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Exploring the Trade-Off Between Leaning Against Credit and Stabilizing Real Activity

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Exploring the Trade-Off Between Leaning Against Credit and Stabilizing Real Activity

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Abstract

Evidence from monetary VARs for ten countries points towards an unfavorable trade-off between leaning against credit fluctuations and stabilizing real economic activity. Results are robust both across countries, and based on two alternative approaches, i.e. either (i) focusing on the impact of monetary policy shocks, which I identify based on a combination of zero and sign restrictions, or (ii) analyzing 'modest' policy interventions in which the central bank reacts weakly, but systematically, to credit fluctuations. In particular, a modest intervention suggests that in the U.S. during the years leading up to the financial crisis a 1% shortfall in real GDP would have been associated with a decrease in credit leverage by 2.5 percentage points.

Keywords: Credit; structural VARs; sign restrictions; zero restrictions; Lucas critique.

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1 Introduction

Both academics and central bankers are largely skeptical about the effectiveness of monetary policies aimed at leaning against credit growth and asset prices' fluctuations. The dominant consensus, expressed e.g. by Bernanke and Gertler (2000, 2001) and Svensson (2017), is that whereas the costs of such policies in terms of output losses are certain and sizeable, the potential benefits in terms of decreases in the probabilities of future financial crises are much more uncertain, and likely small.

An alternative, minority position associated mainly with the Bank for International Settlements (see e.g. BIS, 2014, 2016), advocates instead a policy of systematically reacting to measures of 'excessive' credit growth or 'disequilibria' in asset prices, by marginally increasing monetary policy rates over and above the values dictated by an exclusive focus on inflation and real activity. As discussed, e.g., by Filardo and Rungcharoenkitkul (2016, p. 4), a key rationale behind this position is that the policy rate plays a crucial role in the determination of the prices of leverage and risk. According to this view, macroprudential instruments and a monetary policy of leaning against credit and asset prices fluctuations should be regarded as complements, rather than substitutes. In particular, because of the ubiquitous role played by interest rates in the economy, such a policy would allow the central bank to reach into all the nooks and crannies, thus also affecting credit and asset markets' segments that are not explicitly targeted by macroprudential policies.[1]

In this paper I use monetary VARs identified along the lines of Arias *et al.* (2018, 2019) in order to explore the trade-off faced by central banks between leaning against credit fluctuations and stabilizing real economic activity. Evidence for ten countries points towards an unfavorable trade-off, with the impact of monetary policy on either real credit or credit leverage (defined as the ratio between nominal credit and nominal GDP) not being significantly larger than the corresponding impact on real GDP. Evidence is robust both across countries, and based on two alternative approaches, i.e. either focusing on the impact of monetary policy shocks, or analyzing 'modest' policy interventions in which the central bank reacts, weakly but systematically, to credit fluctuations. In particular, a modest intervention suggests that in the U.S. during the years leading up to the financial crisis a 1% shortfall in real GDP would have been associated with a decrease in credit leverage by 2.5 percentage points.

The paper is organized as follows. The next section discusses the monetary VARs I use throughout the paper in terms of both estimation and the identification of monetary policy shocks, and the response of the economy to identified monetary shocks.

[1] In the words of Stein (2013), 'while monetary policy may not be quite the right tool for the job, it has one important advantage relative to supervision and regulation, namely that it gets in all of the cracks. The one thing that a commercial bank, a broker-dealer, an offshore hedge fund, and a special purpose ABCP vehicle have in common is that they all face the same set of market interest rates. To the extent that market rates exert an influence on risk appetite, or on the incentives to engage in maturity transformation, changes in rates may reach into corners of the market that supervision and regulation cannot.'

Section 3 discusses the trade-off between leaning against credit fluctuations and stabilizing real economic activity induced by contractionary monetary shocks. Section 4 briefly describes the methodology proposed by Benati (2021) for analyzing 'modest' policy counterfactuals in which the central bank leans, weakly but systematically, against fluctuations in a specific target variable (here, credit). Section 5 discusses for all countries evidence on such counterfactuals in population, and for the U.S. evidence for a specific counterfactual in which, during the years leading up to the financial crisis, the Federal Reserve reacts to the dramatic increase in credit leverage that was taking place. Section 6 concludes.

2 The Monetary VAR

In what follows I work with the VAR(p) model

$$Y_t = B_0 + B_1 Y_{t-1} + ... + B_p Y_{t-p} + u_t, \quad E[u_t u_t'] = \Omega \tag{1}$$

where Y_t features the central bank's monetary policy rate; a long-term government bond yield; the logarithms of real GDP, a price index,[2] a broad monetary aggregate,[3] a measure of the total amount of credit granted by the domestic private commercial banking sector to the domestic private non-financial sector (discussed in detail below), either the nominal effective exchange rate (for Denmark, New Zealand, Norway, and Sweden) or the total amount of reserves held by commercial banks at the central bank (for all other countries),[4] and a commodity price index for all countries except Denmark, New Zealand, Norway, and Sweden. For the U.S. Canada, and the U.K. I work at the monthly frequency, whereas for all other countries, for which monthly data are not available for all series, I am compelled to work with quarterly data. The data and their sources are discussed in detail in the Online Appendix.

For all countries I start the sample period at the earliest in the early 1980s (thus excluding the highly volatile period associated with the Great Inflation, which in principle could distort the inference), and I end it at the latest in 2019 (thus excluding the COVID pandemic).[5] In the U.S., due to the extraordinary turbulence associated with the financial crisis, non-borrowed reserves turned negative in January to November 2008, so that they cannot be entered into the VAR in logarithms. Because of this I end the sample in November 2007. For the U.K. the reform of money market operating procedures introduced by the *Bank of England* in May 2006, allowing commercial

[2] The core PCE deflator for the U.S., the core CPI for Canada and the U.K., and the GDP deflator for all other countries.

[3] M3 for Australia, New Zealand and Sweden, and M2 for all other countries.

[4] For the U.S. I consider non-borrowed reserves, whereas for all other countries, for which non-borrowed reserves are not available, I am compelled to work with total reserves.

[5] The sample periods are the following. Australia: 1982Q3-2019Q4; Canada: Jan. 1983-Dec. 2019; Denmark: 1982Q1-2012Q2; New Zealand: 1988Q1-2019Q4; Norway: 1982Q1-2019Q4; South Korea: 1980Q1-2019Q1; Sweden: 1981Q1-2019Q4; Switzerland: 1985Q1-2019Q4; United Kingdom: Jan. 1983-Apr. 2006; United States: Jan. 1983-Nov. 2007.

banks to earn interest on the reserves they hold at the central bank, introduced a discontinuity in the series for reserves, which starting in May 2006 has literally skyrocketed. Because of this, I end the sample in April 2006. In Denmark the monetary policy rate reached the Zero Lower Bound (ZLB) in 2013Q1, and I therefore end the sample in 2012Q2.

For the U.S. the measure of total credit is the sum of (FRED II acronyms in parentheses) 'Real Estate Loans, All Commercial Banks' (REALLN), 'Consumer Loans at All Commercial Banks' (CONSUMER), 'Commercial and Industrial Loans All Commercial Banks' (BUSLOANS), 'Other loans and leases: All other loans and leases, all commercial banks' (AOLACBW027SBOG). For the U.K. is the 'Bank lending series (break-adjusted)' from the Bank of England, whereas for Canada is the sum of (series' codes from Statistics Canada in parentheses) 'Total consumer credit' (V122707), 'Total residential mortgage credit' (V122746), 'Total business loans' (V105926372). For all other countries the measure of total credit is 'Credit to the private non-financial sector from banks, total at market value in domestic currency, adjusted for breaks' from the Bank for International Settlements (BIS).

The evidence obtained by replacing log credit with the logarithm of credit leverage, defined as the ratio between nominal credit and nominal GDP, is qualitatively the same as that reported herein, and it is available upon request.

The VAR is estimated *via* Bayesian methods as in Uhlig (1998, 2005). I exactly follow Uhlig's approach in terms of both distributional assumptions (the distributions for the VAR's coefficients and its covariance matrix are postulated to belong to the Normal-Wishart family) and of priors. For estimation details the reader is therefore referred to either the Appendix of Uhlig (1998), or Appendix B of Uhlig (2005). Results are based on 1,000,000 draws from the posterior distribution of the VAR's reduced-form coefficients and the covariance matrix of its reduced-form innovations (the draws are computed exactly as in Uhlig (1998, 2005)). I set the lag order to p=6 with monthly data, and to p=2 with quarterly data.

In line with Arias *et al.* (2019), I identify monetary policy shocks by combining zero and sign restrictions. Specifically, monetary shocks are identified based on the restrictions that

(I) the monetary policy rate reacts contemporaneously only to real GDP, the price index, and commodity prices (when they are available). Its reaction to any of the three variables is positive.[6]

(II) Both on impact, and over the subsequent year and a half, a monetary shock induces a non-negative response in the monetary policy rate and the real effective exchange rate (REER), and non-positive responses in commodity prices, reserves, and the broad monetary aggregate. For all other variables, the responses are left unrestricted both on impact, and at all subsequent horizons.

I implement restrictions (I) and (II) *via* Arias *et al.*'s (2018) algorithm for combining zero and sign restrictions. For any of the draws from the posterior distribution

[6] This is in line with Arias *et al.*'s (2019) Restrictions 1 and 2.

