



EUROPEAN CENTRAL BANK

EUROSYSTEM

U.S. monetary policy spillovers

Good versus bad times

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Motivation

- Heated discussion about the global impact of US monetary policy
 - Tapering
 - Lift-off
- Economic literature: ambiguity of international spillovers
 - Expenditure switching
 - Income absorption
- Can we observe secular trends wrt global spillovers of US monetary policy shocks?
- Are spillovers state-dependent?

Methodology

The adopted methodology is outlined as follows:

- Empirical TVP-VAR is employed to evaluate how U.S. monetary policy affects variables that are crucial for spillovers over time
- Two-country NK DSGE model is then used to analyse why the effects have changed over time by the estimation of the key structural parameters:
 - Exchange rate pass-through
 - Price stickiness
 - Taylor rule parameters
 - Trade elasticity
- Scenario analysis using the estimates of the structural parameters aimed to identify the key determinants of time variation
- The advantages of the adopted methodology includes: *(i)* estimation of time variation in main structural parameters that are crucial for international spillovers, *(ii)* micro-founded scenario analysis

Empirical analysis

In the spirit of Primiceri (2005), we consider the following reduced form representation of a Bayesian VAR with time-varying parameters

$$y_t = c_t + B_{1,t}y_{t-1} + \dots + B_{p,t}y_{t-p} + u_t \quad u_t \sim N(0, \Omega_t)$$

where y_t is a vector of observed endogenous variables: output, prices, exchange rate, interest rate and trade balance

- The model is estimated using the data sample of 1960Q1-2013Q3 (including the first 10 years used as a training sample)
- Apart from the interest rate which is in levels, the variables are transformed to non-annualized growth rates
- Similar to Corsetti et al. (2008), all data is U.S. (home economy) relative to a foreign economy (RoW), which is constructed as a weighted average of following countries: Australia, Canada, Germany, Japan and the U.K.

Empirical analysis (cont.)

The reduced-form innovations of the TVP-VAR are assumed to be normally distributed with zero-mean and the following time-varying covariance matrix

$$y_t = \Omega_t = A_t^{-1} H_t (A_t^{-1})'$$

where

- H_t is a diagonal matrix that contains the stochastic volatilities that capture changes in the magnitude of structural shocks
- A_t is a lower triangular matrix that models the contemporaneous interactions.

Identification approach

The identification via sign restrictions:

- Agnostic about the impact of structural shocks
- Consistent with a wide class of theoretical models and robust for parameter uncertainty

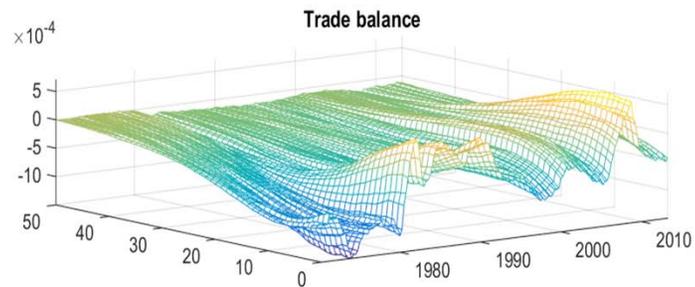
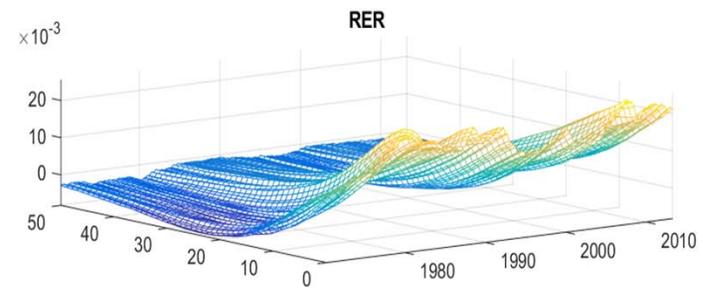
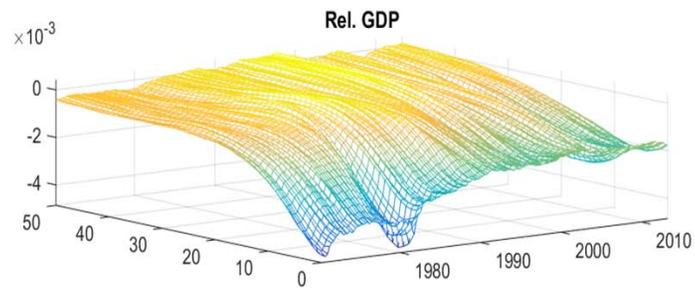
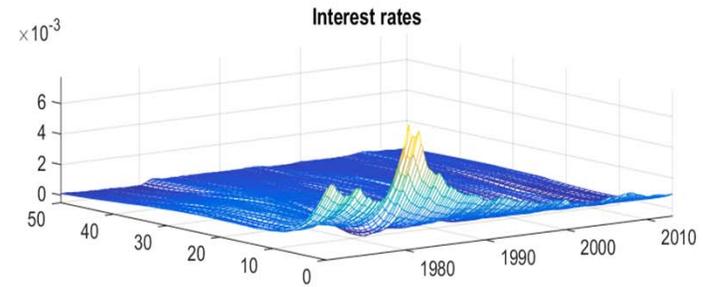
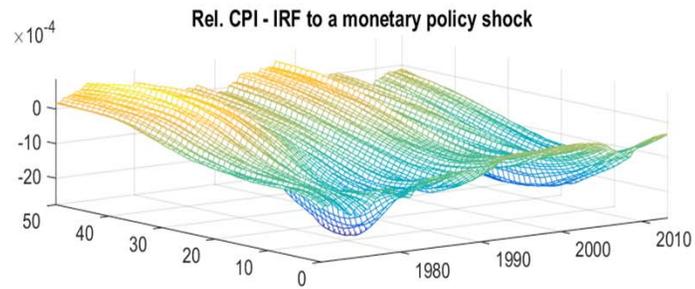
	Rel. Output	Rel. Prices	Diff. Int. Rate	RER*	Trade Balance
Monetary Policy	≤ 0	≤ 0	≥ 0	≥ 0	unrestricted

