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US Monetary Policy, Global Risk Aversion, and New Zealand Funding Conditions

Eric Tong

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New Zealand Government

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Abstract

Instrumenting US monetary shocks with fed funds future contracts and extracting global risk sentiment from VIX, this paper uses a structural vector autoregression framework to estimate the causal impact of US monetary policy on New Zealand financial and real sectors. The paper finds that 20 basis points increase in US one-year rate leads to about 14 and 59 percent increase in domestic and external funding spreads of New Zealand banks, respectively. The paper also finds that credit default swap spread rises contemporaneously following a US monetary tightening shock. Similar patterns are documented in Australia, Canada, Sweden and United Kingdom. These results suggest the existence of a global financial cycle underpinned by US monetary policy, and prompt the reassessment of the relevance of Mundellian trilemma in an increasingly globalised economic system.

JEL CLASSIFICATION F30; G21

KEYWORDS US monetary policy; risk aversion; NZ funding conditions

Non-technical Summary

Since the Global Financial Crisis, global interest rates have dropped to the lowest level seen in 5,000 years of human history, and, as the economies recover, the low interest rates are bound to reverse. Indeed, recently the Federal Reserve has raised the federal funds rate for the fifth time in a decade. In this context, this paper looks into the impact of US monetary policy and global risk appetite on New Zealand funding conditions, and compare the results across countries. The results speak to the design of monetary and fiscal policies, as well as the intricate coordination between the two.

Throughout the paper, conscious efforts are made to try to differentiate changes in US monetary policy that can be considered causal, from changes in US monetary policy that are responses to other developments in the world. This differentiation, when done properly, serves two purposes. First, it affords a clearer estimation of the causal impact of US monetary policy, which is our initial quest. Second, it allows for the conduct of thought experiments in tracing how a causal change in US monetary policy flows through an economic system over time. Both quests can only be achieved when exogenous "shocks" are identified.

Another innovation of the paper is in identifying global risk sentiment. Crudely put, the method involves subtracting expected uncertainty from the Chicago Board of Exchange Volatility Index (VIX), commonly known in the market as the "fear index".

Key findings include the follows. First, it is found that the impact of US monetary policy on mortgage spread – an indicator of banks' funding costs as well as real estates market viability – is benign, despite signs that it is correlated with global risk sentiment and begins to pick up in the medium run following a US monetary tightening. Second, the impacts of US monetary tightening on domestic and external funding pressure of New Zealand banks are significant – a 20 bp rise in US one-year rate leads to about 14 and 59 percent increase in the domestic and external funding spread, respectively. Third, market participants price in the US monetary tightening news efficiently, and perceive a higher default risks of New Zealand banks contemporaneously following the monetary tightening news.

Similar patterns are found across a range of comparable open economies, namely, Australia, Canada, Sweden, and the United Kingdom. These results suggest that floating exchange rates may not fully insulate open economies from the influence of US monetary policy. The results also cast doubt on the conventional Mundellian trilemma that countries opting for floating exchange rates may preserve monetary autonomy.

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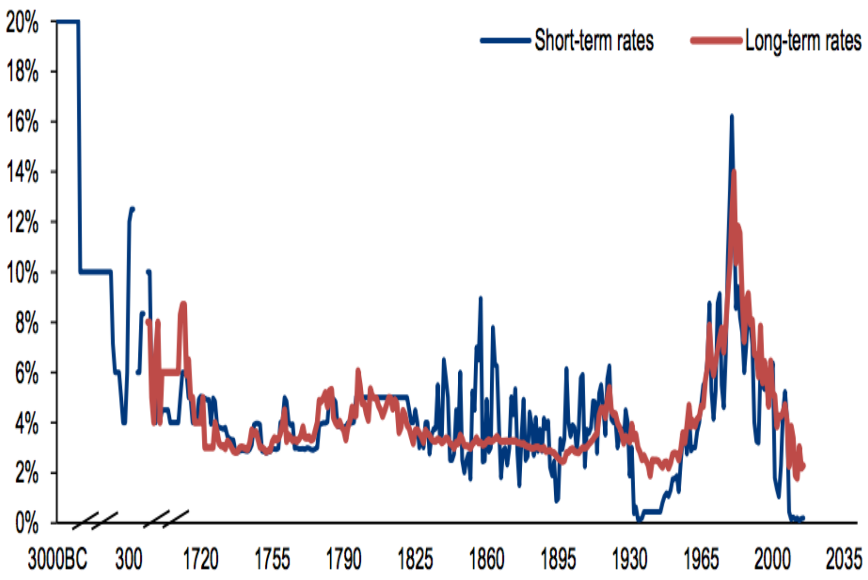
US Monetary Policy, Global Risk Aversion, and New Zealand Funding Conditions

1 Introduction

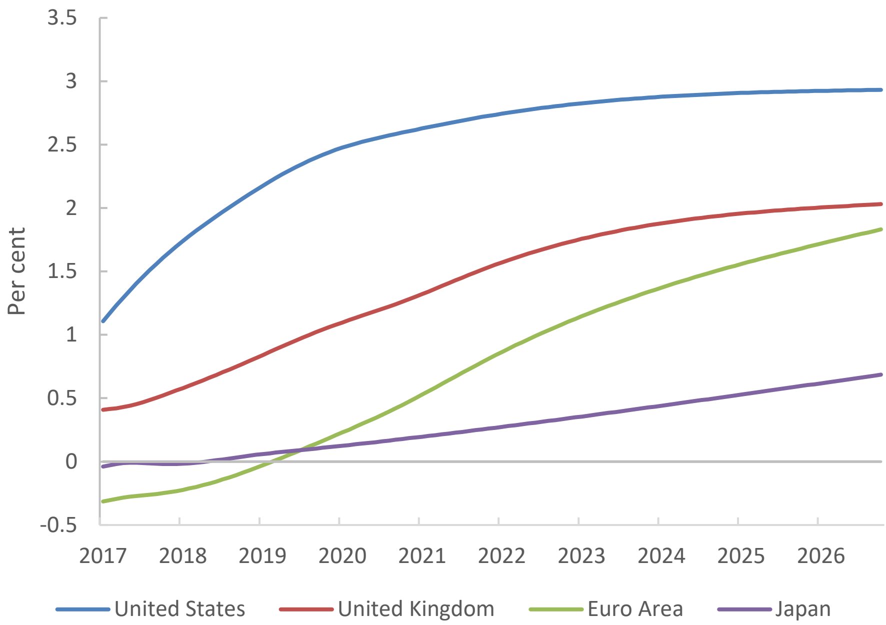
Global interest rates have dropped to the lowest level in modern financial history (Figure 1), and are likely to rise in the future as the global economy recovers. Indeed, the Federal Reserve has recently raised the fed funds target rate for the fifth time in a decade, setting its path to reach the projected level of 2% by 2019 and 3% by 2023 (Figure 2). In this light, it is crucial to understand the impact of this trend on small, open economies like New Zealand, as the outcomes would be relevant to a range of issues from financial stability to housing affordability, as well as the coordination between monetary and fiscal policies. The closest studies available to date are Wong (2012) and Munro and Wong (2014), yet both have focused on the domestic relationship between the Official Cash Rate (OCR) and banks' funding costs. This paper sheds light on how global factors affect New Zealand households and banks.

