BANK FOR INTERNATIONAL SETTLEMENTS

On the Macroeconomics of Commodity Exporters: Some Empirical Estimates

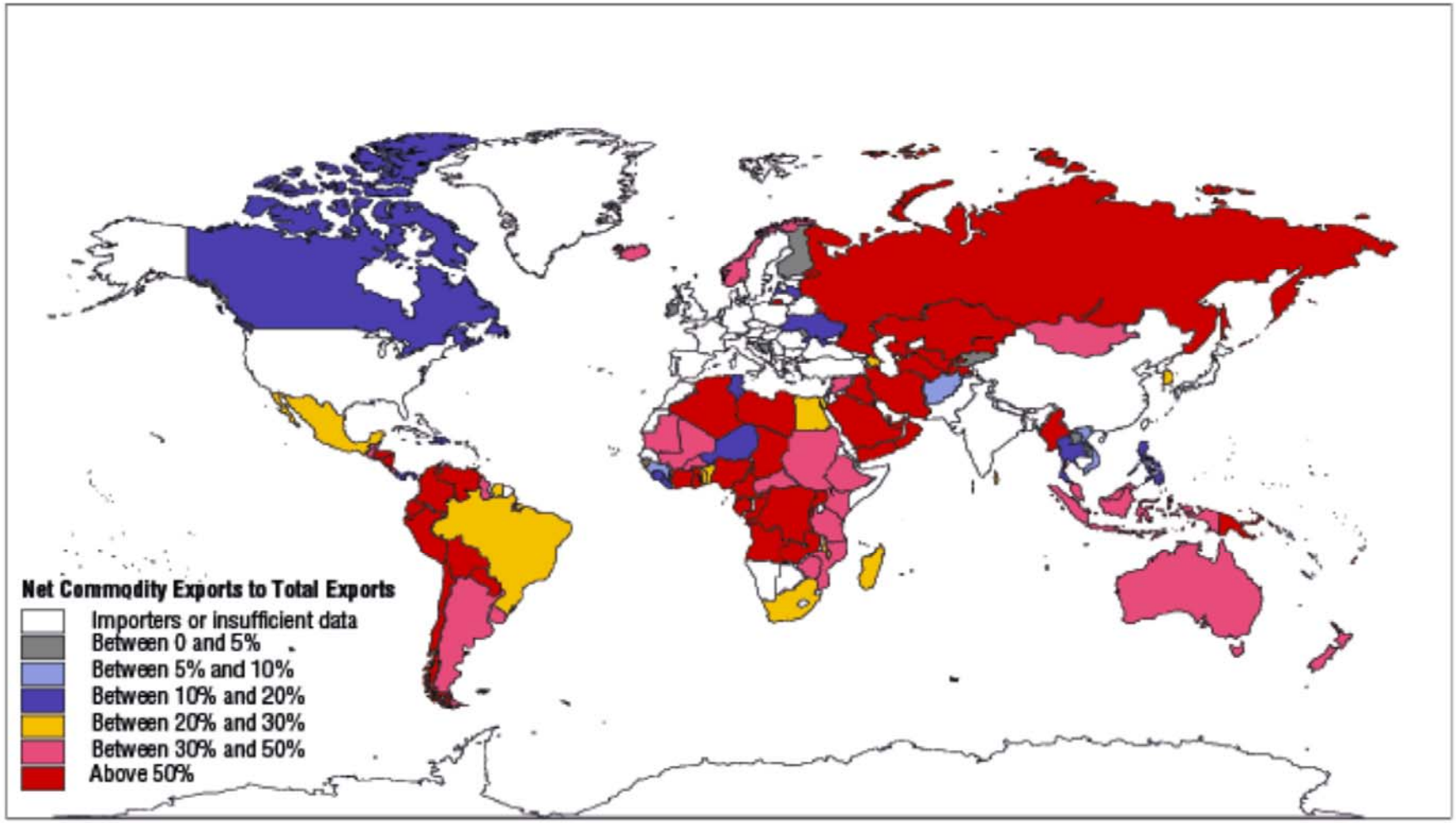
E. Kohlscheen and R. Sousa

August 2016

BIS CCA Research Network on Commodities

The views presented are our own and do not necessarily reflect those of the BIS.

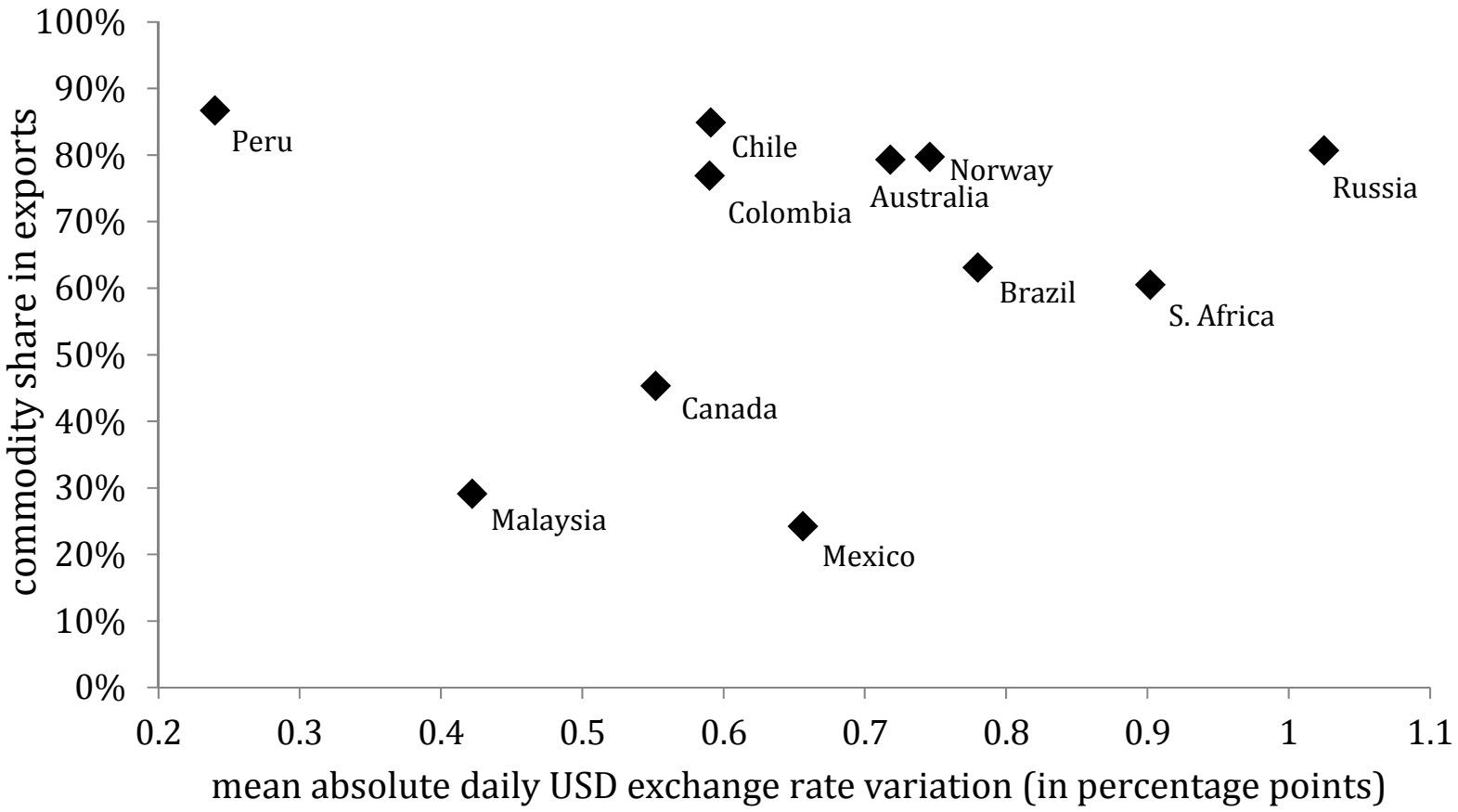
Global Map of Commodity Exporters (net terms)



Source: IMF, WEO 2012

Commodity Exporters (gross terms)

Fig. 3 - Commodity Share in Exports and Exchange Rate Volatility



Based on data from 2004 to 2015.

