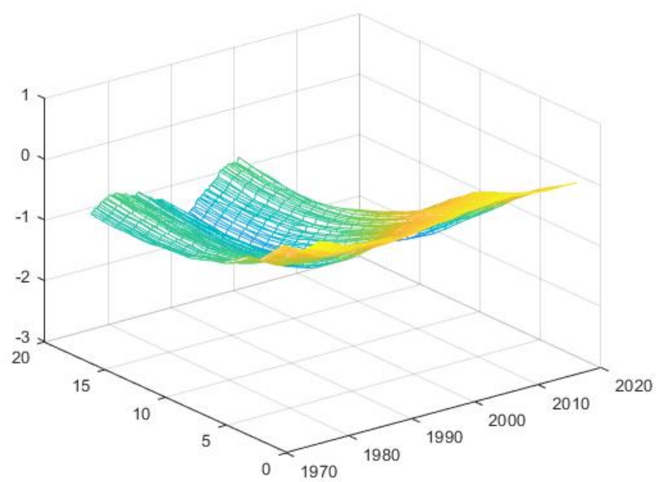

Figure A.1: Housing Price Response

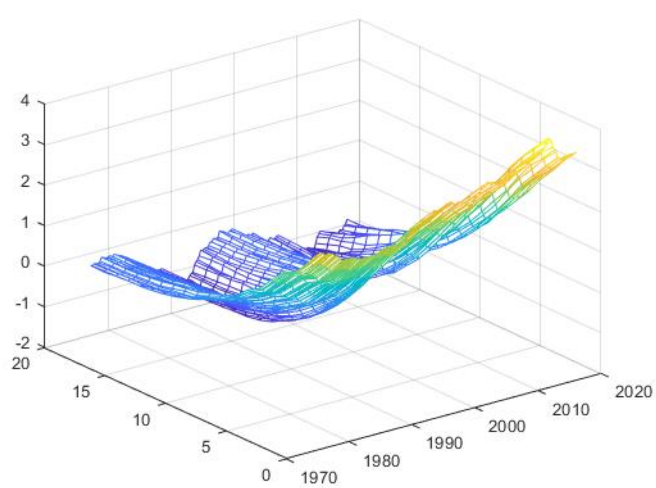

Figure A.2: Bubble Growth Response for Housing

Appendix B. The Impact of Monetary Policy Shocks on Bubbles for the US: Case-Shiller series

