Online Appendix for

Measuring Exchange Rate, Price, and Output Dynamics at the Effective Lower Bound

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1 Introduction

This document provides supplementary material to Bäurle and Kaufmann (2018). It first provides the theoretical basis to define the sign of the initial impulse responses to a risk premium shock under various policy regimes. Then, it describes the estimation procedure, documents the results for the posterior distribution of the prior weight, and compares the results to the estimates from a time-varying parameter VAR (TVP-VAR). Finally, it contains additional results and robustness tests.

2 A small-open-economy DSGE model

2.1 Log-linearised model

This section provides the linearised first-order conditions using the notation of Bäurle and Menz (2008) for the small open-economy model by Justiniano and Preston (2010). The only difference is that we do not express the domestic nominal interest rate in terms of approximate percent-deviations from the steady state and therefore subtract its steady-state value ($\bar{r}$), we adapted the monetary policy rule(s), and we appended a long-term interest rate. All variables except the domestic nominal interest rates and the term spread are denoted in terms of deviations from steady state. Conditional

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expectations about the variable one period ahead are denoted by $x_{t+1|t}$. The derivation of the non-linearised first-order conditions are given in Justiniano and Preston (2010) and Bäurle and Menz (2008).

The model features an Euler equation relating consumption (c_t) to future consumption, the real interest rate ($i_t - \bar{r} - \pi_{t+1|t}$) and preference shocks ($\varepsilon_{g,t}$). Habit persistence introduces lagged consumption multiplied by the parameter h.

$$c_t - hc_{t-1} \quad = \quad c_{t+1|t} - hc_t - \frac{1-h}{\sigma}(i_t - \bar{r} - \pi_{t+1|t}) - \frac{1-h}{\sigma}(\varepsilon_{g,t+1|t} - \varepsilon_{g,t}) \quad . \tag{1}$$

Then, domestic goods market clearing requires that domestic output (y_t) is related to consumption, the terms of trade (s_t), the law of one price gap ($\psi_{F,t}$), and foreign output (y_t^*). The parameter α can be interpreted as a measure of openness.

$$y_t \quad = \quad (1-\alpha)c_t + \alpha\eta(2-\alpha)s_t + \alpha\eta\psi_{F,t} + \alpha y_t^* \tag{2}$$

In addition, we have Phillips-curve relationships for both domestic and import price deflators ($\pi_{H,t}, \pi_{F,t}$), respectively. Notice that the import price deflator is a price index composed of prices paid in domestic currency at the docks. In the import price Phillips-curve, we additionally have a cost-push shock ($\varepsilon_{cp,t}$):

$$\begin{aligned} \pi_{F,t} - \delta_F \pi_{F,t-1} &= \beta(\pi_{F,t+1|t} - \delta_F \pi_{F,t}) + \kappa_F \psi_{F,t} + \varepsilon_{cp,t} \qquad (3) \\ \pi_{H,t} - \delta_H \pi_{H,t-1} &= \beta(\pi_{H,t+1|t} - \delta_H \pi_{H,t}) + \kappa_H mc_t \quad , \end{aligned}$$

where $\kappa_i = (1-\theta_i)(1-\theta_i\beta)/\theta_i$, $i \in \{H, F\}$. Firms which cannot change their prices follow an indexation rule introducing lagged foreign and domestic inflation by the parameters δ_H, δ_F. Real marginal costs are given by

$$mc_t \quad = \quad \varphi y_t - (1+\varphi)\varepsilon_{a,t} + \alpha s_t + \frac{\sigma}{1-h}(c_t - hc_{t-1}) \tag{4}$$

where $\varepsilon_{a,t}$ represents an autocorrelated technology shock. Domestic CPI inflation, which enters the policy rules described below, is given by

$$\pi_t = \pi_{H,t} + \alpha \Delta s_t \quad . \tag{5}$$

The uncovered interest rate parity condition includes a term for the log real net foreign asset position as a fraction of steady state domestic income (a_t) and it is set up in terms of the inflation differential, the real interest rate and the real exchange rate (q_t). The risk premium shock is given by $\varepsilon_{rp,t}$:

$$(i_t - \bar{r}) - (i_t^* - \bar{r}^*) = \pi_{t+1|t} - \pi^*_{t+1|t} + \Delta q_{t+1|t} - \chi a_t - \varepsilon_{rp,t} \quad . \tag{6}$$

The log-linear approximation to the budget constraint reads:

$$c_t + a_t = \frac{1}{\beta} a_{t-1} - \alpha(s_t + \psi_{F,t}) + y_t \quad , \tag{7}$$

where the law of one price gap ($\psi_{F,t}$), the terms of trade (s_t) and the nominal as well as the real exchange rate ($e_t,\ q_t$) are related by:

$$\begin{aligned} \Delta\psi_{F,t} &= \Delta e_t + \pi_t^* - \pi_t - (1-\alpha)(s_t - s_{t-1}) \\ \Delta s_t &= \pi_{F,t} - \pi_{H,t} \\ q_t &= \psi_{F,t} + (1-\alpha)s_t \quad . \end{aligned} \tag{8}$$

The monetary policy rule differs in some respects from Bäurle and Menz (2008), as described in the main part of the paper. The general form of the four rules, including the ZLB constraint, reads:[1]

$$\begin{aligned}\tilde{i}_t &= \bar{r} + \rho_i(\tilde{i}_{t-1} - \bar{r}) + \psi_\pi \pi_t + \psi_p p_t + \psi_e e_t + \psi_x x_t + \varepsilon_{i,t} \\ i_t &= \max(0, \tilde{i}_t) \quad ,\end{aligned} \tag{9}$$

where $(x_t = y_t - y_t^n)$ denotes the deviation of output from its natural level (the output gap). The four rules follow from the calibration as specified in Table 1. The natural level of output, and other variables, is pinned down by adding five relationships analogous to (1), (2), (4), (6), and (7), where we impose flexible domestic prices and full pass-through. This implies that the deviation of the natural level of marginal costs from steady state is zero and that the law of one price holds in every point in time (see Monacelli 2005, for a special case without habit formation and complete asset markets).

The price level is defined as

$$p_t = p_{t-1} + \pi_t \quad . \tag{10}$$

In the empirical part of the paper, we use the term spread to identify a risk premium shock. Therefore, we follow Svensson (2000) and Gerlach-Kristen and Rudolf (2010) and append to the DSGE model a long-term interest rate (b_t) which is defined under the expectations hypothesis as the weighted average of future expected short-term interest rates:

$$b_t = \frac{1}{40} \sum_{j=0}^{39} \bar{b} + i_{t+j|t} \quad . \tag{11}$$

We assume that there is a positive, but constant, term premium $\bar{b}$. The term spread is then given by $b_t - i_t$.

The foreign economy is the closed-economy limiting case of the small open economy. Therefore, it can be described by an Euler equation, a Phillips curve, a marginal cost

[1] Impulse response functions including the ZLB constraint are derived using the algorithm developed by Holden (2011) and extended by Holden and Paetz (2012). This algorithm can be used to simulate DSGE models and impulse response functions with inequality constraints. The algorithm is designed to analyse local dynamics of linearised models around a particular steady state. We also simulated impulse responses using the deterministic solution of the model. The results are qualitatively identical.

relationship, a relationship pinning down the output gap and an inertial Taylor rule.

$$
\begin{aligned}
y_t^* - h^* y_{t-1}^* &= y_{t+1|t}^* - h^* y_t^* - \frac{1-h^*}{\sigma^*}(i_t^* - \pi_{t+1|t}^* + \varepsilon_{g,t+1|t}^* - \varepsilon_{g,t}^*) \qquad (12)\\
\pi_t^* - \delta^* \pi_{t-1}^* &= \beta^*(\pi_{t+1|t}^* - \delta^* \pi_t^*) + \kappa^* mc_t^* \\
mc_t^* &= \varphi^* y_t^* - (1+\varphi^*)\varepsilon_{a,t}^* + \frac{\sigma^*}{1-h^*}(y_t^* - h^* y_{t-1}^*) \\
mc_t^* &= \left[\varphi^* + \frac{\sigma^*}{1-h^*}\right] x_t^* - \sigma^* \frac{h^*}{1-h^*} x_{t-1}^* \\
i_t^* &= \rho_i^* i_{t-1}^* + \psi_\pi^* \pi_t^* + \psi_x^* x_t^* + \varepsilon_{i,t} \quad ,
\end{aligned}
$$

with $\kappa^* = (1-\theta^*)(1-\theta^*\beta^*)/\theta^*$. Note that the foreign economy is exogenously given to the small domestic economy. Moreover, we assume that the foreign economy does not face a ZLB on the short-term interest rate.