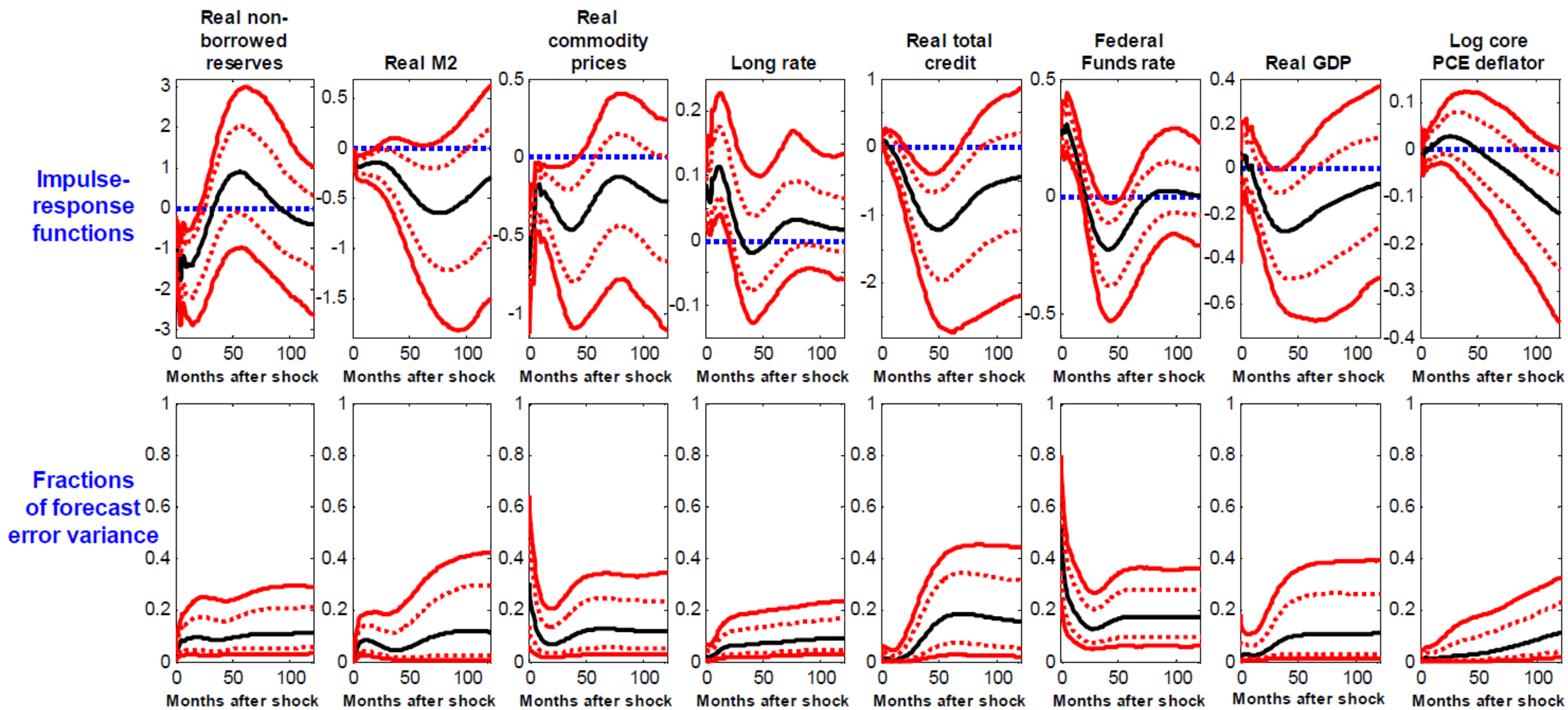

Figure 1 United States: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

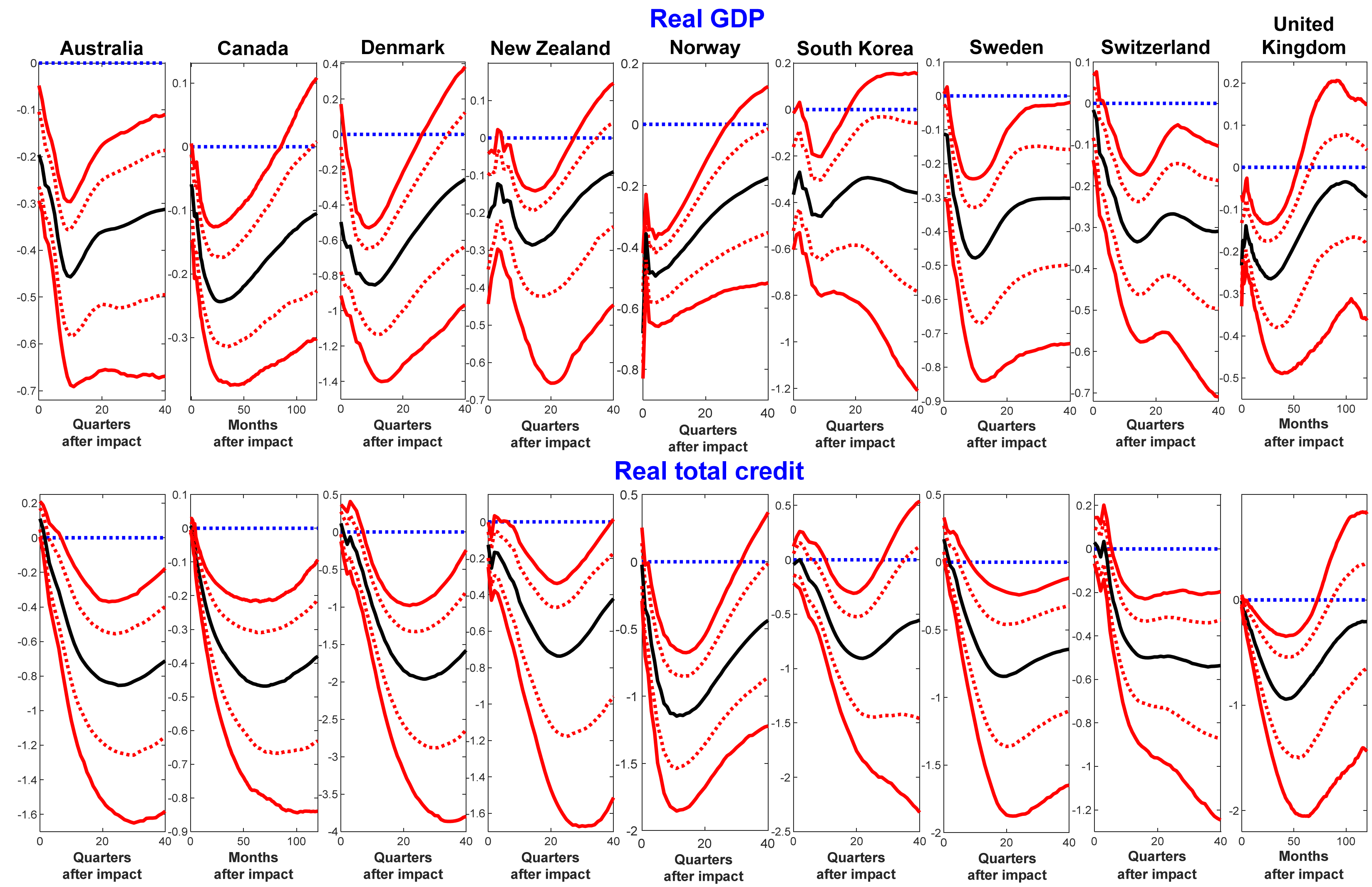

Figure 2 Impulse-response functions to a monetary policy shock (percentage points, median, and 16-84 and 5-95 percentiles)

of the VAR's reduced-form coefficients, I consider 100 random rotation matrices implementing the zero exclusion restrictions on the contemporaneous coefficients of the VAR's structural monetary policy rule,[7] which I generate *via* Arias *et al.*'s (2018) Algorithm 5. If the sign restrictions on both the contemporaneous coefficients of the VAR's structural monetary rule and the relevant IRFs are all satisfied I keep the draw for the resulting structural VAR (SVAR). Otherwise, I discard it. The number of successful draws ranges between 2377 for Canada and Sweden for Sweden. From now on I will use the word 'draw' as a shorthand for 'successful draw', that is: a draw for which all of the zero and sign restrictions have been satisfied.

Figure 1 shows, for the U.S., the impulse-response functions (IRFs) to a monetary policy shock, and the fractions of forecast error variance (FEV) explained by the shock, whereas Figures A.1-A.9 in the Online Appendix show the corresponding evidence for the other nine countries. Figure 2 shows, again for the nine countries other than the U.S., the IRFs of real GDP and real credit to a contractionary monetary shock. The IRFs have been normalized in such a way that, on impact, the median response of the monetary policy rate is equal to 25 basis points. The IRFs are near-uniformly in line with both the conventional view about the impact of monetary shocks, and previous evidence. In particular,

(1) in all ten countries the monetary shock causes a decline in GDP. For the U.S. statistical significance is strong based on the 16-84 percentiles of the posterior distribution, whereas it is borderline based on the 5-95 percentiles. For all other nine countries evidence is very strong even based on the 5-95 percentiles.

(2) As for the price level there is virtually no evidence of a price puzzle.[8] For the U.S. evidence for the core PCE deflator is in line with (e.g.) Sims and Zha (2006, see their Figure 2), with the IRF being insignificant at short to medium horizons, and becoming statistically significant only at long horizons (based on the 16-84 percentiles about 8 years after impact). For the other countries the response of prices is mostly insignificant at short horizons (with the exception of Sweden and Switzerland), and in most cases it becomes significantly negative only further out. Statistical significance is especially strong for Australia, Canada, Denmark, Norway, Sweden, and the U.K., whereas it is near-uniformly weak for New Zealand and South Korea.

(3) The response of real credit is near-uniformly statistically insignificant both on impact and at the very short horizons, whereas at longer horizons it is negative, and strongly statistically significant for all ten countries.

(4) The responses of monetary aggregates and commodity prices, which are restricted to be negative for one year and a half after the shock, often become insignificant at longer horizons. This is the case, e.g., for the U.S..

[7] So, to be clear, the restriction that the contemporaneous coefficients in the structural monetary policy rule are equal to zero for all variables except real GDP, the price index, and commodity prices (when they are available).

[8] Specifically, the IRF for the price level turns positive, and significantly so based on the 5-95 percentiles, only for New Zealand for a single quarter, immediately after impact.

A comparison between the IRFs for GDP and credit suggests that the trade-off between leaning against credit fluctuations and stabilizing real GDP is an unfavorable one.

I now turn to the trade-off between leaning against credit fluctuations, and stabilizing real economic activity, induced by monetary policy shocks, by analyzing the ratio between the cumulative IRFs of real credit and real GDP.

Table 1 Median, and 16-84 percentiles of the posterior distribution of the ratio between the cumulative IRFs of real credit and real GDP to a monetary policy shock

	5-years ahead:	*10-years ahead:*
Australia	1.279 [0.846 1.645]	1.825 [1.432 2.181]
Canada	1.488 [1.130 2.013]	2.104 [1.537 3.181]
Denmark	1.181 [0.839 1.559]	2.316 [1.728 3.236]
New Zealand	1.825 [1.230 2.463]	2.685 [1.932 3.737]
Norway	2.119 [1.565 2.794]	2.402 [1.838 3.236]
South Korea	1.132 [0.630 1.818]	1.622 [1.008 2.632]
Sweden	1.247 [0.626 1.898]	1.769 [1.125 2.595]
Switzerland	1.278 [0.870 1.808]	1.555 [1.275 2.000]
United Kingdom	3.052 [2.107 4.303]	3.845 [2.435 5.932]
United States	3.444 [2.167 6.154]	3.566 [2.227 6.042]

3 The Trade-Off Induced by Monetary Shocks

Table 1 reports the median and the 16-84 percentiles of the posterior distribution of the ratio between the cumulative IRFs of real credit and real GDP to a monetary policy shock for two alternative horizons, either 5 or 10 years after the shock.[9] Focusing on the median ratio between the two cumulative IRFs, evidence suggests that central banks face a near-uniformly unfavorable trade-off between leaning against credit fluctuations and stabilizing real economic activity. Ignoring for the time being the U.K. and the U.S., for the remaining eight countries the median ratio ranges between 1.1 and 2.1 5 years ahead, and between 1.6 and 2.7 at the 10-years horizon. This implies is that even in the most favorable case (for New Zealand), a contractionary monetary shock causes, over the subsequent 10 years, a cumulative decrease in real credit that is equal to less than 3 times the corresponding cumulative fall in real GDP. The implication for the ability on the part of the central bank to reign an 'excessive' extent of credit leverage are sobering. If, just for the sake of the argument, the central bank were to deem the current level of credit leverage as being 10% in excess of the level it

[9]So, to be absolutely clear, the evidence for (e.g.) Australia means that, 10 years after the shock, the median ratio between the cumulative IRF of real credit and the cumulative IRF of real GDP is equal to 1.825.

regards as 'normal', in order to eliminate such excess leverage it should be willing to accept a shortfall of real GDP greater than 3%. It is highly unlikely that any central bank would purposefully attempt to exploit such trade-off. For the U.K. and the U.S. the trade-off is more favorable, but not to an extent such as to plausibly induce the Bank of England and the Federal Reserve to attempt to exploit it. Focusing e.g. on the 10 years horizon, the two median ratios of 3.8 and 3.6, respectively, imply that a monetary contraction designed to eliminate a 10% excess leverage the central bank would cause a shortfall of real GDP slightly greater than 2.5 and 3.5 percentage points, respectively. Again, these are trade-offs neither central bank would plausibly be willing to purposefully exploit.

Overall, the evidence produced by random variation in the monetary policy rate around the path induced by the systematic component of monetary policy suggests that in none of the ten countries I study the central bank faces a favorable trade-off between leaning against credit fluctuations and stabilizing real economic activity.

4 Evidence from Modest Policy Interventions

I now turn to exploring the trade-offs associated with 'modest' (in the sense of Leeper and Zha, 2003) policy interventions, in which the monetary policy rate reacts, weakly but systematically, to fluctuations in credit leverage. To this end I re-estimate the VARs replacing log credit with log credit leverage, which, as before, is defined as the ratio between nominal credit and nominal GDP.

The methodology I use in order to perform the interventions is the same I used in Benati (2021) in order to explore the impact of monetary policy interventions on real house prices and real GDP in the U.S., U.K., and Canada. The approach builds upon Leeper and Zha (2003) and Adolfson *et al.* (2005), and can be succintly summarized as follows. I start by detailing how the posterior distribution of the parameters of the VAR's structural monetary policy rule is perturbed, and I then turn to discussing how the issue of whether the resulting policy interventions are, or are not modest in the sense of Leeper and Zha (2003) is assessed.

4.1 The policy intervention

Let $Y_t = B_{0,j} + B_{1,j}Y_{t-1} + ... + B_{p,j}Y_{t-p} + A_{0,j}\epsilon_t$ be the structural VAR associated with draw j from the posterior distribution, and let $Y_t'[A_{0,j}^{-1}]' = [A_{0,j}^{-1}(B_{0,j} + B_{1,j}Y_{t-1} + ... + B_{p,j}Y_{t-p})]' + \epsilon_t'$, that is,

$$Y_t'\tilde{A}_{0,j} = \tilde{B}_{0,j} + Y_{t-1}'\tilde{B}_{1,j} + ... + Y_{t-p}'\tilde{B}_{p,j} + \epsilon_t' \qquad (2)$$

be its associated structural form, with $\tilde{A}_{0,j} \equiv [A_{0,j}^{-1}]'$ and $\tilde{B}_{k,j} \equiv [A_{0,j}^{-1}B_{k,j}]'$, $k = 0, 1, 2, ..., p$. Within the present context the first shock in ϵ_t is the monetary policy shock, thus automatically implying that the first equation in (2) is the VAR's structural monetary policy rule (see Arias *et al.*, 2019). Since, according to identifying restriction I the monetary policy rate is postulated to react contemporaneously only to real GDP, the price index, and commodity prices, for the purpose of the perturbation only the coefficients on lagged log leverage in the structural monetary policy rule are relevant. For draw j from the posterior distribution, let these coefficients be labelled as $\gamma_{l,j}$, for l = 1, 2, ..., p. For each draw j, and each l = 1, 2, ..., p, I perturb the $\gamma_{l,j}$'s by rescaling them as $\gamma^*_{l,j} = \gamma_{l,j} + K \cdot |\gamma_{l,j}|$, where $|\cdot|$ means 'absolute value of', and K is a 'small number', which in what follows I will choose so that median counterfactual credit leverage at the 10-year horizon (i.e., 10 years after the beginning of the policy intervention) is 1 per cent below what it would have been without the intervention. In plain English this means that, for each draw from the posterior, and for each lag, I increase the relevant coefficients by a small percentage amount, thus slightly 'shifting upwards' the entire posterior distributions of the $\gamma_{l,j}$'s. This causes the monetary policy rate to become marginally more aggressive towards deviations of log leverage from a reference value (discussed below). On the other hand, I leave all of the other coefficients in the structural monetary policy rule unchanged. Based on the resulting counterfactual (or 'perturbed') structural form, I then recover the corresponding counterfactual structural VAR for draw j, $Y_t = B^c_{0,j} + B^c_{1,j} Y_{t-1} + ... + B^c_{p,j} Y_{t-p} + A^c_{0,j} \epsilon_t$,[10] which I then use to re-run the history of the economy conditional on the previously identified structural shocks,[11] thus obtaining counterfactual paths for any of the variables.

It is worth stressing that, although in what follows I will assess whether the resulting policy counterfactuals are, or are not modest in the sense of Leeper and Zha (2003), the type of intervention I am considering here is different from theirs: whereas they worked by manipulating *monetary policy shocks*, here I am instead perturbing the parameters of the *structural monetary policy rule*. My experiments are rather conceptually the same as the 'Greenspan Hawk' policy counterfactual performed by Sims and Zha (2006, Section VI, Figure 8), in which the coefficient on inflation in the VAR's monetary policy rule had been set equal to twice its estimated value.

As for the reference value for credit leverage I proceed as follows. Since leverage has near-uniformly exhibited a continuuous increase in all countries over the entire sample period,[12] it is virtually impossible to define a truly meaningful benchmark value. Because of this I perform the modest policy interventions by considering as the benchmark the value taken by leverage at three alternative dates, corresponding to the beginning (i.e., τ=p+1), middle (τ=[T/2]), or end (τ=T) of the sample, where [$\cdot$]

[10] To be precise, since the monetary policy rate is postulated not to react contemporaneously to credit, $A^c_{0,j} = A_{0,j}$, so that $B^c_{0,j} = B_{0,j}$.

[11] So, to be absolutely clear, in *all* of these counterfactuals I *only* perturb the parameters on the (lagged) log credit in the structural monetary policy rule, whereas the structural shocks—which, for each draw j, I had previously computed based on the original (i.e., non-perturbed) structural VAR as $\epsilon_t = A^{-1}_{0,j}[Y_t - B_{0,j} - B_{1,j} Y_{t-1} - ... - B_{p,j} Y_{t-p}]$—are left unchanged.