Figure 1 – Global interest rates in 5000 years



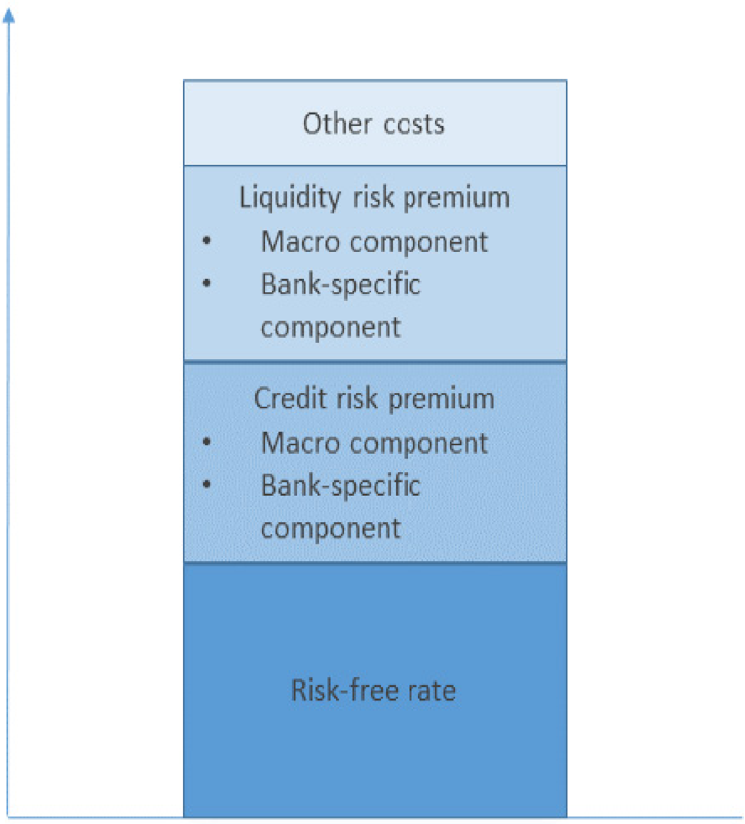
Sources: Bank of England, Global Financial Data, Homer and Sylla 'A History of Interest Rates'
Note: the intervals on the x-axis change through time up to 1700. From 1700 onwards they are annual intervals. Full methodology available upon request

Figure 2 – International forward 3-month rate



Sources: Bloomberg; author's calculations.

Figure 3 – Components of bank's funding costs



In theory, there are two channels through which US monetary policy affects New Zealand banks' funding costs. In general, costs of fund are comprised of two components: the risk-free rate determined by the Reserve Bank of New Zealand (RBNZ), and a risk premium determined by the market perception of risks borne by banks (Figure 3). When the federal funds rate rises, RBNZ may tighten the OCR to reduce the interest rate differential and capital inflow, thus increasing the first component of funding costs. The impact of federal funds rate on the second component – risk premium – is less clear. On one hand, depreciated New Zealand currency increases the debt burden of local firms that have borrowed US dollars, raising their chance to default. On the other hand, the increase in exports implies that firms' profits would be higher and balance sheets stronger, offsetting the former effect. On top of these forces, there also exists a global risk-taking channel underpinned by the intricacy between global and local risk sentiment (Borio and Zhu, 2012; Tong, 2016). On one hand, US monetary contraction tends to go with heightened risk aversion, resulting in tightened credit from global to local banks in periphery countries. On the other hand, heightened risk aversion may actually promote robust risk management, the opposite of what we saw during the low interest rate era before the global financial crisis. A priori, therefore, how local cost of funds changes with US interest rate is unknown.

In this paper, I use structural vector autoregression (SVAR) to model the interactions among US monetary policy, global risk appetite, and New Zealand real and financial variables. Two challenges usually confront these studies. First, US monetary policy tends to co-move with other financial variables, such as exchange rate, making it difficult to disentangle causation from correlation. Second, although risk sentiment is critical to asset-pricing and banks' risk-taking in the literature (Rajan, 2006; Adrian and Shin, 2008; Borio and Zhu, 2008), there exists no conventional method to measure it. The CBOE Volatility Index (VIX) is usually used as a substitute, but the calculation of VIX itself implies that the index also captures the conditional uncertainty of the stock market, convoluting its measurement of risk sentiment.

To overcome the first challenge, I use a method known as high frequency identification to extract the exogenous component of US monetary policy shocks (Matheson and Stavrev, 2014; Gertler and Karadi, 2015). This method makes use of intraday information embedded in the fed funds futures contract. Fed funds futures incorporate market participants' views on the average federal funds rate. On the date in which the federal funds target rate is announced, one can compare the futures rate within a tight time-frame (30 minutes) of the announcement. If the futures rate changes within this period, it can be inferred that market is surprised by the announcement, as it is unlikely that any other significant event occurs during such short period. Exogenous US monetary shock can then be extracted from these changes in futures rate.

With regard to the second challenge, I leverage on the research of Bekaert and Hoerova (2014), who have compared 31 models to come up with the most informative forecast model for conditional stock market variance. Subtracting this conditional uncertainty from VIX allows me to obtain the risk aversion series.[1]

I present the results in two parts. In the first part, I present an estimation of the impact of US monetary shock on the New Zealand funding costs, taking into account the effect of global risk aversion at work. I use the 2-year mortgage spread, domestic funding spread, external funding spread, and an actuarial credit default swap (CDS) spread respectively to measure New Zealand funding costs from different angles. Domestic funding spread is compiled by RBNZ, which reflects the average wholesale funding cost of the four banks in New Zealand. External funding spread captures the funding cost of an AA rated bank in raising one-year US dollars, plus a cost associated with hedging the currency risk by use of the FX swap. The CDS spread is compiled by the National University of Singapore, which in principle captures the credit default risks of banks as perceived by market participants.[2]

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[1] Technically speaking, this is the Variance Premium series, which incorporates risk aversion.

[2] See https://rmicri.org/en/

On average, it is found that the impact of US monetary shock on New Zealand mortgage spread is benign. A shock that causes US one-year rate to increase by 20 basis points (bp) causes an increase in mortgage spread by 3 bp over four years. That said, it is found that the response in mortgage spread closely traces that in the global risk aversion series, which begins to increase around 20 months after the shock.

Responses in the other three spreads are relatively strong. For the same shock aforementioned, domestic funding spread increases by about 14 percent in three years.[3] External funding spread increases by 59 percent, which reflects both the increase in US funding cost, as well as the increase in hedging cost due to a persistent weakening of New Zealand dollars. A set of robustness checks confirms the latter point. When the bilateral NZD-USD exchange rate is incorporated in the estimation, it is found that New Zealand dollars experience a persistent weakening following a US monetary tightening shock, consistent with the literature that documents the deviation from interest rate parity. Lastly, the CDS spread shows that market participants price in the news of US monetary tightening contemporaneously, and perceive an increase in the default risk of New Zealand banks from the outset of the monetary tightening shock.

In the second part of the analysis, I put New Zealand experience in the context of comparable countries: Australia, Canada, Sweden, and United Kingdom. Similar to New Zealand, these countries are floating exchange rate regimes that have adopted inflation targeting around 1990s. They have also pursued capital account mobility as New Zealand has (measured by the Chinn-Ito index of Chinn and Ito, 2006). According to the Mundell-Fleming logic, then, flexible exchange rate in these countries should have absorbed most foreign influences, leaving domestic interest rate free to achieve the internal price and output stabilisations (Mundell, 1963; Fleming, 1962).

Against this backdrop, the second part of the analysis finds two points that leave the Mundellian trilemma open to questions. First, it is found that policy rates of these floating regimes closely trace the US monetary shocks, reflecting a “fear of floating” channel. Second, when one looks beyond the short-term policy rate and focuses on the broader monetary conditions, it is found that Canada and Sweden share a similar pattern as New Zealand: that mortgage spread follows a V-shaped fall-then-rise pattern. Responses in CDS spread of all five countries have also increased following the US monetary tightening shock. These results point to the weakening of the Mundellian trilemma, the existence of the global financial cycle, and an international credit/risk-taking channel of US monetary policy at work.

In what follows, I outline the econometric framework in Section 2, discuss the data and estimation in Section 3, and present the results in Section 4. Section 5 concludes.