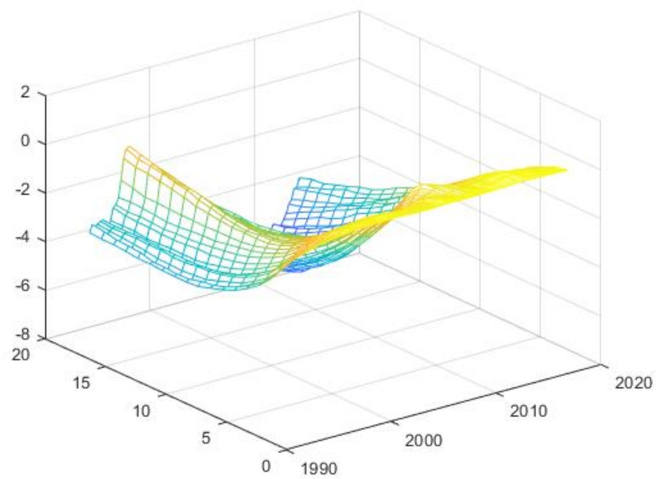

Figure B.1: Housing Price Response

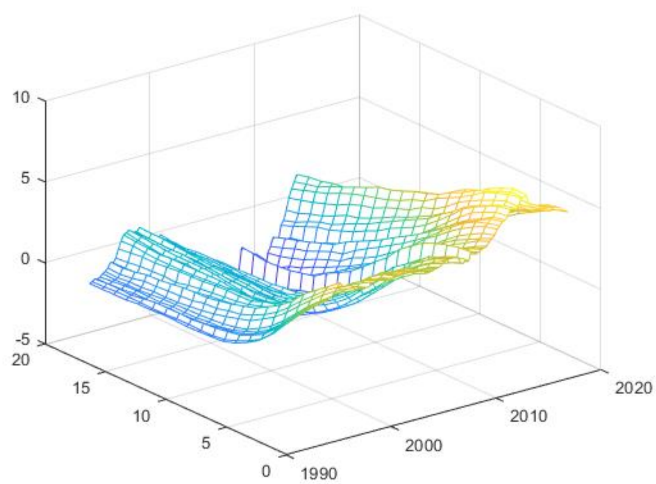

Figure B.2: Bubble Growth Response

Appendix C. The Impact of Monetary Policy Shocks on Bubbles for the US: actual rents series

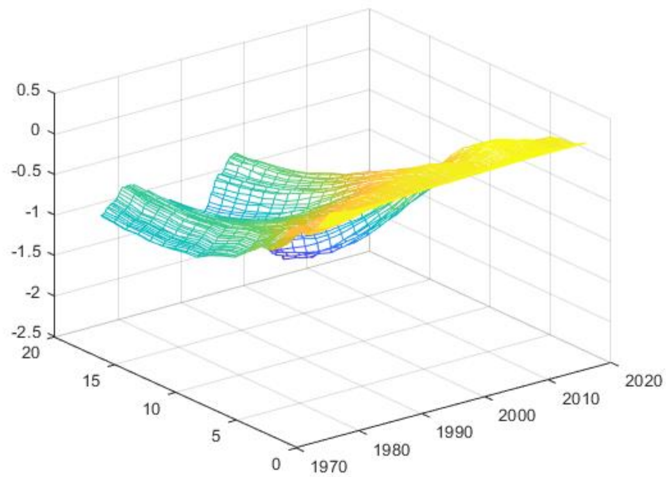

Figure C.1: Housing Price Response

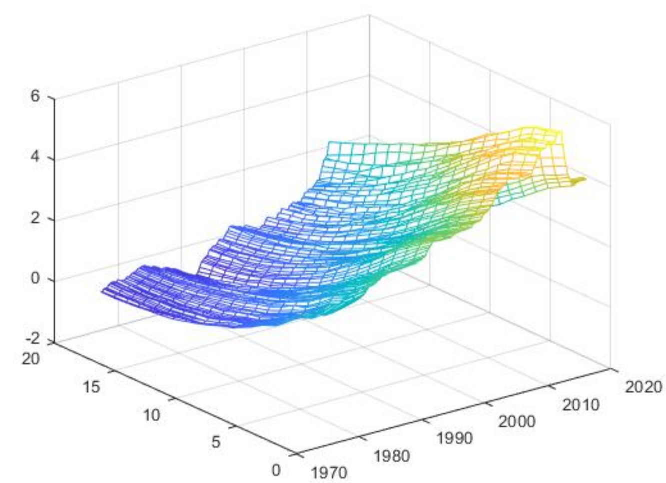

Figure C.2: Bubble Growth Response

Appendix D. The Impact of Monetary Policy Shocks on Bubbles for the UK: baseline model