* An increase is a depreciation of the RER

- The TVP-VAR model is specified in terms of relative variables:
 - Parsimonious model (minimise the curse of dimensionality issue)
 - Shock originates in the U.S. (relative interest increases)
- The sign restrictions are imposed for 4 quarters after the shock to rule out transitory shocks
- The identifying restrictions are standard. See: Mumtaz and Sunder-Plassmann (2013), Mountford (2005), Peersman and Straub (2009)

Empirical results

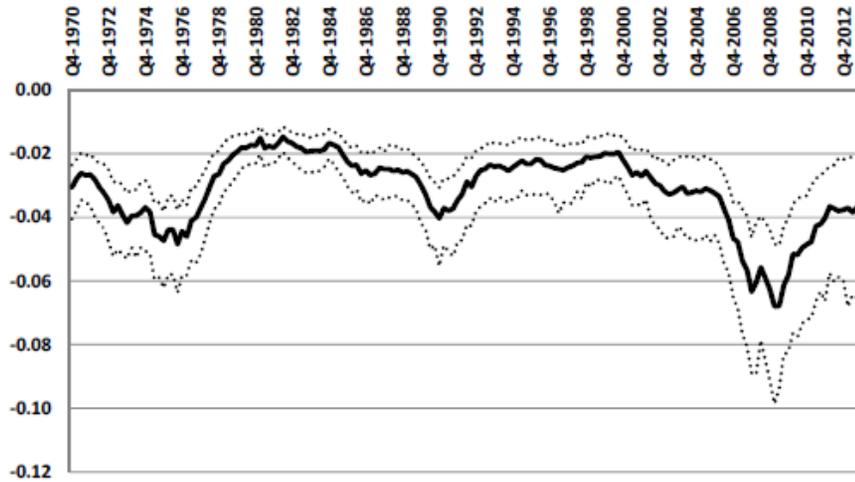
Figure 1: Time-varying effects of U.S. monetary policy tightening



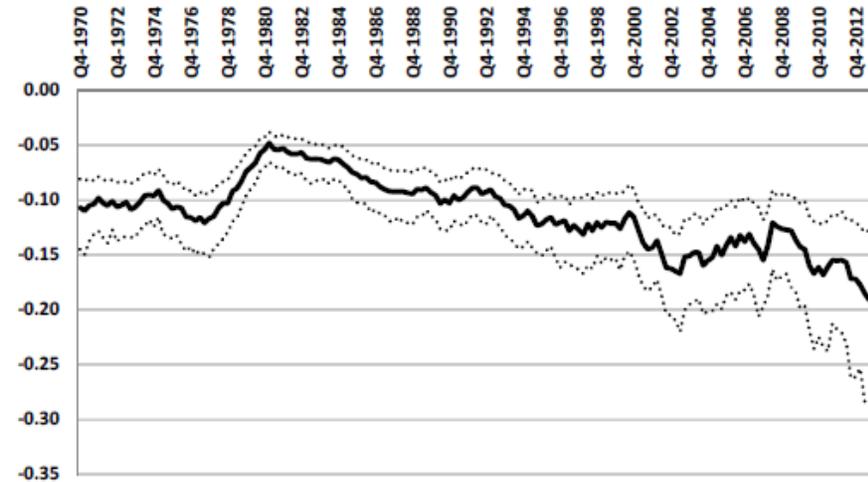
Empirical results (cont.)

