The Effects of Permanent Monetary Shocks on Exchange Rates and Uncovered Interest Rate Differentials

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Motivation

• Most existing empirical work assumes that monetary policy shocks come in only one flavor, namely, in the transitory one.

• However, recent work on the **Neo-Fisher effect** has shown that it is important to distinguish between transitory and permanent monetary disturbances for at least two reasons:
(1) Permanent monetary policy shocks have been shown to be **at least as important** as transitory ones in explaining the dynamics of changes in output, inflation, and interest rates in the United States and Japan (Uribe, 2018) and the U.K. France, and the Euro Area (Azevedo, Ritto, Teles, 2019).
(2) And the sign of the response of output and inflation to transitory and permanent monetary shocks is of the **opposite sign**.

• Motivated by these findings, the present paper studies the effects of monetary policy shocks on exchange rates and uncovered interest rate differentials in frameworks that distinguish between transitory and permanent monetary shocks.

Related Literature I:

A monetary tightening causes:

- an appreciation of the nominal exchange rate
- deviations from uncovered interest rate parity in favor of the high interest rate currency

See, for example, Eichenbaum and Evans, 1995; Kim and Roubini, 2000; Faust and Rogers, 2003; Bjørnland, 2009; Scholl and Uhlig, 2008; Kim, Moon, and Velasco, 2017; Faust Rogers, Swanson, and Wright, 2003; Inoue and Rossi, 2019; Zhang, 2020; Hettig, Müller, and Wolf, 2018.

Main difference across these papers is the identification of the monetary policy shock (recursive, SVAR, sign restrictions, high frequency, narrative).

Related Literature II: Permanent Monetary Shocks

- Uribe (2018) and Azevedo, Ritto, Teles (2019): a permanent monetary tightening causes
  - an increase in inflation already in the short run
  - no output loss

- De Michelis and Iacoviello (2016): An increase in the U.S. inflation target causes
  - a real depreciation of the U.S. dollar in the short run.

Main findings of present paper:

• transitory tightenings cause an appreciation of the exchange rate, whereas permanent tightenings cause a depreciation (already in the short run).

• transitory tightenings cause deviations from uncovered interest-rate parity in favor of domestic assets, whereas permanent tightenings cause deviations in favor of foreign assets.

• permanent monetary shocks explain the majority of short-run movements in dollar-pound and dollar-yen exchange rates.

• the estimated responses are qualitatively consistent with the predictions of an open economy NK model with incomplete markets and portfolio adjustment costs.

Permanent and Transitory Monetary Policy Shocks in an Open Economy New Keynesian Model with Portfolio Adjustment Costs

Before going to the empirical analysis, let's look at the predictions of a (linearized) open economy NK model à la Galí-Monacelli (2005) but with:

– permanent monetary policy shocks and

– deviations from uncovered interest rate parity

Assume incomplete international financial markets. Deviations from UIP arise due to portfolio adjustment costs (PAC) for foreign bonds as in Schmitt-Grohé and Uribe (2003). Yakhin (2020) shows that, up to a first-order approximation, a model with PAC is isomorphic to the Gabaix and Maggiori (2015) or the Fanelli and Straub (2019) model of deviations from UIP.

Transitory (z_t^m) and permanent (X_t^m) monetary policy shocks

- Nominal rate, i_t, is cointegrated with X_t^m.
- Inflation, $\pi_{H,t}$, also cointegrated with X_t^m
- Monetary policy follows a Taylor rule buffeted by both shocks

$$i_t = r + \alpha_\pi \pi_{H,t} + \alpha_y \widehat{Y}_{H,t} + z_t^m + (1 - \alpha_\pi) X_t^m$$

Deviations from Uncovered Interest Rate Parity from Portfolio Adjustment Costs

Incomplete markets, only nominal bonds, domestic (D_t) and foreign (D_t^*). Foreign bonds are subject to convex portfolio adjustment costs (PAC), $\psi(D_t^*)$.

Budget constraint:

$$P_t C_t + (1+i_{t-1})D_{t-1} + \mathcal{E}_t(1+i_{t-1}^*)D_{t-1}^* = P_{H,t}Y_{H,t} + D_t + \mathcal{E}_t\left[D_t^* - \psi(D_t^*)\right]$$

Effective interest rate on foreign bonds: $\frac{1+i_t^*}{1-\psi'(D_t^*)}$

Let $uid_t \equiv i_t - i_t^* - E_t\epsilon_{t+1}$, where $\epsilon_{t+1} \equiv \ln \mathcal{E}_{t+1}/\mathcal{E}_t$.

PAC model implies that (up to first-order)

$$\widehat{uid}_t = \Psi \widehat{D}_t^*; \qquad \text{with } \Psi > 0$$

$\Rightarrow$ If tightening deteriorates the current account, then $uid_t \uparrow$.

First-order accurate numerical approximation of solution

- To obtain a balanced growth path, assume some form of lagged indexation.