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[3] These percentage changes are calculated based on the average values of domestic, external and CDS spreads in the sample.

2 Econometric Framework

Let Y_t be a vector of economic and financial variables, A and C_j their respective coefficient matrices, and ε_t a vector of structural white noise shocks. The structural VAR is

Equation 1

$$AY_t = \sum_{j-1}^{p} C_j Y_{t-j} + \varepsilon_t,$$

Multiplying each side of the equation by A^{-1} yields the reduced form representation

Equation 2

$$Y_t = \sum_{j-1}^{p} B_j Y_{t-j} + u_t,$$

where u_t is the reduced form shocks, given by the following function of the structural shocks:

$$u_t = S\varepsilon_t,$$

with $B_j = A^{-1}C_j$ and $S = A^{-1}$. The variance covariance matrix of the reduced form VAR equals $\sum$:

$$E_t[u_t u'_t] = E_t[SS'] = \sum.$$

Let $Y_t^P \in Y_t$ be the policy indicator, specifically the variable in equation (1) with exogenous variation due to the associated primitive policy shock ε_t^P. Futhermore, let s denote the column in S that records the impact of US monetary policy shock (ε_t^P) on each element of the reduced form residuals (u_t). Accordingly, equation (2) can be written as

Equation 3

$$Y_t = \sum_{j-1}^{p} B_j Y_{t-j} + S\varepsilon_t,$$

which can be estimated by ordinary least squares regression (OLS).

Although one can use Cholesky ordering to retrieve S, such timing restriction is problematic when financial variables appear in the VAR along with the policy indicator. A restriction that an innovation in the policy indicator has no contemporaneous effect on other financial variables is generally implausible. In addition, policy indicator may also respond to news reflected by financial variables. Accordingly, we need to identify monetary policy surprises by way of external instruments.

Following Gertler and Karadi (2015) and Mertens and Ravn (2013), I use a vector of instrumental variables Z_t to identify monetary shocks. To be a valid set of instruments, Z_t has to be correlated with ε_t^p but othogonal to ε_t^q, the vector of structural shocks other than the policy shock. Specifically:

$$E\left(Z_t \varepsilon_t^p\right) = \alpha,$$

$$E\left(Z_t \varepsilon_t^q\right) = 0.$$

To obtain estimates of the elements in the vector S in equation (3), we proceed as follows: first, obtain estimates of the reduced form residuals from the reduced form VAR. Next, let u_t^p, u_t^q be the reduced form residuals from the equation for the policy indicator and other equations respectively. Also, let $s_t^q \in s$ be the response of u_t^p to a unit increase in the policy shock, ε_t^p. From this setup, we can obtain an estimate of the ratio s^q/s^p from the two stage least squares regression of u_t^q on u_t^p, using the instrument Z_t. Intuitively, the first stage regression of u_t^p on Z_t isolates the variation in the reduced form residual for the policy indicator that is due to the structural policy shock. As the variation in the fitted value $\widehat{u_t^p}$ is due only to ε_t^p, the second stage regression of u_t^q on $\widehat{u_t^p}$ would yields a consistent estimate of s^q/s^p. Footnotes (14) – (18) of Gertler and Karadi (2015) give a detailed exposition of the method.

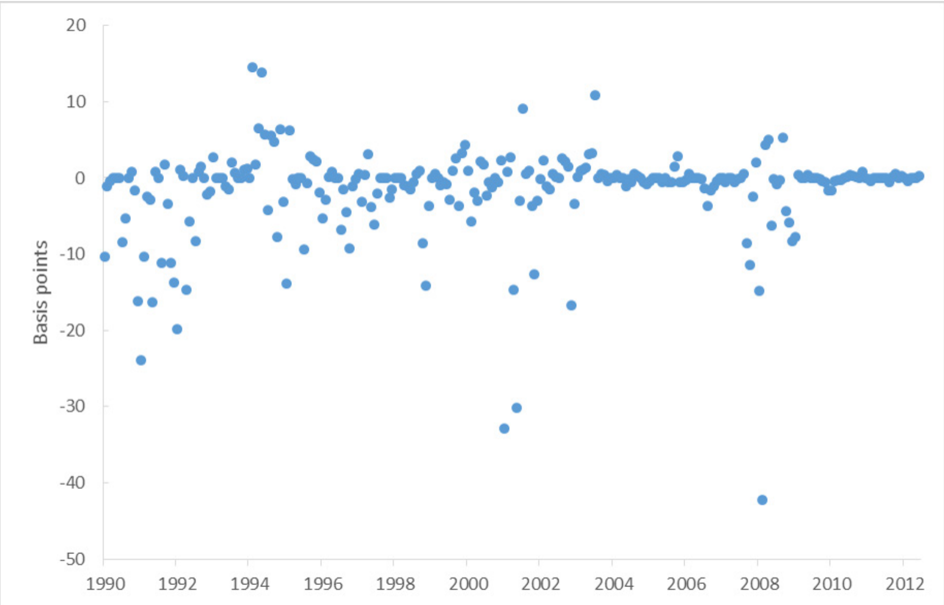
3 Data and Estimation

3.1 Policy Indicator and Instrument

To capture shocks to forward guidance, which has become a primary tool of Federal Reserve since the zero lower bound is hit, I take as the policy indicator a government bond rate with a maturity longer than the fed funds rate. The advantage of the government bond rate is that its innovations incorporate not only the effects of surprises in the current funds rate, but also the shifts in expectations about the future path of the funds rate, ie, shocks to forward guidance.

Following Gertler and Karadi (2015), I use surprise reflected in the three month ahead fed funds futures rate (FF4) as the primary choice of instrument variables – FF4 is found to have the strongest performance as an external instrument among other fed funds futures contracts. Fed funds future rate reflects market expectation of monetary policy rates, so any change in them within a tight window (30 minutes) of the Federal Open Market Committee (FOMC) meetings likely reflects a monetary policy surprise. Known as high frequency identification (HFI), the method has gained prominence in identifying monetary shocks (Gürkaynak, Sack, and Swanson, 2005; Hamilton, 2008; Campbell et al, 2012) (Figure 4).

Figure 4 – US monetary policy surprises



3.2 Risk Aversion

Following Bekaert et al (2013) and Bekaert and Hoerova (2014), I derive risk aversion from the Chicago Board Options Exchange Volatility Index (VIX). As VIX conceptually captures both stock market uncertainty and risk aversion, we need a method to identify the latter from the former. Let RV be the realised variance of the S&P500 index and VP be the variance risk premium, VIX can be expressed as:

$$VIX_t^2 = E_t[RV_{t+1}] + VP_t,$$

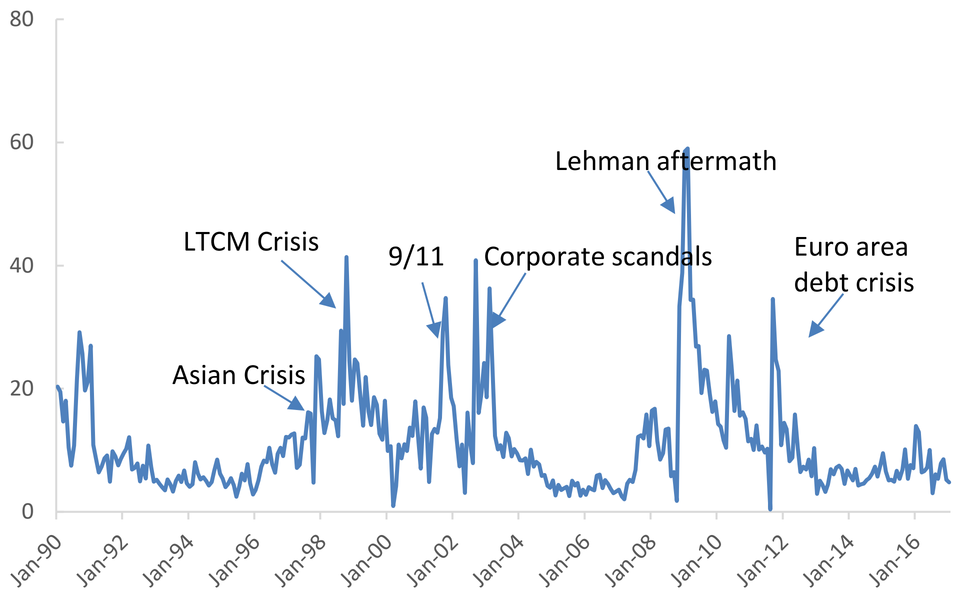
The variance premium is our measurement of risk aversion. It is usually positive and displays substantial time-variation. Recent finance models attribute these facts either to non-Gaussian components in fundamentals and stochastic risk aversion (Bollerslev et al, 2009; Drechsler and Yaron, 2011), or even Knightian uncertainty (Drechsler, 2013).