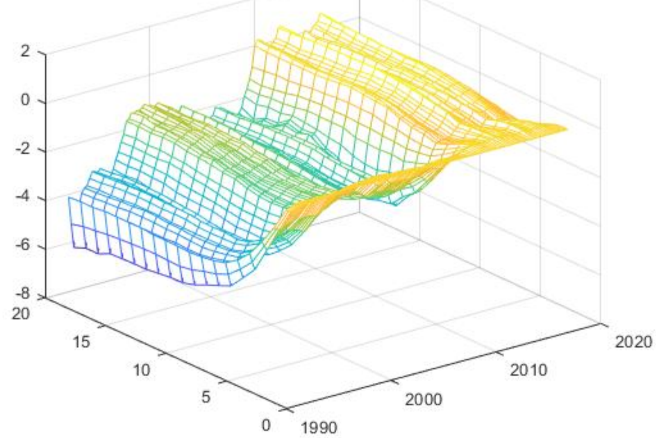

Figure D.1: Housing Price Response

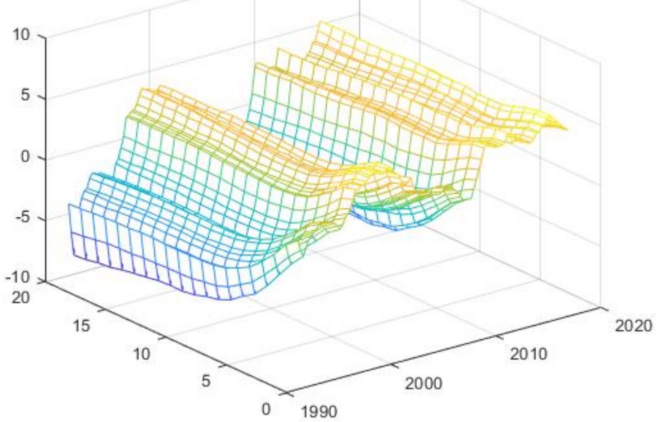

Figure D.2: Bubble Growth Response

Appendix E. The Impact of Monetary Policy Shocks on Bubbles for the UK: Nationwide series

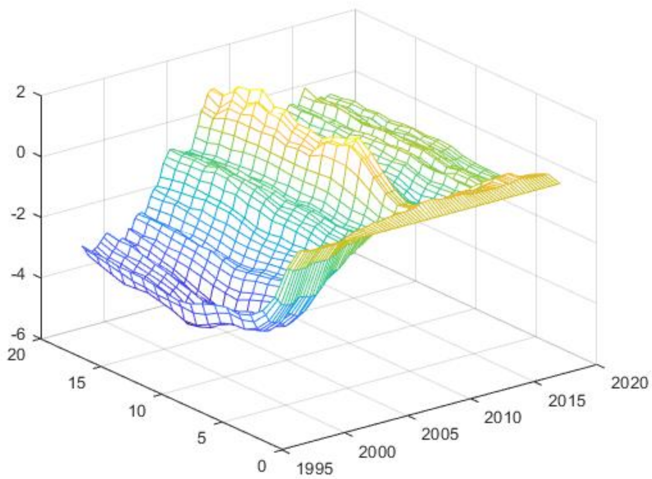

Figure E.1: Housing Price Response

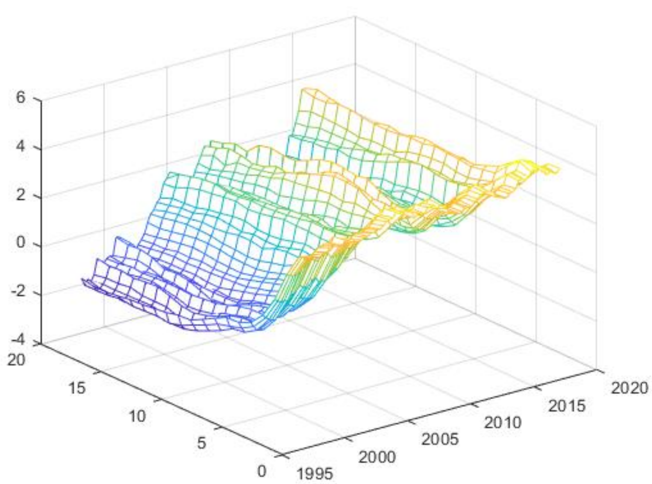

Figure E.2: Bubble Growth Response

Appendix F. The Impact of Monetary Policy Shocks on Bubbles for the UK: actual rents series