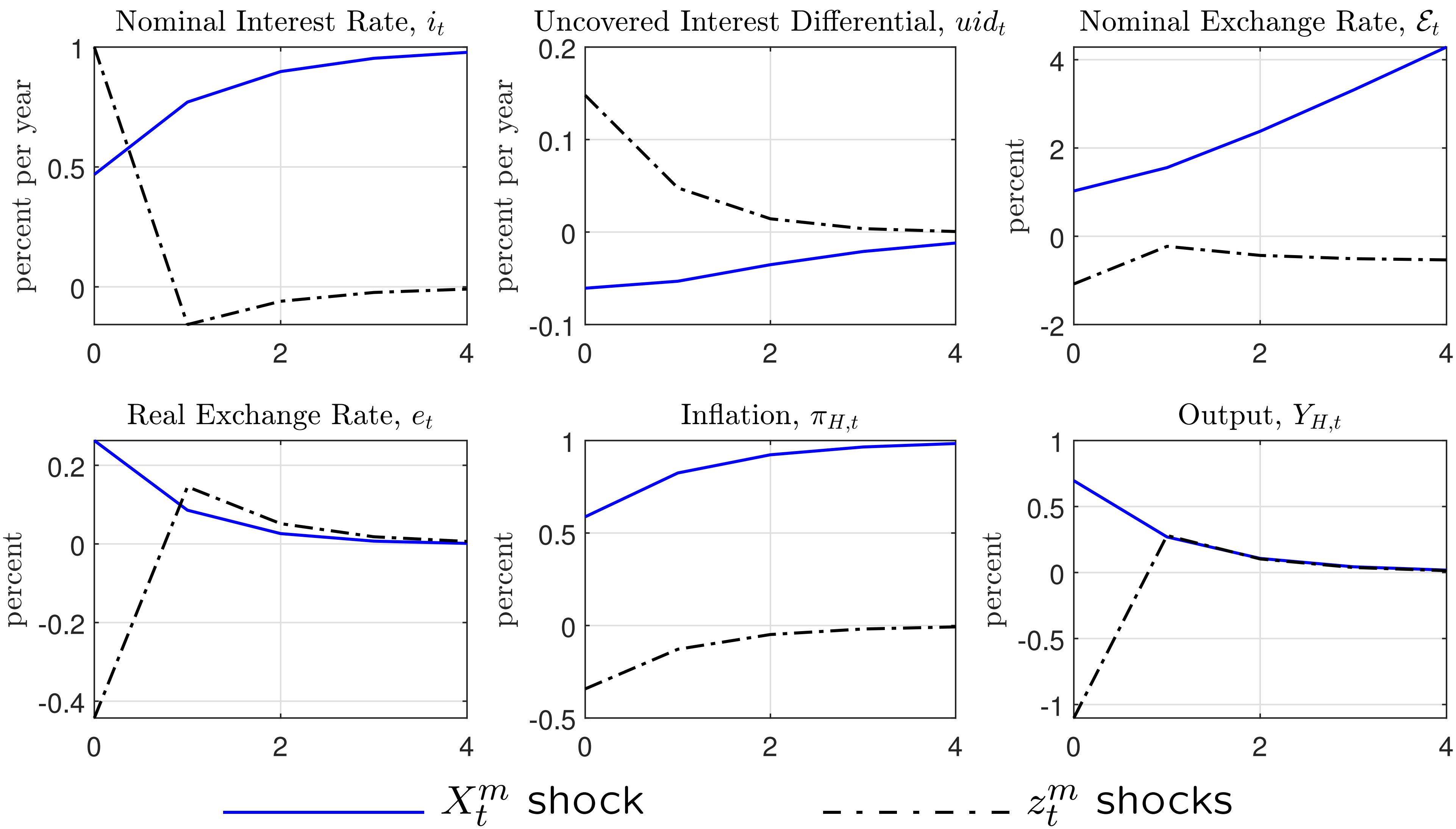
- Monetary policy shocks are i.i.d.

- Calibration: The time unit is one quarter. Parameters as in Galí (2015), but for η and ψ.

η	1.5	trade elasticity
β	0.99	subjective discount factor
θ	0.75	Calvo price stickiness parameter
φ	5	inverse of Frisch elasticity
σ	1	intertemporal elasticity of substitution
ϵ	9	elasticity of substitution across varietes of intermediate inputs
ν	0.4	home bias parameter
α_π	1.5	Taylor rule coefficient
α_y	0.125	Taylor rule coefficient
Ψ	1	portfolio adjustment cost parameter

- Impulse responses to transitory (z_t^m) and permanent (X_t^m) monetary policy shocks

Impulse Responses to Permanent (X_t^m) and Transitory (z_t^m) Monetary Shocks in an Open Economy NK Model with PAC



Observations on the figure:

Transitory tightening:

• as familiar from Gali-Monacelli, inflation and output fall and the nominal and real exchange rate appreciate with an overshooting effect.

• with PAC, UIP no longer holds. Excess returns in favor of the high interest rate asset. Why? 2 opposing effects.
(1) Intertemporal substitution effect: real rate $\uparrow$, save more, borrow less, $D_t^* \downarrow$.
(2) Expenditure switching effect: Temporarily imports are cheap, and exports are expensive, thus increase trade deficit, borrow more.
For sufficiently large trade elasticity (2) dominates, country borrows more, $D_t^* \uparrow$, marginal portfolio adjustment costs $\uparrow$, uncovered interest rate differential $\uparrow$.

Permanent tightening:

• as familiar from Uribe (2018) inflation and output increase. NEW: Nominal and Real Exchange Rate <u>depreciate</u>.