The challenge of disentangling VP from VIX lies in finding a good estimation of the conditional variance of stock returns, $E_t[RV_{t+1}]$. Bekaert and Hoerova (2014) compare across 31 models, and find that the Corsi's HAR model (Corsi, 2009), supplemented with the squared VIX, wins over other models in terms of root-mean-square error and other criteria.[4] I therefore use the HAR model to estimate realised variance. Daily data between 1990 and 2016 are used in the estimation. The resulting coefficients are (with heteroskedasticity-robust standard errors in brackets):

$$RV_t^{(22)} = \frac{0.69}{(0.88)} + \frac{0.41}{(0.05)} VIX_{t-22}^2 + \frac{0.16}{(0.07)} RV_{t-22}^{(22)} + \frac{0.22}{(0.06)} RV_{t-22}^{(5)} + \frac{0.004}{(0.02)} RV_{t-22}^{(1)},$$

where $RV_t^{(22)}, RV_t^{(5)}, RV_t^{(1)}$ represent realised variance at monthly, weekly, and daily interval respectively.[5] Once we obtain the empirical projections of the realised variance, we can compute variance premium as the difference between VIX and the physical conditional expected variance as specified in equation (4). The decomposed variance premium will be used as our risk aversion series (Figure 5).

Figure 5 – Monthly risk aversion



3.3 Other Model Setup

In addition to US 1-year rate (instrumented) and risk aversion, I include New Zealand real GDP (logged), logged CPI, Official Cash Rate (OCR), and 2-year mortgage spread as a measure of banks' funding conditions.[6] To complement the benchmark result, I sequentially replace mortgage spread with domestic funding spread, external funding spread and the New Zealand financial sector's 5-year CDS spread as alternative measurements of domestic financial conditions.

4 HAR stands for Heterogeneous Auto-Regressive. See Table 3 of Bekaert and Hoerova (2014).

5 22 trading days in a month and five trading days in a week.

6 Using the mortgage spread has an additional advantage: the real estate market is central for financial stability and has been shown to be very important in boom-bust cycles around the world.

The domestic funding spread is obtained from RBNZ, and reflects the average cost of debts of the big four banks in New Zealand. The external funding spread is the cost of funds of an AA rated bank in obtaining a one year loan less the one year bill rate, plus a hedging cost using FX swaps to cover the currency risks. The 5-year CDS spread is an actuarial spread compiled by the National University of Singapore. It represents the premium the buyer of a CDS pays in exchange for protection against potential defaults of a reference entity. An increase in the CDS spread implies a higher probability of default of New Zealand banks. In the Appendix, I also show the results where I replace risk aversion for exchange rate in terms of US dollar per New Zealand dollar for each of the above mentioned regressions.[7]

I estimate the regressions over the monthly sample period of 1991:1 – 2012:6. 12 lags are chosen. These setups follow closely those of Gertler and Karadi (2015).

[7] Exchange rate is suggested as a key medium of transmission of balance sheet risks in Borio and Zhu (2012) and Bruno and Shin (2015). The inclusion of exchange rate may reflect the international risk-taking channel as well as the interest rate parity at work.

4 Results

This section presents the results in two parts: the impact of US monetary shock on New Zealand funding cost, and international comparison.

4.1 Impacts on NZ Funding Costs

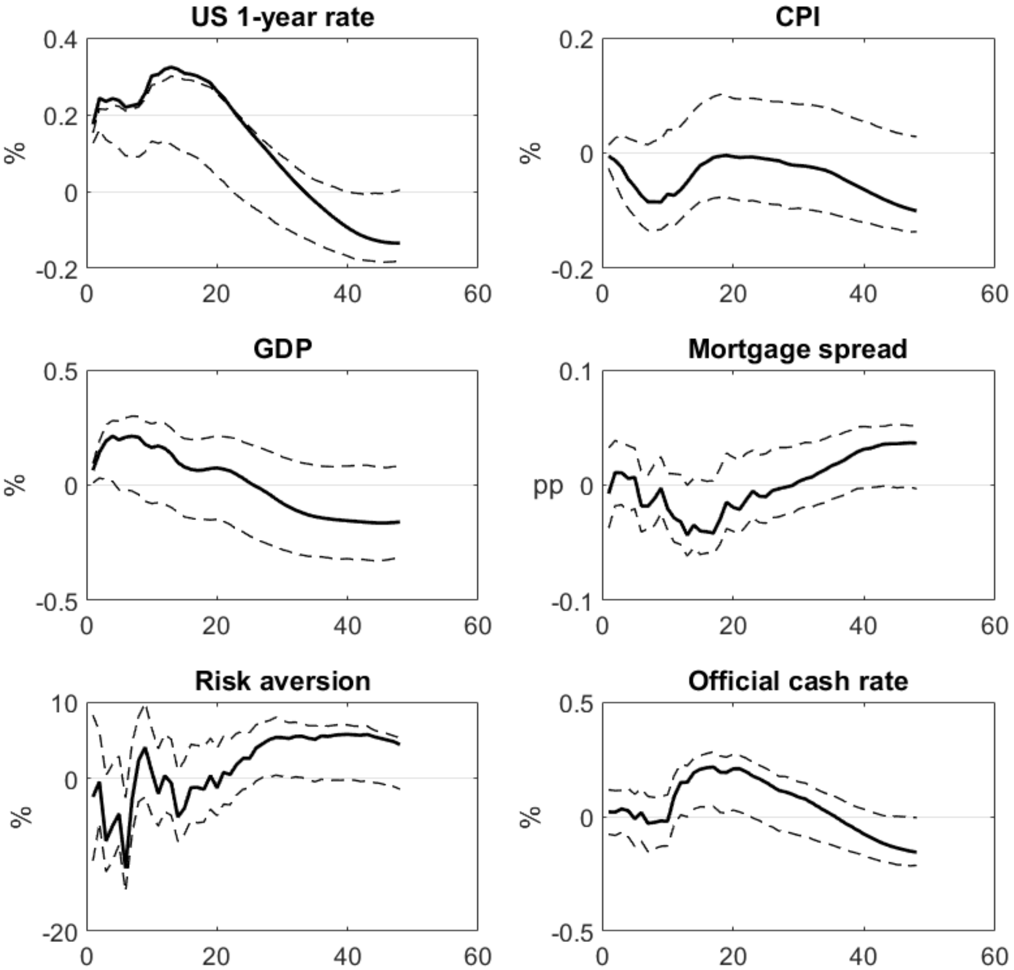
Figure 6 shows that a unit of monetary shock in US leads to about 20 basis points (bp) increase in US one-year bond rate. In turn, it leads to a gradual increase in risk aversion and mortgage spread. Although the response in mortgage spread is initially suppressed, it gradually rises in about 20 months after the shock, similar to the pattern in risk aversion. In total, the cumulative increase in mortgage spread is 3 bp by the end of the fourth year after the shock, or about a two percent increase in long-term funding costs.[8]

The real economy also contracts following the tightening of US monetary policy. Real GDP falls at around the same time as risk aversion and funding costs rise. Price level drops over the impulse response duration. Taken together, these responses are consistent with the international credit channel at work: that as the Federal Reserve tightens monetary policy, global risk aversion and local funding pressure go up, and real economic conditions deteriorate.