Source: Kohlscheen, Avalos, Schrimpf (2016)

Short-term relation

Global risk adjusted exchange rates and commodity prices

	Australia	Canada	Norway	Brazil	Chile	Colombia
*1st stage regression (D.V.: 100*log diff of exchange rate)*						
VIX	0.130***	0.088***	0.088***	0.158***	0.100***	0.088***
	(7.24)	(7.45)	(6.12)	(8.46)	(8.36)	(7.75)
R2	0.0673	0.0597	0.0368	0.0896	0.0695	0.0482
2nd stage regression (D.V.: residual of first stage regression)						
CXPI	-0.518***	-0.257***	-0.167***	-0.440***	-0.154***	-0.131***
	(11.46)	(17.56)	(14.49)	(9.94)	(13.03)	(9.64)
R2	0.1967	0.1928	0.1301	0.0768	0.0999	0.0515
observations	2912	2912	2912	2912	2912	2912

	Mexico	Peru	South Africa	Russia	Malaysia
*1st stage regression (D.V.: 100*log diff of exchange rate)*					
VIX	0.120***	0.028***	0.152***	0.165***	0.026***
	(7.99)	(6.36)	(8.46)	(6.37)	(5.24)
R2	0.1011	0.0285	0.0655	0.0725	0.0166
2nd stage regression (D.V.: residual of first stage regression)					
CXPI	-0.163***	-0.039***	-0.493***	-0.221***	-0.061***
	(12.64)	(5.43)	(12.20)	(11.94)	(10.07)
R2	0.1042	0.0207	0.1330	0.0896	0.0461
observations	2912	2912	2912	1584	2499

Notes: Regression of the residual of the first stage regression on the log change of the commodity price index at daily frequency. Sample period is Jan 2004 to Feb 2015. Constants are not shown, as they were not significant in any case. t-statistics based on Newey-West standard errors are reported in parenthesis. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Key Issues for Commodity Exporting Economies

- main drivers of commodity export prices

  (global vs. domestic factors)
- relevant mechanisms through which commodity price variations impact macroeconomic variables
- order of magnitude of these effects, in particular:
  - their effect on the business cycle
  - their effect on the financial cycle

Policy considerations:

- monetary policy responses to commodity price shocks
- responses of the exchange rate and credit

  (and their implications for macroprudential policies)

Related Literature I

Effects of Commodity Price Swings

- strong link between commodity prices and exchange rate movements

  Low-frequency: Amano and van Norden (1995), Chen and Rogoff (2003), Cashin, Cespedes and Sahay (2004), Aizenman, Edwards and Riera-Crichton (2012)

  High-frequency: Ferraro, Rogoff and Rossi (2015), Kohlscheen, Avalos and Schrimpf (2016)

- association of currency appreciations and credit booms

  Mendoza and Terrones (2008), Bruno and Shin (2015a, 2015b), Hofmann, Shim and Shin (2016)

- effects of wealth variation on credit

  Aron and Muellbauer (2013), Rajan and Ramcharam (2015), Bejarano, Hamann, Mendoza and Rodriguez (2016)

- effects of commodity booms on

  growth and credit: van der Ploeg and Poelhekken (2009), Cespedes and Velasco (2012)

  TFP: de la Huerta and Garcia-Cicco (2016)

Related Literature II

Drivers of Commodity Prices

- key global determinants of commodity price movements

  Akram (2009), Kilian (2009), Anzuini, Lombardi and Pagano (2013), Baumeister and Kilian (2015)

- "commodity currencies and currency commodities"

  Clements and Fry (2008), Chen, Rogoff and Rossi (2010)

Structural VAR Model for a Commodity Exporting EME

Aim: quantification of shocks and their effects

- global vs. local factors
- effects of commodity price shocks on:
  - output,
  - credit,
  - monetary policy and
  - exchange rate

Approach: SVAR with block exogeneity (a la Cushman and Zha (1997) and Zha (1999))

.EME economy too small to affect main global variables
(either contemporaneously or with lags)

.but may have effect on its own, country-specific commodity export price index
(CXPI - based on 83 commodity prices and weights from 3-digit UN Comtrade)
(not ruled out by construction)

$$\begin{bmatrix} \Gamma_{11}(L) & 0 \\ \Gamma_{21}(L) & \Gamma_{22}(L) \end{bmatrix} \begin{bmatrix} X_t^{Global} \\ X_t^{C.Exporter} \end{bmatrix} = c + \begin{bmatrix} v_t^{Global} \\ v_t^{C.Exporter} \end{bmatrix}$$

Each block is lower triangular and *vt* s are the structural shocks.

Global block: global GDP, an indicator of the stance of US monetary policy (Lombardi and Zhu's shadow rate) and the dollar index.

Commodity exporter block: commodity export price index (CXPI), GDP, real credit, real interest rate and exchange rate (vis-à-vis USD).

Commodity exporter block variables do not affect global block variables either contemporaneously or with a lag (i.e. $\Gamma_{12}(L)=0$)

- probability bands computed based on MCMC algorithm (10,000 burn ins, 50,000 reps);
- Jeffrey's (non-informative) prior as in Kim and Roubini (2008)
- (log) difference specification (short sample for EMEs; more robust to structural changes – Hendry (1997));
- Illustration through synthetic economy, with floating exchange rate regime: weighted average of time series of 4 key commodity exporting EMEs: Brazil, Chile, Mexico and South Africa (weights based on PPP adjusted GDP values);
- 2 lags, following information criteria;
- Sample period: 2000:Q1-2014:Q3 (ie starting one year after last float).

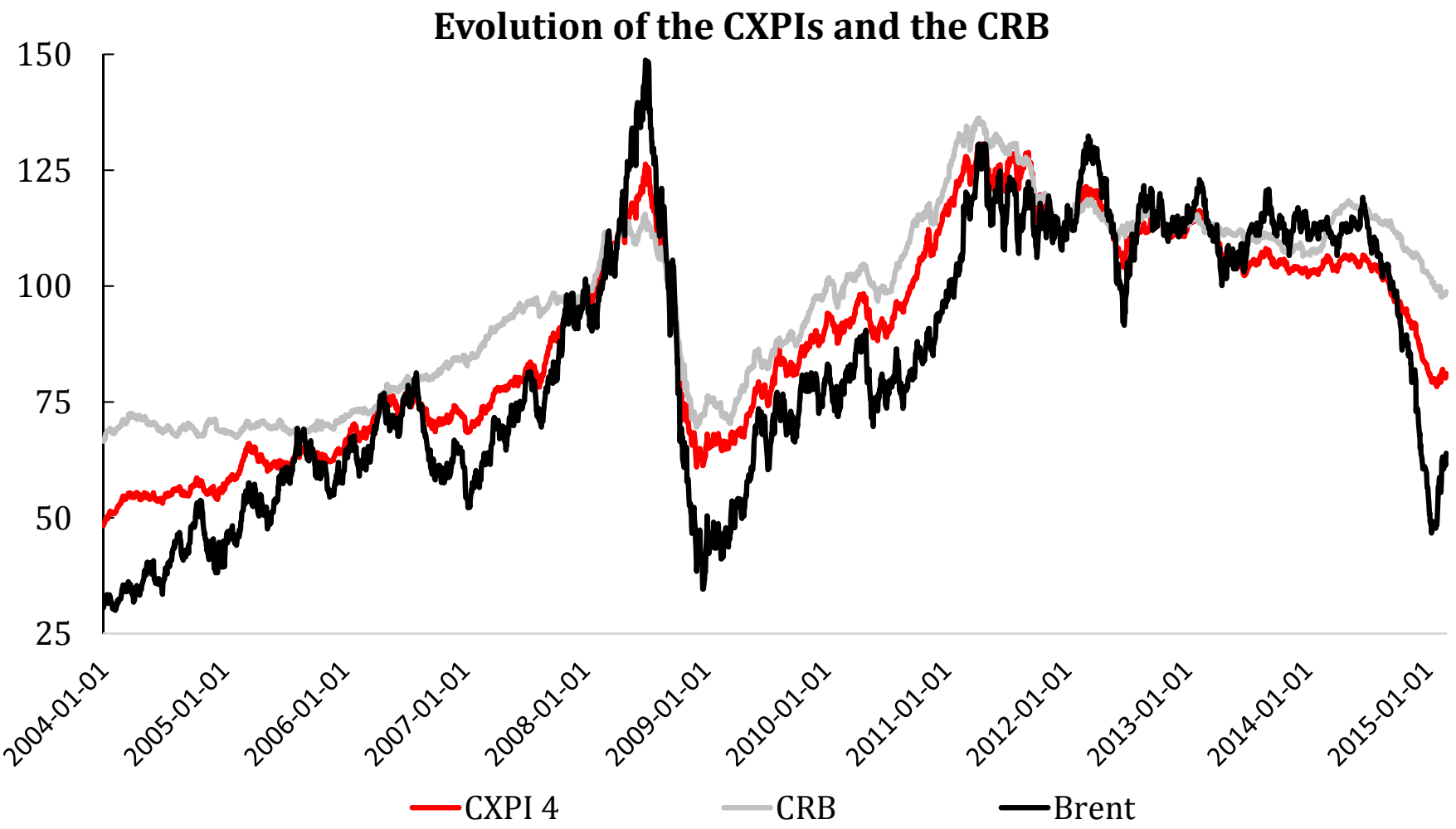
Variables/Ordering

Global block:

GDP G7 (log): G7 output growth, s.a. (OECD)
real interest rate: shadow Fed Funds rate – 12 month core CPI infl.
dollar (log): dollar index (Fed St Louis)

Commodity exporter block:

real CXPI (log): country specific commodity price index, based on 83 3-digit UN Comtrade groups, deflated by US CPI
GDP (log): quarterly s.a.
real credit (log): BIS long credit series, deflated by CPI
real interest rate: money market rate – 12 month CPI infl.
s (log): real exchange rate (vs. USD)



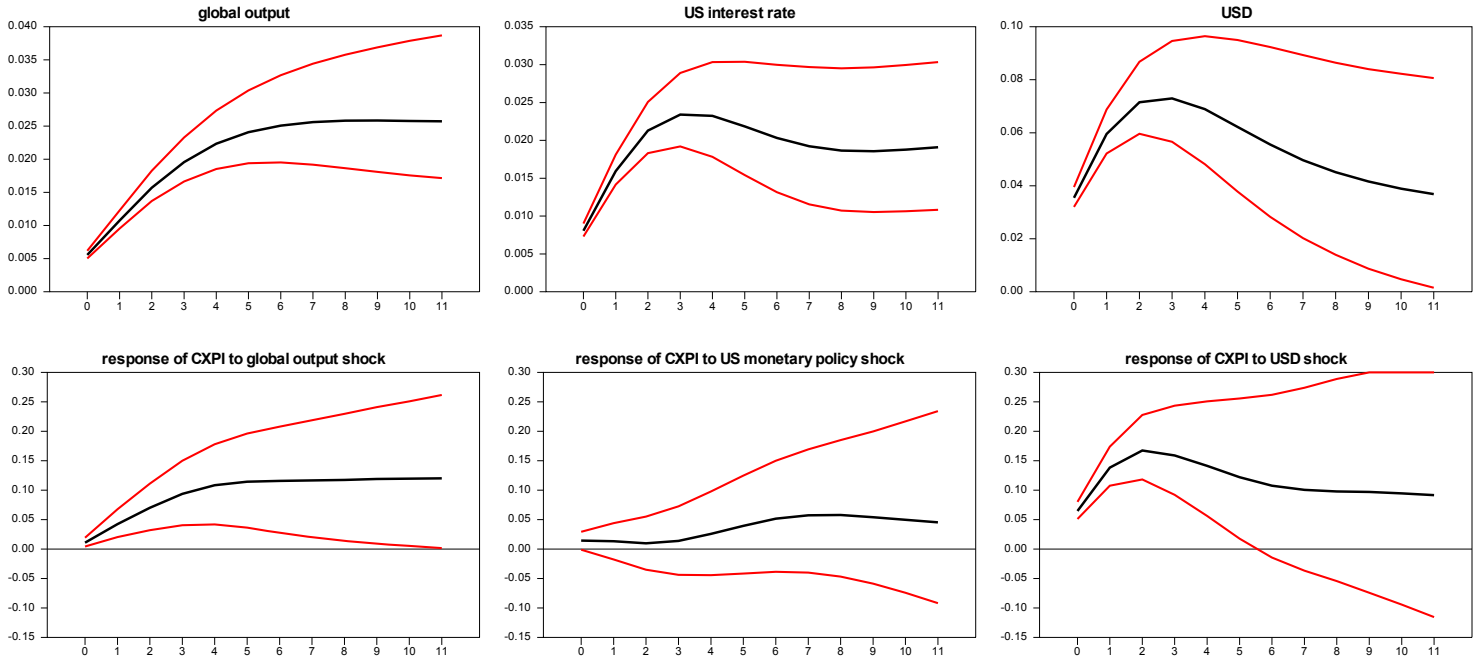
Note: Average of 2008 = 100.

Pairwise correlations (at quarterly frequency)

	CXPI	CXPI *t-4*	CXPI *t-8*	RER	RER *t-4*	RER *t-8*
Output	0.841	0.868	0.900	-0.673	-0.834	-0.880
Credit	0.773	0.882	0.907	-0.596	-0.800	-0.888
Real interest rate	-0.594	-0.705	-0.839	0.449	0.540	0.783
Nominal interest rate	-0.753	-0.734	-0.876	0.647	0.708	0.805
Exchange rate	-0.904	-0.566	-0.557	1.000	0.698	0.616
VIX	-0.032	0.307	0.150	0.016	-0.268	-0.222

Note: An increase in RER means a depreciation of the local currency.

Fig. 4 - Effects of global shocks on CXPI



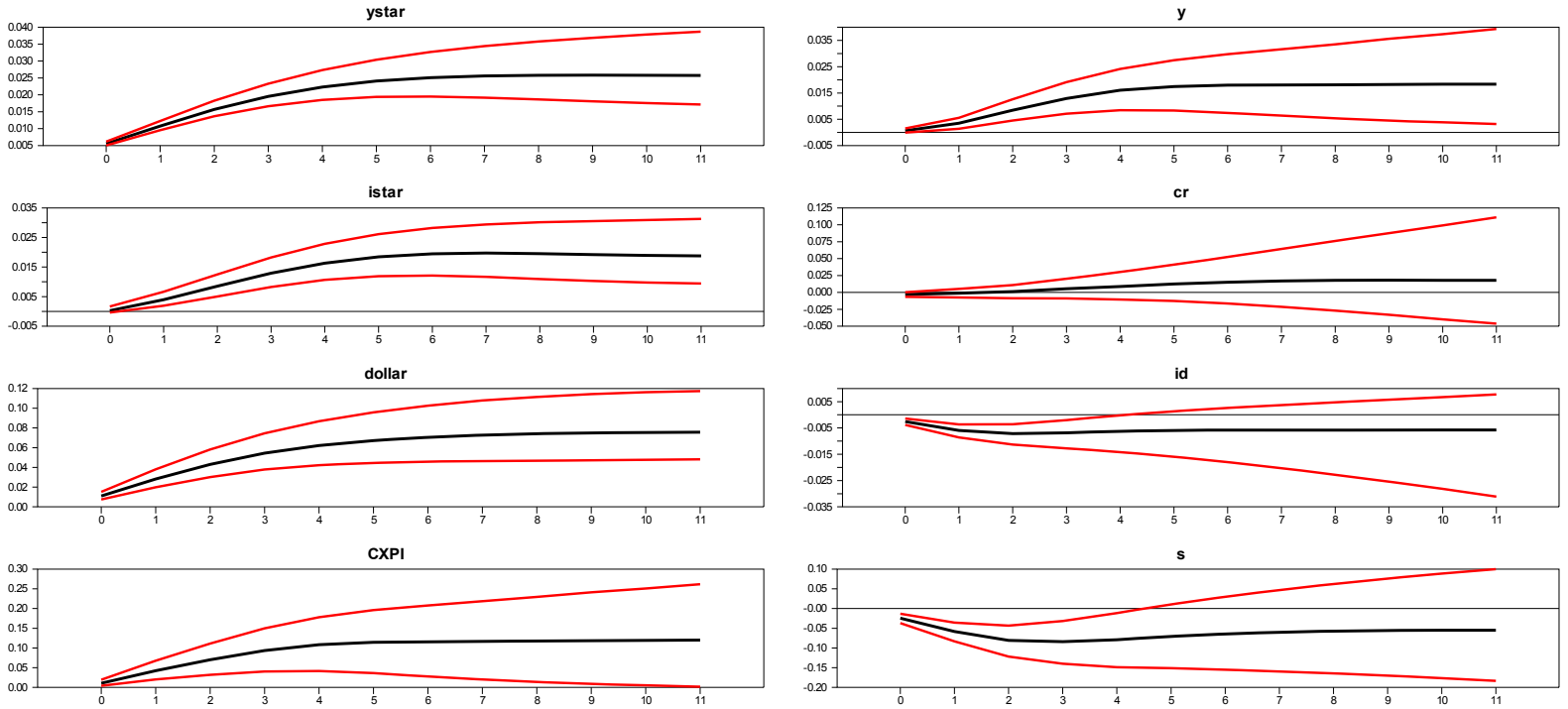
global output shock | US mon. pol. shock | USD shock