2.2 Calibration

Table 1 — Policy rule calibration

Parameter	Description	Value
Taylor rule		
ρ_i	Persistence monetary policy rule	0.000
ψ_π	Inflation response	1.724
ψ_x	Output gap response	0.572
ψ_p	Price-level response	0.010
ψ_e	Exchange rate response	0.000
Inertial Taylor rule		
ρ_i	Persistence monetary policy rule	1.000
ψ_π	Inflation response	0.641
ψ_x	Output gap response	0.325
ψ_p	Price-level response	0.010
ψ_e	Exchange rate response	0.000
Wicksellian rule		
ρ_i	Persistence monetary policy rule	0.000
ψ_π	Inflation response	0.000
ψ_x	Output gap response	0.201
ψ_p	Price-level response	2.338
ψ_e	Exchange rate response	0.000
Exchange rate rule		
ρ_i	Persistence monetary policy rule	0.000
ψ_π	Inflation response	0.000
ψ_x	Output gap response	0.201
ψ_p	Price-level response	0.000
ψ_e	Exchange rate response	2.338

Note: All parameters are optimal values for a closed economy derived by Giannoni (2014). The calibration of the exchange rate rule follows from the calibration of the Wicksellian rule.

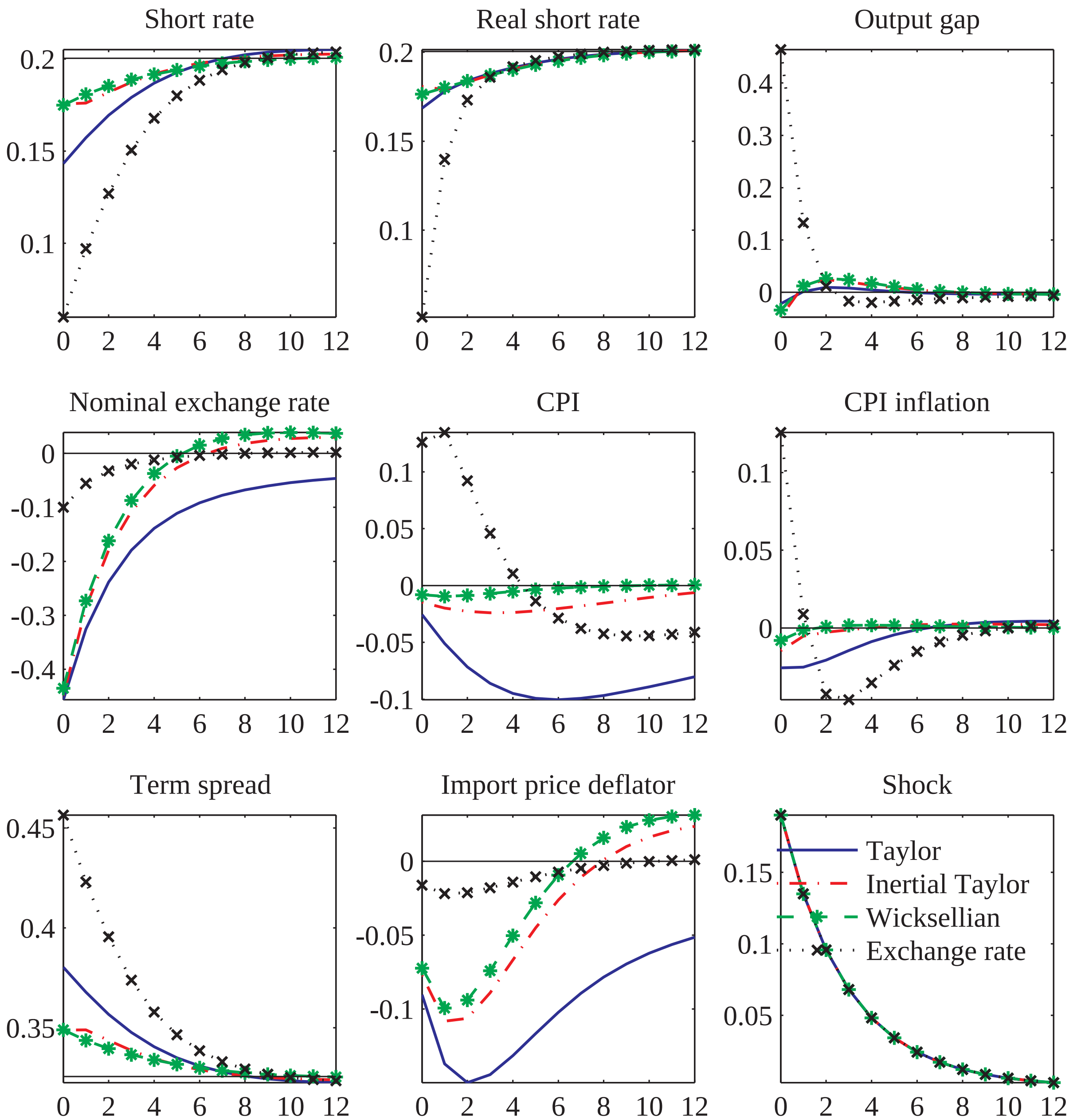
Table 2 — Model calibration

Parameter	Description	Value
h	Habit persistence	0.080
h^*	Habit persistence	0.730
β	Discount factor	0.998
β^*	Discount factor	0.990
σ	Coefficient of relative risk aversion	0.200
σ^*	Coefficient of relative risk aversion	0.730
α	Weight of foreign goods relative to total consumption	0.370
η	Elasticity of substitution for domestic and foreign goods	1.260
φ	Inverse labour supply elasticity	1.130
φ^*	Inverse labour supply elasticity	1.510
δ_H	Indexation domestic producers	0.170
θ_H	Calvo-parameter domestic producers	0.580
δ_F	Indexation importing retail firms	0.130
θ_F	Calvo-parameter importing retail firms	0.680
χ	Elasticity of risk premium w.r.t. net foreign debt	0.010
$\bar{r}$	Steady state real interest rate	$1/\beta - 1$
$\bar{b}$	Steady state term premium	$\exp(1.4/400) - 1$
ρ_a	Persistence technology shock	0.310
ρ_a^*	Persistence technology shock	0.810
ρ_g	Persistence preference shock	0.790
ρ_g^*	Persistence preference shock	0.780
ρ_{cp}	Persistence cost push shock	0.370
ρ_{rp}	Persistence risk premium shock	0.710
σ_i	Standard deviation interest rate shock	0.260
σ_i^*	Standard deviation interest rate shock	0.450
σ_a	Standard deviation technology shock	0.490
σ_a^*	Standard deviation technology shock	0.210
σ_g	Standard deviation preference shock	0.330
σ_g^*	Standard deviation preference shock	0.480
σ_{cp}	Standard deviation cost push shock	0.210
σ_{rp}	Standard deviation risk premium shock	0.190
ρ_i^*	Persistence monetary policy rule	1.000
ψ_π^*	Inflation response	0.641
ψ_x^*	Output gap response	0.325
ψ_p^*	Price-level response	0.010
ψ_e^*	Exchange rate response	0.000

Note: All parameters, except the discount factor, steady state term premium, and parameters on the foreign policy rule, are posterior means from Bäurle and Menz (2008). Parameters of the foreign economy are indicated by an asterisk.