Response of OCR also suggests that the "fear of floating channel" – central banks facing large capital flows try to reduce the interest rate differential and tighten their policy rate – may be at work. Specifically, OCR has started to rise ten months after the tightening shock. The peak increase comes in about 16 months after the shock, where OCR increases by 23 bp relative to the expected level. In the Appendix, I document that the New Zealand currency is persistently weakened following a US tightening shock, providing another reason for the rise in local funding pressure.

[8] Percentage increase is calculated based on the average mortgage spread over the sample period – 1.54 percentage points.

Figure 6 – Impulse response functions of US monetary shock (Mortgage spread)



First stage regression: F: 21.02 robust F: 16.45

Figures 7 – 9 replace the mortgage spread with domestic funding spread, external funding spread, and CDS spread respectively. Their responses are stronger than that in mortgage spread. Figure 7 shows that US monetary tightening raises the costs of fund of domestic banks. Figure 8 points to US monetary tightening raises the costs in both raising US dollars loans, and in hedging currency fluctuation during the terms of loan. Figure 9 shows that market participants contemporaneously revise their perception on New Zealand banks' viability following the US monetary shock.

Figure 7 – IRFs of US monetary shock (Domestic funding spread)

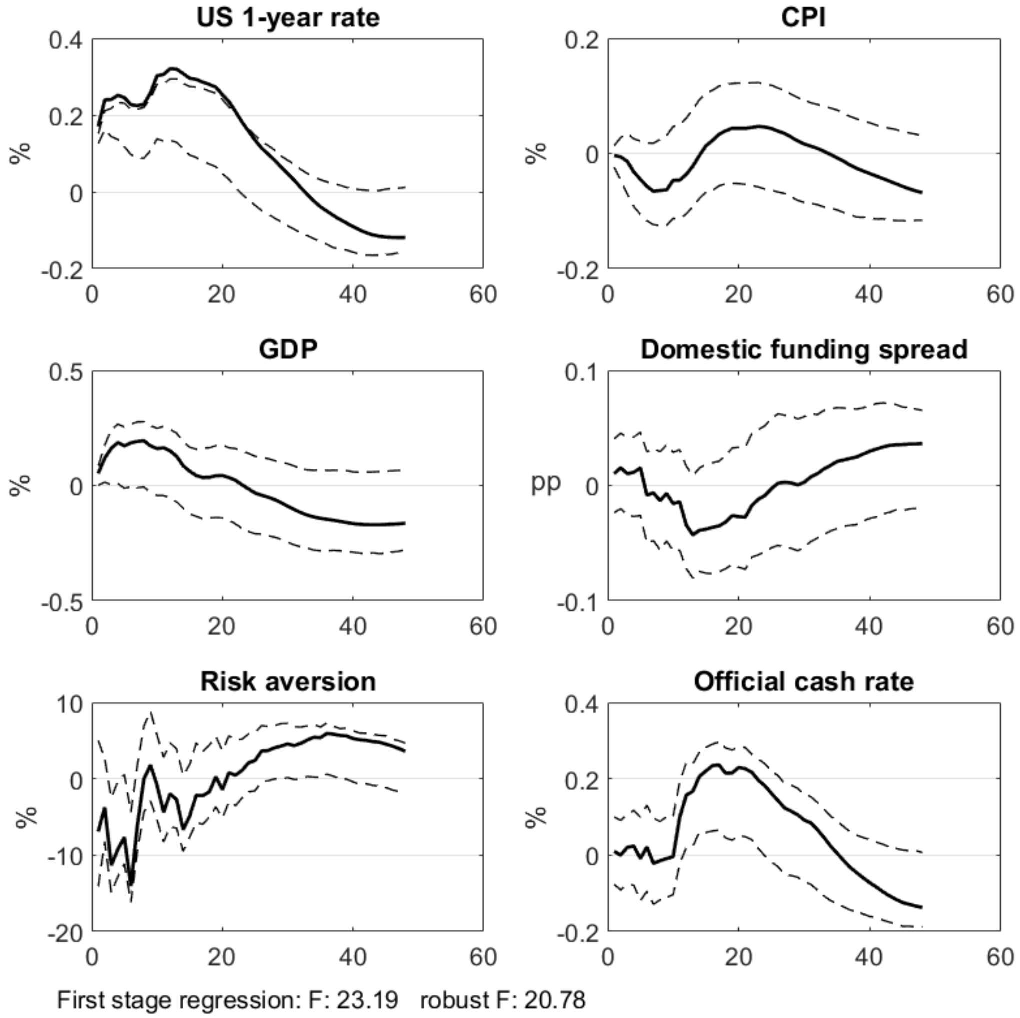
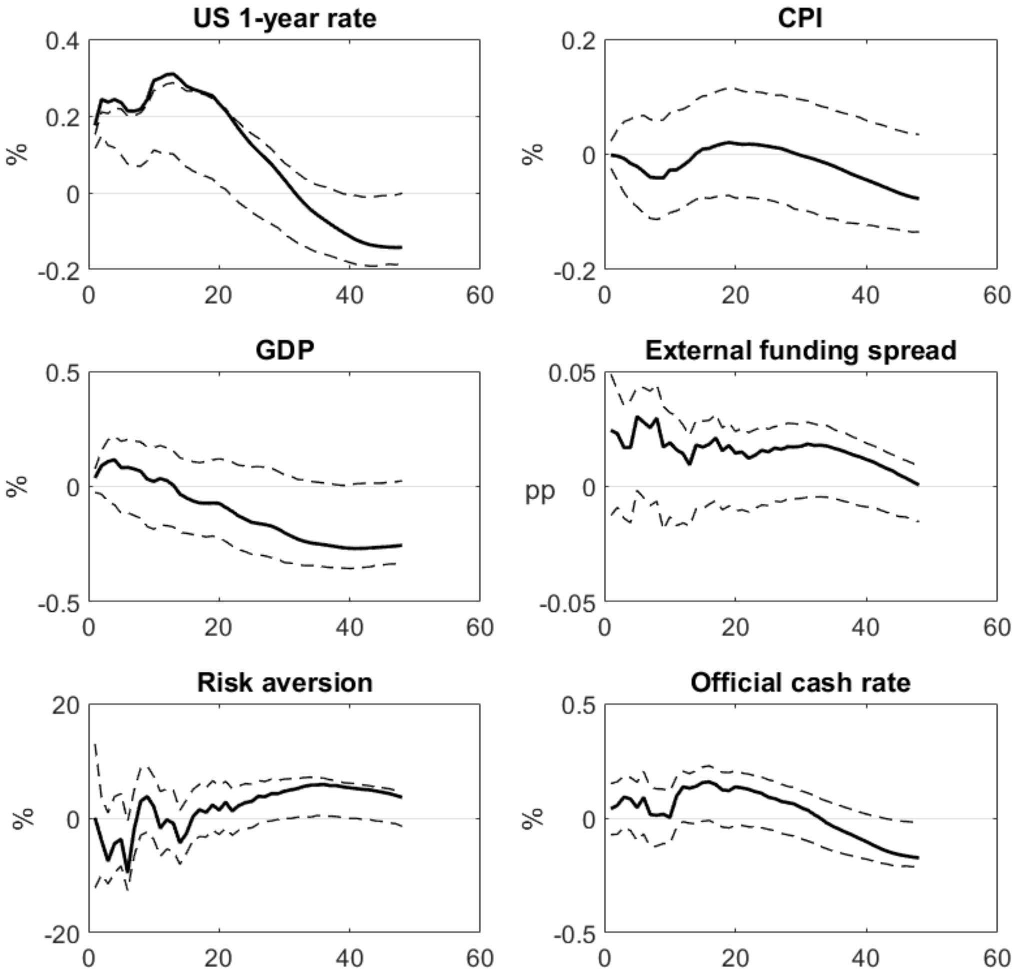
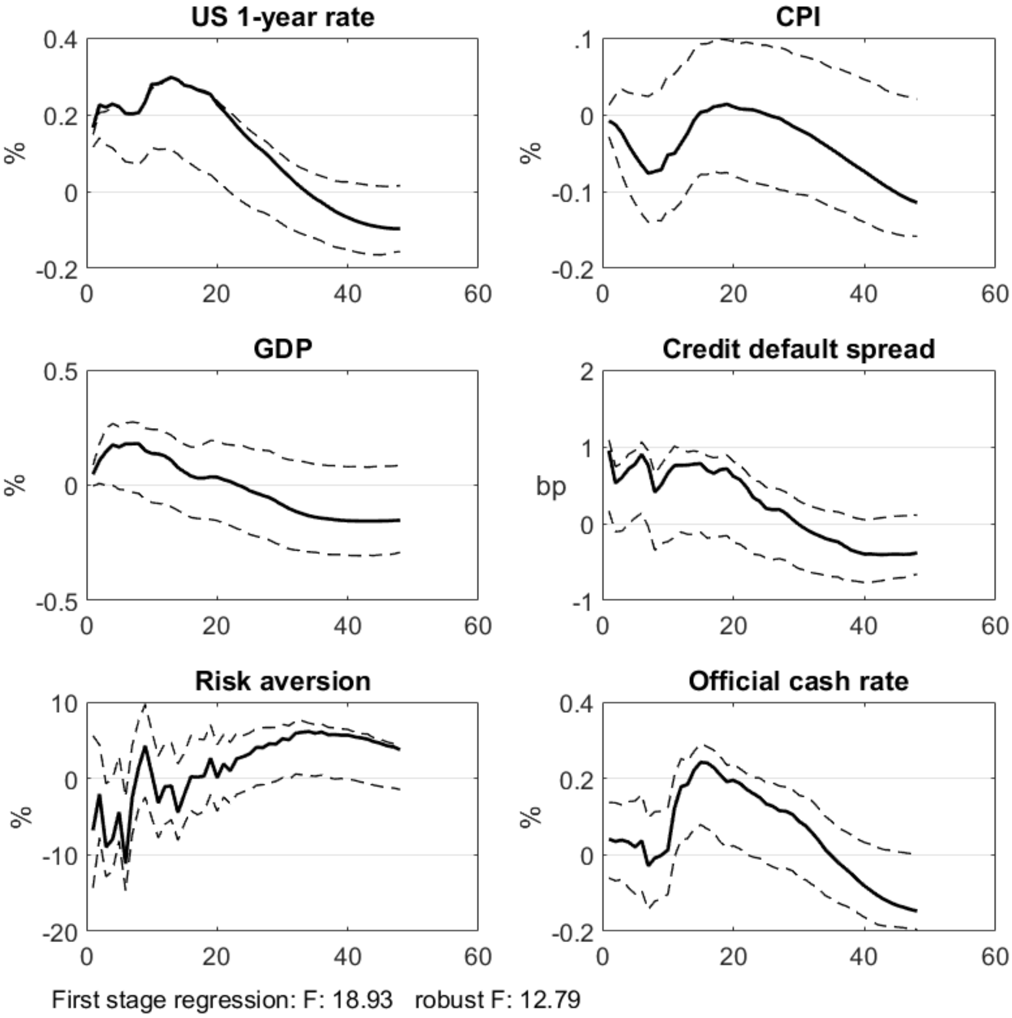