Table 1
Variance Decomposition of Forecast Errors

		contribution of							
Variable / Horizon in quarters	std. error	Y*	i*	DOLLAR	CXPI	Y	CR	i	s
Commodity Export Price Index (CXPI)									
1	0.0738	5.6	1.8	33.0	59.5	0.0	0.0	0.0	0.0
4	0.1136	25.4	1.1	30.6	30.6	5.2	5.6	0.2	1.3
8	0.1247	21.9	3.8	36.3	26.0	4.5	5.8	0.2	1.6
12	0.1286	20.6	5.4	35.9	24.9	4.6	6.7	0.2	1.9
Credit (CR)									
1	0.0175	2.0	1.2	1.3	0.2	21.8	73.6	0.0	0.0
4	0.0297	2.8	7.5	1.8	13.6	13.7	57.2	0.6	2.9
8	0.0494	2.2	22.4	10.3	11.8	8.9	39.2	0.2	5.0
12	0.0634	1.4	28.0	13.6	11.1	7.2	33.0	0.1	5.5
Exchange rate (s)									
1	0.0595	15.9	4.3	8.4	11.8	1.4	8.4	3.3	46.6
4	0.0906	24.4	8.3	12.7	10.9	1.6	5.1	2.9	34.1
8	0.0938	23.6	8.6	13.3	10.3	2.1	7.1	3.0	31.9
12	0.0980	21.7	9.8	14.7	10.3	2.5	8.6	2.8	29.6

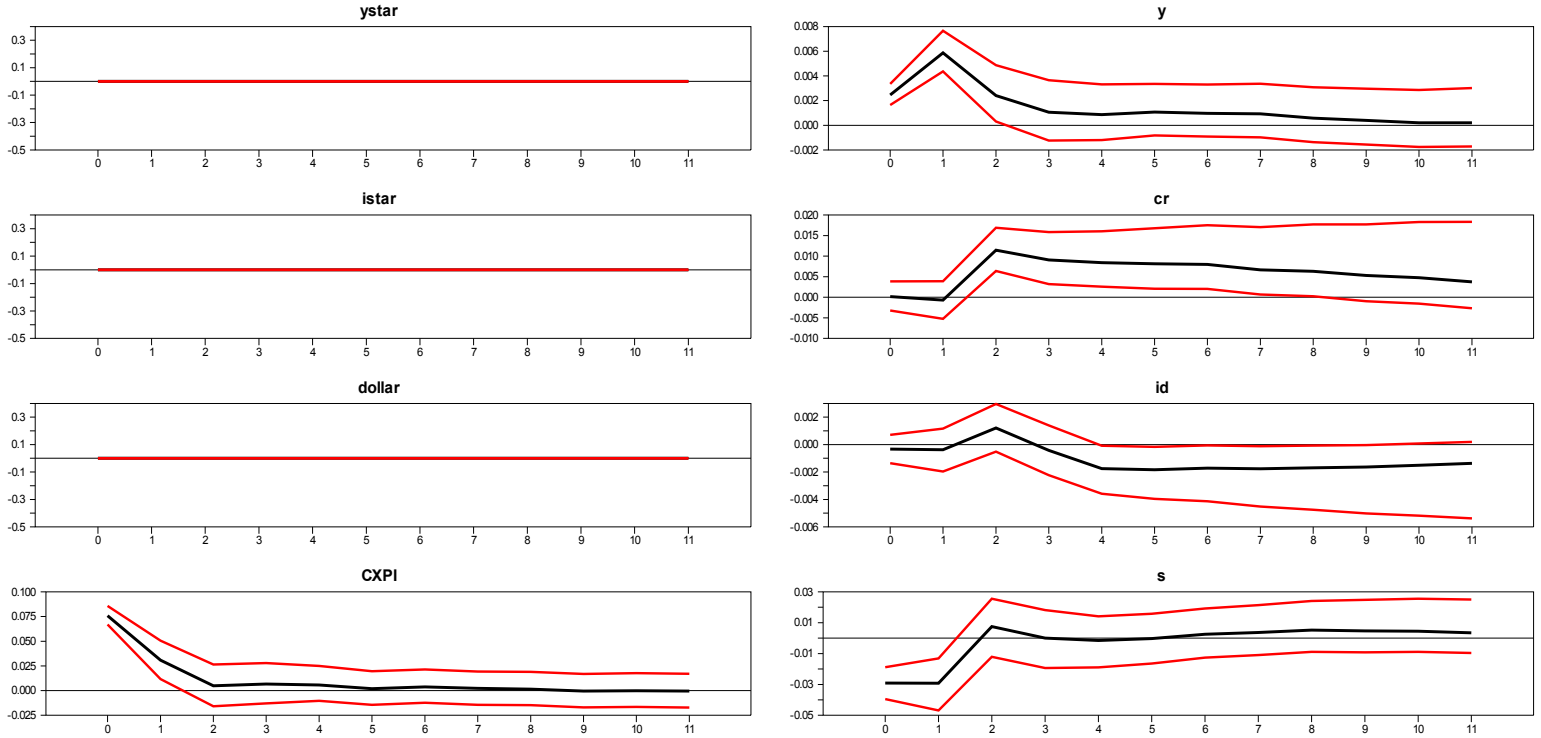
Effects of an Uptick in Global Activity

Fig. 5 - Cumulative IRFs for global output shock



Effects of CXPI shock (non-cumulative)