[12] See Figure A.10 in the Online Appendix. The only partial exception, discussed in sub-section 4.4, is the U.S..

means 'the largest integer of'. For any date τ I subtract to log leverage the value it takes at τ, and I estimate the resulting Bayesian VAR.[13] In this way, by construction, in any of the three modest interventions the value taken by log leverage at τ is automatically imposed as the reference value, and the monetary policy rate reacts to deviations of leverage from such benchmark.

4.2 Assessing the modesty of the policy intervention

Leeper and Zha (2003) proposed to assess the modesty of a specific policy intervention over the horizon $\tau+h$, $h = 1, 2, 3, ..., H$, based on the (im)plausibility of the resulting counterfactual path(s) for the monetary policy rate (and possibly other series) from the perspective of a forecast based on information at time τ. As discussed by Adolfson *et al.* (2005), there are two issues involved in performing such an assessment:

(*i*) whether the forecast based on information at time τ is computed conditional on *all shocks*, or *only monetary shocks*, and

(*ii*) whether the assessment is performed (i.e., the modesty statistic is computed) with reference to *only the monetary policy rate*, or to *all series*.

With reference to (*i*), Leeper and Zha (2003) originally conditioned the forecasts uniquely on monetary policy shocks. As argued by Adolfson *et al.* (2005), however, since the economy is routinely hit by a multitude of structural disturbances, and, crucially, most VAR evidence suggests that the importance of monetary shocks is comparatively modest, a more sensible choice might be to condition the forecast on all of the structural disturbances. As for (*ii*), on the other hand, there is no clear-cut argument in favor of assessing the modesty of the policy intervention with reference to only the monetary policy rate, or to all series.

In fact, within the present context (exactly as in Benati, 2021) this issue appears to be irrelevant, as qualitatively the same results are obtained for either of the two 'polar cases', i.e. by either

(1) computing the forecast based on information at time τ only conditional on monetary shocks, and the modesty statistic only with reference to the monetary policy rate, or

(2) computing the forecast conditional on all shocks, and the modesty statistic with reference to all series.[14]

Appendix A discusses how the modesty statistic is computed following Adolfson *et al.* (2005), who extend Leeper and Zha's (2003) definition to the most general case of all shocks and all series. In what follows I define a modest policy intervention as a perturbation of the monetary policy rule such that, for *all* $h = 1, 2, 3, ..., H$—with H

[13] So, to be clear, each of the three modest interventions that consider as the benchmark the value taken by leverage at $\tau = p+1$, $[T/2]$, or T is based on a different VAR.

[14] For reasons of space I do not report evidence for the two other possible cases, i.e. either (3) computing the forecast conditional on all shocks, and the modesty statistic only with reference to the monetary policy rate, and (4) the opposite of (3). This evidence is qualitatively in line with that reported herein, and it is available upon request.

set to 10 years ahead—the modesty statistic associated with the counterfactual path for the relevant series (either the monetary policy rate, or all series) lies uniformly below the 90th percentile of the distribution generated under the no policy intervention scenario. Such a definition of modesty is a very conservative one, since it rules out the possibility that a counterfactual path be perceived as immodest *even for just a single month*.

In the next sub-section I analyze the trade-off *in population*, whereas in the following one I explore it with reference to a *specific historical path* for the variables of interest, i.e. the path travelled by the U.S. economy during the years leading up to the financial crisis.

Table 2 Median, and 16-84 percentiles of the posterior distribution of the ratio between counterfactual minus actual real credit and counterfactual minus actual real GDP at the 10 years horizon

	Starting date:		
	p+1	$T/2$	T
	I: Forecasts based only on monetary shocks, with the modesty statistic based only on the monetary policy rate:		
Australia	-0.452 [-1.302 -0.240]	0.060 [0.021 0.329]	0.136 [-0.631 0.155]
Canada	-0.602 [-1.171 -0.336]	-0.324 [-0.600 -0.143]	-0.526 [-0.909 -0.282]
Denmark	-0.646 [-2.795 1.637]	-0.075 [-0.627 0.157]	0.365 [-1.035 0.778]
New Zealand	0.779 [0.222 0.895]	0.792 [-0.208 0.909]	1.316 [0.937 1.449]
Norway	1.587 [1.270 3.101]	1.495 [1.135 1.535]	1.933 [1.809 2.135]
South Korea	-0.168 [-0.874 0.122]	2.699 [-0.554 4.496]	-0.474 [-1.213 -0.287]
Sweden	-0.695 [-3.465 0.694]	-0.206 [-1.203 0.032]	-0.036 [-0.487 0.040]
Switzerland	0.611 [-0.162 0.655]	0.824 [0.656 1.682]	0.849 [0.534 1.069]
United Kingdom	1.040 [0.213 1.409]	0.817 [-0.087 1.192]	0.732 [-0.423 1.381]
United States	1.273 [-0.820 1.305]	1.546 [0.120 2.083]	0.766 [-2.742 2.092]
	II: Forecasts based all shocks, with the modesty statistic based on all series:		
Australia	-0.439 [-1.193 -0.241]	-0.451 [-1.684 -0.147]	0.313 [-0.065 0.340]
Canada	-0.348 [-0.711 -0.044]	-0.150 [-0.636 0.032]	-0.156 [-0.563 0.864]
Denmark	0.039 [-0.833 1.913]	-0.450 [-1.097 -0.188]	0.455 [-1.959 3.207]
New Zealand	1.144 [0.171 1.755]	1.510 [1.396 1.836]	-0.369 [-1.271 -0.258]
Norway	1.876 [1.763 1.978]	1.488 [1.137 1.536]	2.438 [2.261 2.972]
South Korea	0.345 [-0.370 0.821]	0.243 [-0.213 0.546]	-0.511 [-1.229 0.428]
Sweden	-0.322 [-0.580 -0.211]	0.346 [0.185 0.473]	0.927 [-0.077 1.202]
Switzerland	0.206 [-0.379 0.551]	0.815 [-0.026 0.861]	1.943 [-0.300 2.502]
United Kingdom	0.970 [-0.355 1.313]	1.122 [0.154 1.530]	2.256 [0.290 3.401]
United States	0.710 [-0.948 1.151]	0.776 [-1.991 1.193]	0.729 [-0.521 0.990]

4.3 The trade-off induced by modest policy interventions in population

I start by generating the distribution of the modesty statistic under the no policy intervention scenario. Conditional on Y_τ, $Y_{\tau\text{-}1}$, ..., $Y_{\tau\text{-}p+1}$, and for each draw j from the posterior distribution, I stochastically simulate the SVAR into the future, drawing the structural shocks from a multivariate N(0, 1) distribution, thus generating artificial paths $Y^*_{j,\tau+h}$ for the series in the VAR *under no policy intervention*. The type of shocks I use for simulating the VAR are the same featured in the computation of the modesty statistic, that is either only monetary policy shocks, or all shocks. For each draw j, and each artificial path $Y^*_{j,\tau+h}$ I then perform the policy intervention as described in sub-section 4.1, thus obtaining an artificial *counterfactual* path $Y^{*,C}_{j,\tau+h}$. Finally, for each $Y^{*,C}_{j,\tau+h}$ I compute the associated modesty statistic, $M^{*,C}_{\tau,h}$, as described in Appendix A. If $M^{*,C}_{\tau,h}$ is such that the policy intervention can be labelled as modest I keep both the original artificial path, $Y^*_{j,\tau+h}$, and its counterfactual counterpart, $Y^{*,C}_{j,\tau+h}$; otherwise I discard them. In this way I generate distributions of counterfactual paths produced by modest policy interventions, and of the associated original non-perturbed paths, thus allowing to fully characterize the impact of modest policy counterfactuals.

Figures A.11 and A.12 in the Online Appendix report, for the U.S., the difference between the counterfactual and the actual series for the two polar cases (1) and (2) as defined in the previous subsection, whereas Table 2 reports, for all countries and the same two polar cases, the median and the 16-84 percentiles of the posterior distribution of the ratio between counterfactual minus actual real credit and counterfactual minus actual real GDP at the 10 years horizon (i.e., 10 years after the start of the policy intervention). Tables A.1 and A.2 in the Online Appendix also report the corresponding evidence at the 5 years horizon, which is qualitatively the same as that in Table 2.

In brief, the evidence in Table 2 is qualitatively in line with that for the trade-off induced by monetary policy shocks reported in Table 1, and not in a single case it points towards a sizeable trade-off. Focusing on the case in which the forecast is computed based on all shocks, and the modesty statistic is computed based on all series—which as argued by Adolfson *et al.* (2005) should be regarded as the most relevant one—the median ratio between the cumulative IRFs ranges between -0.51 and 2.44, whereas the corresponding figures for the case in which the forecast is computed based only on monetary shocks, and the modesty statistic is computed based only on the monetary policy rate, are -0.70 and 2.70. Once again, these are hardly trade-offs that may induce a central bank to lean against fluctuations in credit leverage in order to decrease the probability and/or severity of a future financial crisis.

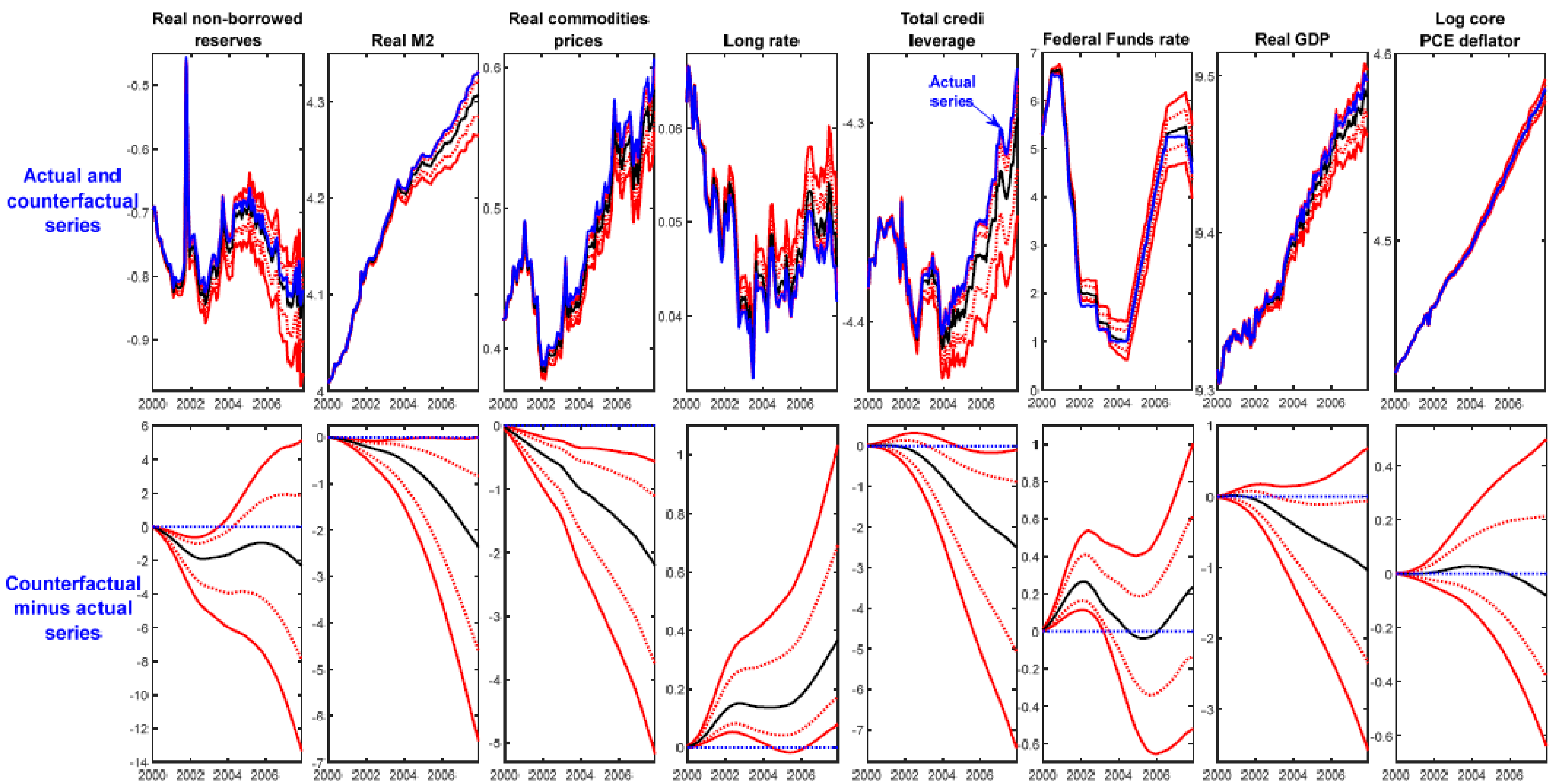

Figure 3 United States: evidence from a modest policy counterfactual based on actual data (modesty statistic computed based on all series and all shocks)

4.4 Evidence from a modest intervention for the years leading up to the financial crisis

Figure 3 reports, for the U.S., evidence from a modest policy intervention for the years leading up to the financial crisis, in which the Federal Funds rate reacts to deviations of log leverage from its average value over the period January 1983-December 1999. The reason for taking this specific value as the benchmark is that, as shown in the last panel of Figure A.10 in the Online Appendix, up until the end of the 1990s the behavior of leverage appears to have been broadly stationary, whereas only starting from the early 2000s it has exhibited a clear upward trend as all other countries. In line with the previous sub-section I subtract such benchmark value from log-leverage and I estimate the VAR for the resulting vector of series Y_t in (1), so that, by construction, when performing the modest intervention the Federal Funds rate reacts to deviations of leverage from the benchmark. All of the other details of the policy intervention are exactly as before. I calibrate the size of the intervention in such a way that in the last month of the sample (November 2007) the median of the posterior distribution of the difference between the counterfactual path for real GDP and its actual historical path is equal to -1% (see the seventh panel in the second row of Figure 3). Evidence is in line with what we have seen up until now, with the corresponding decrease in credit leverage being equal to 2.5 percentage points. As shown in the fifth panel of the first row of Figure 3, this would have had a limited impact on the significant increase in leverage that had taken place between early 2004 and the end of the sample. Once again, evidence from monetary VARs consistently suggests that, given the unfavorable trade-off between leaning against credit fluctuations and stabilizing real economic activity, a central bank that wanted to prevent large increases in credit leverage should be willing to accept sizeable shortfalls of real GDP.