Figure 1: Time-varying impact effects of a normalized 10bp US monetary policy shock tightening

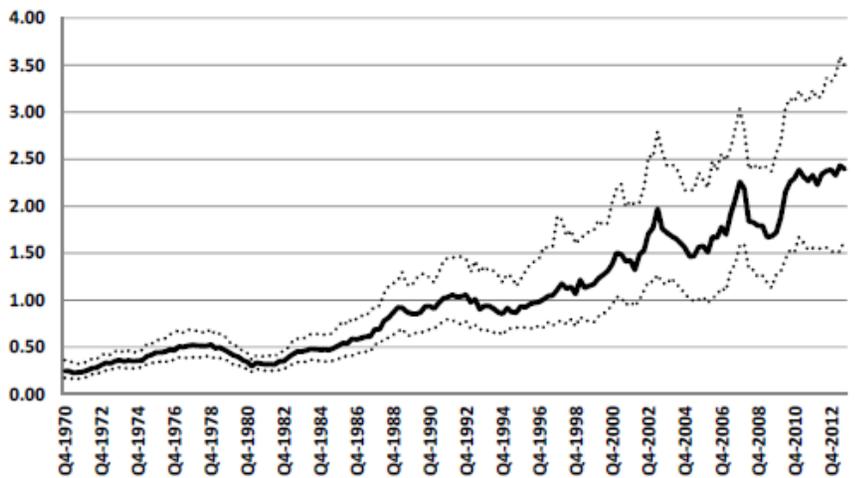
relative CPI



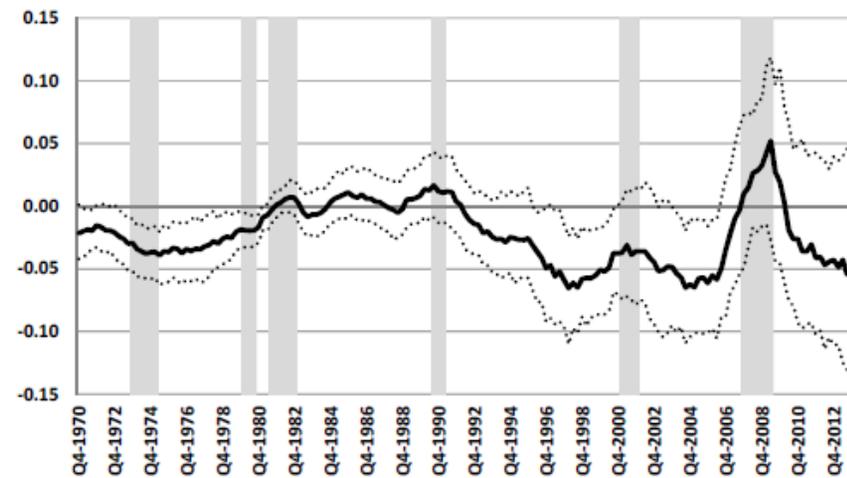
relative GDP



USD real effective exchange rate



US trade balance (as % of GDP)



Empirical results (cont.)

Table 2: Comparison of the trade balance and US dollar real effective exchange rate effects in NBER recessions and period three years prior

	US trade balance (as % of GDP)	US dollar real effective exchange rate
NBER recession: 1981Q1 - 1982Q4	-0.010	0.39
<i>3 years prior</i>	<i>-0.013</i>	<i>0.50</i>
NBER recession: 1990Q3-1991Q1	0.013	0.93
<i>3 years prior</i>	<i>0.004</i>	<i>0.81</i>
NBER recession: 2001Q1-2001Q4	0.004	1.46
<i>3 years prior</i>	<i>-0.018</i>	<i>1.20</i>
NBER recession: 2007Q4 - 2009Q2	0.039	1.91
<i>3 years prior</i>	<i>-0.008</i>	<i>1.66</i>
Average NBER recessions	0.012	1.17
Average 3 years prior	-0.009	1.04

Notes: the impact is calculated as the maximum estimated median impact over a horizon of 29 quarters following a normalized 10bp impact increase in the annualized relative interest rate (US minus foreign) using the TVP-BVAR. The impact is calculated as an average over the indicated period, with 3 years taken as the 12 quarters before the onset of the recession. The recession over the period 1981Q1 - 1980Q3 and 1981Q3 - 1982Q4 are grouped together given the little time in between.