• with PAC, excess return for the low interest rate (foreign) asset, $uid_t \downarrow$. Again determined as a tradeoff between an intertemporal SE effect and and intratemporal SE effect: (1) Intertemporal substitution effect: real rate $\downarrow$, save less, borrow more, $D_t^* \uparrow$. This leads to $uid_t \uparrow$. (2) Intratemporal substitution effect: Depreciation increases price of imports and lowers price of exports. Expenditure switch towards domestic goods; trade balance improves, current account improves, this means $D_t^* \downarrow$, effective rate of foreign debt down, and $uid_t \downarrow$ For sufficiently large trade elasticity (1) dominates, $uid_t \downarrow$.

Empirical Model

Variables of Interest

The empirical model is an open-economy extension of Uribe (2018).

Let

$$\begin{bmatrix} y_t \\ \pi_t \\ i_t \\ \epsilon_t \\ i_t^* \\ \pi_t^* \end{bmatrix} = \begin{bmatrix} \text{log of real US output} \\ \text{US inflation} \\ \text{US nominal interest rate} \\ \text{change in dollar exchange rate} \\ \text{foreign nominal interest rate} \\ \text{foreign inflation} \end{bmatrix}$$

Cyclical Components of Variables of Interest

The variables of interest are nonstationary.

Their cyclical components are stationary yet **unobservable**.

$$\begin{bmatrix} \widehat{y}_t \\ \widehat{\pi}_t \\ \widehat{i}_t \\ \widehat{\epsilon}_t \\ \widehat{i}_t^* \\ \widehat{\pi}_t^* \end{bmatrix} \equiv \begin{bmatrix} y_t - X_t \\ \pi_t - X_t^m \\ i_t - X_t^m \\ \epsilon_t - (1-\alpha)X_t^m + X_t^{m*} \\ i_t^* - \alpha X_t^m - X_t^{m*} \\ \pi_t^* - \alpha X_t^m - X_t^{m*} \end{bmatrix}$$

$X_t =$ permanent nonmonetary shock (output trend)

$X_t^m =$ domestic (U.S.) permanent monetary shock

$X_t^{m*} =$ foreign permanent monetary shock

- assume that X^m does not affect y in the long run

- structural empirical model allows to impose more restrictions than, say, Blanchard and Quah, where impossible to impose both that X_t^m has no long run effect on output and X_t has no long run effect on inflation.

- assume that i and π co-integrated with X^m; (we do not allow permanent component in the real rate)

- if $\alpha = 1$ and variance of $X^{m*} = 0$, then just 1 permanent monetary shock.

- assume that real depreciation rate is stationary

The cyclical unobservable components follow an AR process

$$\begin{bmatrix} \widehat{y}_t \\ \widehat{\pi}_t \\ \widehat{i}_t \\ \widehat{\epsilon}_t \\ \widehat{i}^*_t \\ \widehat{\pi}^*_t \end{bmatrix} = B(L) \begin{bmatrix} \widehat{y}_{t-1} \\ \widehat{\pi}_{t-1} \\ \widehat{i}_{t-1} \\ \widehat{\epsilon}_{t-1} \\ \widehat{i}^*_{t-1} \\ \widehat{\pi}^*_{t-1} \end{bmatrix} + C \begin{bmatrix} \Delta X^m_t \\ z^m_t \\ \Delta X_t \\ z_t \\ \Delta X^{m*}_t \\ z^*_t \\ w^*_t \end{bmatrix}; \begin{bmatrix} \Delta X^m_t \\ z^m_t \\ \Delta X_t \\ z_t \\ \Delta X^{m*}_t \\ z^*_t \\ w^*_t \end{bmatrix} = \rho \begin{bmatrix} \Delta X^m_{t-1} \\ z^m_{t-1} \\ \Delta X_{t-1} \\ z_{t-1} \\ \Delta X^{m*}_{t-1} \\ z^*_{t-1} \\ w^*_{t-1} \end{bmatrix} + \psi \begin{bmatrix} \nu^1_t \\ \nu^2_t \\ \nu^3_t \\ \nu^4_t \\ \nu^5_t \\ \nu^6_t \\ \nu^7_t \end{bmatrix}$$

X^m_t = permanent monetary shock
z^m_t = transitory monetary shock
X_t = permanent nonmonetary shock
z_t = transitory nonmonetary shock
X^{m*}_t = foreign permanent monetary shock
z^*_t = transitory foreign shock
w^*_t = UIP shock

Innovations $\nu_t \sim \text{iid}\,\mathcal{N}(0, I)$, ρ and ψ are diagonal matrices.

(To simplify the exposition constants are omitted.)

6 Observables

Sample: 1974Q1 to 2018Q1.

(1) Δy_t, output growth rate.

(2) $r_t \equiv i_t - \pi_t$, interest-rate-inflation differential.

(3) Δi_t, time difference of domestic nominal rate.

(4) $\Delta \epsilon_t$, time difference of devaluation rate.

(5) Δi_t^*, time difference of foreign nominal rate.

(6) ϵ_t^r, real devaluation rate.

Foreign country either United Kingdom, or Japan, or Canada.