Fig. 1 - IRFs for export commodity price shock



Effects of CXPI shock

Fig. 2 - Cumulative IRFs for export commodity price shock

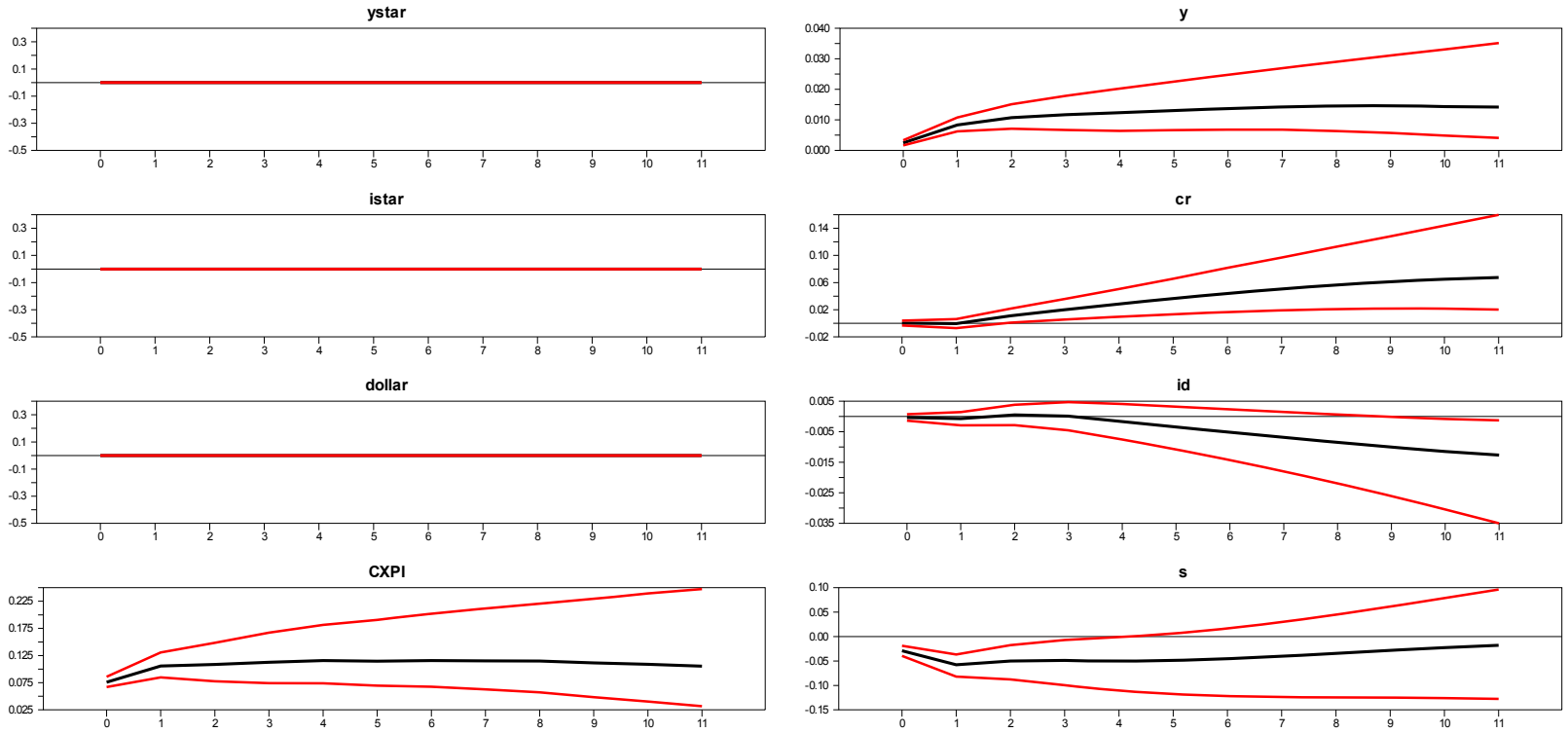


Table A1 - Responses to Structural Commodity Price Shock

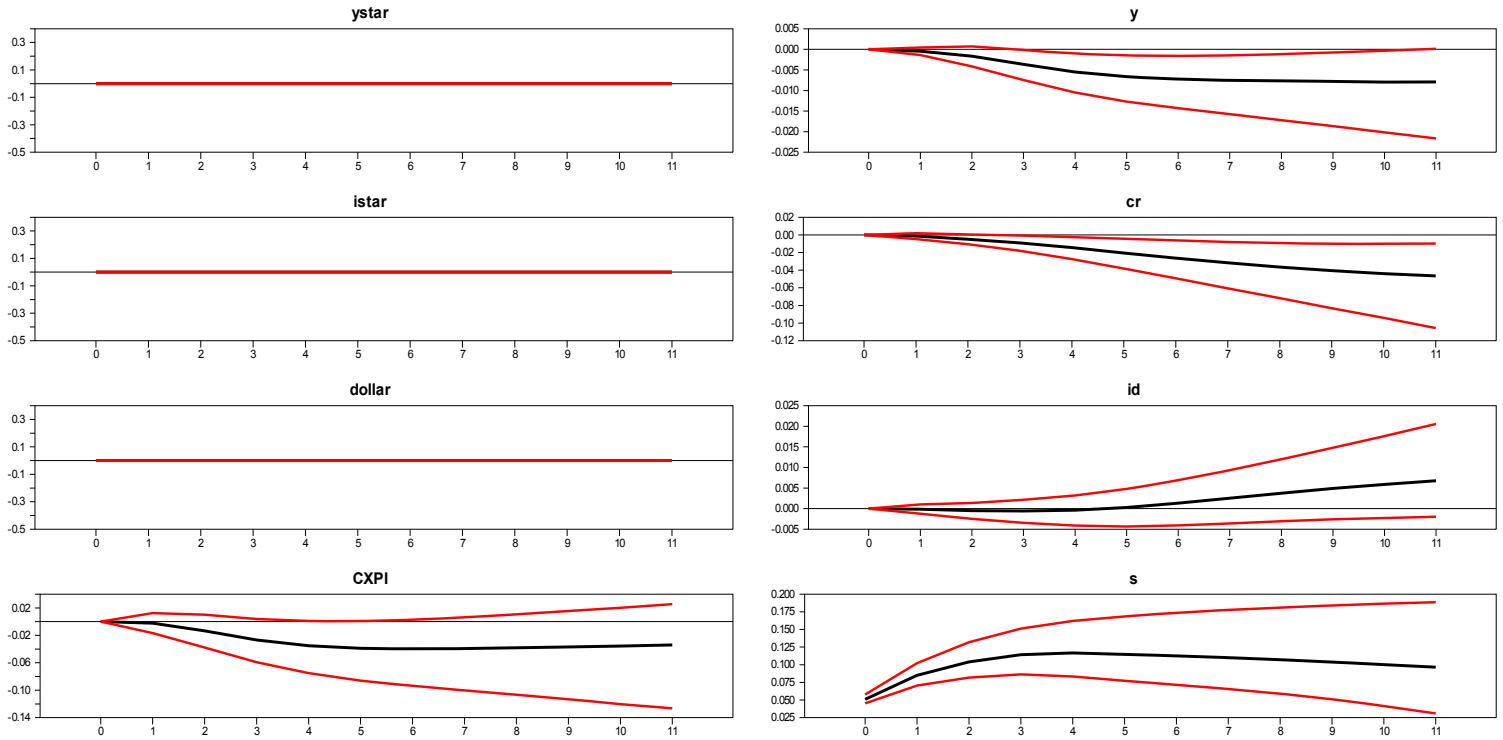
[median and 16%,84% probability interval]

quarter	CXPI		Y		CR		i		s	
1	0.0739	[0.0653,0.0837]	0.0024	[0.0016,0.0033]	0.0002	[-0.0031,0.0038]	-0.0003	[-0.0013,0.0007]	-0.0284	[-0.0385,-0.0183]
2	0.1032	[0.0827,0.1275]	0.0081	[0.0061,0.0105]	-0.0005	[-0.0069,0.0061]	-0.0007	[-0.0028,0.0014]	-0.0564	[-0.0798,-0.0357]
3	0.1060	[0.0756,0.1447]	0.0104	[0.0069,0.0147]	0.0107	[0.0009,0.0210]	0.0005	[-0.0028,0.0038]	-0.0487	[-0.0854,-0.0171]
4	0.1099	[0.0723,0.1628]	0.0114	[0.0065,0.0174]	0.0194	[0.0054,0.0350]	0.0001	[-0.0044,0.0046]	-0.0477	[-0.0970,-0.0069]
5	0.1129	[0.0720,0.1770]	0.0120	[0.0062,0.0198]	0.0276	[0.0094,0.0492]	-0.0016	[-0.0073,0.0040]	-0.0485	[-0.1077,-0.0009]
6	0.1116	[0.0679,0.1860]	0.0127	[0.0065,0.0220]	0.0355	[0.0129,0.0641]	-0.0034	[-0.0105,0.0031]	-0.0479	[-0.1149,0.0060]
7	0.1130	[0.0658,0.1967]	0.0134	[0.0066,0.0241]	0.0432	[0.0164,0.0796]	-0.0050	[-0.0139,0.0023]	-0.0441	[-0.1186,0.0164]
8	0.1125	[0.0611,0.2062]	0.0139	[0.0066,0.0263]	0.0494	[0.0185,0.0944]	-0.0067	[-0.0175,0.0014]	-0.0396	[-0.1206,0.0285]
9	0.1119	[0.0559,0.2154]	0.0142	[0.0062,0.0283]	0.0551	[0.0205,0.1100]	-0.0082	[-0.0214,0.0006]	-0.0332	[-0.1216,0.0438]
10	0.1086	[0.0471,0.2233]	0.0142	[0.0056,0.0303]	0.0596	[0.0210,0.1250]	-0.0098	[-0.0254,-0.0001]	-0.0276	[-0.1220,0.0599]
11	0.1063	[0.0393,0.2333]	0.0140	[0.0048,0.0322]	0.0633	[0.0210,0.1403]	-0.0112	[-0.0297,-0.0008]	-0.0220	[-0.1227,0.0767]
12	0.1027	[0.0309,0.2413]	0.0138	[0.0040,0.0343]	0.0659	[0.0198,0.1558]	-0.0123	[-0.0341,-0.0013]	-0.0174	[-0.1245,0.0939]

Note: Computation of probability bands follows Wagonner and Zha (2003).