Identifying the sources of time-variation

The TVP-VAR is silent about the causes of time-variation in the effects of monetary policy

To disentangle the underlying reasons of time-variation in the spillovers of monetary policy, we estimate the structural parameters of a two-country NK DSGE model following Hofmann et al. (2012), outlined as follows:

- Match the time-varying IRFs of the TVP-VAR model for every point in time (quarter) with that of the DSGE model
- The minimum distance estimation approach consists of choosing parameter values so to minimise the distance between the structural model IRFs and the empirical IRFs
- The time-variation in the TVP-VAR can be explained by the time-variation in the relevant structural parameters (e.g. exchange rate pass-through, trade elasticity, monetary policy stance)

Two-country NK DSGE model

The proposed two-country New Keynesian DSGE model features:

- Nominal rigidities à la Calvo
- Incomplete international asset markets
- Investment adjustment costs à la Christiano et al. (2005)
- Tradable and non-tradable goods sector.
- Endogenous discount factor in the utility function to induce stationarity, as proposed by Uribe and Schmitt-Grohé (2003)
- Deviations from the Law of One Price, as discussed in Monacelli (2005)
- Monetary authorities follow a conventional Taylor-type interest rate rule specified in terms of consumer price inflation and output growth

Deviations of LOOP

- As discussed in Monacelli (2005), imperfect ERPT is ensured via nominal rigidities à la Calvo (1983)
- Local retailers import goods "at the dock", for which the law of one price holds
 - Reset the price of imported good in local currency only infrequently
 - Resell to consumers solving an optimal markup problem
- In line with empirical evidence, the degree of ERPT is partial in the short-run but complete in the long-run, as demonstrated in Campa and Goldberg (2002)
- The Calvo parameter in the import sector can be interpreted as the degree of exchange rate pass-through in the model

Price setting of imported goods

Local retailers importing goods choose a price, in domestic currency, to maximise

$$E_t \sum_{k=0}^{\infty} \rho_{1t,t+k} \xi_{IM}^k \left(\tilde{P}_{1t}^B(j) - S_t P_{2t+k}^B(j) \right) Y_{2t+k}^{B,1}(j)$$

s.t.

$$Y_{2t,+k}^{B,1}(j) = \left(\frac{\tilde{P}_{1t}^B(j)}{P_{1t+k}^B} \right)^{-\epsilon_{IM}} B_{1t+k}$$

The log-linear aggregate import price evolves according to

$$p_{1t}^B = \xi^{IM} (p_{1t-1}^B - \pi_1) + (1 - \xi^{IM}) \tilde{p}_{1t}^B$$

Minimum distance estimator

The DSGE model is estimated using the Bayesian minimum distance estimator approach in the spirit of Christiano *et al.* (2011):

- The vector $\hat{\psi}$ collects the empirical IRFs, while the vector ψ collects the IRFs from the DSGE model
- The vector θ collects the structural parameters. The value of θ is chosen to minimise the distance between $\psi(\theta)$ and $\hat{\psi}$ (treated as data)
- The approximate likelihood of the data, $\hat{\psi}$, as a function of the structural parameters, θ , is defined

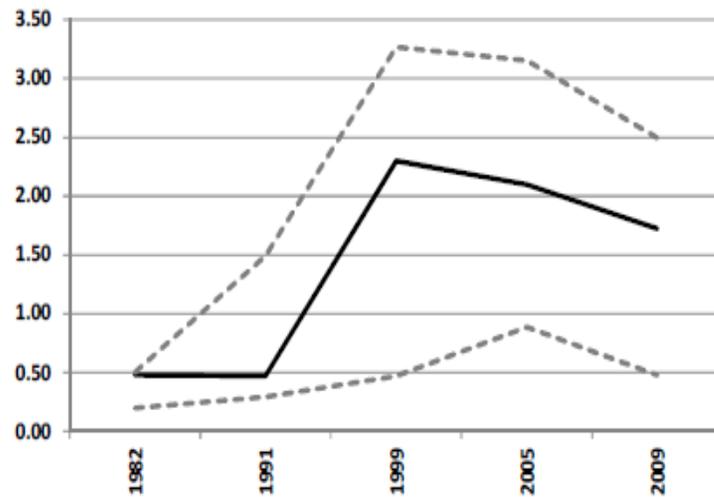
$$f(\hat{\psi}|\theta) = \left(\frac{1}{2\pi}\right)^{N/2} |V(\theta_0, \zeta_0, T)|^{-1/2} \\ \times \exp \left[-\frac{1}{2} (\hat{\psi} - \psi(\theta))' V(\theta_0, \zeta_0, T)^{-1} (\hat{\psi} - \psi(\theta)) \right]$$