Observation Equations

We can then link the unobservables to the observables as follows:

Recall

$$\begin{bmatrix} \widehat{y}_t \\ \widehat{\pi}_t \\ \widehat{i}_t \\ \widehat{\epsilon}_t \\ \widehat{i}^*_t \\ \widehat{\pi}^*_t \end{bmatrix} \equiv \begin{bmatrix} y_t - X_t \\ \pi_t - X^m_t \\ i_t - X^m_t \\ \epsilon_t - (1-\alpha)X^m_t + X^{m*}_t \\ i^*_t - \alpha X^m_t - X^{m*}_t \\ \pi^*_t - \alpha X^m_t - X^{m*}_t \end{bmatrix}$$

$$\begin{aligned} \Delta y_t &= \widehat{y}_t - \widehat{y}_{t-1} + \Delta X_t \\ r_t &= \widehat{i}_t - \widehat{\pi}_t \\ \Delta i_t &= \widehat{i}_t - \widehat{i}_{t-1} + \Delta X^m_t \\ \Delta \epsilon_t &= \widehat{\epsilon}_t - \widehat{\epsilon}_{t-1} + (1-\alpha)\Delta X^m_t - \Delta X^{m*}_t \\ \Delta i^*_t &= \widehat{i}^*_t - \widehat{i}^*_{t-1} + \Delta X^{m*}_t + \alpha \Delta X^m_t \\ \epsilon^r_t &= \widehat{\epsilon}_t + \widehat{\pi}^*_t - \widehat{\pi}_t \end{aligned} \tag{1}$$

Measurement Errors

$$o_t = \begin{bmatrix} \Delta y_t \\ r_t \\ \Delta i_t \\ \Delta \epsilon_t \\ \Delta i_t^* \\ \epsilon_t^r \end{bmatrix} + \mu_t \tag{2}$$

where μ_t is a vector of measurement errors distributed i.i.d. $N(\emptyset, R)$, with R diagonal.

Measurement errors are restricted to explain at most 10 percent of variance of observables.

Long-Run Identification Assumptions

1. Output (y_t) is cointegrated with the permanent nonmonetary shock (X_t).

2. Inflation (π_t) and the nominal interest rate (i_t) are cointegrated with the permanent monetary shock (X_t^m).

3. The foreign nominal interest rate (i_t^*) and inflation (π_t^*) is cointegrated with ($X_t^{m*} + \alpha X_t^m$).

4. The depreciation rate (ϵ_t) is cointegrated with ($(1-\alpha)X_t^m - X_t^{m*}$).

Short-Run Identification Assumptions

$$\begin{bmatrix} \widehat{y}_t \\ \widehat{\pi}_t \\ \widehat{i}_t \\ \widehat{\epsilon}_t \\ \widehat{i}^*_t \\ \widehat{\pi}^*_t \end{bmatrix} = B(L) \begin{bmatrix} \widehat{y}_{t-1} \\ \widehat{\pi}_{t-1} \\ \widehat{i}_{t-1} \\ \widehat{\epsilon}_{t-1} \\ \widehat{i}^*_{t-1} \\ \widehat{\pi}^*_{t-1} \end{bmatrix} + C \begin{bmatrix} \Delta X^m_t \\ z^m_t \\ \Delta X_t \\ z_t \\ \Delta X^{m*}_t \\ z^*_t \\ w^*_t \end{bmatrix}$$

1. A transitory monetary shock that increases the interest rate ($z^m_t \uparrow$) has zero impact effect on output and inflation: $C_{12} = C_{22} = C_{62} = 0$.
2. The permanent U.S. monetary shock (X^m_t) has zero impact effect on output and inflation: $C_{11} = 0$, $C_{21} = -1$, $C_{61} = -\alpha$.
3. The permanent foreign monetary shock (X^{m*}_t) has zero impact effect on output and inflation: $C_{15} = C_{25} = 0$, $C_{65} = -1$.
4. The UIP shock, w^*_t, affects on impact only the depreciation rate, ϵ_t: $C_{17} = C_{27} = C_{37} = C_{57} = C_{67} = 0$.
5. The foreign transitory shock (z^*_t) can affect on impact the exchange rate and the foreign interest rate: $C_{16} = C_{26} = C_{36} = C_{66} = 0$.
6. The permanent foreign monetary shock (X^{m*}_t) has zero impact effect on the U.S. interest rate: $C_{35} = 0$.

Estimation:

The empirical model can be written as

$$\widehat{Y}_t = \sum_{i=1}^{L} B_i \widehat{Y}_{t-i} + C u_t \tag{3}$$

$$u_t = \rho u_{t-1} + \psi \nu_t \tag{4}$$

where

$$\widehat{Y}_t \equiv \begin{bmatrix} y_t - X_t \\ \pi_t - X_t^m \\ i_t - X_t^m \\ \epsilon_t - (1-\alpha)X_t^m + X_t^{m*} \\ i_t^* - \alpha X_t^m - X_t^{m*} \\ \pi_t^* - \alpha X_t^m - X_t^{m*} \end{bmatrix}; \quad \text{and } u_t \equiv \begin{bmatrix} \Delta X_t^m \\ z_t^m \\ \Delta X_t \\ z_t \\ \Delta X_t^{m*} \\ z_t^* \\ w_t^* \end{bmatrix}$$

Empirical Model in State Space Form

Let $\xi_t \equiv \begin{bmatrix} \widehat{Y}_t & \widehat{Y}_{t-1} & \dots & \widehat{Y}_{t-L+1} & u_t \end{bmatrix}'$

Then

$$\xi_{t+1} = F\,\xi_t + P\,\nu_{t+1}$$

$$o_t = H'\,\xi_t + \mu_t$$

We wish to estimate the matrices F, P, and H, which are known functions of the primitive matrices B_i, $i = 1, \dots L$, C, ρ, ψ, and R.