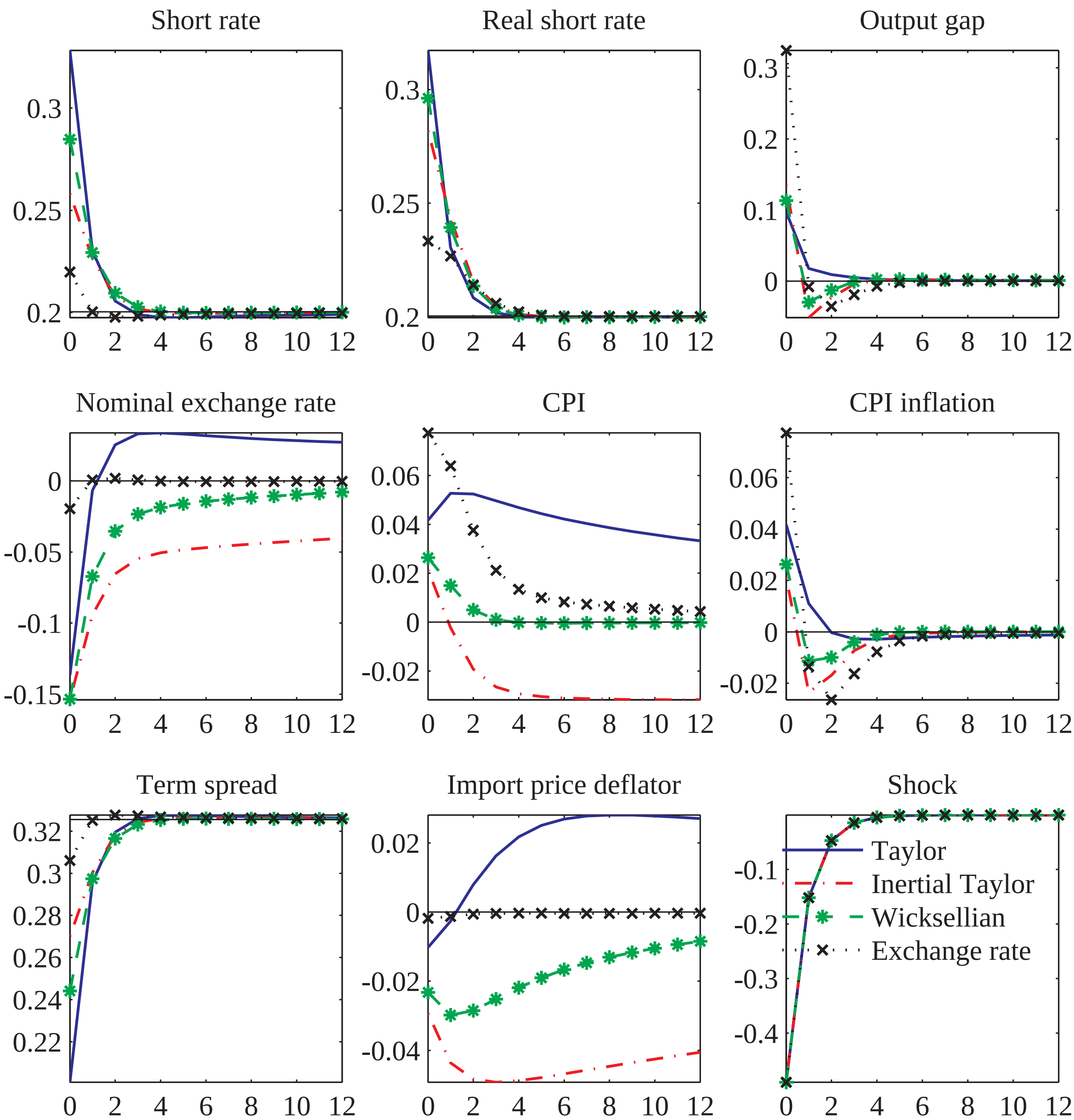
2.3 Impulse responses

Figure 1 — Risk premium shock (non-binding ELB)



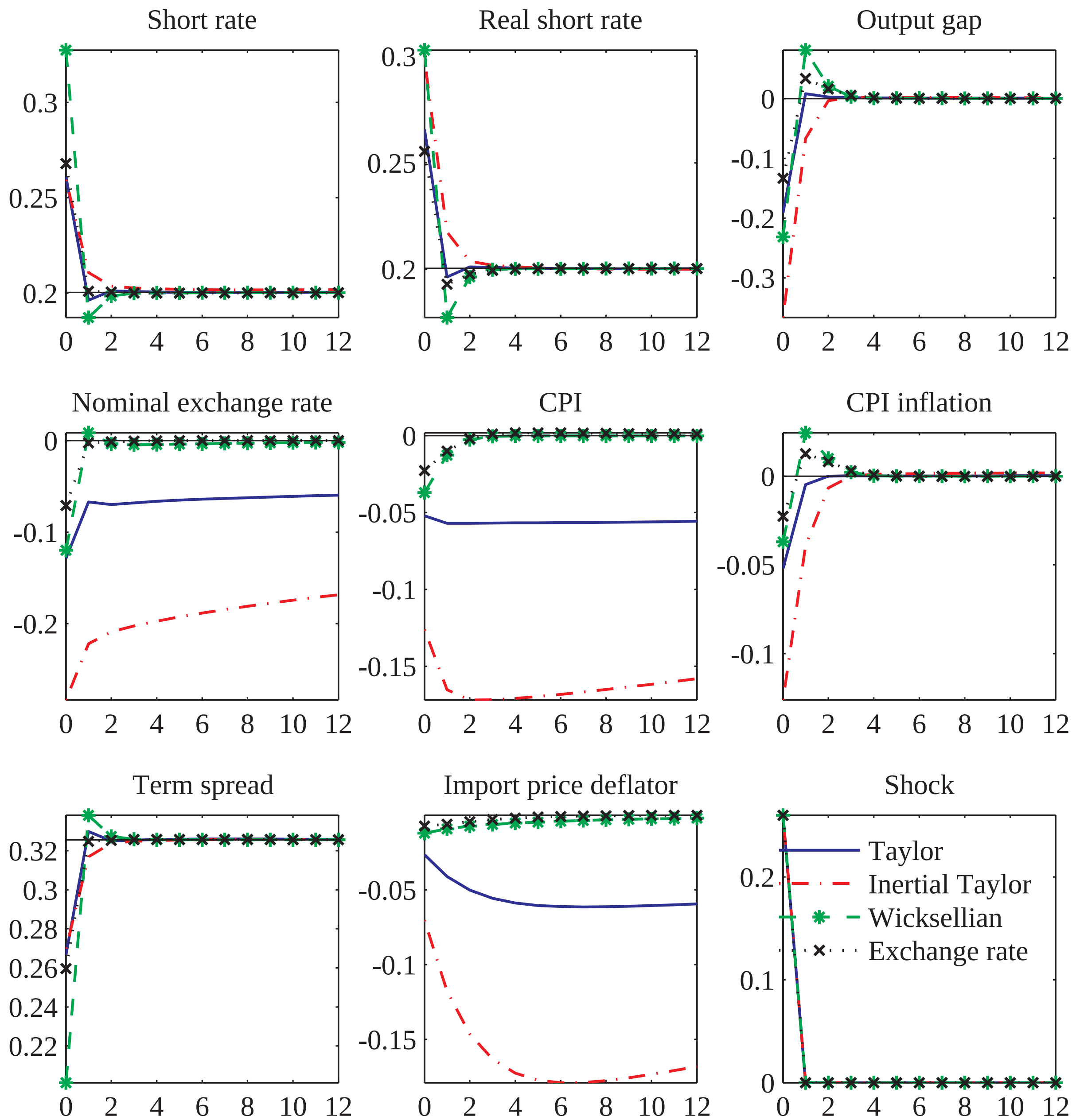
Note: Impulse responses to a risk premium shock with an unconstrained short-term interest rate.

Figure 2 — Technology shock (non-binding ELB)



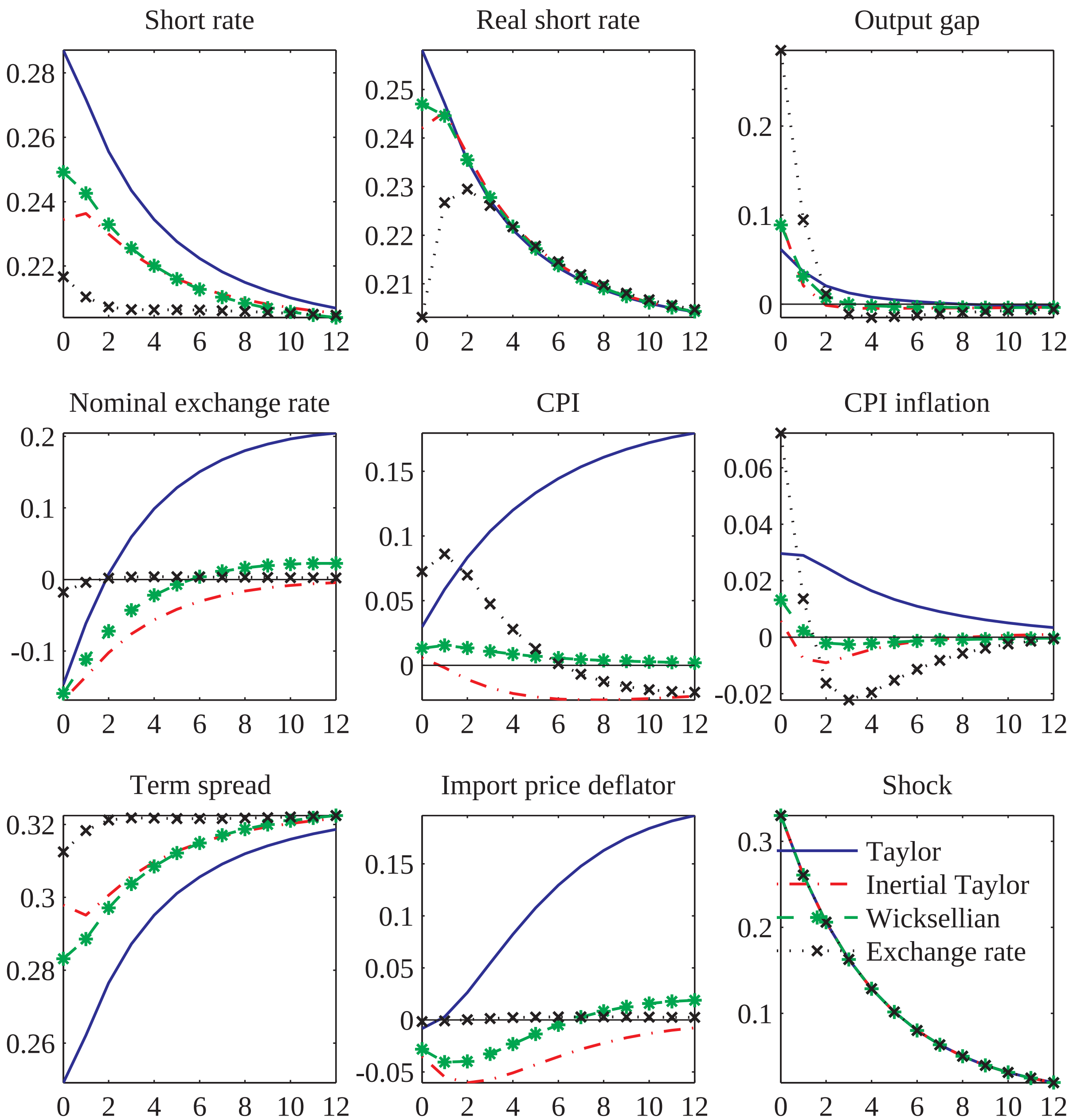
Note: Impulse responses to a technology with an unconstrained short-term interest rate.