where N denotes the number of elements in $\hat{\psi}$

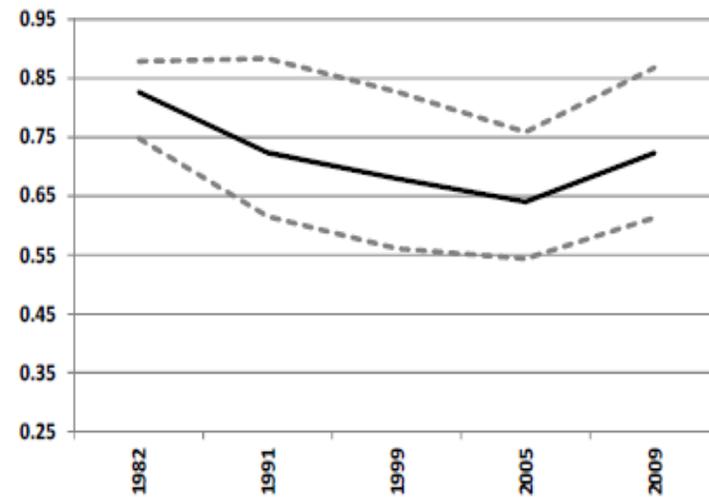
Matching of DSGE and TVP-BVAR IRFs

Time-varying parameter estimates

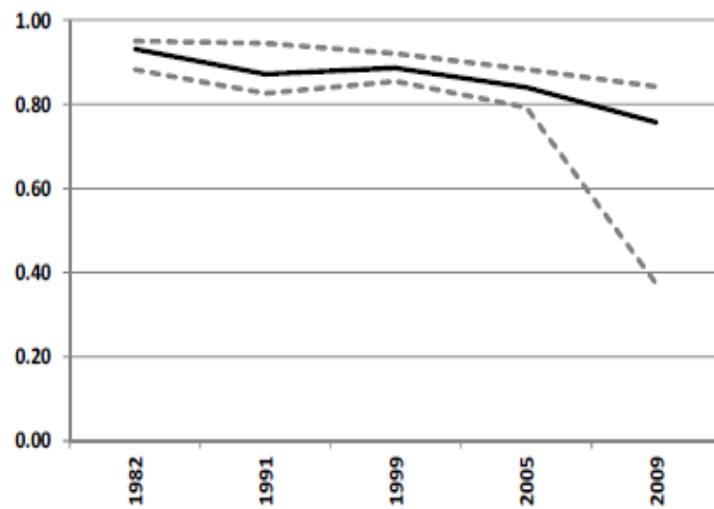
Trade elasticity



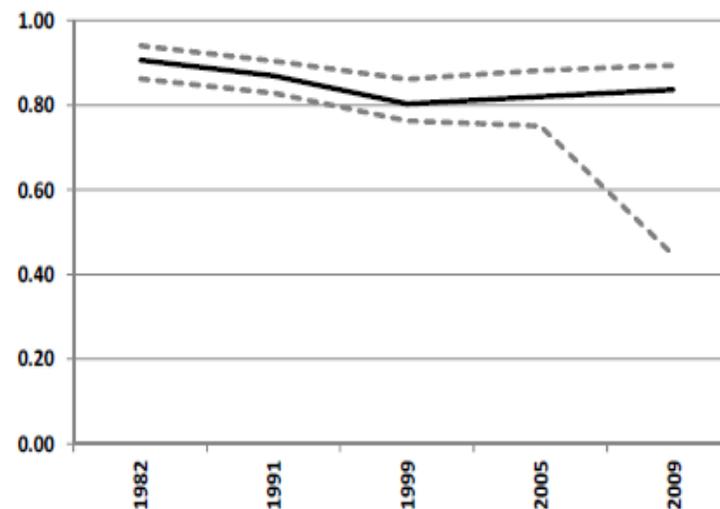
Exchange rate pass-through



Domestic price stickiness

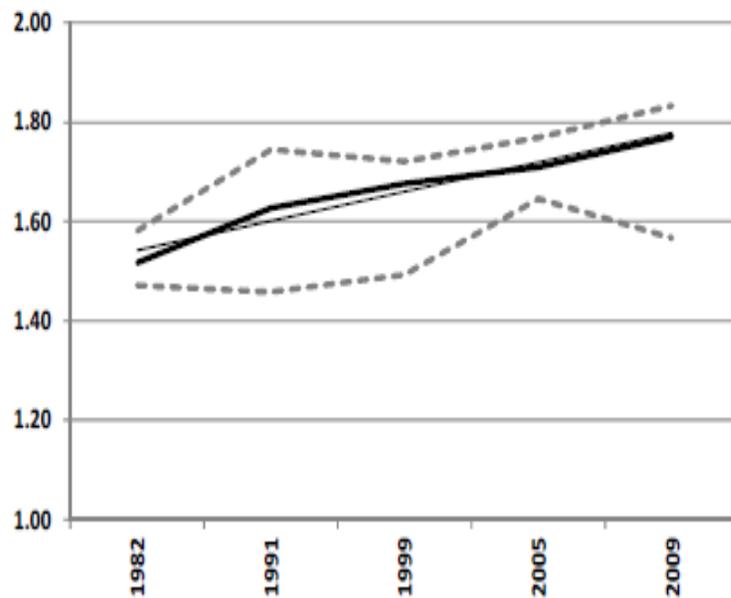


Taylor rule: interest rate smoothing

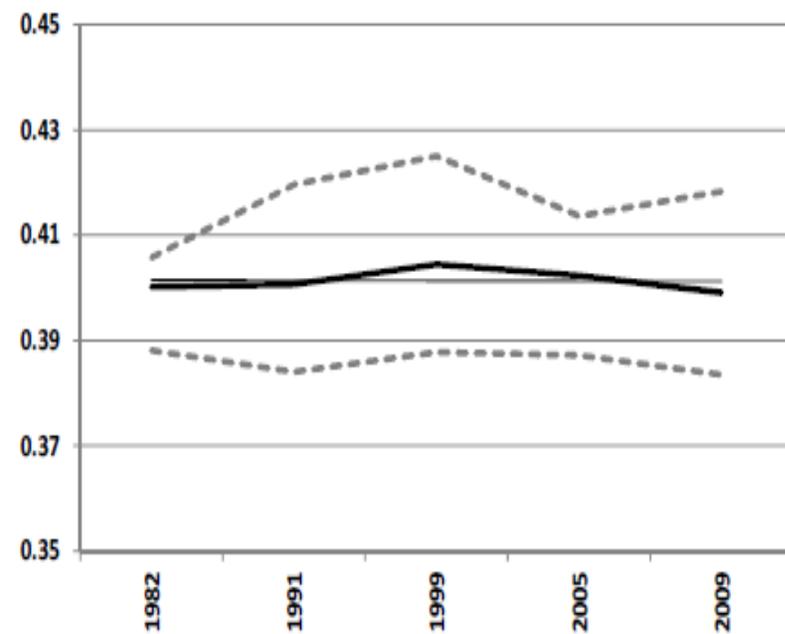


Time-varying Taylor rule parameter estimates

Taylor rule: Inflation coefficient



Taylor rule: output coefficient



Posterior estimates – broader trends

Table A3: Average median estimated structural parameters - broader trends

	trade elasticity	exchange rate pass-through	domestic price stickiness	Taylor rule: interest rate smoothing	Taylor rule: outputgap	Taylor rule: inflation	Taylor rule: shock size
1980s	0.50	0.80	0.91	0.88	0.400	1.56	0.18
1990s	1.61	0.69	0.88	0.84	0.400	1.66	0.12
2000s	1.93	0.68	0.80	0.80	0.403	1.75	0.12

Posterior estimates – NBER recessions

	Trade elasticity parameter	Exchange rate pass-through parameter
NBER recession: 1981Q1 - 1982Q4 <i>3 years prior</i>	0.750 1.447	0.83 0.76
NBER recession: 1990Q3-1991Q1 <i>3 years prior</i>	0.471 0.473	0.72 0.79
NBER recession: 2001Q1-2001Q4 <i>3 years prior</i>	1.981 2.279	0.67 0.65
NBER recession: 2007Q4 - 2009Q2 <i>3 years prior</i>	1.449 1.920	0.71 0.66
Average NBER recessions	1.163	0.73
Average 3 years prior	1.530	0.72