4.5 A *caveat* to the evidence produced by modest policy interventions

An obvious and important *caveat* to the evidence in this section is that, because of the Lucas critique, the estimated trade-offs only represent a lower bound on the effectiveness of a policy of systematically leaning against fluctuations in credit leverage. As argued for example by the BIS (2016, pp. 74-75), if such a policy were explicitly announced, and economic agents regarded it as credible, every increase in leverage compared to the benchmark value would generate expectations of an increase in the monetary policy rate, which would automatically counteract the increase in leverage. Because of this, the trade-off between leaning against credit leverage and stabilizing real GDP would turn out to be more favorable than the one estimated herein.

The only way to assess the strength of such expectational channel, however, would be to use a DSGE model with all of the attendant limitations, in particular in terms of the extent to which the estimated trade-off depends on specific modelling choices.

Further, Rudebusch's (2005) evidence pertaining to perturbations of the parameters of standard monetary policy rules[15] suggests that the resulting impact on the reduced-form structure of the economy is quite limited. In particular, his results suggest that the impact is so small as not to be detectable based on standard statistical tests. This suggests that the modest interventions studied herein could well capture the first-order impact of a policy of systematically leaning against fluctuations in credit leverage.

5 Conclusions

For several years now the macroeconomic profession has intensively debated the meaningfulness of pursuing monetary policies aimed at leaning against credit growth and asset prices' fluctuations. Whereas the vast majority of central bankers and academics subscribe to the skepticism expressed e.g. by Bernanke and Gertler (2000, 2001) and Svensson (2017), a minority position associated mainly with the Bank for International Settlements advocates instead a policy of systematically reacting to measures of excessive credit growth or asset prices' disequilibria in asset prices, by increasing monetary policy rates over and above the values dictated by an exclusive focus on inflation and real activity. A necessary condition for a policy of systematically leaning against fluctuations in credit leverage to be feasible is that monetary policy has a materially greater impact on leverage than on real economic activity. In this paper I have shown that, in fact, this is not the case. Rather, evidence for ten countries from monetary VARs identified along the lines of Arias *et al.* (2018, 2019) consistently points towards an unfavorable trade-off between leaning against credit fluctuations and stabilizing real economic activity. The evidence is robust both across countries, and based on two alternative approaches, i.e. either focusing on the impact of monetary policy shocks, or analyzing modest policy interventions in which the central bank reacts, weakly but systematically, to credit fluctuations. Overall, my evidence provides no support to the view that monetary policy should lean against credit fluctuations.

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[15] I.e., rules in which the monetary policy rate reacts to inflation and the output gap.

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A Computing the Modesty Statistic

Following Adolfson *et al.* (2005), in the most general case in which the modesty statistic is computed with reference to all series, the statistic for period τ and horizon h is given by

$$M_{\tau,h}(\epsilon_t^*) = [Y_{\tau+h}(\epsilon_{\tau+h}^*) - Y_{\tau+h|\tau}]'\Sigma_{\tau+h}^{-1}[Y_{\tau+h}(\epsilon_{\tau+h}^*) - Y_{\tau+h|\tau}] \quad (3)$$

for $h = 1, 2, 3, ..., H$, where ϵ_t^* is the vector of shocks conditional upon which forecasts at time τ are computed (so that it features either all shocks, or only monetary policy shocks); $Y_{\tau+h}(\epsilon_{t+h}^*)$ is a specific path for the vector of variables Y_t in (1), which has been generated by a sequence of structural shocks $\epsilon_{\tau+h}^*$ starting from initial conditions Y_τ, $Y_{\tau\text{-}1}$, ..., $Y_{\tau\text{-}p+1}$; $Y_{\tau+h|\tau}$ is the forecast of Y_{t+h} conditional on information at τ, which following Adolfson *et al.* (2005), I set equal to the median of the distribution of $Y_{\tau+h}(\epsilon_{\tau+h}^*)$ generated by simulating the VAR into the future starting from initial conditions Y_τ, ..., $Y_{\tau\text{-}p+1}$, and randomly drawing the shocks $\epsilon_{\tau+h}^*$ from a multivariate N(0, 1) distribution; and $\Sigma_{\tau+h} = \text{Cov}[Y_{\tau+h}(\epsilon_{\tau+h}^*) - Y_{\tau+h|\tau}]$.

As pointed out by Adolfson *et al.* (2005), since $Y_{\tau+h}(\epsilon_{\tau+h}^*)$ follows a multivariate normal distribution, the distribution of the modesty statistic (3) under the no policy intervention scenario is chi-squared with N degrees of freedom, where N is the number of variables used to compute the statistic. Therefore, if a specific policy intervention produces a path for $Y_{\tau+h}$, $h = 1, 2, 3, ..., H$, such that the corresponding modesty statistic $M_{\tau,h}$ lies 'too far out' in the upper tail of the chi-squared distribution, this suggests that the intervention is not modest.

Online Appendix for: Exploring the Trade-Off Between Leaning Against Credit and Stabilizing Real Activity

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A The Data

Here follows a detailed description of the data and of their sources.

A.1 Australia

Quarterly seasonally adjusted series for real and nominal GDP are from the *Australian Bureau of Statistics* (ABS). Their codes are A2304402X ('Gross domestic product: Chain volume measures, $ Millions') and A2304418T ('Gross domestic product: Current prices, $ Millions'), respectively. The GDP deflator has been computed as the ratio between nominal and real GDP. Monthly seasonally adjusted series for commodity prices ('GRCPAIAD: Index of commodity prices; all items; A$'), M3 ('M3: Seasonally adjusted, A$ billion'), the monetary base ('DMAMMB: Money base, Seasonally adjusted, A$ billion') and currency ('DMACS: Currency: A$ billion') are all from the *Reserve Bank of Australia* (RBA). Reserves have been computed as the difference between the monetary base and currency. A monthly seasonally adjusted series for a short rate ('FIRMMBAB90: 3-month BABs/NCDs, Bank Accepted Bills/Negotiable Certificates of Deposit-3 months; monthly average') is from the RBA. A monthly seasonally adjusted series for a long rate has been constructed by linking the series for the 10-year government bond yield ('FCMYGBAG10: Australian Government, government bonds, 10 yrs') and the series for the 10-year Commonwealth bond yield ('FCMYGBAG10: Yield on Commonwealth government bonds, 10 years maturity') is from the RBA. The resulting linked series is equal to the former series up until 2013Q1, and it is equal to the latter series since then. A monthly seasonally adjusted series for total credit granted by the Australian commercial banking sector

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('DLCACS: Total credit, seasonally adjusted, includes securitisations, A$ billion') is from the RBA. All monthly series have been converted to the quarterly frequency by taking averages within the quarter. The sample period is 1982Q3-2019Q4.

A.2 Canada

Monthly seasonally adjusted series for the commodity price index ('Monthly Bank of Canada commodity price index - Total', series' code is v52673496), real GDP ('Real GDP, Total economy, 1986 constant prices'), the core CPI ('Consumer Price Index, all-items excluding eight of the most volatile components as defined by the Bank of Canada and excluding the effect of changes in indirect taxes, seasonally adjusted', series' code is: v112593705), M2 ('M2+ (gross)'), the monetary base ('Monetary base (notes and coin in circulation, chartered bank and other Payments Canada members' deposits with the Bank of Canada)'), currency ('Currency outside banks'), and a 10-year government bond yield are all from *Statistics Canada*. The Bank of Canada's discount rate is from the Bank of Canada. The series for banks' reserves used for the empirical analysis has been computed as the difference between the monetary base and currency outside banks. A monthly seasonally adjusted series for total credit orginated from the commercial banking system has been computed as the sum of the following three series: 'Total consumer credit (Household credit - Consumer credit)', 'Total residential mortgage credit (Household credit - Residential mortgage credit)', and 'Total business loans (Business credit - Business loans)'. The series' codes are V122707, V122746, V105926372, respectively. The sample period is January 1983-December 2019.

A.3 Denmark

A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the *Bank for International Settlements* (BIS) (the series' code is Q:DK:P:B:M:XDC:A). Quarterly seasonally unadjusted series for nominal GDP and the GDP deflator are from the *International Monetary Fund*'s International Financial Statistics (IMF's IFS), and they have been seasonally adjusted via ARIMA X-12 as implemented in *EViews*. Real GDP has been computed as the ratio between nominal GDP and the GDP deflator. A quarterly seasonally unadjusted series for the nominal effective exchange rate (NEER) is from the BIS. Quarterly seasonally adjusted series for M2 and a long-term nominal interest rate ('Yield on long-term Danish government bonds') are from Kim Abildgren's database. A quarterly seasonally unadjusted series for a short rate ('IRSTCB01DKQ156N: Immediate Rates: Less than 24 Hours: Central Bank Rates for Denmark, Percent, Quarterly') is from the St. Louis FED's internet data portal, FRED II. The sample period is 1982Q1-2012Q2.

A.4 New Zealand

A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the BIS (the series' code is Q:NZ:P:B:M:XDC:A). Quarterly seasonally adjusted series for real GDP ('Expenditure-based gross domestic product, real NZ$m s.a.') and the GDP deflator are from *Statistics New Zealand*. The series' codes are GDE.Q.EY.RS and GDE.Q.DY.RS, respectively. A quarterly seasonally adjusted series for broad money ('MCA.MDB.BM') is from the *Reserve Bank of New Zealand* (RBNZ). A quarterly seasonally adjusted series for the commodity price index ('PPI06.Q.T0I1.ia: Producers price index (PPI) inputs') is from *Statistics New Zealand*. A quarterly seasonally unadjusted series for the long rate ('Secondary market government bond yields: 10 year') is from *Statistics New Zealand*. A quarterly seasonally unadjusted series for the short rate ('INM.MN.NZK: Overnight interbank cash rate') is from the RBNZ. The sample period is 1988Q1-2019Q4.

A.5 Norway

A quarterly seasonally adjusted M2 series is from Klovland (2004) until 2003, and it is from Norges Bank (Norway's central bank) since then. A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the BIS (the series' code is Q:NO:P:B:M:XDC:A). A quarterly seasonally unadjusted series for the nominal effective exchange rate (NEER) is from the BIS. Quarterly seasonally adjusted series for a short rate ('IR3TIB01NOM156N: 3-Month or 90-day Rates and Yields: Interbank Rates for Norway, Percent, Quarterly, Not Seasonally Adjusted') and a long rate ('IRLTLT01NOQ156N: Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for Norway, Percent, Quarterly, Not Seasonally Adjusted') are both from the St. Louis FED's internet data portal, FRED II. Quarterly seasonally unadjusted series for real GDP ('Gross domestic product Mainland Norway, market values, Constant 2014-prices, NOK million') and the GDP deflator ('Gross domestic product Mainland Norway, market values, Price indices') are from *Statistics Norway*, and they have been seasonally adjusted via ARIMA X-12 as implemented in *EViews*. The sample period is 1982Q1-2019Q4.

A.6 South Korea

Quarterly seasonally adjusted series for nominal GDP ('Gross domestic product at market prices, Bil.Won, seasonally adjusted, current prices, quarterly') and the real GDP ('Gross domestic product at market prices, Bil.Won, seasonally adjusted, chained 2010 year prices, quarterly') are from the *Bank of Korea*. The GDP deflator has been computed as the ratio between nominal and real GDP. Quarterly seasonally unadjusted series for a short rate ('INTDSRKRM193N: Interest Rates, Discount Rate for Republic of Korea, Percent per Annum') and a long rate ('INTGSBKRM193N: Interest Rates, Government Securities, Government Bonds for Republic of Korea, Percent per Annum') are both from the St. Louis FED's internet data portal, FRED II. A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the *Bank for International Settlements* (BIS) (the series' code is Q:KR:P:B:M:XDC:A). Quarterly seasonally adjusted series for M2 and a commodity price index (''Domestic Supply Price Indexes: Raw & intermediate materials(raw+intermediate)) are from the *Bank of Korea*. Quarterly seasonally adjusted series for the monetary base and currency in billion Won are from the *Bank of Korea*. They have been seasonally adjusted via ARIMA X-12. The sample period is 1980Q1-2019Q1.

A.7 Sweden

A quarterly seasonally unadjusted series for the nominal effective exchange rate (NEER) is from the BIS. A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the *Bank for International Settlements* (BIS) (the series' code is Q:SE:P:B:M:XDC:A). Quarterly seasonally adjusted series for a short rate ('IRSTCI01SEQ156N: Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate for Sweden, Percent') and a long rate ('SWELOCOLTORSTM: Long-term interest rate: Original series for Sweden, Percent') are both from the St. Louis FED's internet data portal, FRED II. A quarterly seasonally adjusted series for M3 has been constructed by linking the following two series: since 1995Q1 the series ('') is from *Statistics Sweden*; before that it si from the St. Louis FED. Quarterly seasonally adjusted series for real GDP ('GDP at market prices, Seasonally adjusted, constant prices reference year 2016, SEK million') and the GDP deflator are from *Statistics Sweden*. The sample period is 1981Q1-2019Q4.

A.8 Switzerland

A quarterly seasonally adjusted series for total credit to the private non-financial sector from banks in domestic currency is from the *Bank for International Settlements* (BIS) (the series' code is Q:CH:P:B:M:XDC:A). Quarterly seasonally adjusted series for a short rate ('IR3TIB01CHQ156N: Interbank Rates for Switzerland, 3-Month or 90-day Rates and Yields, Percent') and a long rate ('IRLTLT01CHM156N: Long-Term Government Bond Yields: 10-year') are both from the St. Louis FED's internet data portal, FRED II. A quarterly seasonally adjusted series for a commodity price index is from the Swiss Federal Statistical Office. Quarterly seasonally adjusted series for real GDP ('Gross domestic product, expenditure approach, seasonally and calendar adjusted data, in Mio. Swiss Francs, at prices of the preceding year, chained values, reference year 2010') and the GDP deflator ('Gross domestic product, expenditure approach, seasonally and calendar adjusted data, implicit chain price indexes') are from SECO, the Swiss Statistical Agency. Quarterly seasonally adjusted series for the monetary base and currency in circulation are from the *Swiss National Bank*. The sample period is 1985Q1-2019Q4.