The state vector ξ_t is latent, and the vector o_t is observable.

The likelihood of the data can be readily obtained via the Kalman filter.

We estimate the model using Bayesian techniques.

Priors on the Elements of the Matrix C

$$\widehat{Y}_t = B(L)\widehat{Y}_{t-1} + \begin{bmatrix} 0 & 0 & N(0,1) & 1 & 0 & 0 & 0 \\ -1 & 0 & N(0,1) & N(0,1) & 0 & 0 & 0 \\ N(-1,1) & 1 & N(0,1) & N(0,1) & 0 & 0 & 0 \\ U(-1,0) & N(0,1) & N(0,1) & N(0,1) & N(1,1) & N(0,1) & 1 \\ U(-1,0) & N(0,1) & N(0,1) & N(0,1) & N(-1,1) & 1 & 0 \\ -\alpha & 0 & N(0,1) & N(0,1) & -1 & 0 & 0 \end{bmatrix} u_t$$

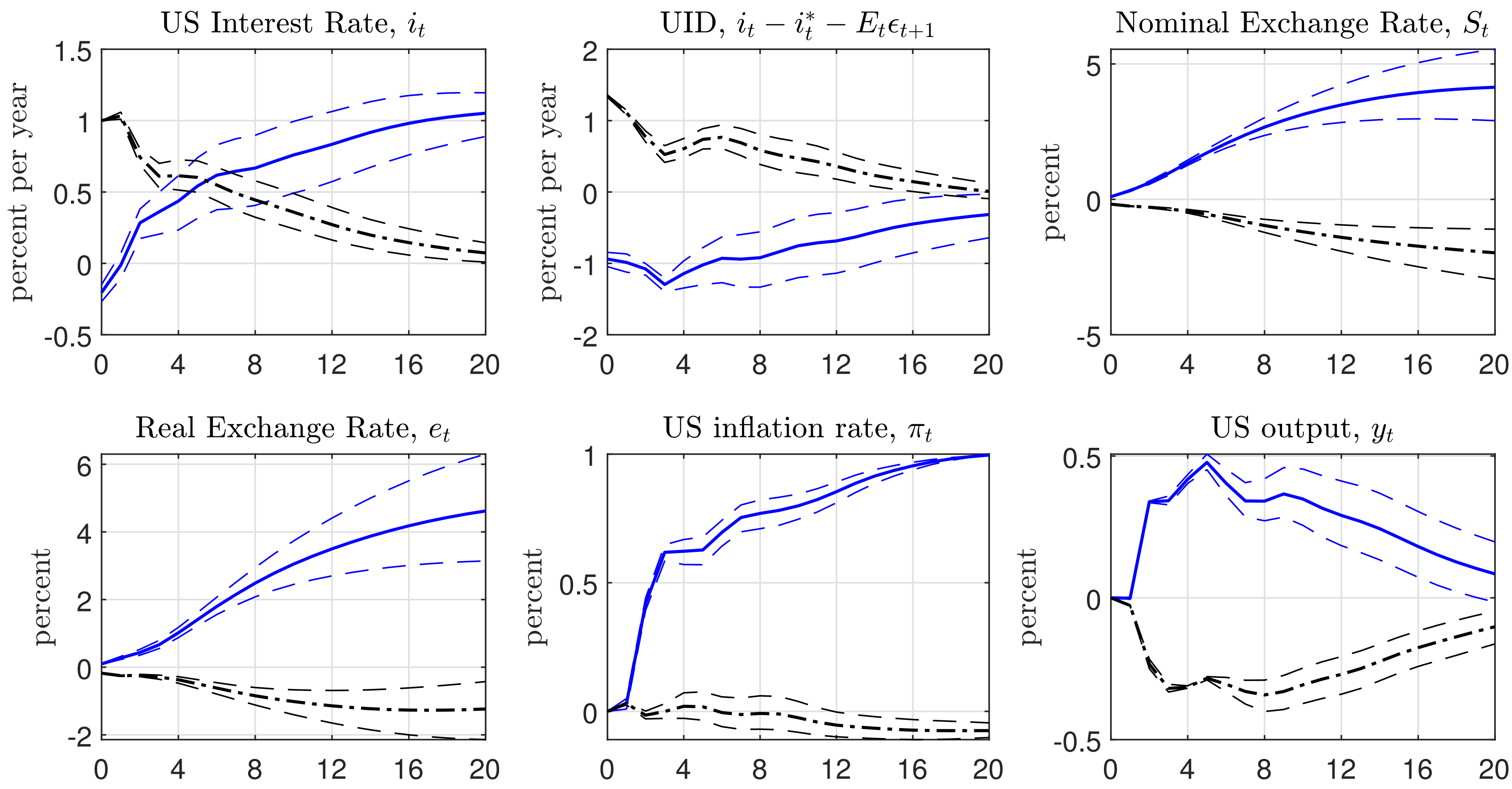
Recall

$$\widehat{Y}_t \equiv \begin{bmatrix} y_t - X_t \\ \pi_t - X_t^m \\ i_t - X_t^m \\ \epsilon_t - (1-\alpha)X_t^m + X_t^{m*} \\ i_t^* - \alpha X_t^m - X_t^{m*} \\ \pi_t^* - \alpha X_t^m - X_t^{m*} \end{bmatrix}; \quad \text{and } u_t \equiv \begin{bmatrix} \Delta X_t^m \\ z_t^m \\ \Delta X_t \\ z_t \\ \Delta X_t^{m*} \\ z_t^* \\ w_t^* \end{bmatrix}$$