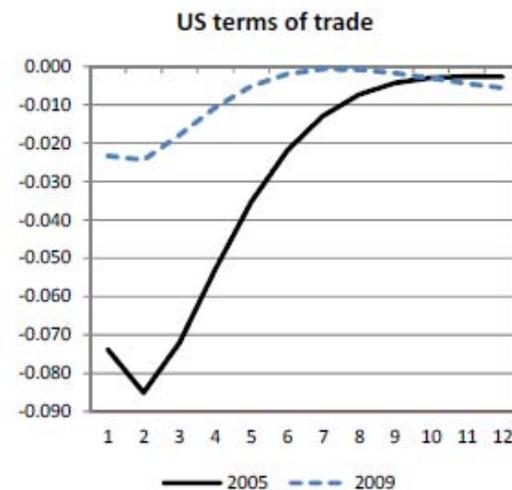
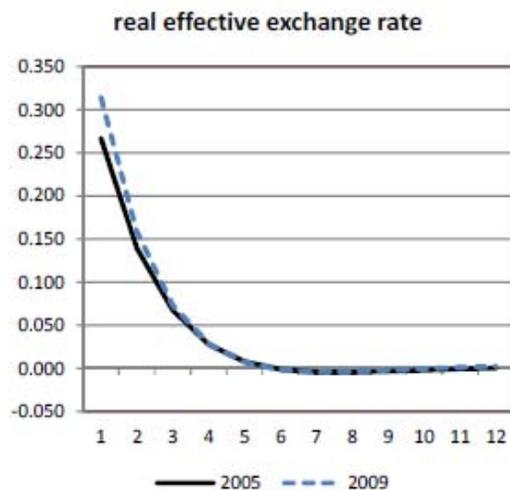
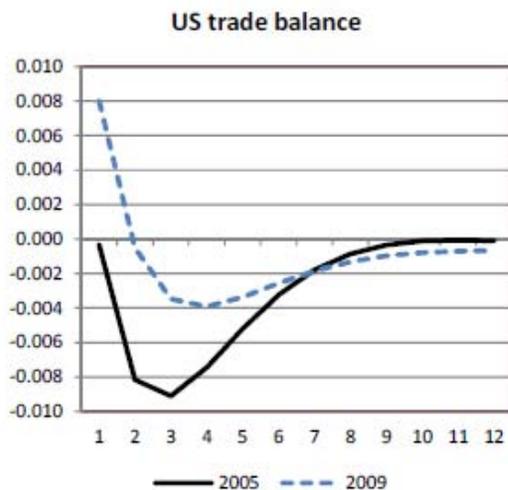
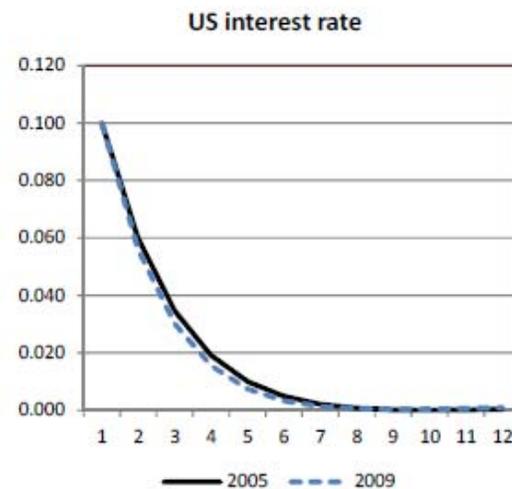
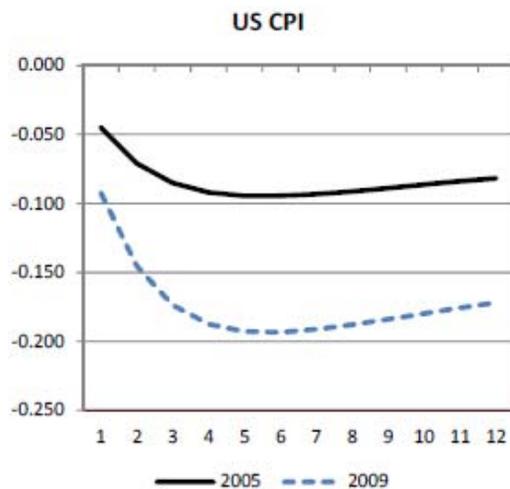
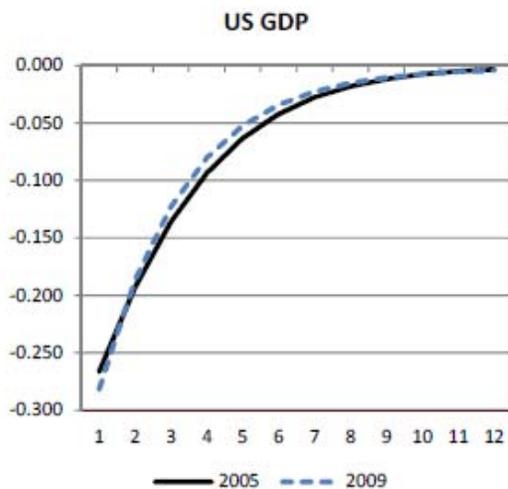
Posterior estimates – NBER recessions

Table A4: Median estimated structural parameters – recessions versus normal times