A.9 United Kingdom

A monthly seasonally adjusted series for M2—which in the United Kingdom is called 'retail M4' ('Retail M4 (or M2) comprises: The M4 private sector's holdings of sterling notes and coin; and sterling denominated 'retail' deposits with UK MFIs')[1]—is from the Bank of England. Monthly seasonally adjusted series for the break-adjusted stock of reserves held by commercial banks at the *Bank of England* ('Reserves: bankers' operational deposits at the *Bank of England*'), a commodity price index (''Spliced wholesale/producer price index 1790-2015), and a series for bank lending ('Bank lending') are all from the spreadsheet of U.K. long-term data 'millenniumofdata_v3_final.xlsx', which is available at the *Bank of England*'s website. A monthly seasonally unadjusted series for the 10-year government bond yield is from the St. Louis FED's internet daata portal, FRED II. The acronym is IRLTLT01GBM156N. A monthly series for the *Bank of England*'s monetary policy rate (i.e., the 'Bank rate') is from the *Bank of England*. A monthly seasonally adjusted series for real GDP is from the *National Institute for Economic and Social Research* (*NIESR*), and it has been kindly provided by Garry Young. A monthly seasonally unadjusted series for the core CPI ('Core CPI: CPIH index excluding energy, food, alcoholic beverages and tobacco'; series' code is L5KB) is from the U.K.'s *Office for National Statistics* (*ONS*). I adjusted the original seasonally unadjusted series *via* ARIMA X-12. The sample period is January 1983-April 2006.

A.10 United States

A monthly seasonally adjusted series for M2 ('M2SL: M2 Money Stock: H.6 Money Stock Measures, Seasonally Adjusted, Monthly, Billions of Dollars') is from the Board of Governors of the Federal Reserve System. A monthly seasonally adjusted series for non-borrowed reserves ('BOGNONBR: Non-Borrowed Reserves of Depository Institutions; Seasonally Adjusted; Monthly; Billions of Dollars') is from the Board of Governors of the Federal Reserve System. The series was discontinued in June 2013, but that is irrelevant for my purposes since, in order to prevent my results from being distorted by the financial crisis and the associated Great Recession, I end the sample period in the month before the beginning of the crisis, July 2007. A monthly seasonally unadjusted series for the commodity price index ('PPIACO: Producer Price Index: All Commodities, Producer Price Index, Not Seasonally Adjusted, Monthly, Index 1982=100') is from the U.S. Department of Labor: Bureau of Labor Statistics. Monthly seasonally unadjusted series for the Federal Funds rate ('FEDFUNDS: Effective Federal Funds Rate, Monthly, Not Seasonally Adjusted, Percent') and the 10-year government bond yield ('GS10: 10-Year Treasury Constant Maturity Rate,

[1] See at: https://www.bankofengland.co.uk/statistics/details/further-details-about-m4-data.

Percent, Monthly, Not Seasonally Adjusted') are from the Board of Governors of the Federal Reserve System. A monthly seasonally adjusted series for interpolated real GDP is from Mark Watson's website. The series is the one which has been used in Stock and Watson (2012). A monthly seasonally adjusted series for the core personal consumption expenditure deflator ('PCEPILFE: Personal Consumption Expenditures Excluding Food and Energy, Chain-Type Price Index, Seasonally Adjusted, Monthly, Index 2009=100') is from the U.S. Department of Commerce: Bureau of Economic Analysis. A monthly seasonally adjusted series for total credit from commercial banks has been computed as the sum of the following four series, all of them from the Board of Governors of the Federal Reserve System: 'REALLN: Real Estate Loans, All Commercial Banks', 'CONSUMER: Consumer Loans at All Commercial Banks', 'BUSLOANS: Commercial and Industrial Loans All Commercial Banks', and 'AO-LACBW027SBOG: Other loans and leases: All other loans and leases, all commercial banks'. The overall sample period is January 1983-November 2007.

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Tables for Online Appendix

Table A.1 Median, and 16-84 percentiles of the posterior distribution of the ratio between counterfactual minus actual real credit and counterfactual minus actual real GDP[a]

	Starting date:		
	p+1	$T/2$	T
	5-years ahead:		
Australia	0.608 [0.326 0.682]	0.149 [-0.405 0.382]	0.079 [-0.495 0.111]
Canada	-0.469 [-1.105 -0.251]	-0.346 [-0.891 0.012]	-0.400 [-0.871 0.042]
Denmark	0.368 [-0.854 2.550]	0.224 [-1.208 0.525]	0.026 [-1.389 0.735]
New Zealand	1.959 [1.222 2.203]	1.132 [0.661 1.415]	0.643 [-0.109 1.012]
Norway	2.148 [1.946 2.504]	2.370 [1.757 2.697]	2.129 [1.960 2.529]
South Korea	-0.010 [-0.365 0.177]	0.305 [-1.347 2.044]	0.110 [-0.377 2.284]
Sweden	-0.064 [-0.844 -0.036]	-0.536 [-1.191 -0.265]	-0.133 [-1.667 0.271]
Switzerland	0.950 [0.192 1.074]	0.398 [-0.180 0.440]	0.191 [-0.122 0.321]
United Kingdom	0.964 [-0.085 1.561]	1.529 [0.119 1.919]	1.830 [1.541 2.111]
United States	1.735 [0.884 1.860]	-0.605 [-6.538 1.690]	1.839 [0.619 2.414]
	10-years ahead:		
Australia	-0.452 [-1.302 -0.240]	0.060 [0.021 0.329]	0.136 [-0.631 0.155]
Canada	-0.602 [-1.171 -0.336]	-0.324 [-0.600 -0.143]	-0.526 [-0.909 -0.282]
Denmark	-0.646 [-2.795 1.637]	-0.075 [-0.627 0.157]	0.365 [-1.035 0.778]
New Zealand	0.779 [0.222 0.895]	0.792 [-0.208 0.909]	1.316 [0.937 1.449]
Norway	1.587 [1.270 3.101]	1.495 [1.135 1.535]	1.933 [1.809 2.135]
South Korea	-0.168 [-0.874 0.122]	2.699 [-0.554 4.496]	-0.474 [-1.213 -0.287]
Sweden	-0.695 [-3.465 0.694]	-0.206 [-1.203 0.032]	-0.036 [-0.487 0.040]
Switzerland	0.611 [-0.162 0.655]	0.824 [0.656 1.682]	0.849 [0.534 1.069]
United Kingdom	1.040 [0.213 1.409]	0.817 [-0.087 1.192]	0.732 [-0.423 1.381]
United States	1.273 [-0.820 1.305]	1.546 [0.120 2.083]	0.766 [-2.742 2.092]

[a] Forecasts based only on monetary shocks. Modesty statistic based only on the monetary policy rate.

Table A.2 Median, and 16-84 percentiles of the posterior distribution of the ratio between counterfactual minus actual real credit and counterfactual minus actual real GDP[a]

	Starting date:		
	p+1	$T/2$	T
	5-years ahead:		
Australia	0.301 [-0.403 0.331]	0.901 [0.394 0.947]	0.122 [-0.310 0.141]
Canada	-0.638 [-1.212 -0.362]	-0.457 [-0.793 -0.048]	-0.536 [-1.170 0.235]
Denmark	1.032 [-0.617 2.225]	0.236 [-1.294 1.006]	-0.305 [-2.119 1.538]
New Zealand	2.564 [1.479 3.144]	0.876 [0.527 1.048]	1.161 [0.241 1.568]
Norway	2.034 [1.674 2.713]	1.973 [1.915 2.302]	1.839 [1.637 2.134]
South Korea	-0.654 [-1.039 -0.453]	0.257 [-0.481 0.960]	0.266 [-0.544 1.048]
Sweden	-0.110 [-0.679 0.742]	-0.064 [-0.554 0.087]	-0.264 [-1.301 0.174]
Switzerland	0.154 [-0.980 0.226]	0.067 [-0.410 0.193]	0.538 [-1.258 0.818]
United Kingdom	0.887 [0.054 1.243]	1.161 [0.132 1.842]	1.100 [-0.377 1.953]
United States	-0.743 [-2.240 -0.066]	1.304 [0.160 2.152]	0.555 [-2.573 2.396]
	10-years ahead:		
Australia	-0.439 [-1.193 -0.241]	-0.451 [-1.684 -0.147]	0.313 [-0.065 0.340]
Canada	-0.348 [-0.711 -0.044]	-0.150 [-0.636 0.032]	-0.156 [-0.563 0.864]
Denmark	0.039 [-0.833 1.913]	-0.450 [-1.097 -0.188]	0.455 [-1.959 3.207]
New Zealand	1.144 [0.171 1.755]	1.510 [1.396 1.836]	-0.369 [-1.271 -0.258]
Norway	1.876 [1.763 1.978]	1.488 [1.137 1.536]	2.438 [2.261 2.972]
South Korea	0.345 [-0.370 0.821]	0.243 [-0.213 0.546]	-0.511 [-1.229 0.428]
Sweden	-0.322 [-0.580 -0.211]	0.346 [0.185 0.473]	0.927 [-0.077 1.202]
Switzerland	0.206 [-0.379 0.551]	0.815 [-0.026 0.861]	1.943 [-0.300 2.502]
United Kingdom	0.970 [-0.355 1.313]	1.122 [0.154 1.530]	2.256 [0.290 3.401]
United States	0.710 [-0.948 1.151]	0.776 [-1.991 1.193]	0.729 [-0.521 0.990]

[a] Forecasts based on all shocks. Modesty statistic based on all series.