Figure 3 — Monetary policy shock (non-binding ELB)



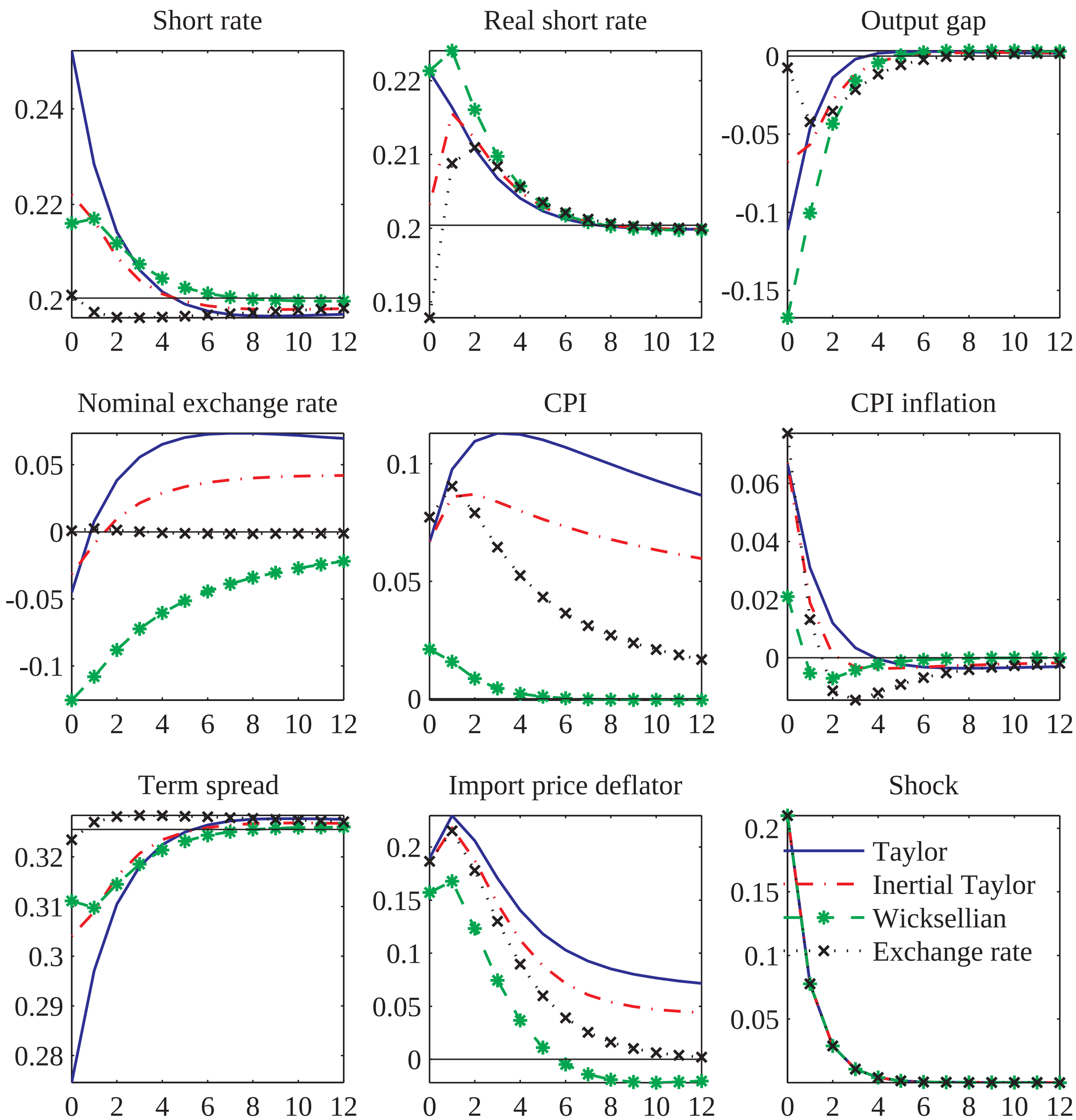
Note: Impulse responses to a monetary policy shock with an unconstrained short-term interest rate.

Figure 4 — Preference shock (non-binding ELB)



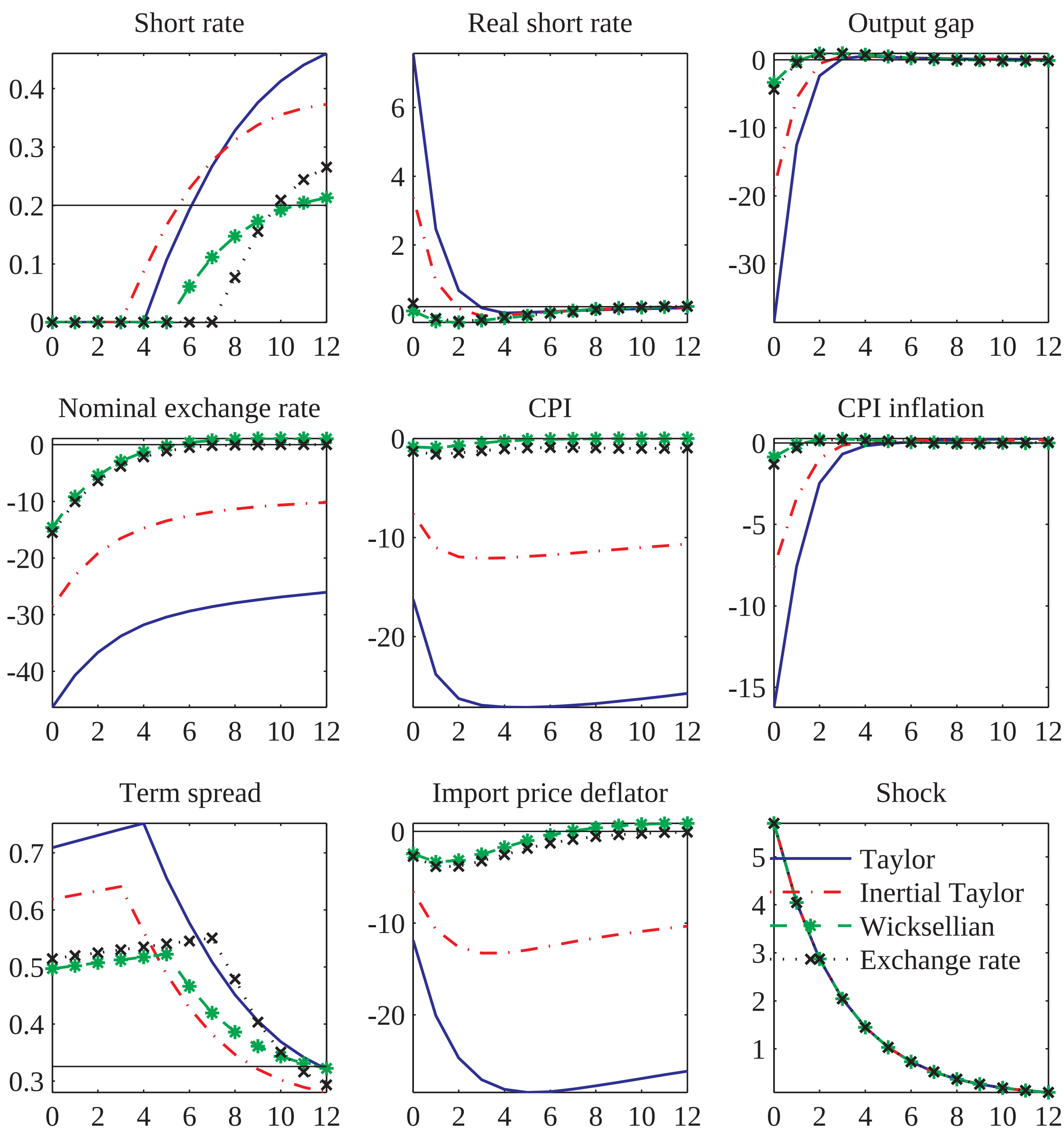
Note: Impulse responses to a preference shock with an unconstrained short-term interest rate.