Empirical Results:

United States - United Kingdom

Impulse Responses to Permanent and Transitory U.S. Monetary Shocks: United Kingdom



Notes. Solid lines display the posterior mean response to a permanent monetary shock that increases the U.S. nominal interest rate by 1 annual percentage point in the long run (an increase in X_t^m). Dash-dotted lines display the posterior mean response to a transitory monetary shock that increases the U.S. nominal interest rate by 1 annual percentage point on impact (an increase in z_t^m). Broken lines are asymmetric 95-percent confidence bands computed using the Sims-Zha (1999) method.

The Importance of Permanent Monetary Shocks for Exchange Rates

Forecast Error Variance Decomposition at Horizon 12 quarters. US-UK pair

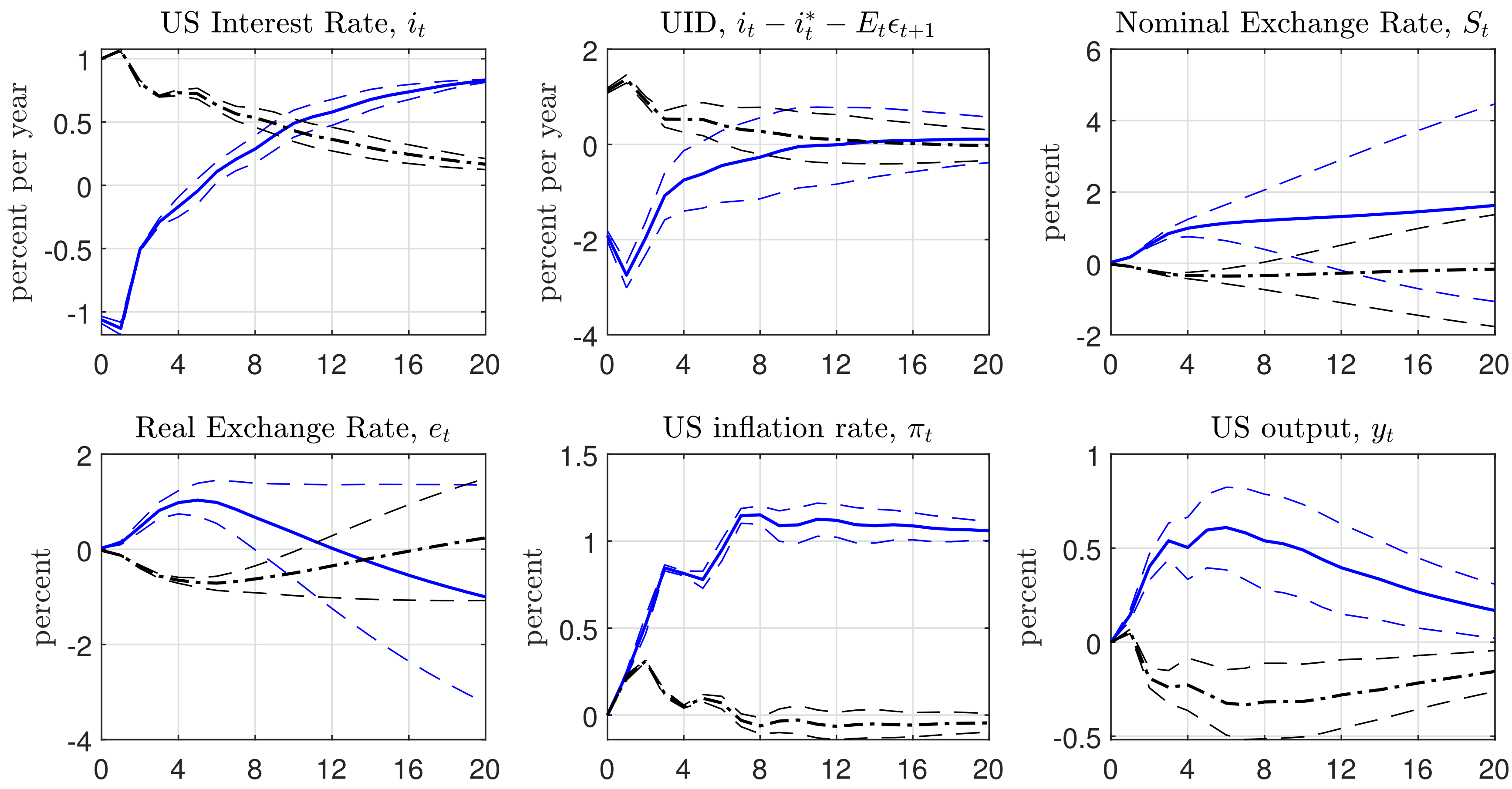
	A. United Kingdom						
	Δy_t	π_t	i_t	$\ln S_t$	$\ln e_t$	i_t^*	uid_t
Permanent Monetary Shock, X_t^m	0.29	0.88	0.47	0.43	0.39	0.37	0.14
Transitory Monetary Shock, z_t^m	0.05	0.00	0.27	0.02	0.02	0.09	0.03
Permanent Nonmonetary Shock, X_t	0.57	0.03	0.19	0.01	0.02	0.06	0.02
Transitory Nonmonetary Shock, z_t	0.02	0.00	0.00	0.00	0.00	0.02	0.00
Foreign Permanent Monetary Shock, X_t^{m*}	0.05	0.06	0.05	0.52	0.55	0.17	0.79
Foreign Transitory Shock z_t^*	0.02	0.03	0.01	0.02	0.01	0.29	0.01
UIP Shock, w_t^*	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes. Δy_t, U.S. output growth; π_t, U.S. inflation; i_t, the Federal Funds rate; $\ln S_t$, dollar-pound nominal exchange rate; $\ln e_t$, the dollar-pound real exchange rate; i_t^*, U.K. nominal interest rate; UID$= i_t - i_t^* - E_t\epsilon_{t+1}$, uncovered interest rate differential; $\epsilon_t \equiv \ln(S_t/S_{t-1})$, dollar devaluation rate.