Figures for the Online Appendix

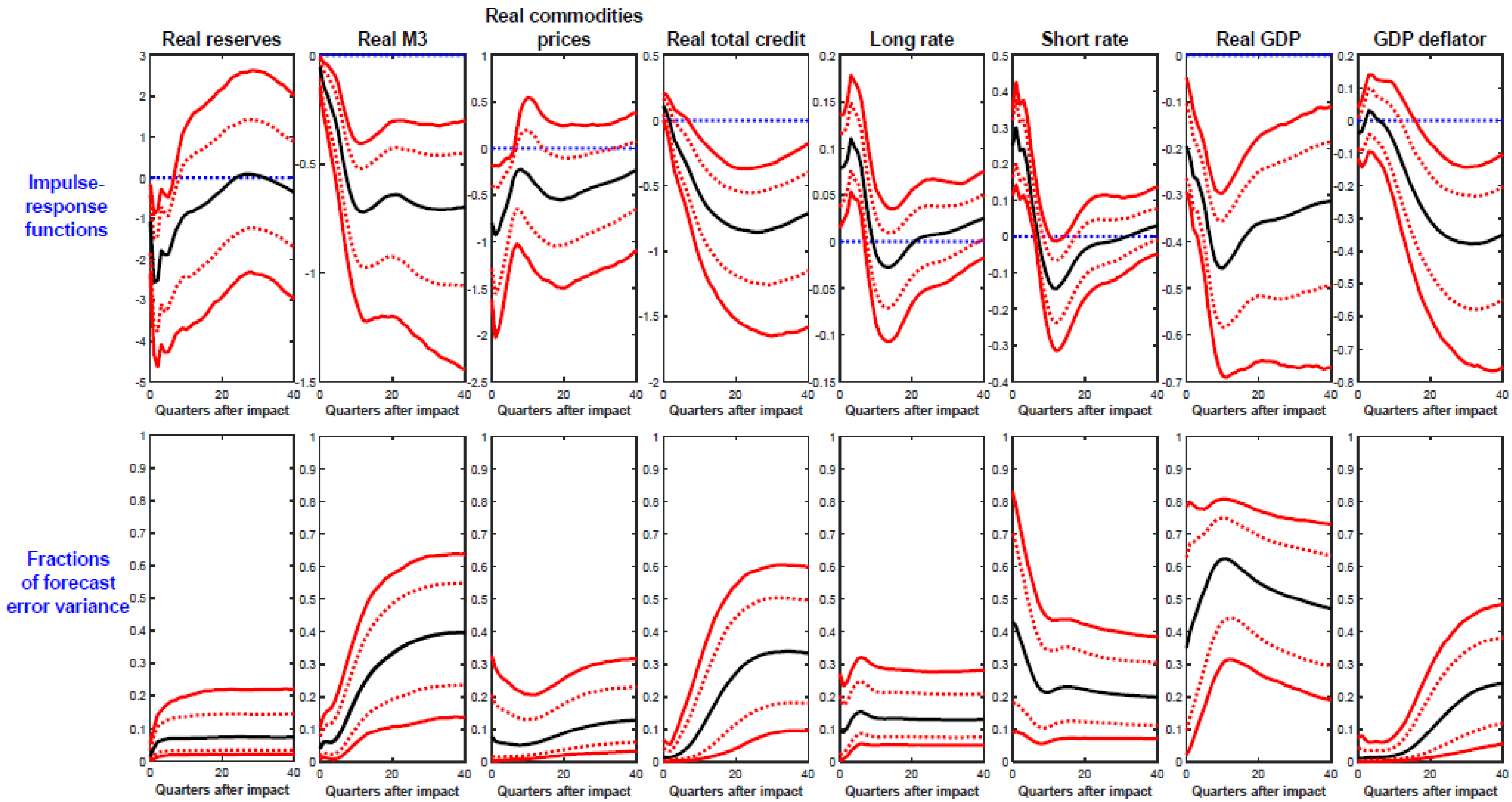

Figure A.1 Australia: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

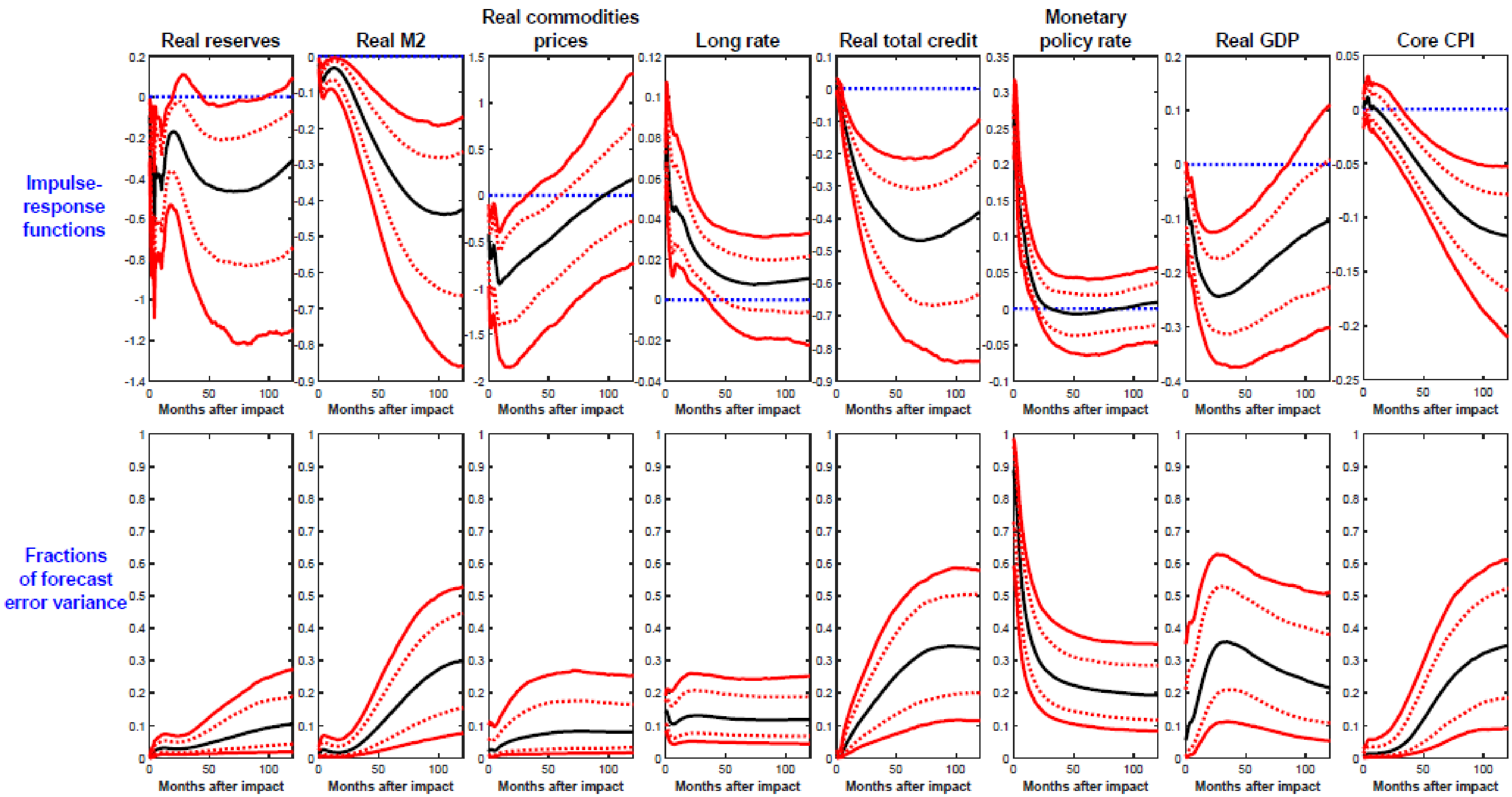

Figure A.2 Canada: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

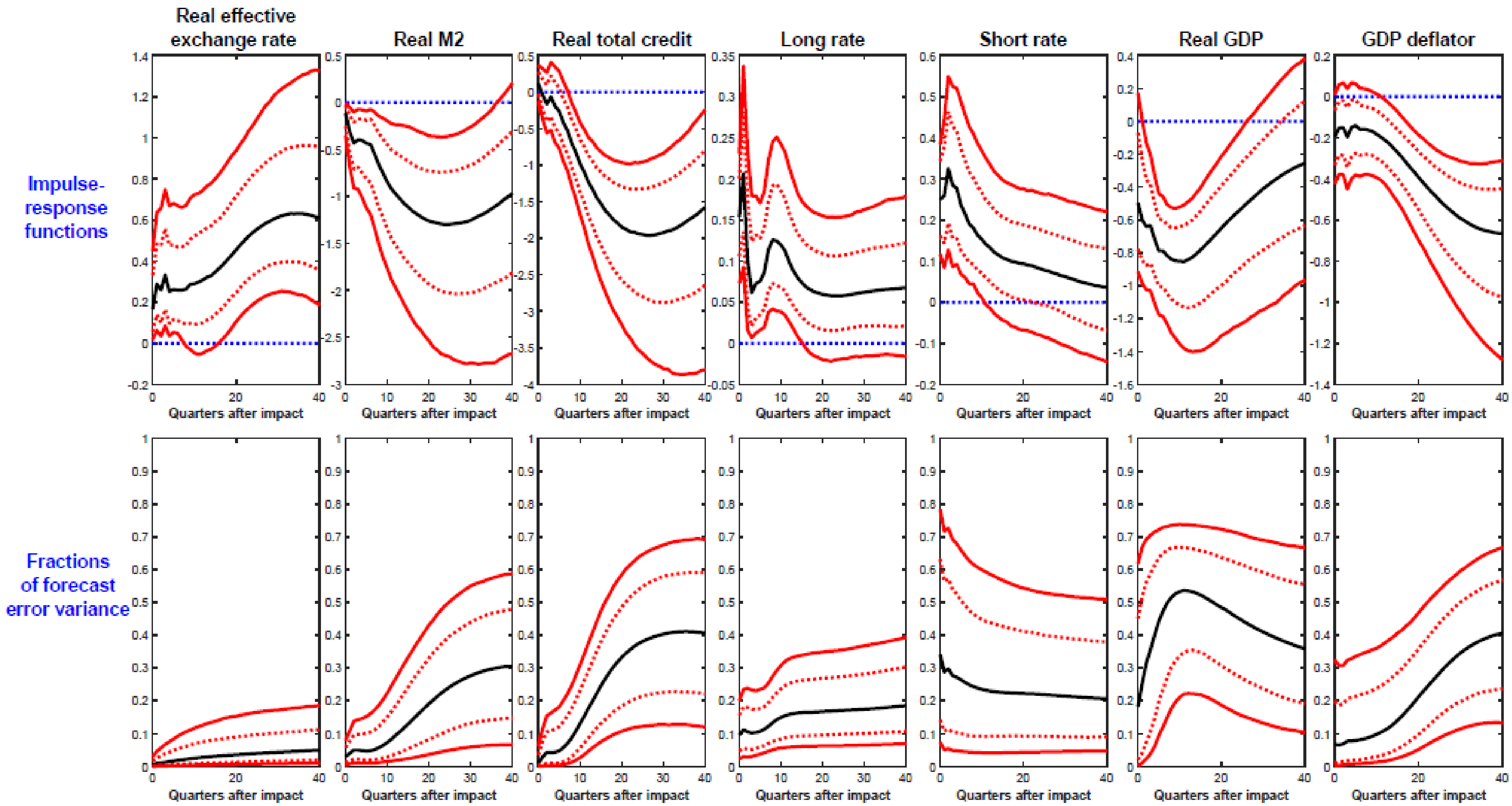

Figure A.3 Denmark: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

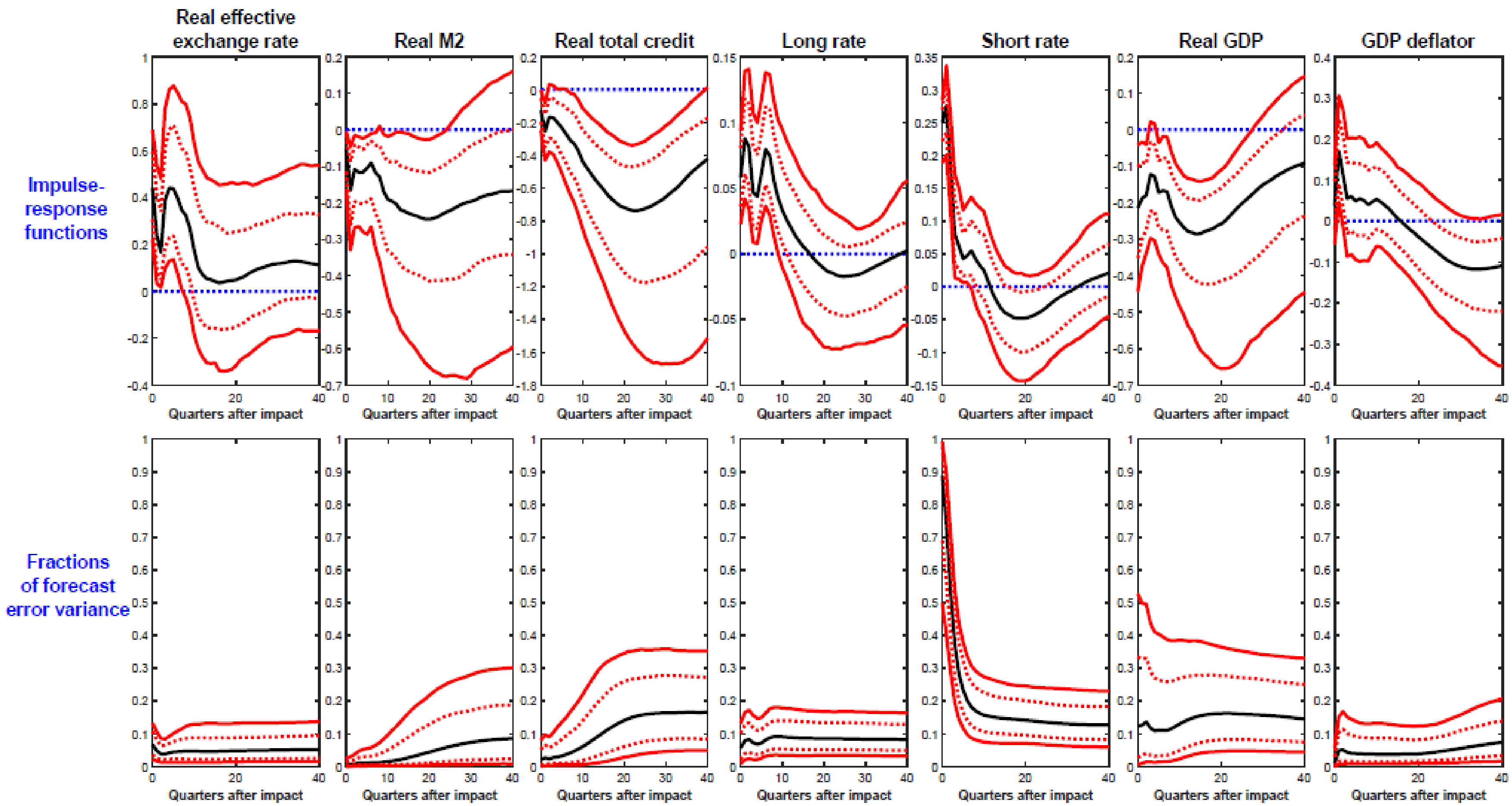

Figure A.4 New Zealand: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

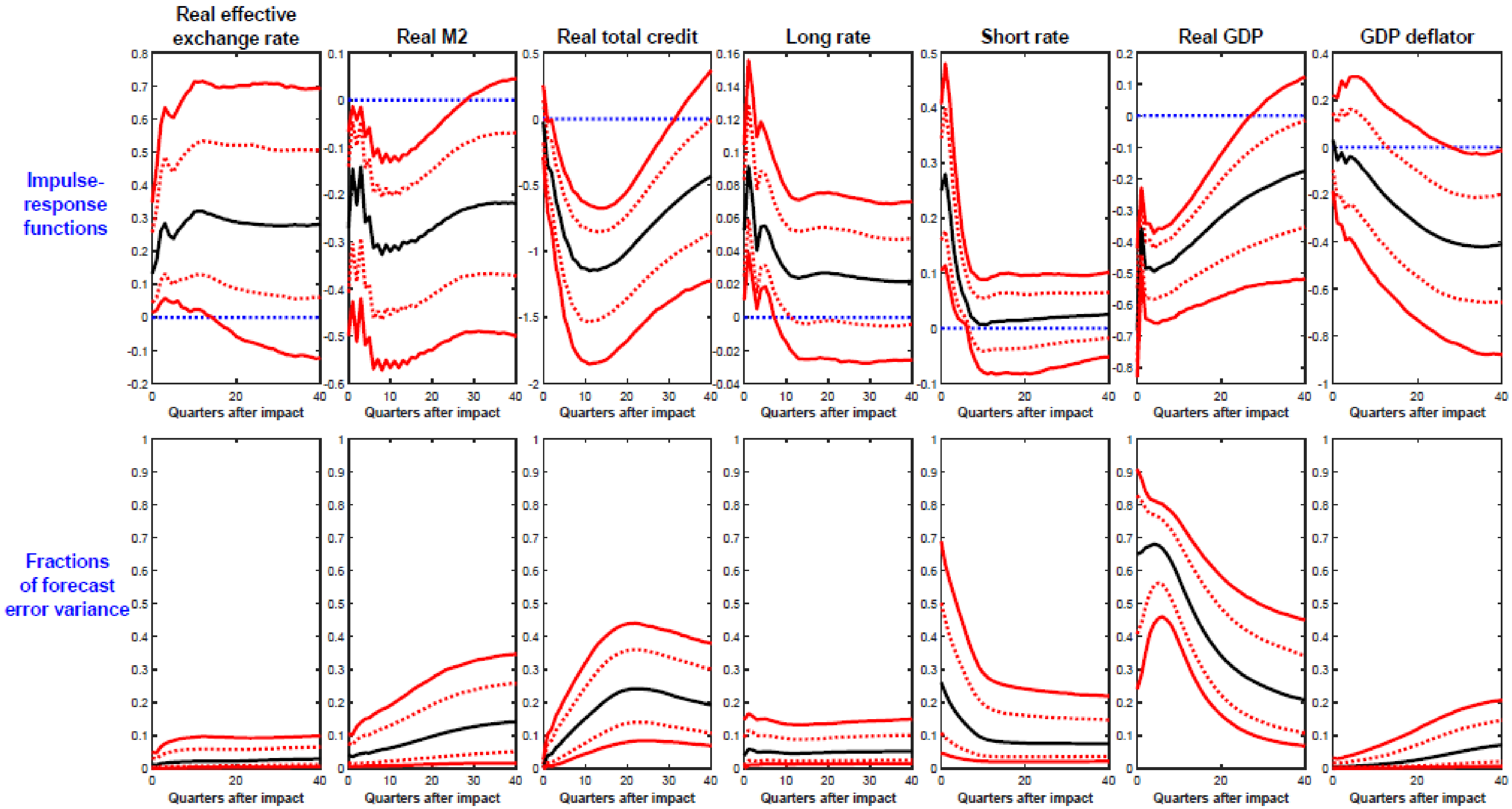

Figure A.5 Norway: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