Figure 5 — Cost push shock (non-binding ELB)



Note: Impulse responses to a cost push shock with an unconstrained short-term interest rate.

Figure 6 — Risk premium shock (binding ELB)



Note: Impulse responses to a risk premium shock with a constrained short-term interest rate.

3 Estimation

This section provides a description of the estimation procedure, documents the results for the posterior distribution of the prior weight λ, and compares our results to the results based on a TVP-VAR.

3.1 Description of sampling procedure

We produce draws from the posterior distribution using the following algorithm. Starting with initial parameter λ_0, we iterate $j = 1, \ldots, J$ times over the following steps:

Step 1: Draw a candidate value λ^* from

$$\lambda^* = \lambda_{j-1} + \zeta$$

with $\zeta \sim N(0, V)$, V being the scaled inverse Hessian of the posterior density evaluated at the posterior mode of $p(\lambda|y) \propto p(\lambda)p(y|\lambda)$. The marginal likelihood $p(y|\lambda)$ can be derived analytically (see Giannone et al. 2015). In our notation, it is

$$\begin{aligned} p(y|\lambda) &= \left(\frac{1}{\pi}\right)^{\frac{n(T_1-p)}{2}} \frac{\Gamma_n\left(\frac{T_1-p+\underline{d}_1}{2}\right)}{\Gamma_n\left(\frac{\underline{d}_1}{2}\right)} \\ &= |\underline{\Omega}_1|^{-\frac{n}{2}} |\underline{\Omega}_1|^{\frac{\underline{d}_1}{2}} |x_1' x_1 + \underline{\Omega}_1^{-1}|^{-1} \\ &= |\underline{\Psi}_1 + \hat{\varepsilon}_1' \hat{\varepsilon}_1 + (\hat{B}_1 - \underline{\hat{\beta}}_1)' \underline{\Omega}_1^{-1} (\hat{B}_i - \underline{\hat{\beta}}_1)|^{\frac{T_i - p + \underline{d}_i}{2}} \end{aligned}$$

Step 2: Accept the candidate values with probability

$$\alpha = \min\left\{1, \frac{p(y|\lambda^*)}{p(y|\lambda_{i,j-1})}\right\}$$

The scale of V is set such that the acceptance rate is between 0.2 and 0.3.

Step 3: Draw $\Sigma_{0,j}$ and $\beta_{0,j}$ from the posterior distribution given in equation (5) in the main paper.

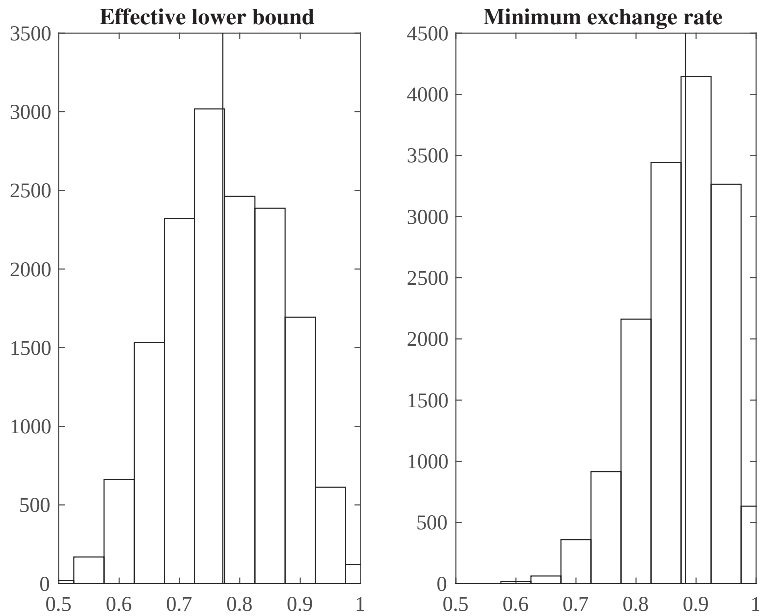
Step 4: For each draw j produce K draws of $Q_{0,j}$ using the method described in Rubio-Ramírez et al. (2010) and retain only the parameter draws for which the implied impulse response functions satisfy certain restrictions.

The estimation for the sample away from the ELB proceeds the same way without steps 1 and 2.

3.2 Posterior distribution of prior weight λ

The prior for the small samples with binding ELB and the minimum exchange rate uses the parameters of the sample during normal times and we determine the weight given to this prior using a formal posterior analysis as described in the previous section. The posterior median of λ, the prior weight, is lower for the sample with binding ELB than for the sample with the minimum exchange rate (see Figure 7). This suggests that the data during normal times are less informative for the ELB sample and indicates that the impulse responses may change.

Figure 7 — Distribution of prior weight (policy uncertainty)



Note: Histogram and median (vertical line) of prior weight (λ) for the specification using the policy uncertainty shock.

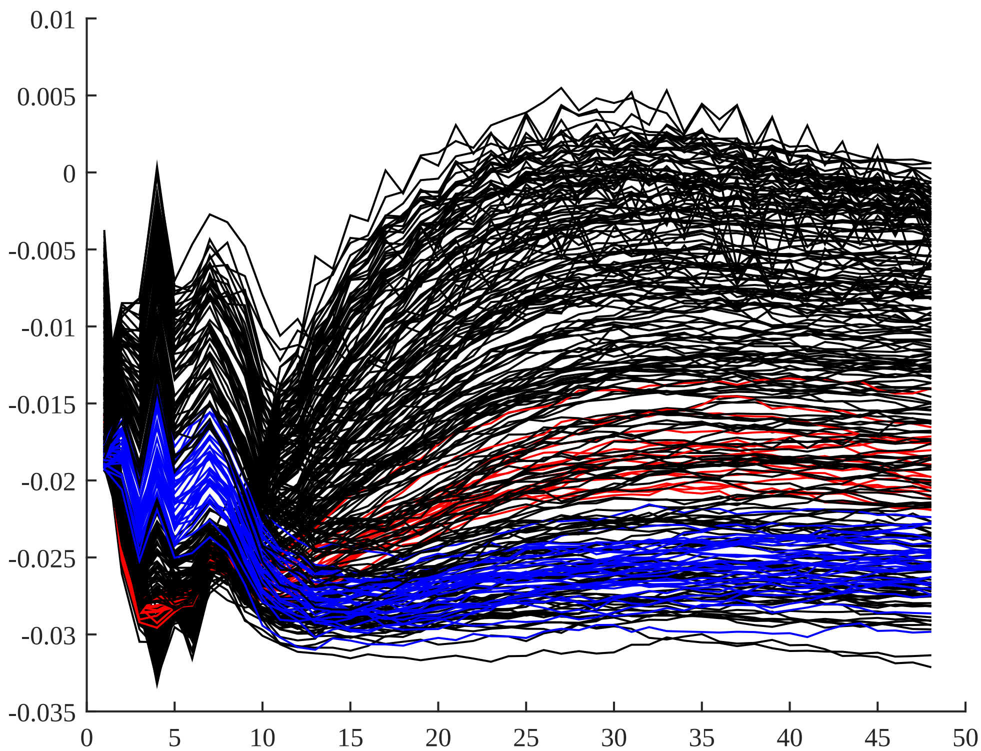
3.3 Comparison with TVP-VAR

To show the advantages of our approach we replicate some results with a TVP-VAR. To circumvent the tractability problem, we opt for a kernel-based estimate following Giraitis et al. (2017), which extends Giraitis and Yates (2014) to the multivariate case with time-varying volatilities. Specifically, we estimate the posterior moments using locally weighted data. Giraitis et al. (2017) show that a classical version of this estimator performs well in a realistic setting.

We use a normal kernel and for the bandwidth, we chose H=60, which is at the lower end of what Giraitis and Yates (2014) suggest and turns out to be close to the minimum required to estimate our sizeable TVP-VAR. The lag number is set to 5, as it is in our baseline analysis.

Figure 8 shows the responses of the exchange rate to a risk premium shock for all points in time using our baseline identification with the policy uncertainty measure. The median responses for the first lower bound sample are coloured red; the responses for the second lower bound sample are coloured blue. For the remaining points in time, the IRFs are shown in black. The red and blue estimates are among the most negative and persistent responses, confirming our results that the persistence of the responses increases markedly at the lower bound.