Empirical Results:

United States - Japan

Impulse Responses to Permanent and Transitory U.S. Monetary Shocks: Japan



Notes. Solid lines display the posterior mean response to a permanent monetary shock that increases the U.S. nominal interest rate by 1 annual percentage point in the long run (an increase in X_t^m). Dash-dotted lines display the posterior mean response to a transitory monetary shock that increases the U.S. nominal interest rate by 1 annual percentage point on impact (an increase in z_t^m). Broken lines are asymmetric 95-percent confidence bands computed using the Sims-Zha (1999) method.

The Importance of Permanent Monetary Shocks for Exchange Rates

Forecast Error Variance Decomposition at Horizon 12 quarters. US-Japan pair

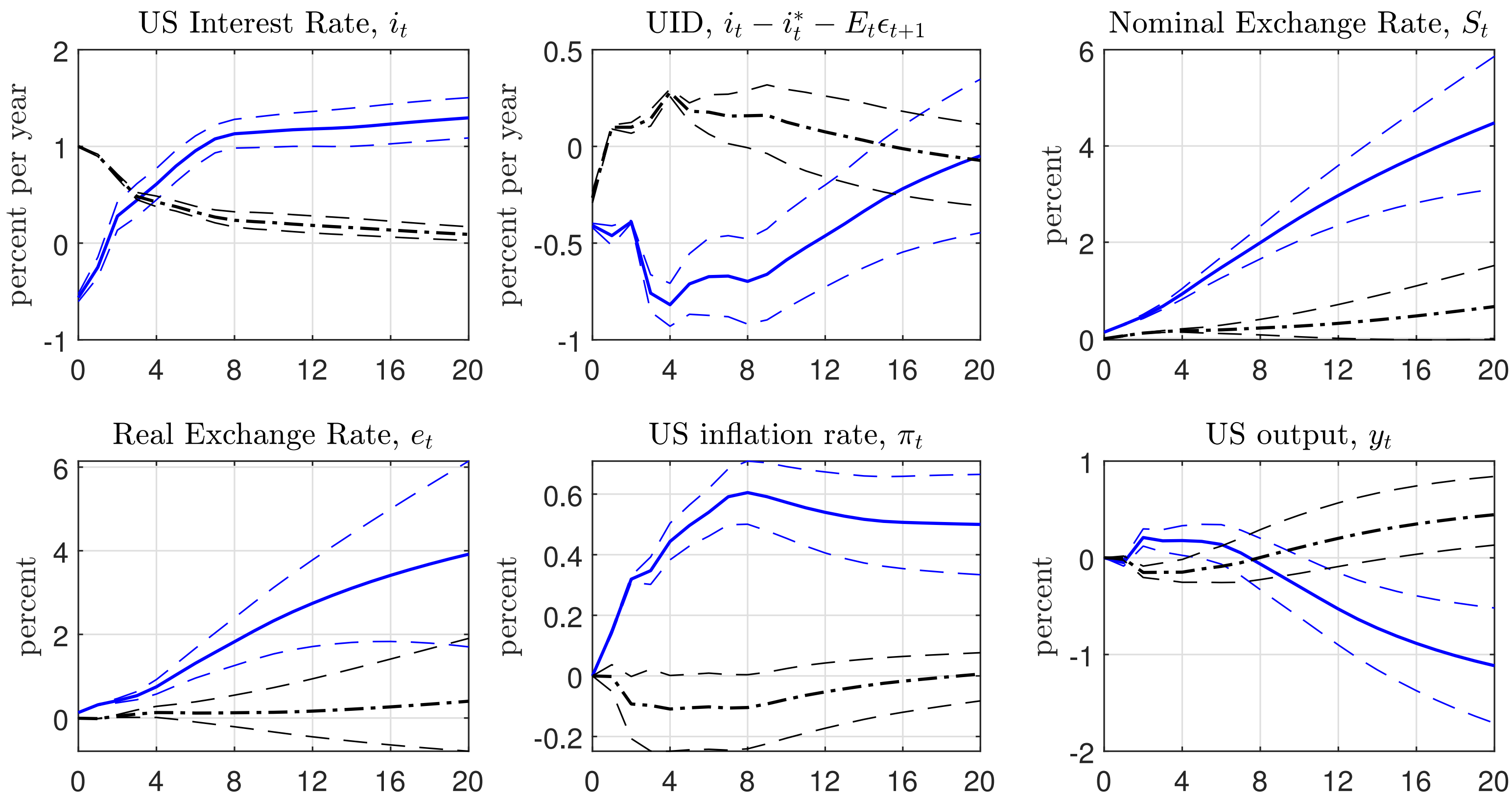
	B. Japan						
	Δy_t	π_t	i_t	$\ln S_t$	$\ln e_t$	i_t^*	uid_t
Permanent Monetary Shock, X_t^m	0.05	0.59	0.11	0.00	0.00	0.05	0.02
Transitory Monetary Shock, z_t^m	0.03	0.02	0.23	0.00	0.00	0.03	0.01
Permanent Nonmonetary Shock, X_t	0.23	0.13	0.01	0.00	0.00	0.03	0.01
Transitory Nonmonetary Shock, z_t	0.49	0.14	0.25	0.00	0.00	0.03	0.04
Foreign Permanent Monetary Shock, X_t^{m*}	0.13	0.11	0.35	0.88	0.87	0.80	0.76
Foreign Transitory Shock, z_t^*	0.00	0.00	0.00	0.00	0.00	0.03	0.00
UIP Shock, w_t^*	0.06	0.02	0.04	0.11	0.13	0.04	0.17