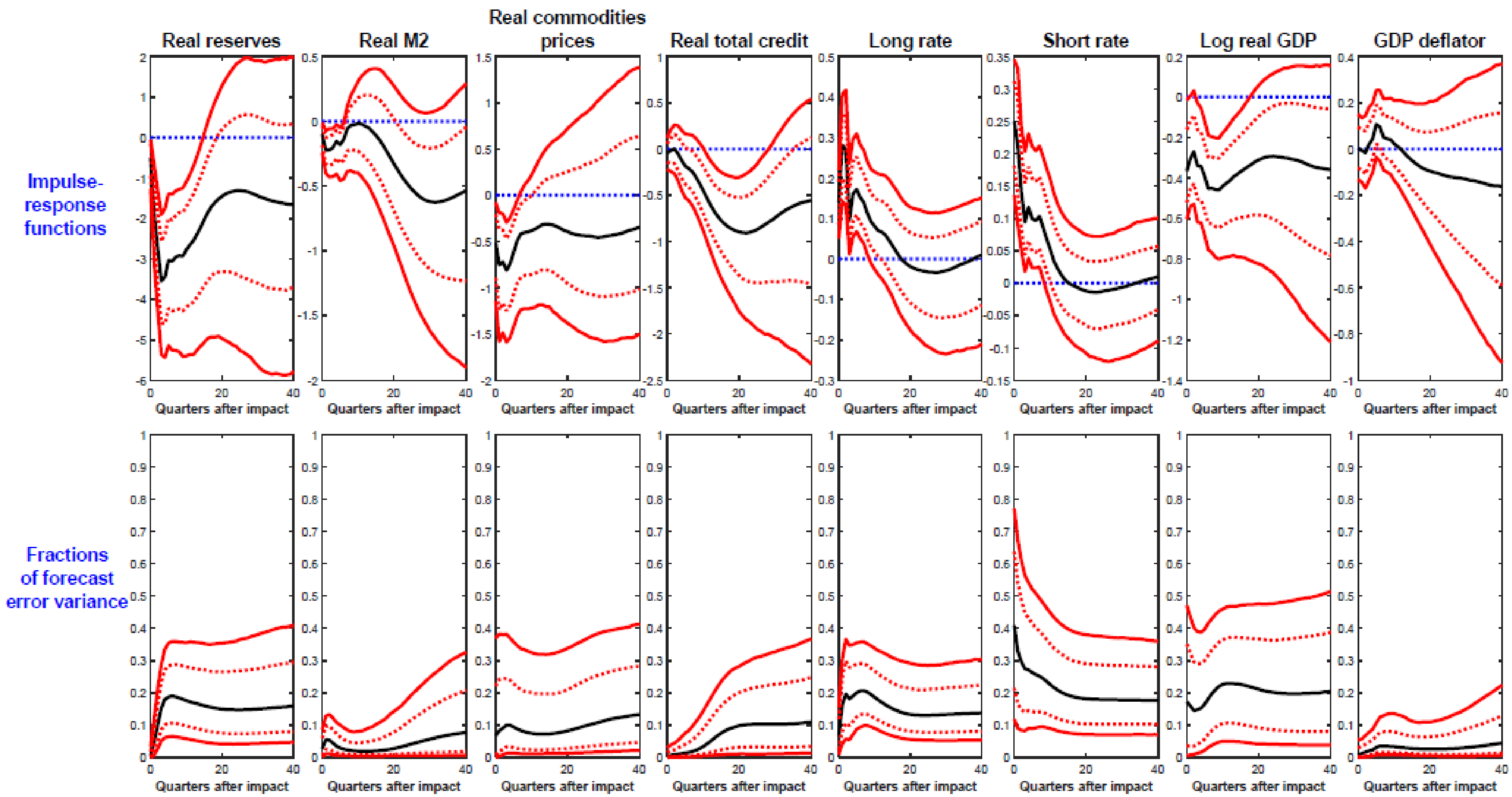

Figure A.6 South Korea: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

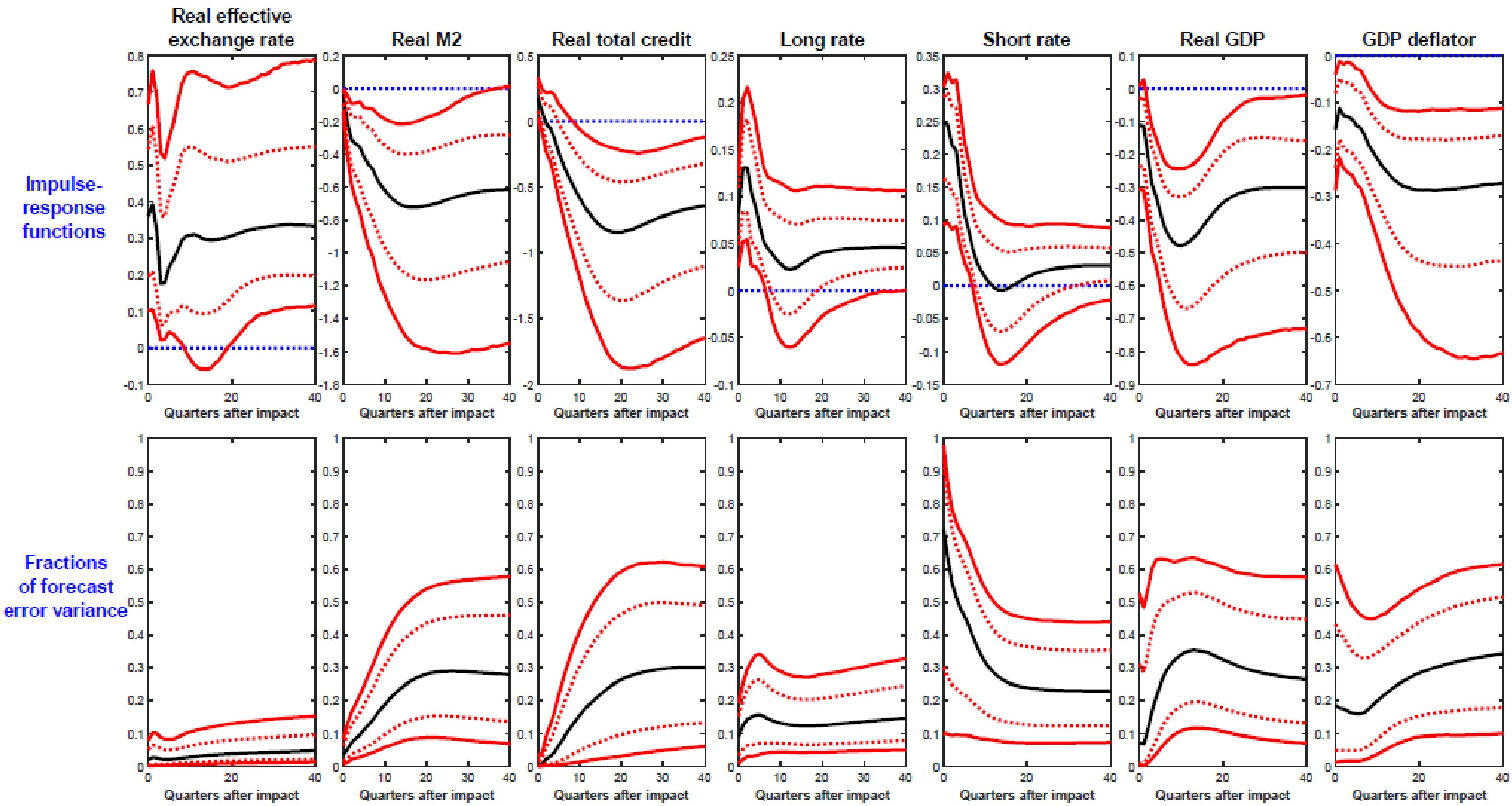

Figure A.7 Sweden: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

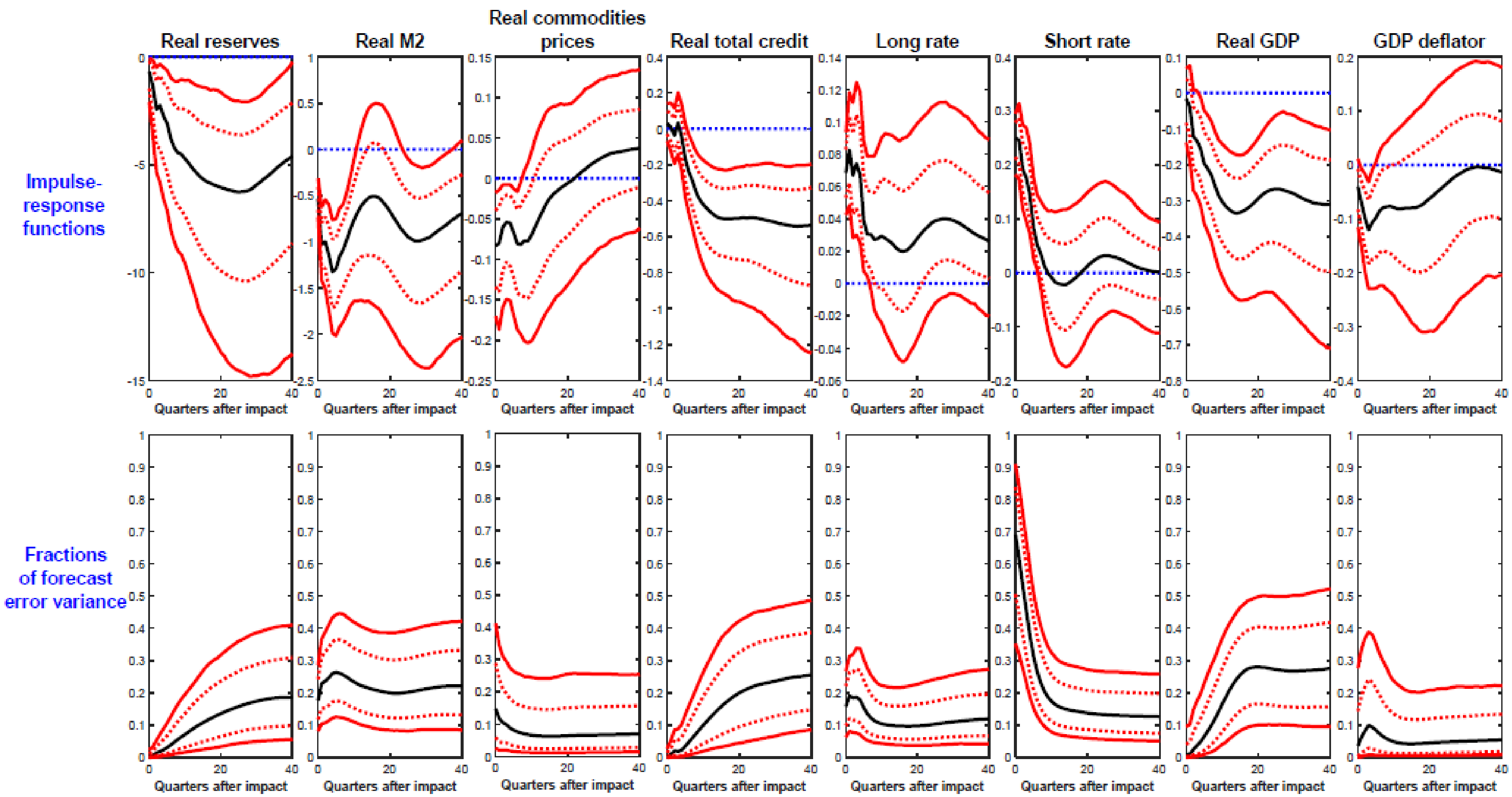

Figure A.8 Switzerland: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

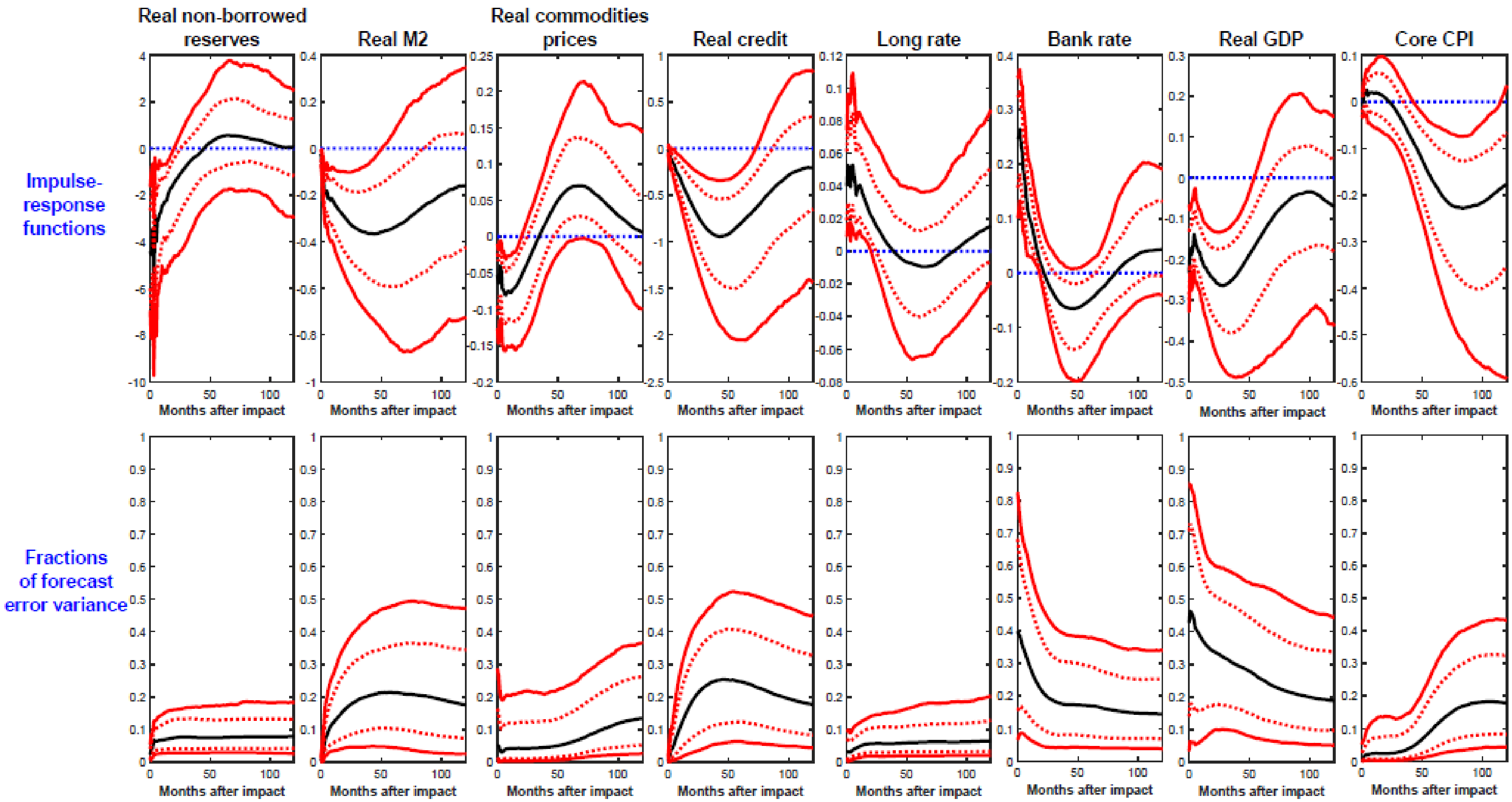

Figure A.9 United Kingdom: impulse-response functions to a monetary policy shock, and fractions of forecast error variance explained by the shock (median, and 16-84 and 5-95 percentiles)

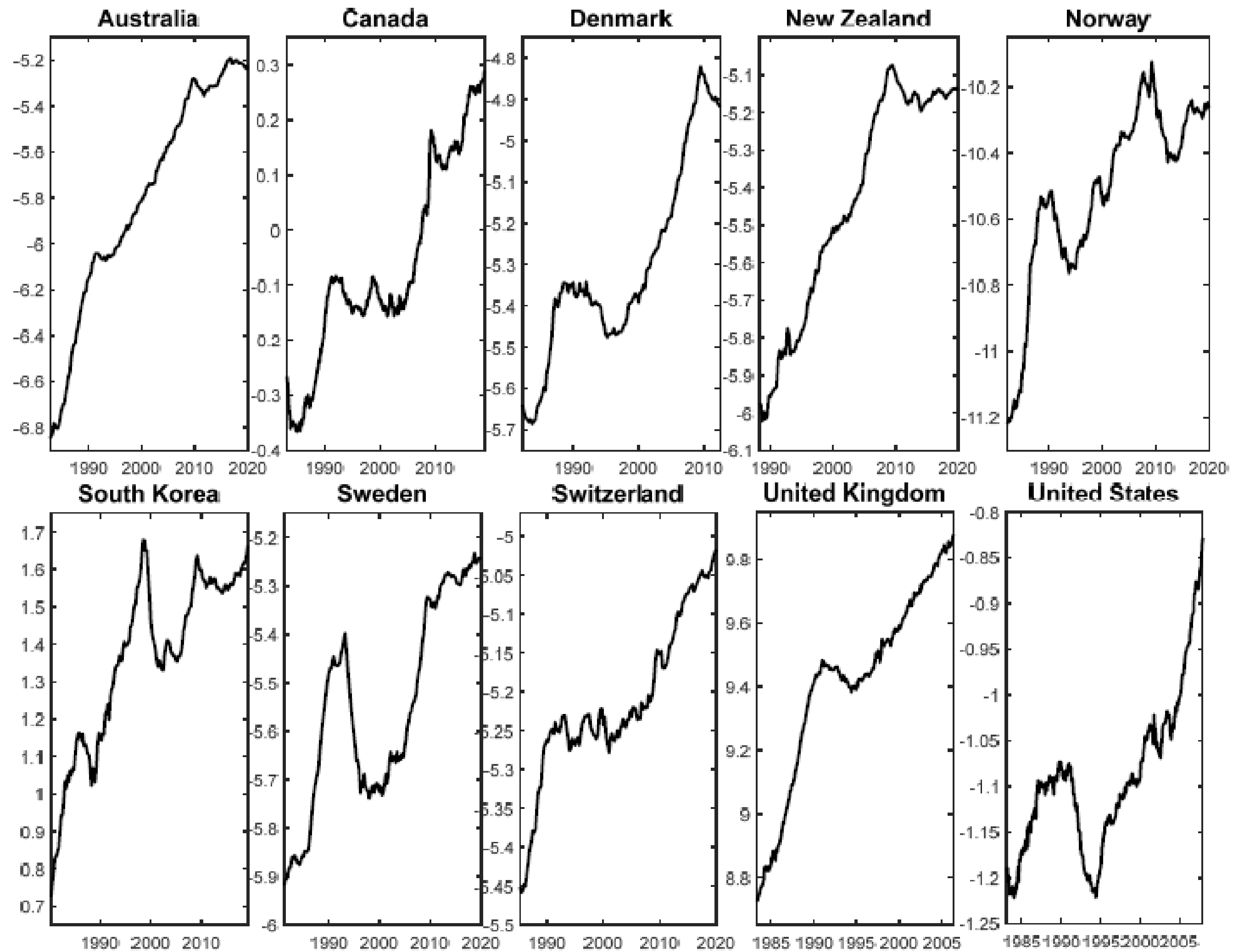