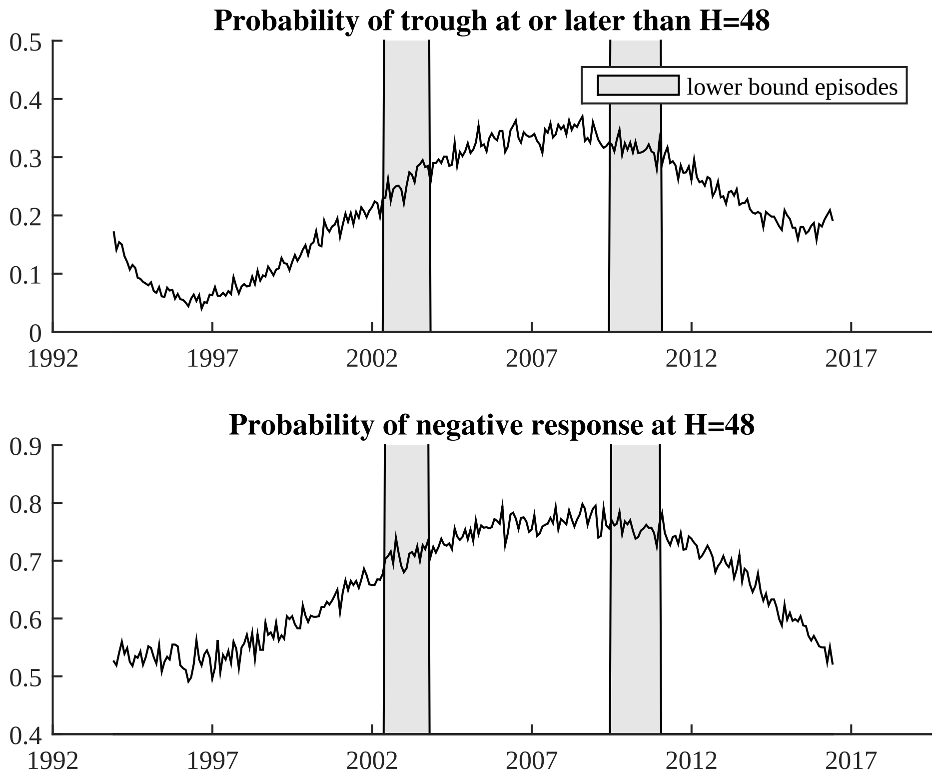
Figure 8 — Impulse responses based on TVP-VAR approach



Note: Posterior median impulse responses to a risk premium shock. The median responses for the first lower bound sample are coloured red; the responses for the second lower bound sample are coloured blue. For the remaining points in time, the IRFs are shown in black.

However, Figure 9 below illustrates why we still prefer our approach with pre-specified samples. It shows the probability of the trough being at H=48 or later (upper panel) and the probability of a negative response at H=48 (lower panel). The statistics signal a relatively persistent response in the ELB samples (shaded), but that these statistics evolve very smoothly. This is because the kernel still gives a large weight to information quite far away from the point in time of interest. As the normal kernel is continuously decaying with increasing time distance from the point of interest, the parameter change is blurred. The method does not allow for the more sudden change in parameters and policy that we attempt to capture using our model.

Figure 9 — Posterior probability based TVP-VAR



Note: Probability of the trough being at H=48 or later (upper panel) and probability of a negative response at H=48 (lower panel). ELB samples are shaded.

4 Additional results

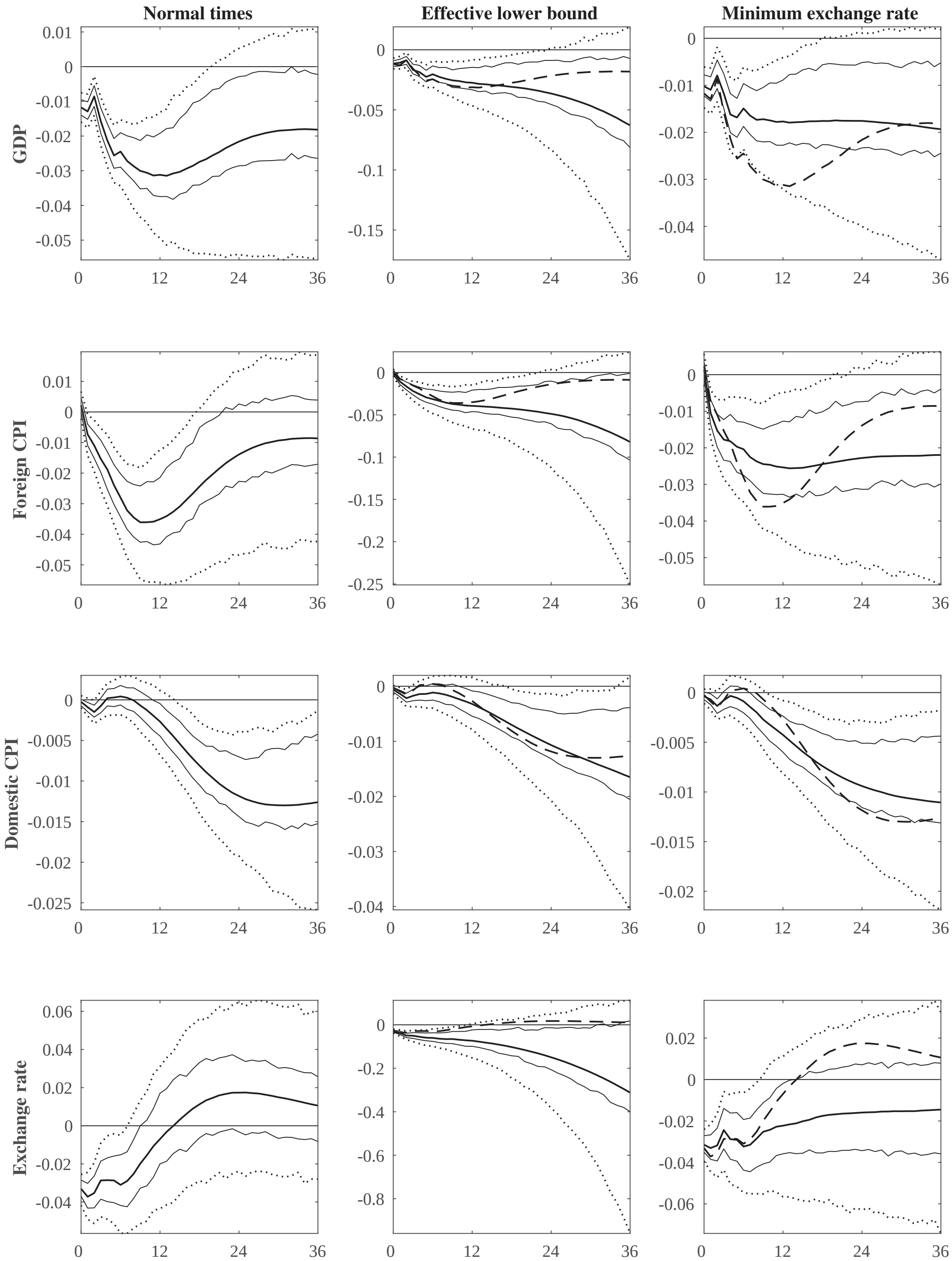
We estimate four main specifications that are based on different information sets and employ different strategies for the identification of the risk shock. Table 3 gives an overview over the various specifications. Because of the small number of observations, we keep the number of variables as small as possible for the corresponding identification scheme. This implies that we include one uncertainty measure at a time in the Cholesky identification schemes and replace them with an import price index when using sign restrictions.

TABLE 3 — MODELS AND INFORMATION SETS

Model	Information set	Identification
Model 1	GDP, CPI (domestic, imported), exchange rate, term spread, policy uncertainty	Cholesky (policy uncertainty ordered first)
Model 2	GDP, CPI (domestic, imported), exchange rate, term spread, VIX	Cholesky (VIX ordered first)
Model 3	GDP, CPI (domestic, imported), exchange rate, term spread, real activity uncertainty	Cholesky (real activity uncertainty ordered first)
Model 4	GDP, CPI (domestic, imported), exchange rate, term spread, import price index	Sign restrictions