Effects of Exchange Rate Shock

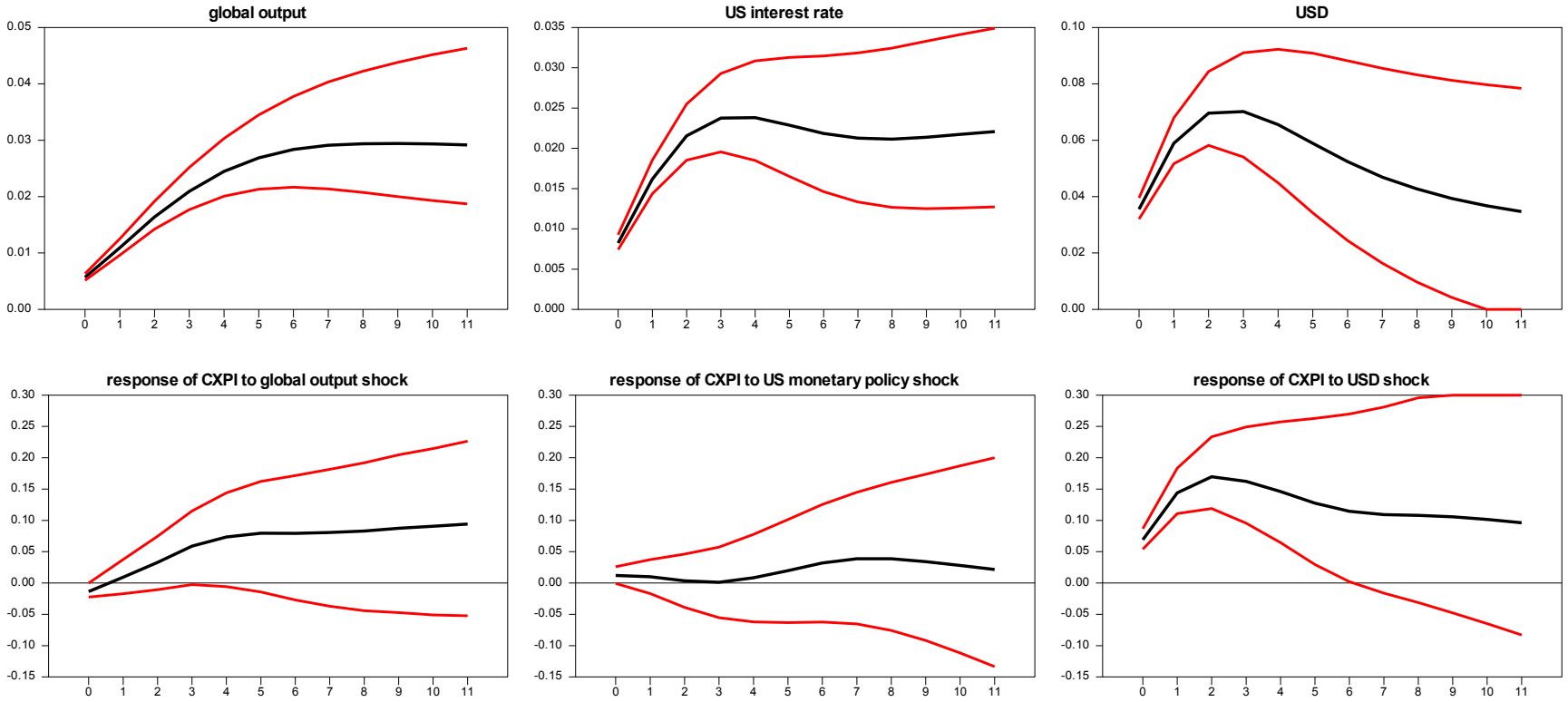
Fig. 3 - Cumulative IRFs for exchange rate shock



Robustness - I

model with shadow FF rate
(w/o US core inflation adjustment)

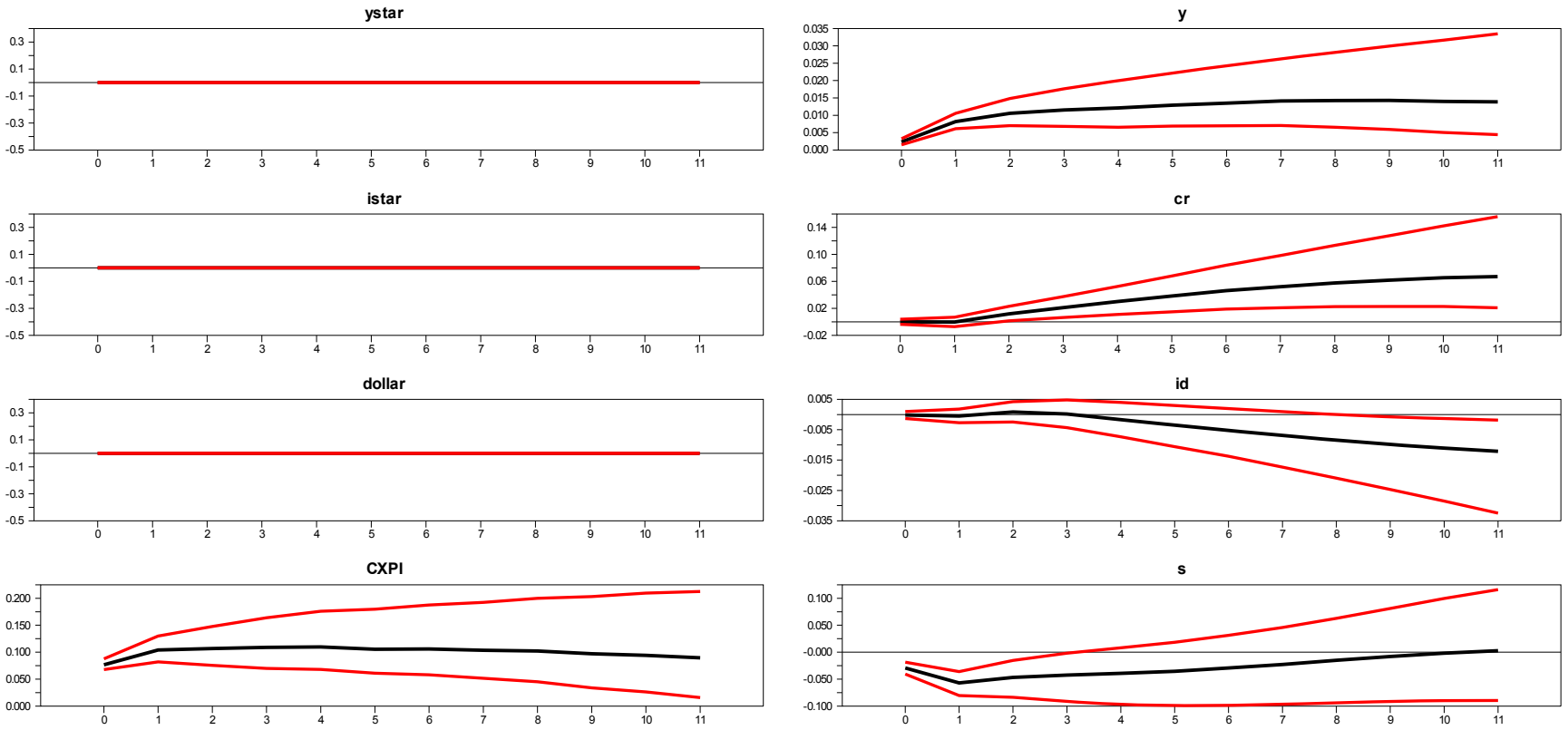
Fig. 5 - Effects of global shocks on CXPI



Robustness - I

model with shadow FF rate
(w/o US core inflation adjustment)