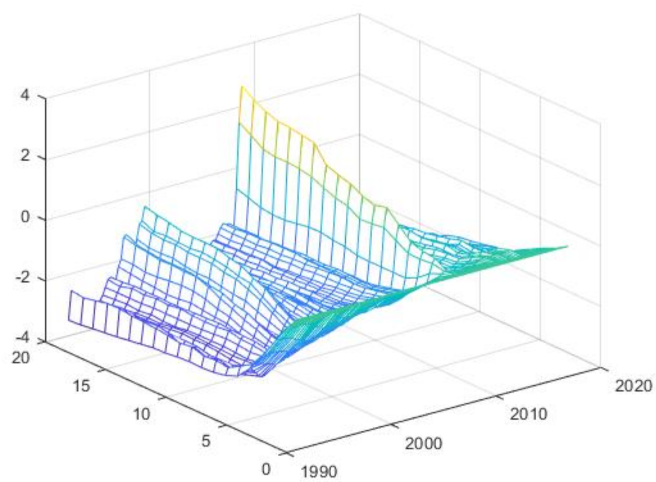

Figure F.1: Housing Price Response

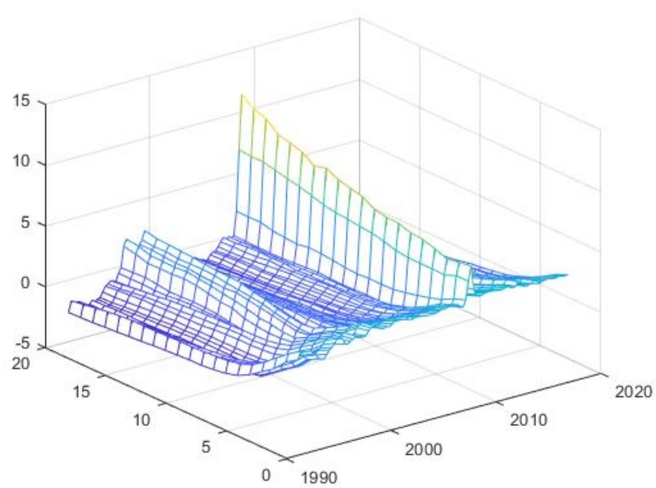

Figure F.2: Bubble Growth Response

Appendix G. The Impact of Monetary Policy Shocks on Bubbles for Canada: baseline model

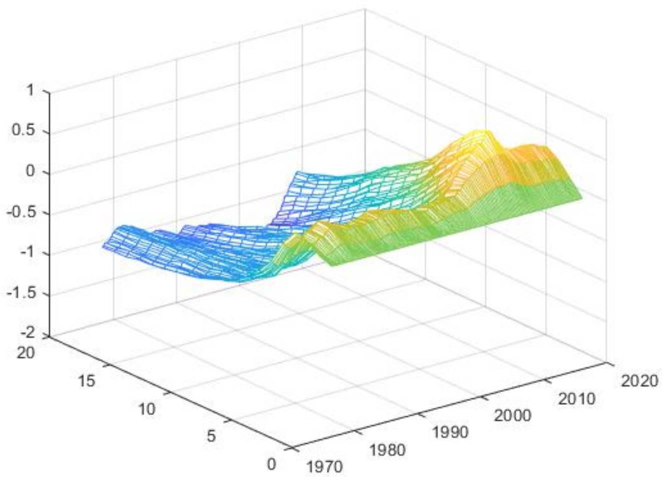

Figure G.1: Housing Price Response

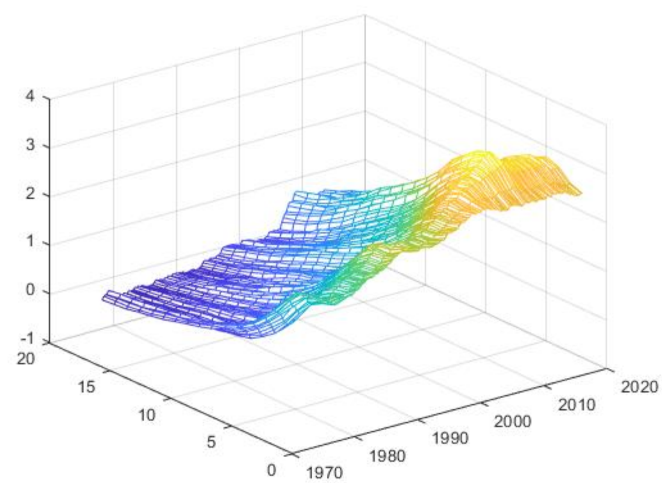

Figure G.2: Bubble Growth Response

Appendix H. The Impact of Monetary Policy Shocks on Bubbles for Canada: actual rents series