Notes. Δy_t, U.S. output growth; π_t, U.S. inflation; i_t, the Federal Funds rate; $\ln S_t$, dollar-yen nominal exchange rate; $\ln e_t$, the dollar-yen real exchange rate; i_t^*, JP nominal interest rate; UID$= i_t - i_t^* - E_t \epsilon_{t+1}$, uncovered interest rate differential; $\epsilon_t \equiv \ln(S_t/S_{t-1})$, dollar devaluation rate.

Empirical Results:

United States - Canada

Impulse Responses to Permanent and Transitory U.S. Monetary Shocks: Canada



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The Importance of Permanent Monetary Shocks for Exchange Rates

Forecast Error Variance Decomposition at Horizon 12 quarters. US-CA pair

	C. Canada						
	Δy_t	π_t	i_t	$\ln S_t$	$\ln e_t$	i_t^*	uid_t
Permanent Monetary Shock, X_t^m	0.13	0.77	0.74	0.28	0.20	0.50	0.07
Transitory Monetary Shock, z_t^m	0.01	0.02	0.09	0.00	0.00	0.06	0.00
Permanent Nonmonetary Shock, X_t	0.27	0.11	0.08	0.65	0.67	0.09	0.86
Transitory Nonmonetary Shock, z_t	0.50	0.08	0.08	0.06	0.13	0.05	0.02
Foreign Permanent Monetary Shock, X_t^{m*}	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Foreign Transitory Shock, z_t^*	0.08	0.02	0.02	0.00	0.01	0.28	0.05
UIP Shock, w_t^*	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes. Δy_t, U.S. output growth; π_t, U.S. inflation; i_t, the Federal Funds rate; $\ln S_t$, dollar-CA dollar nominal exchange rate; $\ln e_t$, the dollar-CA dollar real exchange rate; i_t^*, CA nominal interest rate; UID$= i_t - i_t^* - E_t\epsilon_{t+1}$, uncovered interest rate differential; $\epsilon_t \equiv \ln(S_t/S_{t-1})$, dollar devaluation rate.

Conclusion

The innovation of the present paper is to allow for permanent and transitory monetary shocks. Estimation on quarterly post-Bretton-Woods data from the United States, the United Kingdom, Japan, and Canada shows that:

- transitory tightenings cause an appreciation of the exchange rate, whereas permanent tightenings cause a depreciation (already in the short run).

- transitory tightenings cause deviations from uncovered interest-rate parity in favor of domestic assets, whereas permanent tightenings cause deviations in favor of foreign assets.

- permanent monetary shocks explain the majority of short-run movements in dollar-pound and dollar-yen exchange rates.

- the estimated responses are qualitatively consistent with the predictions of an open economy NK model with portfolio adjustment costs

EXTRAS

Prior Distributions

Parameter	Distribution	Mean.	Std. Dev.
Main diagonal elements of B_1	Normal	0.95	0.5
All other elements of B_i, $i = 1, \ldots, L$	Normal	0	0.25
C_{31}, C_{55}	Normal	-1	1
C_{45}	Normal	1	1
C_{41}, C_{51}	Uniform$[-1, 0]$	-0.5	0.2887
All other estimated elements of C	Normal	0	1
α	Uniform$[0, 1]$	0.5	0.2887
ψ_{ii}, $i = 1, \ldots, 7$	Gamma	1	1
ρ_{ii}, $i = 1, 2, 3, 5, 6, 7$	Beta	0.3	0.2
ρ_{44}	Beta	0.7	0.2
R_{ii}, $i = 1, \ldots, 7$	Uniform$\left[0, \frac{\text{var}(o_t)}{10}\right]$	$\frac{\text{var}(o_t)}{10\times 2}$	$\frac{\text{var}(o_t)}{10\times\sqrt{12}}$
Elements of A	Normal	mean(o_t)	$\sqrt{\frac{\text{var}(o_t)}{T}}$

The lag length, L, is assumed to be 4 quarters.

The sample period is 1974:Q1-2018:Q1.

The sample length, T, is 177 periods.