Figure A.10 Logarithm of credit leverage

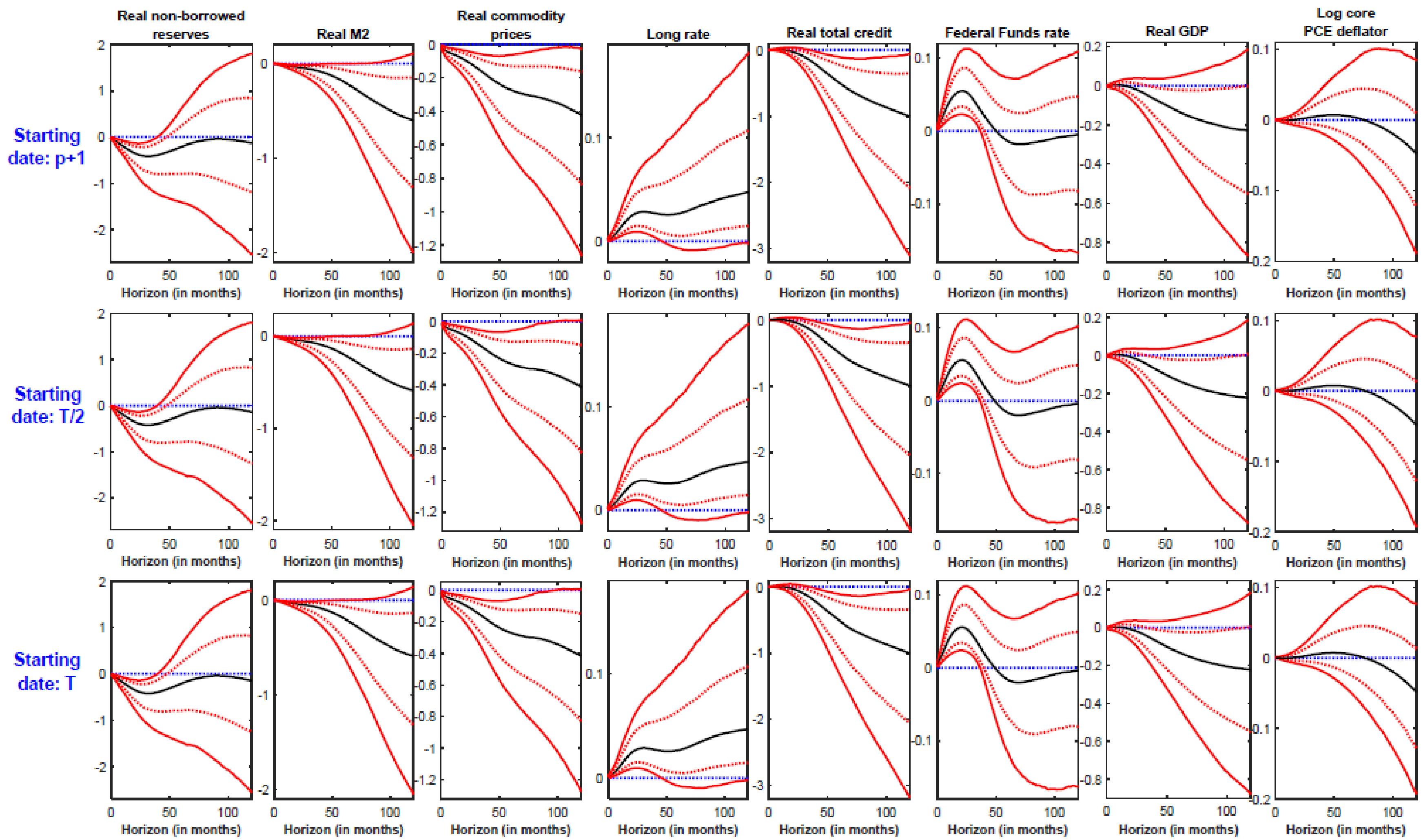

Figure A.11 United States: evidence from modest policy interventions in population: counterfactual minus actual series in percentage points (median and 16-84 and 5-95 percentiles; modesty statistic based only on the monetary policy rate and monetary policy shocks)

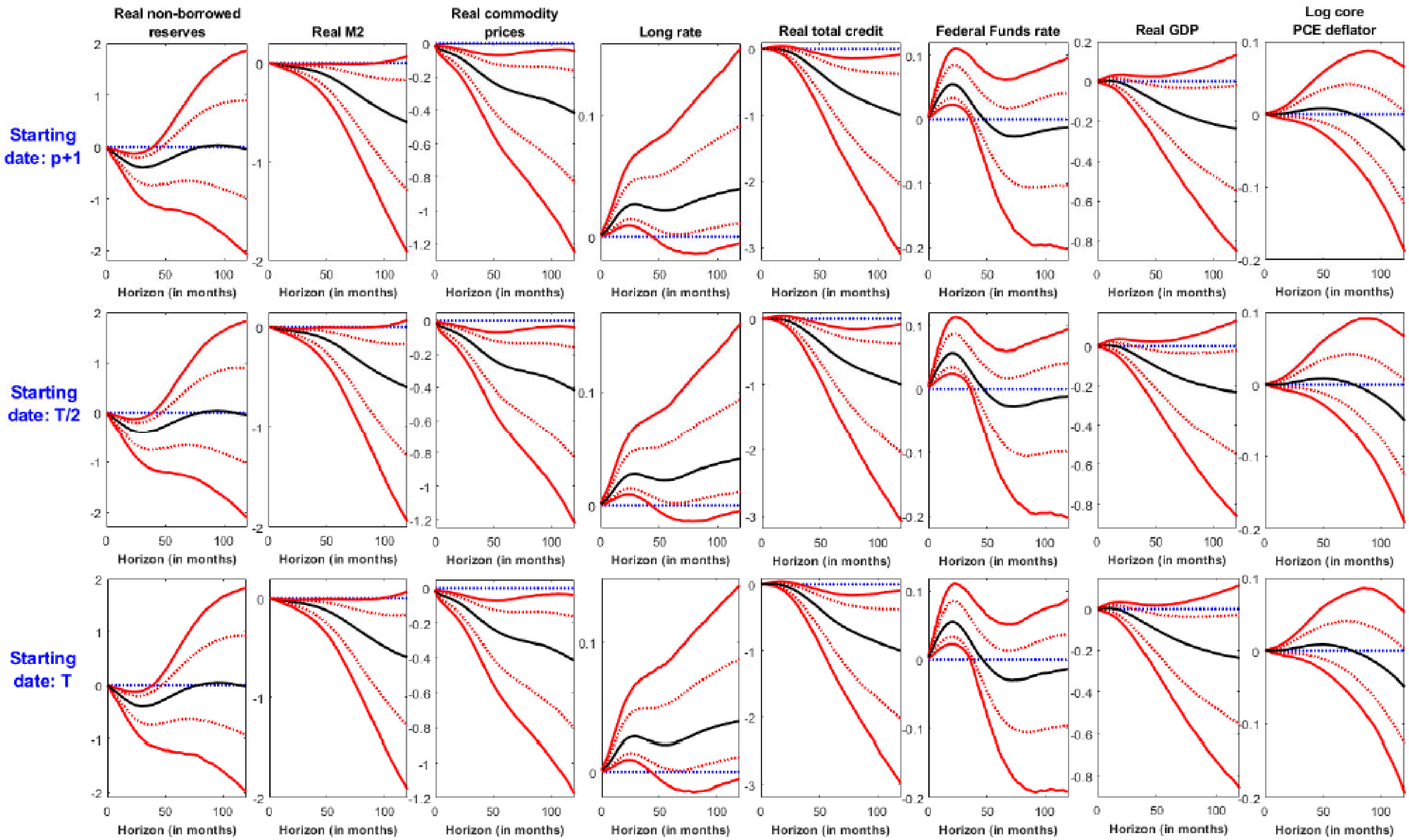

Figure A.12 United States: evidence from modest policy interventions in population: counterfactual minus actual series in percentage points (median and 16-84 and 5-95 percentiles; modesty statistic based on all series and all shocks)