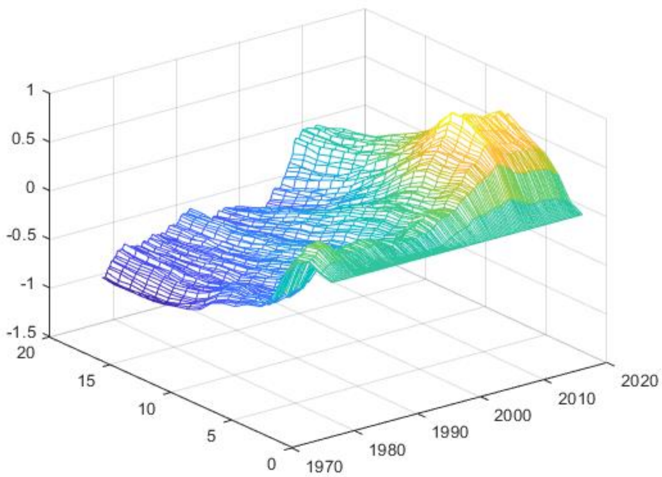

Figure H.1: Housing Price Response

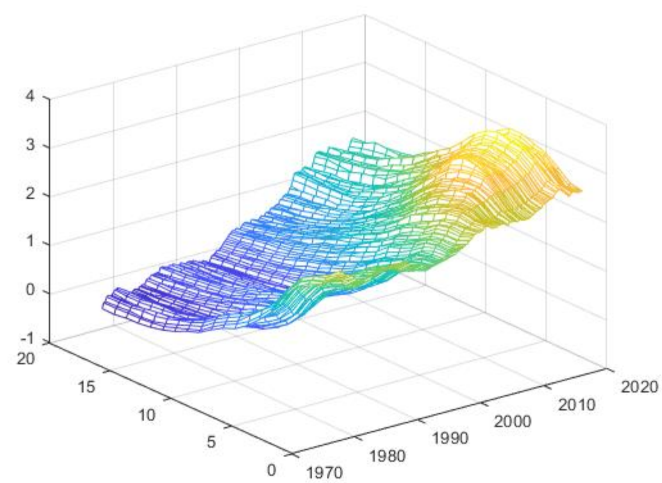

Figure H.2: Bubble Growth Response

Appendix I. The Impact of Monetary Policy Shocks on Bubbles versus sentiment mood

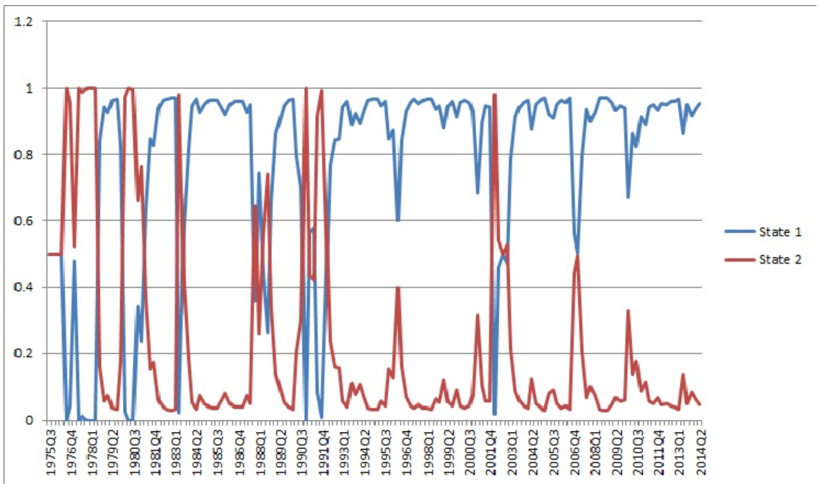

Figure I.1: The Regime Switches in Housing Sentiments; State 1 - bullish sentiment; State 2 - bearish sentiment