Figure 8 – IRFs of US monetary shock (External funding spread)



First stage regression: F: 16.65   robust F: 13.31

Figure 9 – IRFs of US monetary shock (Actuarial CDS spread)



4.2 International Comparison

Table 1 sums up the cumulative response in mortgage spread and CDS spread among four other small, open economies. The upper panel shows that similar to New Zealand, Canada and Sweden also register a gradual increase in mortgage spread following a US monetary shock. The lower panel shows that countries consistently exhibit a rise in CDS spread following the US monetary shock.

Table 1 International comparison

Cumulative response of mortgage spread to US monetary shock				
	After 1 year	After 2 years	After 3 years	After 4 years
Australia	-1.72	-1.79	-1.65	-1.49
Canada	-0.01	-0.09	0.09	0.17
New Zealand	-0.15	-0.42	-0.34	0.03
Sweden	-0.03	-0.14	0.05	0.19
United Kingdom	-0.3	-0.48	-0.44	-0.32
Cumulative response of CDS spread to US monetary shock				
	After 1 year	After 2 years	After 3 years	After 4 years
Australia	7.04	7.03	12.48	16.93
Canada	3.48	3.32	-0.02	-0.06
New Zealand	9.09	15.91	15.18	10.89
Sweden	1.59	1.31	1.97	2.47
United Kingdom	1.27	-0.49	0.44	3.69

5 Conclusion

Instrumenting US monetary shocks with fed funds future contracts and extracting global risk sentiment from VIX, this paper finds that US monetary shocks are influential to New Zealand financial and real sectors. Similar patterns are found in other small, open economies. These results suggest the existence of a global financial cycle underpinned by US monetary policy, and prompt the reassessment of the relevance of Mundellian trilemma in an increasingly globalised economic system.

The crude abstractions of the model used in this paper suffer from several deficiencies. In particular, it uses CDS and mortgage spreads as proxies for the external finance premium in the literature (Bernanke and Gertler, 1989), when in fact, the former is a component of the premium, and the latter a symptom of it. A more systemic approach would be along the lines of Mizen and Tsoukas (2012), who compile bond premia across countries from firm-level data. This paper also confines itself within the domain of positively describing the impact of monetary policies, without endorsing their optimality, as in Agur and Demertzis (2012). Enriching the present model along these directions may prove fruitful in informing the international linkages between global monetary policies and regional financial risks.

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Appendix A – Data

All data are monthly. All CPI and IP are seasonally adjusted. CPI, IP, exchange rate and VIX are logged. All IP series are sourced from IMF. Name in square brackets refers to the Bloomberg syntax. Except for Singapore, all mortgage spreads are calculated as the difference between the respective mortgage rate of the country and the risk-free five-year government bond rate. Government bond rate, exchange rates and VIX are drawn from Bloomberg.

Australia

Monthly data from 1993:6 to 2016:4.

CPI: Interpolated from the quarterly Australia CPI All Groups Goods Component [AUCPI Index]. Source: Australian Bureau of Statistics.

Mortgage spread: Australia Lending Rate for Standard Housing Loans Issued by Mortgage Managers [AILRHLMS Index] less [GACGB5 Index]. Source: RBA.

Policy rate: Cash Target Rate [RBATCTR Index]. Source: RBA.

Canada

Monthly data from 1990:1 to 2016:8.

CPI: Canada CPI NSA 2002=100 [CACPI Index]. Source: Statistics Canada.

Mortgage spread: 5 Year Conventional Mortgage Rate [CANMORT5 Index] less [GCAN5YR Index]. Source: Bank of Canada.

Policy rate: Bank of Canada Bank Rate.

New Zealand

Monthly data from 1990:1 to 2016:4.

CPI: New Zealand CPI All Groups (2006.6=1000) [NZCPCCPI Index]. Source: Statistics New Zealand.