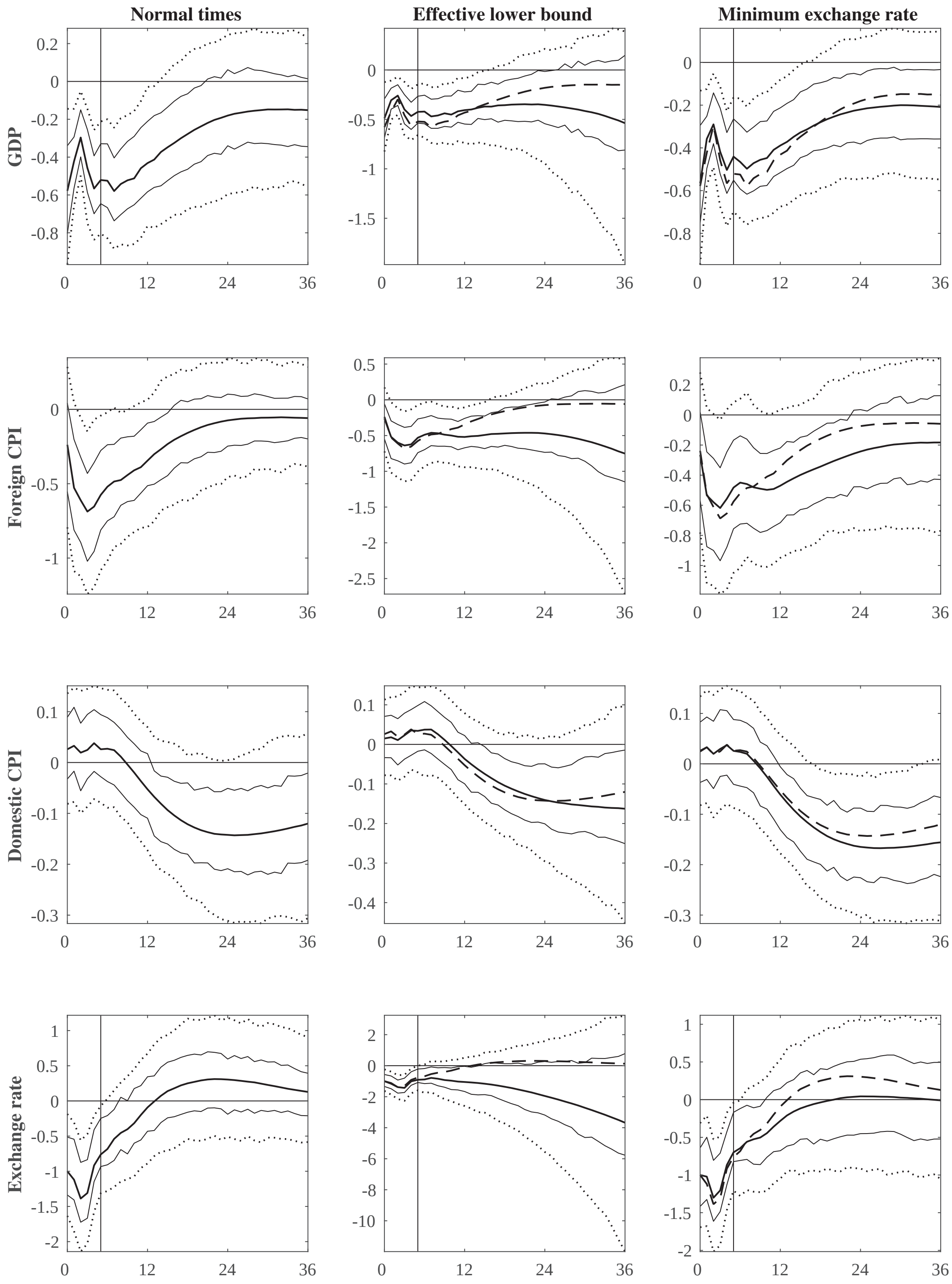
The results of the two alternative specifications including the VIX and sign restrictions provide similar results. Only the model using real activity uncertainty does not lead to an appreciation of the Swiss franc and the difference between the regimes is small. The figures are discussed in detail in the main paper.

Figure 10 — Stock market uncertainty shock



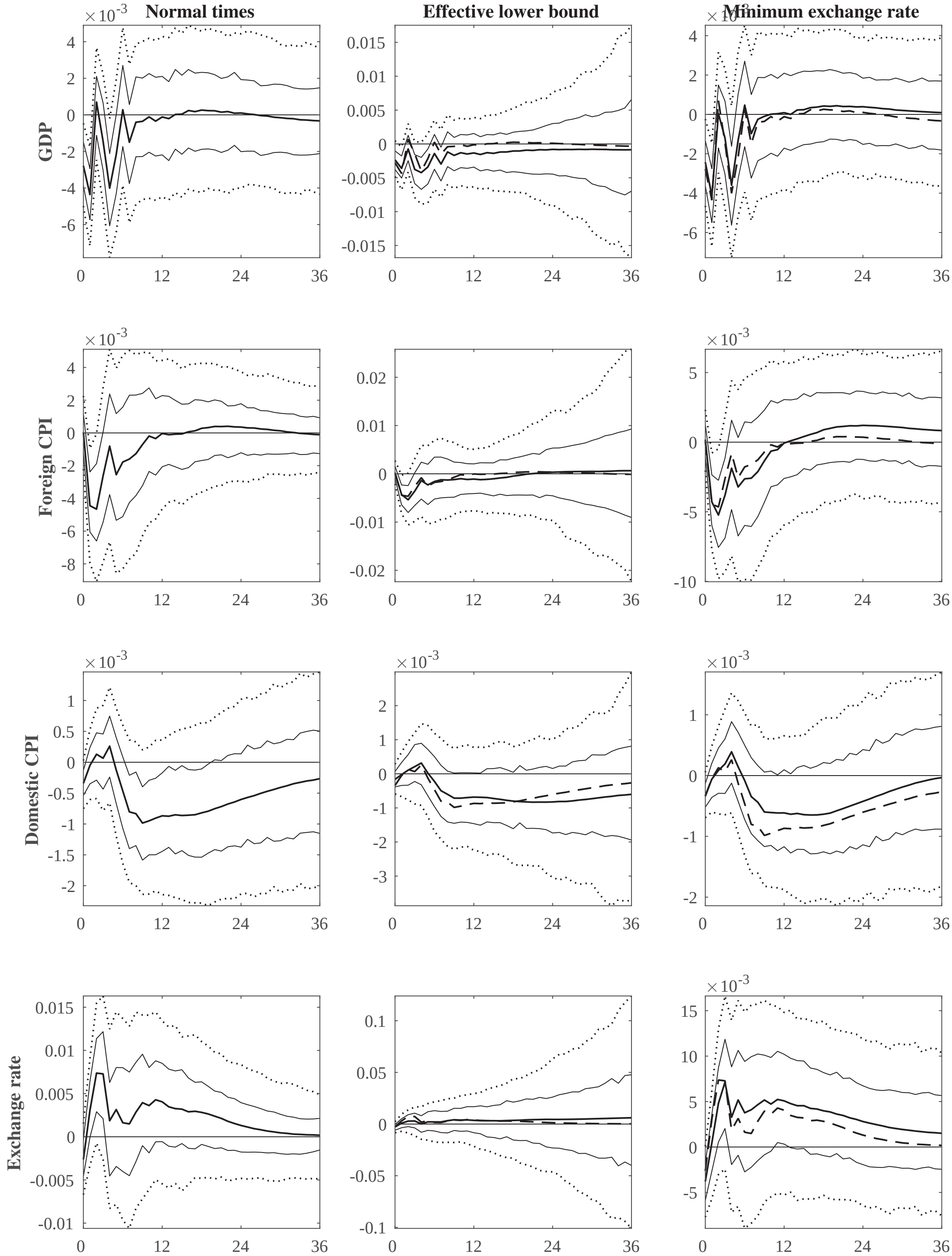
Note: Monthly posterior median impulse responses to a stock market uncertainty shock in terms of one unit of the log-uncertainty measure. 80%- and 50%-HPDI (highest posterior density intervals) are given as solid and dotted lines. Shock identified as an orthogonal innovation to a weighted average of the US and German VIX. The responses are normalized by the initial median response of the VIX. All responses are measured in percent.

Figure 11 — Risk premium shock sign restrictions



Note: Monthly posterior median impulse responses to a risk premium shock identified using sign restrictions. 80%- and 50%-HPDI (highest posterior density intervals) are given as solid and dotted lines. Imposed sign restrictions are indicated by a vertical line. The dashed impulse response reiterates the posterior median in normal times. The responses are normalized to unity by the initial median response of the exchange rate. All responses are measured in percent.

Figure 12 — Real activity uncertainty



Note: Monthly posterior median impulse responses to a real activity uncertainty shock in terms of one unit of the log-uncertainty measure. 80%- and 50%-HPDI (highest posterior density intervals) are given as solid and dotted lines. Imposed sign restrictions are indicated by a vertical line. The dashed impulse response reiterates the posterior median in normal times. The responses are normalized by the initial median response of the real activity uncertainty index. All responses are measured in percent.