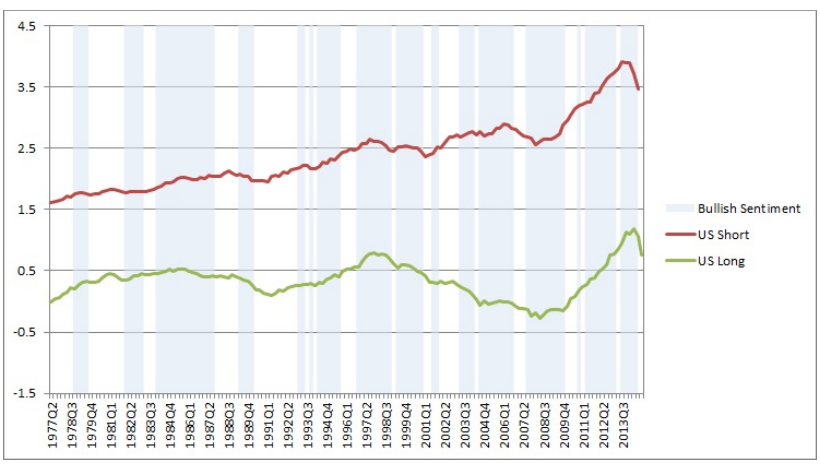

Figure I.2: Bubble Response for US; Bullish sentiment - the probability of a positive sentiment is higher than 90%; US Short - The responses of US bubbles as an average over the first 4 quarters; US Long - The responses of US bubbles as an average over the first 20 quarters

Appendix J. The Impact of Monetary Policy Shocks on output and inflation in United States (baseline model)

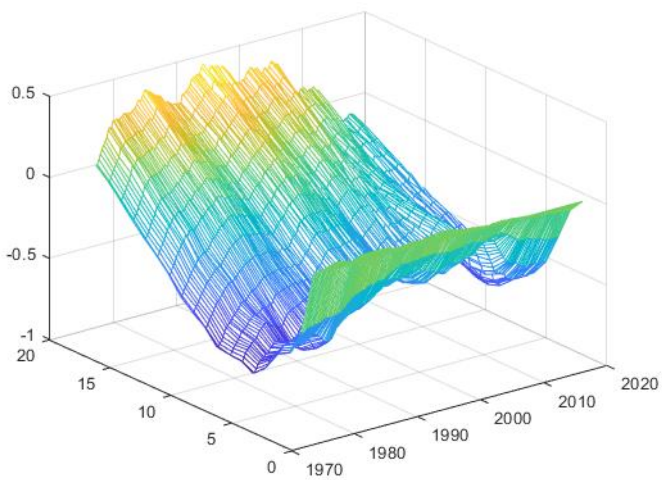

Figure J.1: Output Response for US

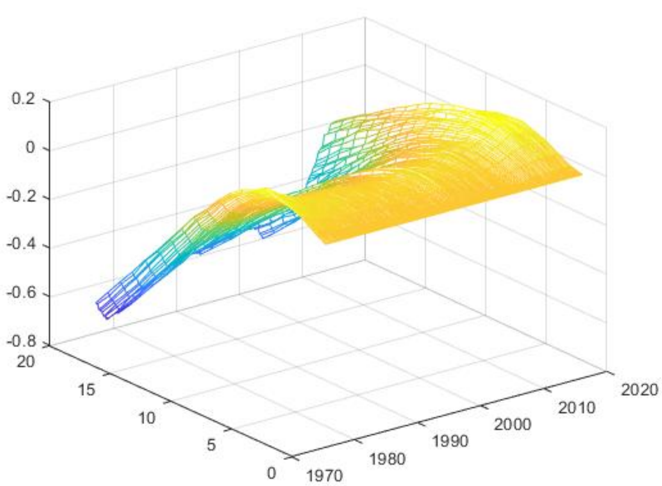

Figure J.2: Inflation Response for US

Appendix K. The Impact of Monetary Policy Shocks on output and inflation in United Kingdom (baseline model)