Mortgage spread: 2-year fixed mortgage rate minus 2-year NZD swap rate. Source: RBNZ, Bloomberg.

Policy rate: Official Cash Rate spliced with Overnight interbank cash rate. Source: Reserve Bank of New Zealand.

Domestic funding rate: series downloaded from RBNZ. It provides an indication of registered banks weighted average New Zealand dollar cost of funding and claims. The figures exclude foreign currency funding, which accounts for approximately 21% of total registered bank funding at December 2015. New Zealand dollar funding costs also exclude the impact of hedging, for example interest rate swap costs incurred against fixed rate claims.

1-year NZD/USD basis swap rate: 1 year NZD swap rate plus 1-year NZD/USD basis swap rate.

Sweden

Monthly data from 1997:1 to 2016:8.

CPI: Sweden CPI 1980=100 [SWCPI Index]. Source: Statistics Sweden.

Mortgage spread: Sweden 5y mortgage bond rate less [GSGB5YR Index]. Source: Riksbank.

Policy rate: Sweden Repo Rate (Effective Rate) [SWRRATE Index].

United Kingdom

Monthly data from 1995:1 to 2016:8.

CPI: UK CPI EU Harmonized 2015=100 [UKRPCHVJ Index]. Source: Office for National Statistics.

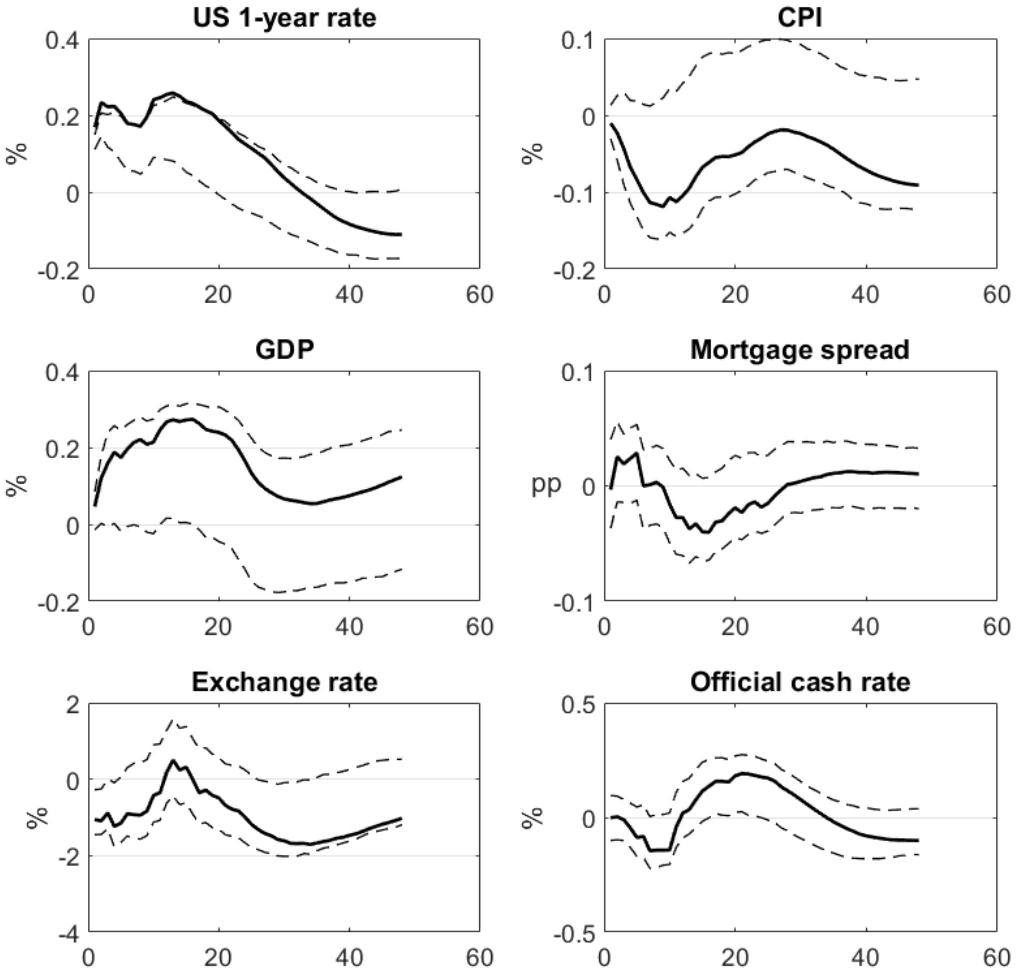
Mortgage spread: 5-yr Mortgage Fixed Rate [UKMRM5Y Index] less [GUKG5 Index]. Source: Bank of England.

Policy rate: Bank of England Official Bank Rate [UKBRBASE Index].

Appendix B – Results in Which Risk Aversion is Replaced by Exchange Rate

In this set of regression, I have replaced the risk aversion with bilateral USD/NZD exchange rate. The reason is that the valuation impact due to currency movement may play a prominent role in the international risk-taking channel of monetary policy. As Figures 10 – 13 show, New Zealand dollars persistently depreciates following US monetary tightening shock. This would have the effect of weakening New Zealand banks' and firms' balance sheets, making it more costly to borrow overseas.

Figure 10 – IRFs of US monetary shock (Mortgage spread)



First stage regression: F: 16.18   robust F: 12.10

Figure 11 IRFs of US monetary shock (Domestic funding spread)