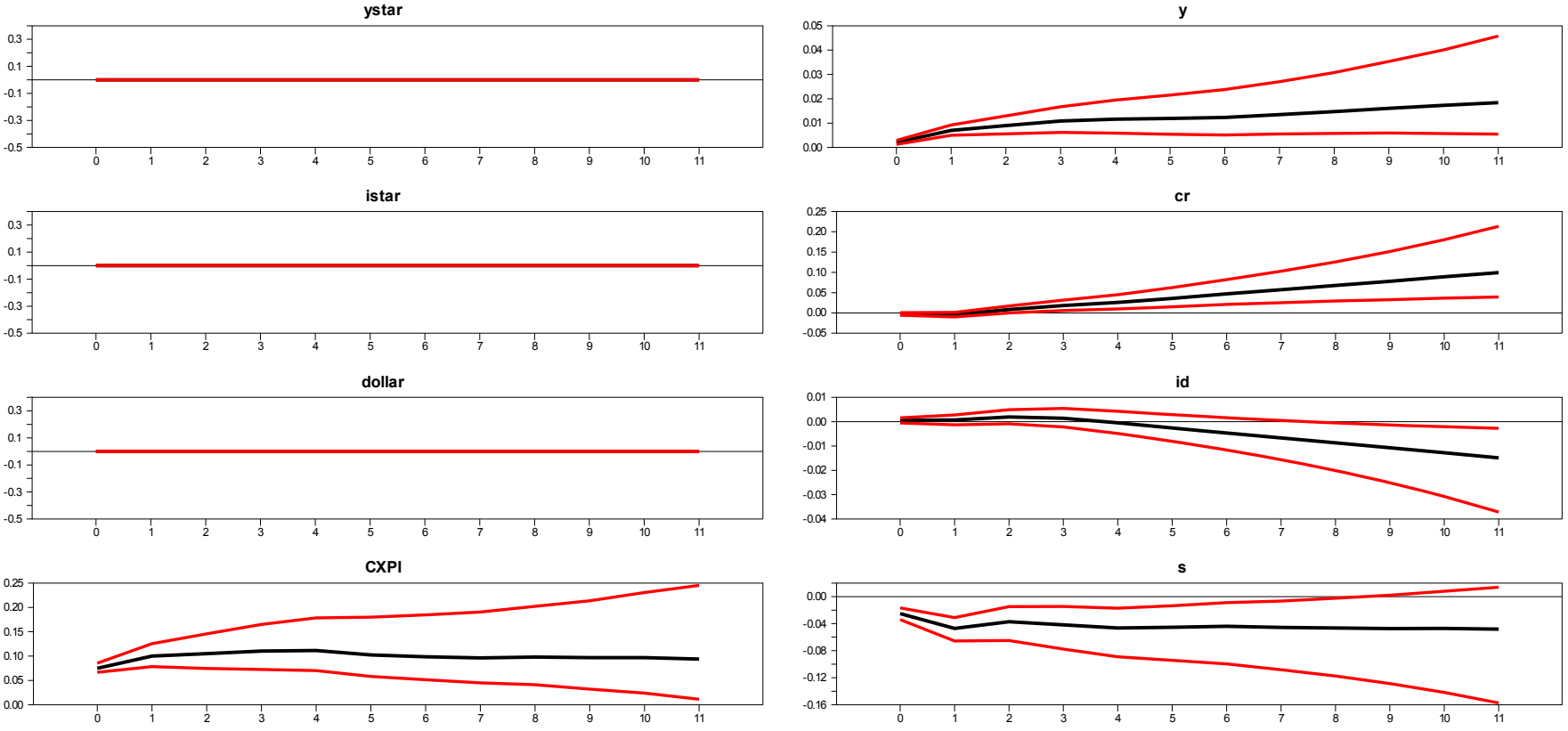
Fig. 2 - Cumulative IRs for export commodity price shock



Robustness - II

model with nominal exchange rate

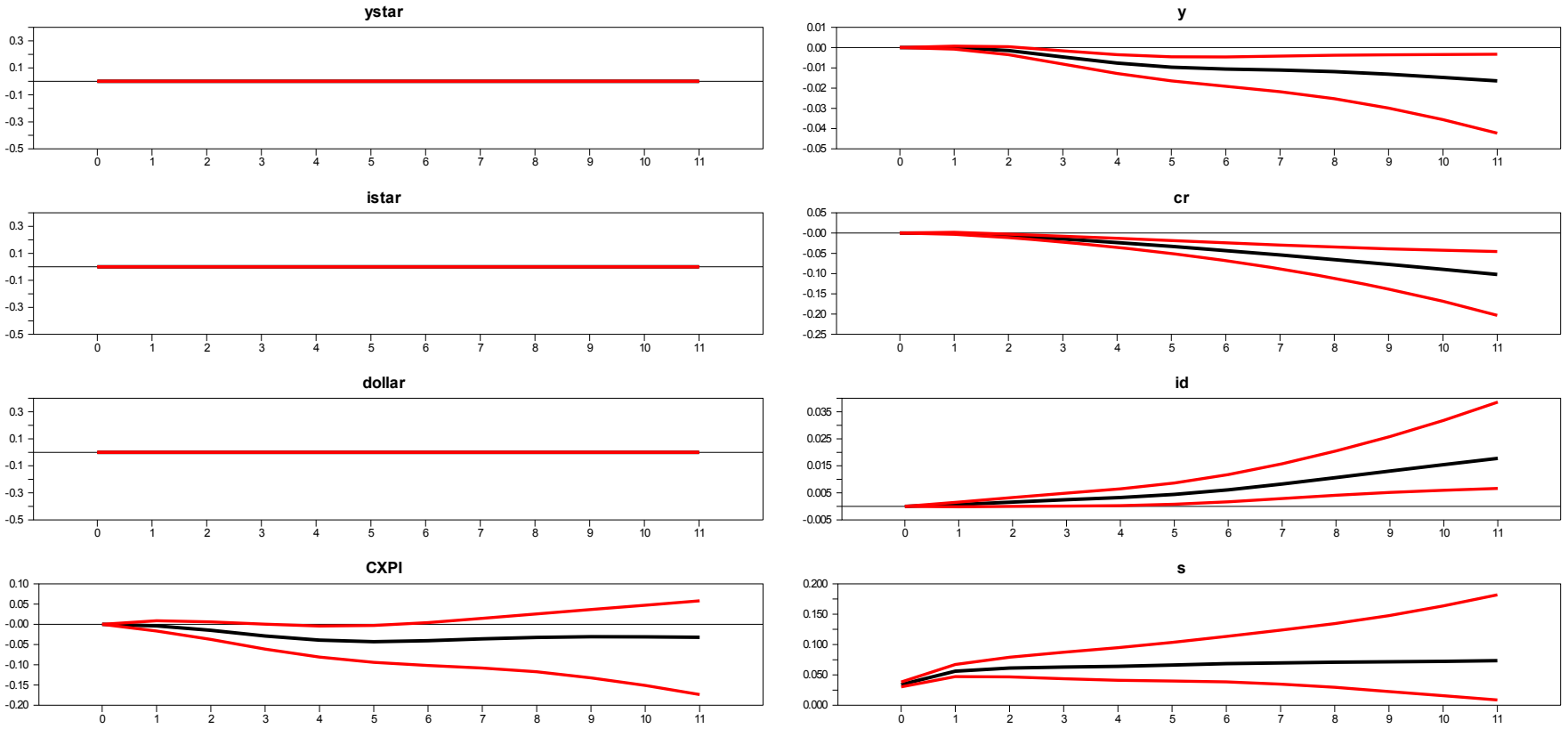
Fig. 2 - Cumulative IRs for export commodity price shock