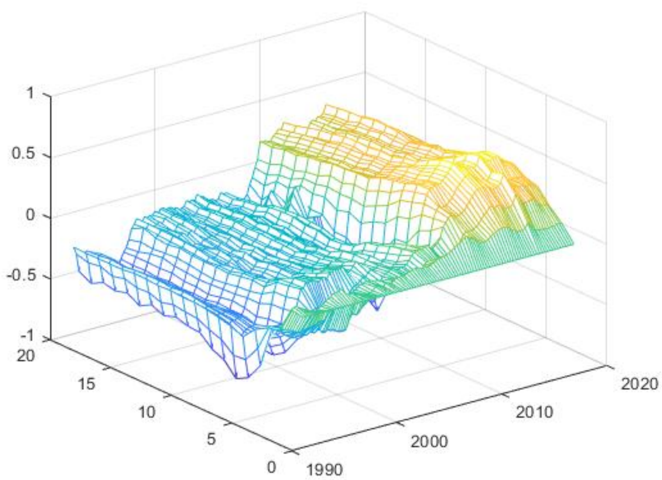

Figure K.1: Output Response for UK

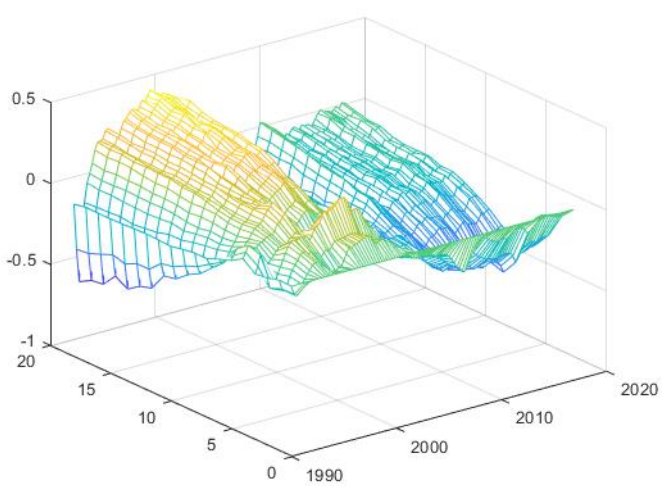

Figure K.2: Inflation Response for UK

Appendix L. The Impact of Monetary Policy Shocks on output and inflation in Canada (baseline model)

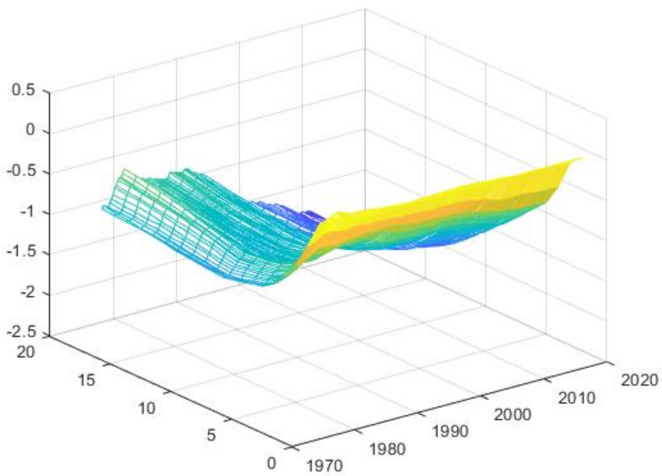

Figure L.1: Output Response for Canada

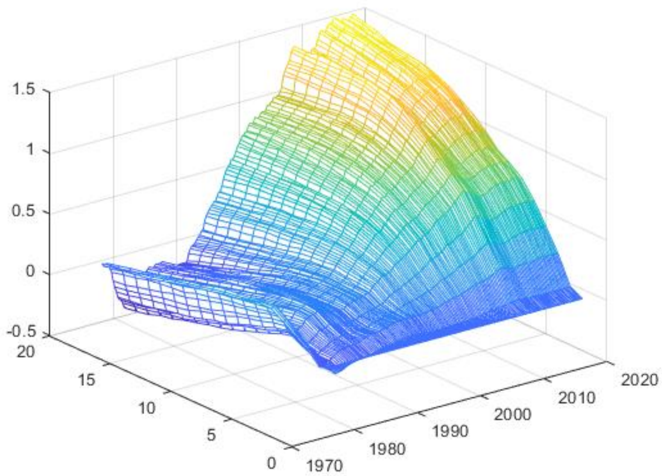

Figure L.2: Inflation Response for Canada