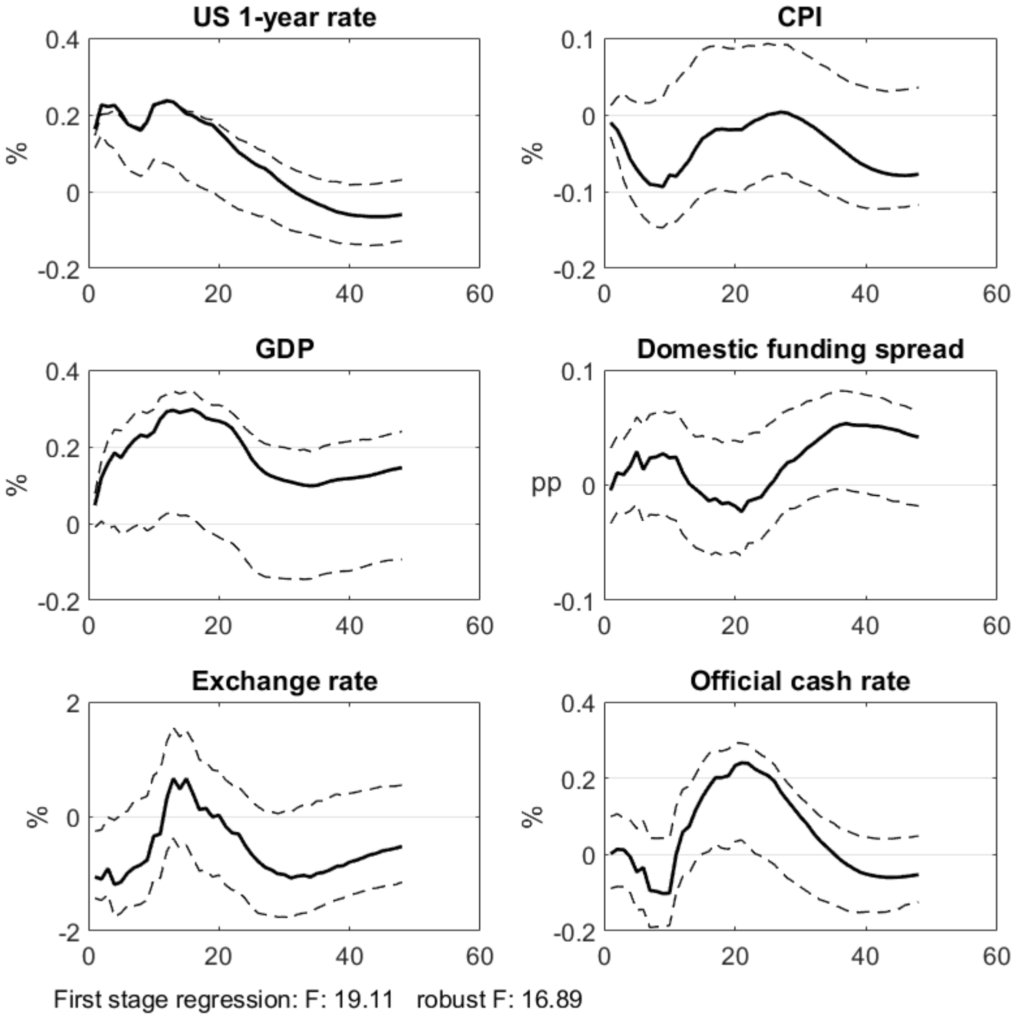
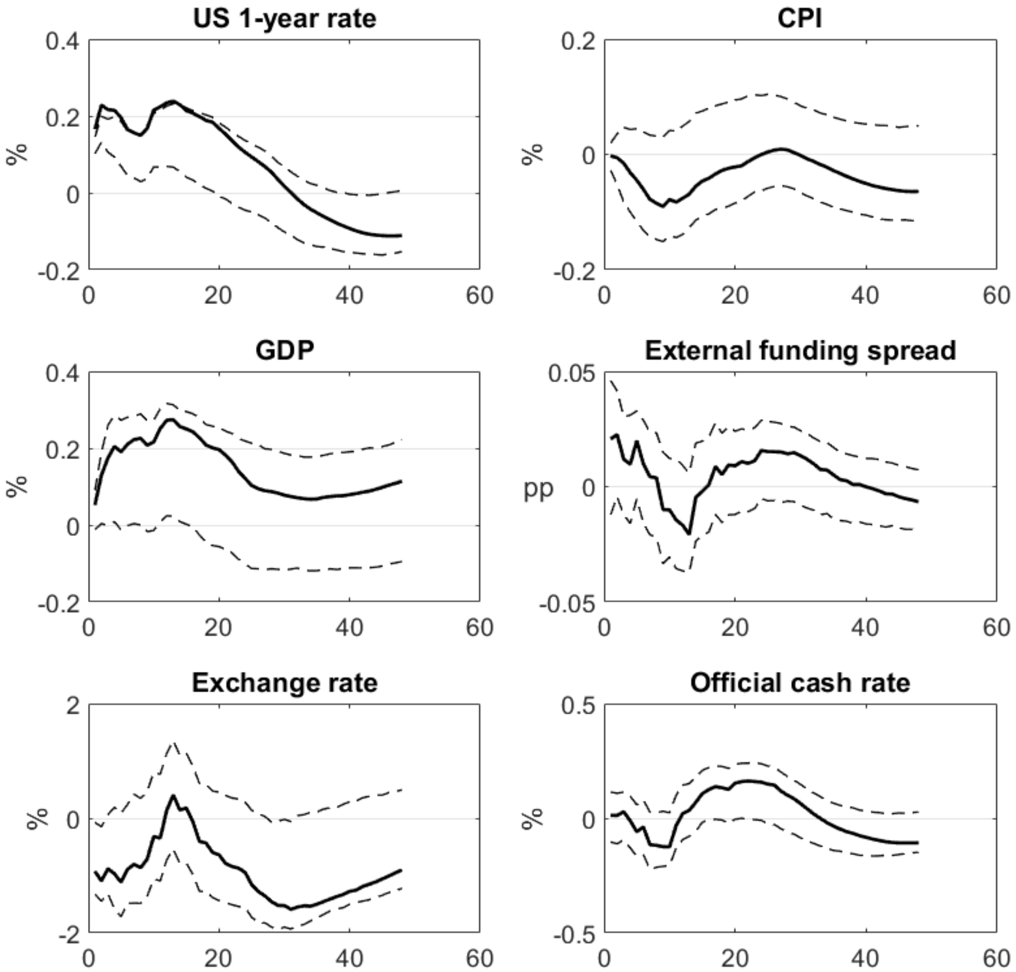
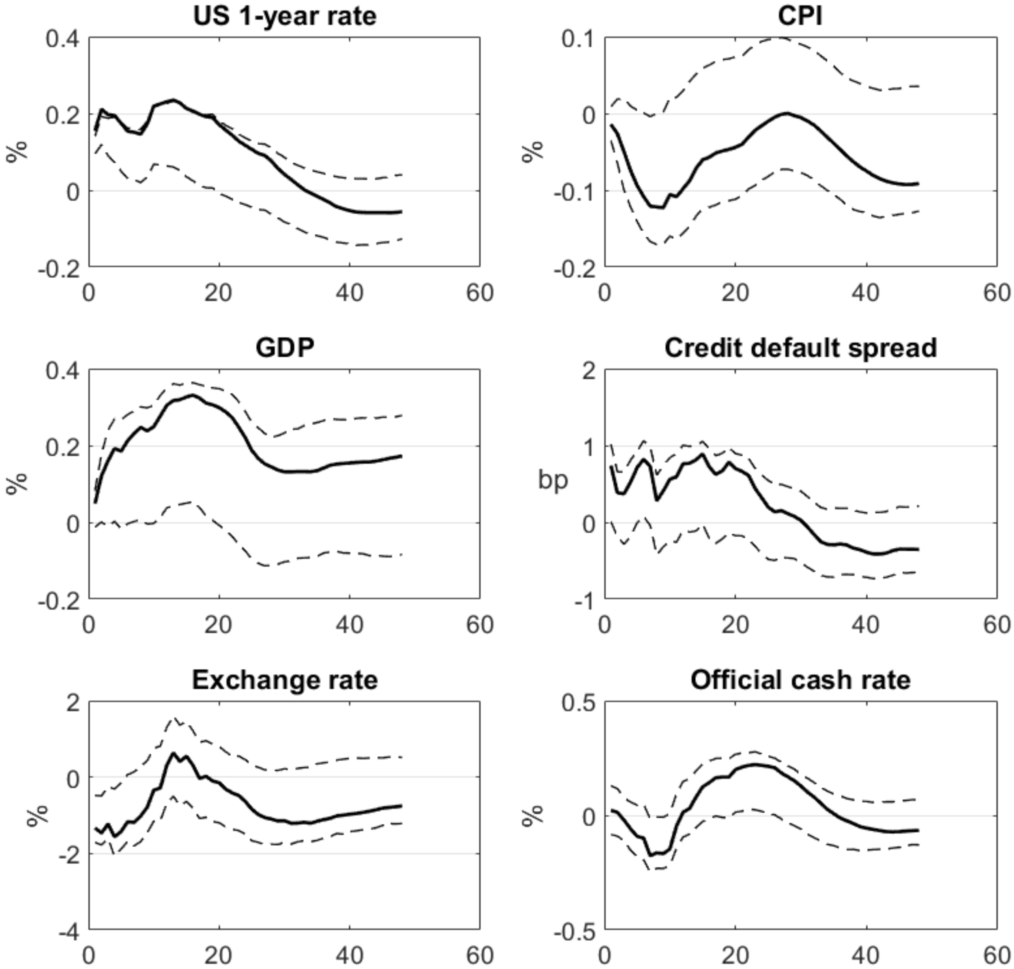


Figure 12 IRFs of US monetary shock (External funding spread)



First stage regression: F: 13.38 robust F: 10.26

Figure 13 IRFs of US monetary shock (Actuarial CDS spread)



First stage regression: F: 13.88   robust F: 9.22