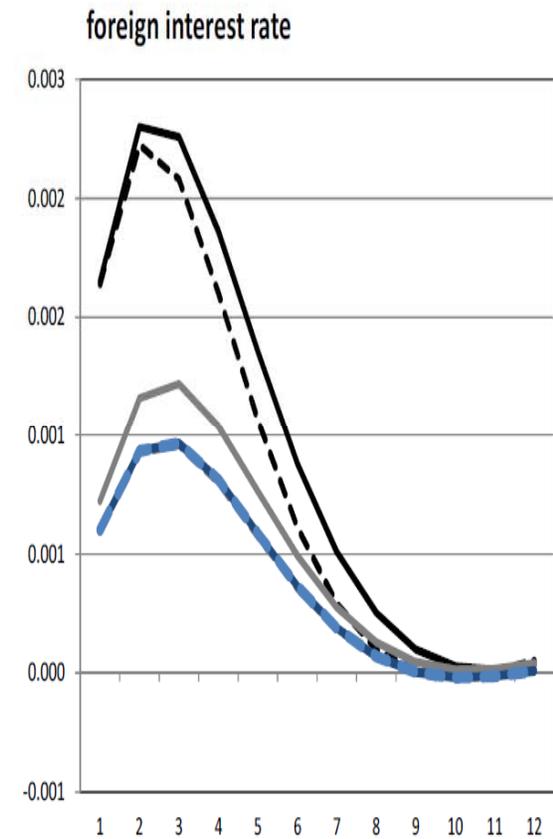
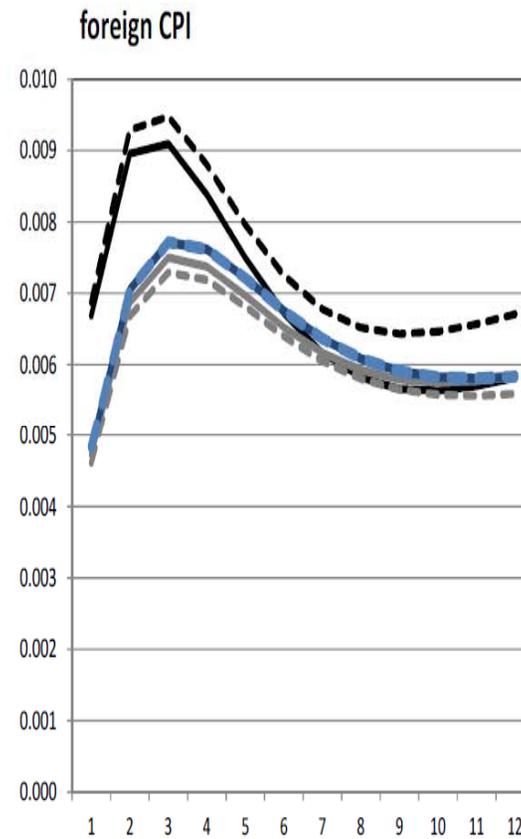
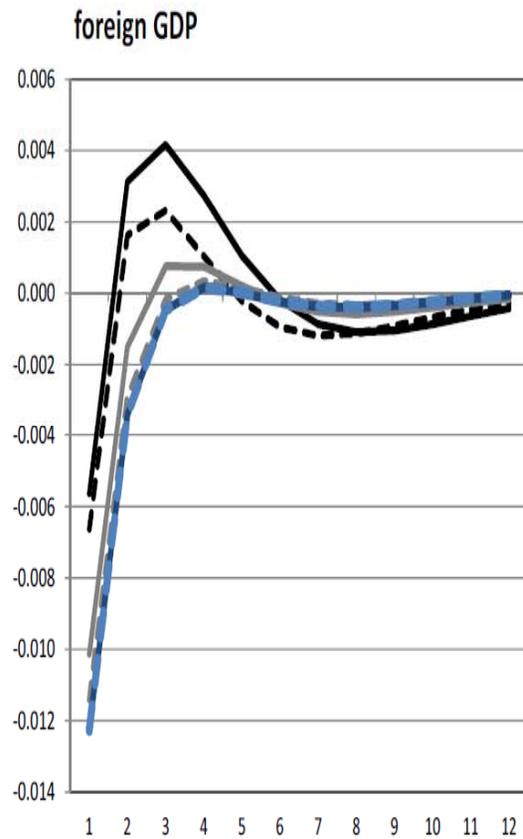
	trade elasticity	exchange rate pass- through	domestic price stickiness	Taylor rule: interest rate smoothing	Taylor rule: outputgap	Taylor rule: inflation	Taylor rule: shock size
average recessions	1.02	0.72	0.85	0.87	0.38	1.57	0.16
average normal times	1.48	0.71	0.87	0.83	0.40	1.67	0.13

Notes: the averages are based on the estimation of the DGSE model as outlined in section 3.1.2 for each quarter over the period 1980Q1 – 2013Q3. The recessions are defined as NBER recessions.

Spillover and spillbacks in good and bad times



Spillover and spillbacks in good and bad times



Conclusion

- Documenting the time-variation in the transmission of US monetary policy shocks
- Two observations:
 - Impact on the RER has substantially increase over time
 - Cyclical time-variation of the trade balance response
 - Recession: positive correlation between TB and RER (expenditure switch)
 - Boom: negative correlation between TB and RER (income absorption)
 - Mainly driven by changes in trade elasticity
- Spill-backs to US GDP are less affected, in contrast to US CPI and foreign variables.