Robustness - II

model with nominal exchange rate

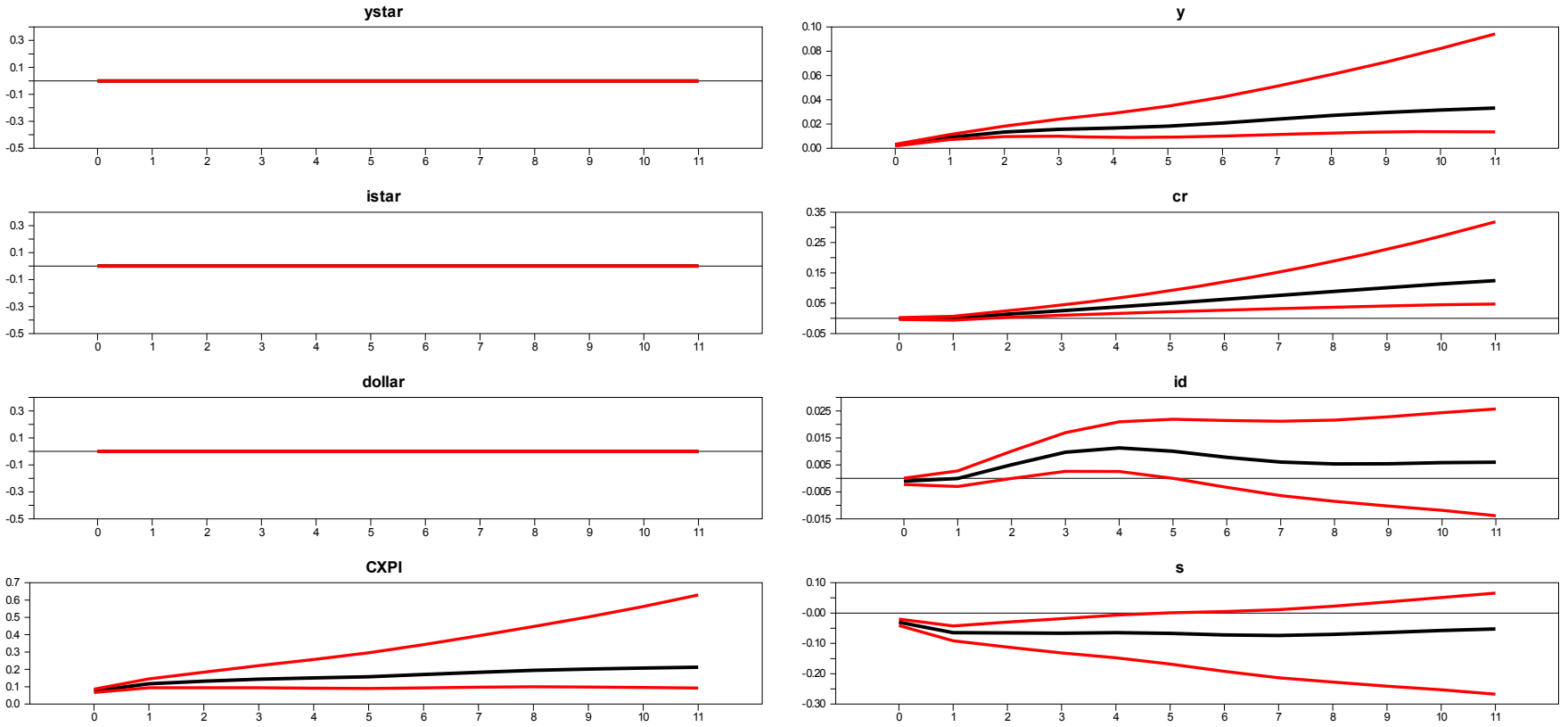
Fig. 3 - Cumulative IRs for exchange rate shock



Robustness - III

model with domestic nominal interest rate

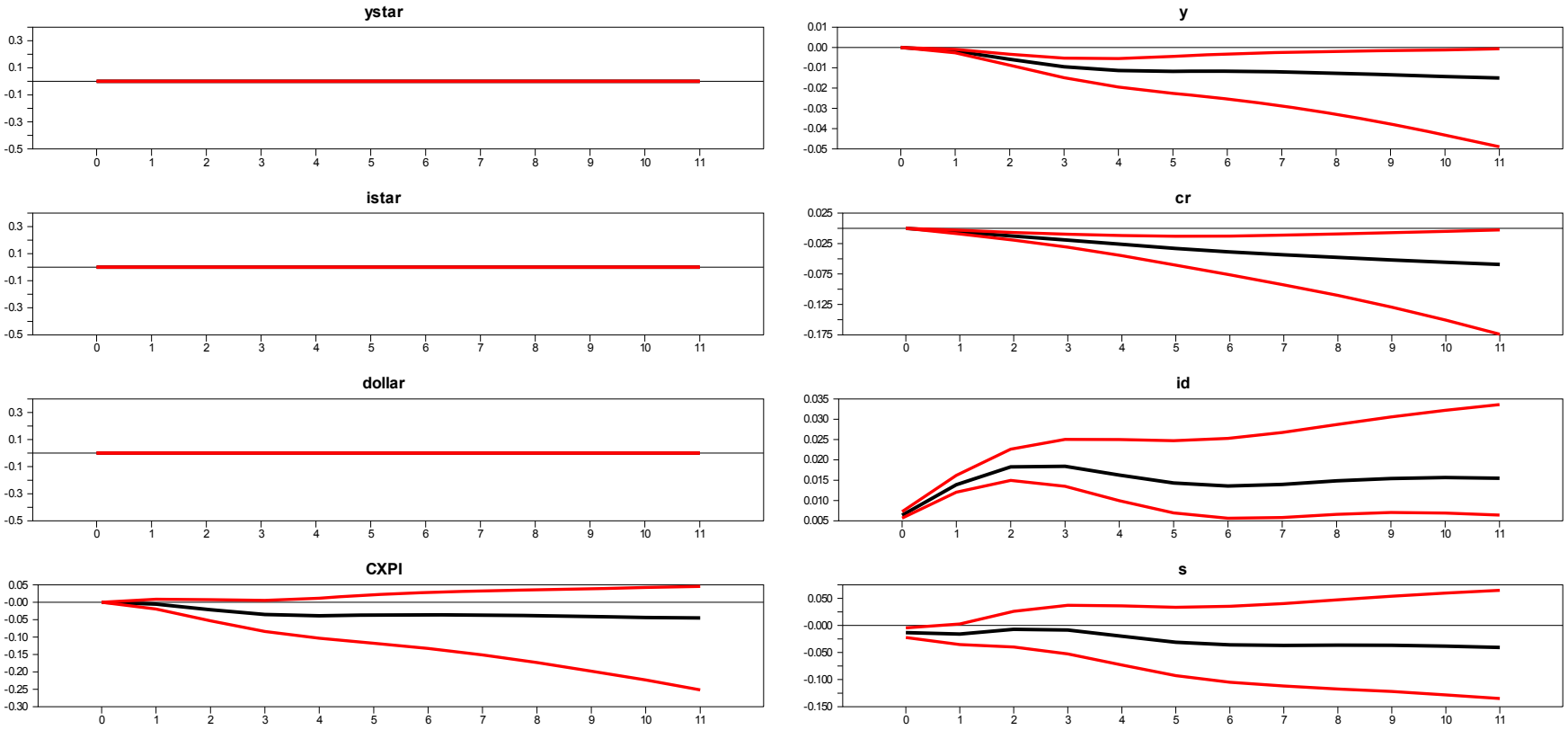
Fig. 2 - Cumulative IRs for export commodity price shock



Robustness - III

model with domestic nominal interest rate

Fig. 6 - Cumulative IRs for monetary policy shock



Main Takeaways

- global activity and international value of US dollar are the key drivers of commodity export prices;
- effects of US monetary policy stance on commodity prices are found to be small/not significant (but effects on EME credit growth strong);
- estimated commodity price shocks display high degree of persistence (self-perpetuating elements)
- commodity export price increases simultaneously
  - boost output,
  - appreciate the currency,
  - eventually lead to a (moderate) reduction in the real interest rate
  - → each of these factors tends to boost credit growth
- credit to GDP ratio falls during first two quarters after a positive commodity price shock but then grows strongly
  - (LT effect on credit ~3 times that on GDP)

Three mechanisms for inflows/appreciation – credit expansion nexus

- currency-risk taking channel:

  global banks lend to locals, subject to VaR constraint. Appreciation relaxes constraint and leads to increased lending.

  (Bruno and Shin (2015a,b), Hofmann, Shim and Shin (2016))
- debt securities issued by EME corporates:

  deposited in domestic banking sector, funding domestic credit expansion

  (MacCauley, Upper and Villar (2013), Shin (2013))
- inflows that lead to sterilized FX purchases by CBs:

  sterilization increases holding of bonds by banks, which later rebalance their bond-loan portfolio, increasing lending

  (Garcia (2011), Gadanecz, Mehrotra and Mohanty (2014))

Final remarks

- commodity export prices have an effect on exchange rate that is at least as important as that of monetary policy;

> Potential of credit to amplify shocks originating from real sector suggests that effective macroprudential policies to avoid excessive leverage particularly important in commodity exporting EMEs.

> In principle, FX reserves could be used to lean-against-the-wind and reduce volatility (though more difficult if shocks persistent)

> Gross positions of residents could potentially play a stabilizing role (eg if domestic investors encouraged to invest abroad during a boom)