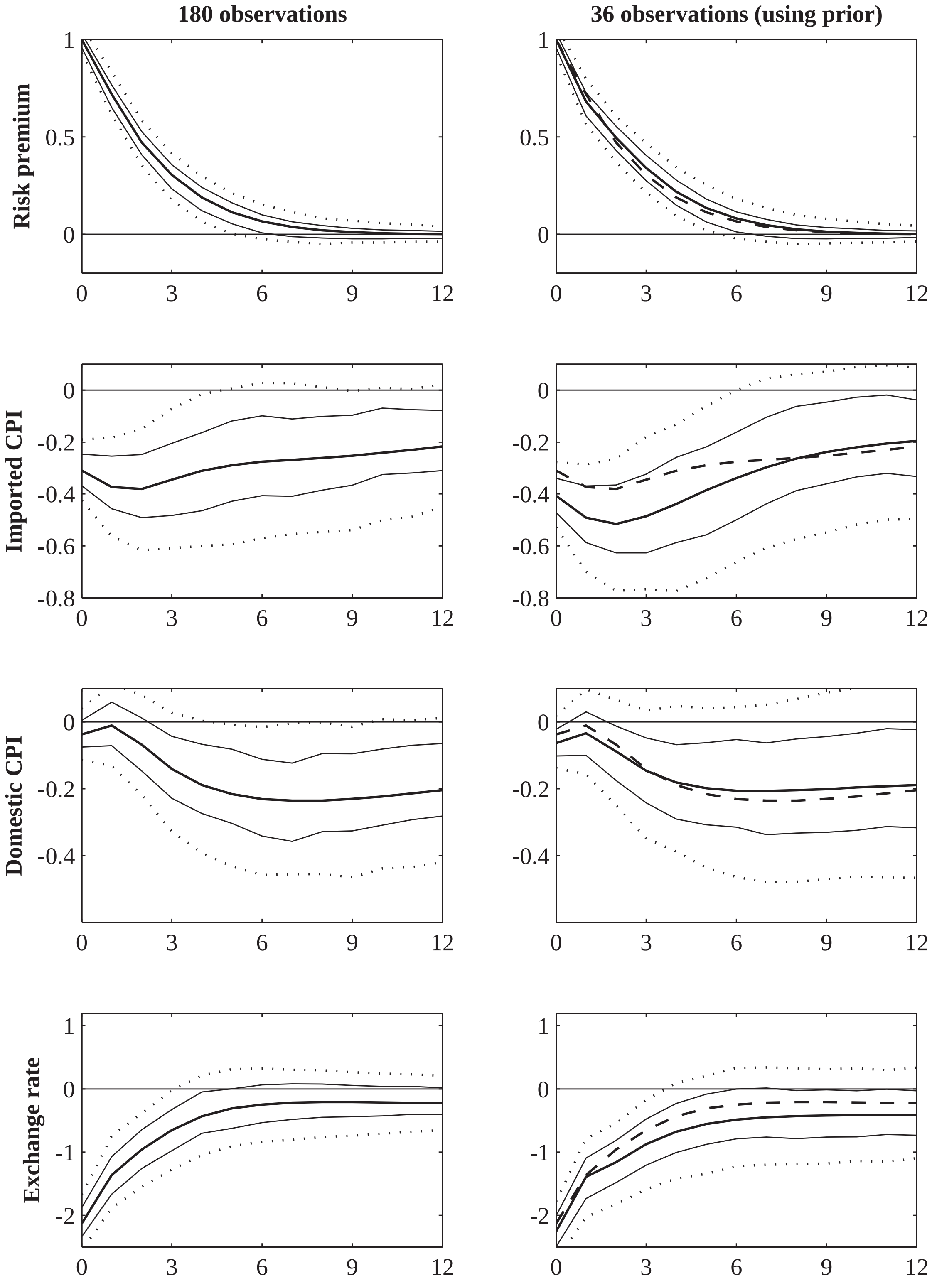
5 Robustness tests

Table 4 — Posterior probabilities using simulated DSGE data

	180 observations for prior			
	Risk premium	Import prices	Consumer prices	Exchange rate
Probability of negative response after 6 periods				
Large sample (prior)	0.15	0.90	0.92	0.71
Tiny sample	0.12	0.92	0.86	0.80
Probability of trough at or later than 6 periods				
Large sample (prior)	0.99	0.21	0.76	0.00
Tiny sample	1.00	0.12	0.62	0.02

Note: The table shows the posterior probabilities for the impulse responses to a risk premium shock estimated using the Bayesian SVAR. The data are generated using the calibrated DSGE model discussed in the previous section. We report two measures for the persistence of the responses: the posterior probability of a negative response after two and six periods and the posterior probability that the minimum of the response occurs at or later than two and six periods. We see that for a small sample, our approach tends to underestimate the persistence according to our preferred measure in the second panel. Therefore, our approach seems conservative.

Figure 13 — Impulse responses using simulated DSGE data



Note: The figure shows impulse responses to a risk premium shock estimated using the Bayesian SVAR. The data are generated using the calibrated DSGE model discussed in the previous section. 80%- and 50%-HPDI (highest posterior density intervals) are given as solid and dotted lines. The left column shows the estimate for a large sample. The right panel shows the estimates for a small sample using the prior based on the large sample (solid line) and the posterior median of the estimate based on the large sample (dashed line). We see that Bayesian VAR is able to accurately recover the impulse responses even on a short period.

Table 5 — Posterior probability of trough at 24 or 36 months

(A) Horizon 36 months (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.13	0.06	0.61	0.02
Effective lower bound	0.70	0.67	0.73	0.78
Minimum exchange rate	0.29	0.21	0.68	0.08

(B) Fewer lags $p = 3$ (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.13	0.12	0.91	0.01
Effective lower bound	0.71	0.68	0.79	0.71
Minimum exchange rate	0.41	0.33	0.88	0.07

(C) Model in first differences (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.10	0.12	0.79	0.01
Effective lower bound	0.17	0.25	0.63	0.20
Minimum exchange rate	0.07	0.08	0.74	0.01

(D) Deflationary shock (sign restrictions)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.08	0.04	0.37	0.17
Binding ELB	0.37	0.35	0.52	0.54
Minimum exchange rate	0.11	0.11	0.45	0.18

(E) Minnesota prior (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.56	0.45	0.82	0.08
Effective lower bound	0.50	0.57	0.73	0.47
Minimum exchange rate	0.52	0.44	0.75	0.20

(F) Lower prior weight $\lambda = 0.2$ (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.19	0.14	0.94	0.03
Effective lower bound	0.76	0.75	0.73	0.74
Minimum exchange rate	0.62	0.58	0.65	0.55

(G) Placebo ELB sample (policy uncertainty)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.19	0.13	0.94	0.03
Placebo sample	0.20	0.11	0.91	0.03

(H) Placebo ELB sample (through later than 6 quarters in simulated DSGE data)	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.07	0.21	0.76	0.00
Placebo sample	0.14	0.12	0.62	0.02

Note: The table gives the posterior probability that the minimum of the response occurs at or later than 36 months (panel A) or 24 months (remaining panels). All specifications except Panels (D) and (H) use the policy uncertainty measure. Panel (D) identifies a general deflationary shock where import prices fall and the term spread increases, but all other variables are left unrestricted. Panel (G) estimates the impulse responses on a placebo sample when the ELB was not binding to show the impact of using a small sample. Panel (H) repeats the exercise using an SVAR estimated on simulated DSGE data with 180 observations (normal times) and 36 observations (placebo sample).

Table 6 — Posterior probabilities of negative response

(A) Horizon 36 months (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.92	0.81	0.97	0.27
Effective lower bound	0.96	0.95	0.92	0.94
Minimum exchange rate	0.98	0.93	0.97	0.78

(B) Fewer lags $p = 3$ (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.97	0.95	0.75	0.36
Effective lower bound	0.95	0.95	0.77	0.89
Minimum exchange rate	0.97	0.93	0.83	0.86

(C) Model in first differences (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.96	0.85	0.50	0.85
Effective lower bound	0.97	0.89	0.41	0.86
Minimum exchange rate	0.98	0.88	0.51	0.91

(D) Deflationary shock (sign restrictions)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.51	0.47	0.86	0.23
Binding ELB	0.58	0.59	0.80	0.57
Minimum exchange rate	0.54	0.57	0.92	0.30

(E) Minnesota prior (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.97	0.84	0.69	0.56
Effective lower bound	0.86	0.80	0.64	0.80
Minimum exchange rate	0.92	0.78	0.71	0.51

(F) Lower prior weight $\lambda = 0.2$ (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.98	0.89	0.93	0.38
Effective lower bound	0.64	0.65	0.60	0.65
Minimum exchange rate	0.64	0.64	0.66	0.66

(G) Placebo ELB sample (policy uncertainty)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.98	0.88	0.94	0.40
Placebo sample	1.00	0.96	0.99	0.30

(H) Placebo ELB sample (negative response later than 6 quarters in simulated DSGE data)

	GDP	Imported CPI	Domestic CPI	Exchange rate
Normal times	0.91	0.92	0.97	0.63
Placebo sample	0.80	0.98	0.98	0.79

Note: The table gives the posterior probability that the response is negative in 36 months (panel A) or 24 months (remaining panels). All specifications except Panels (D) and (H) use the policy uncertainty measure. Panel (D) identifies a general deflationary shock where import prices fall and the term spread increases but the exchange rate is left unrestricted. Panel (G) estimates the impulse responses on a placebo sample when the ELB was not binding to show the impact of using a small sample. Panel (H) repeats the exercise using an SVAR estimated on simulated DSGE data with 180 observations (normal times) and 36 observations (placebo sample).

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