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Exchange Rate Forecasting with DSGE models

16 IWH-CIREQ Macroeconometric Workshop: Challenges for Forecasting
Halle/ 7 December 2015

Motivation

Motivation for the research

➤ Economic theory provides policy makers with clear guidance on how the exchange rate channel operates after disturbances, for example following a monetary policy or technology shock.

➤ Since Meese and Rogoff (1983) there is however a cloud in international economics: has all of this limited empirical relevance? However, every cloud has a silver lining:

1. The exchange rate literature recognized that part of the dismal forecasting performance of macro models can be attributed to estimation rather than mis-specification error (Engel et al., 2008).

2. There has been a certain re-appraisal of PPP theory. The consensus has turned back to the 1970s view that real exchange rates tend to converge back to a slow moving equilibrium (Taylor and Taylor, 2004)

3. The responsiveness of exchange rates to monetary policy announcements constitutes "prima facie" evidence that fundamentals matter after all (event studies)

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Research question

➤ If real exchange rates are mean-reverting – a feature also embedded in most new open economy models – why it is not possible to exploit it in order to beat the RW?

➤ The aim of this paper is to see if the forecasting performance of a state-of-the-art open economy DSGE model, albeit conceptually more appealing than the model of the 70s, also disappoint in terms of forecasting.

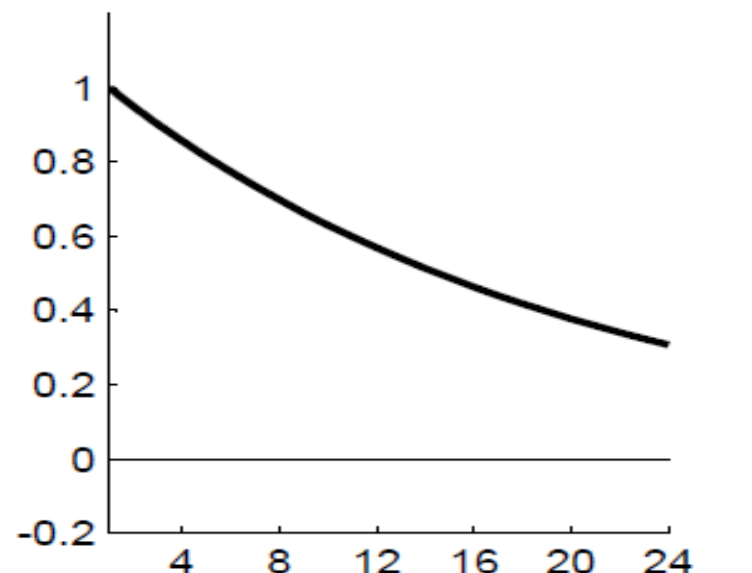➤ We find some encouraging results. Research in progress.

Forecasting horse race

What is AR fixed / mean-reversion mechanism?

It is a simple model
that assumes
gradual reversion to
historical mean
(5% per quarter, i.e.
half-life at slightly over 3 years)

> In a recent NBP/ECB working paper and VOX article (Ca'Zorzi, Mućk and Rubaszek, presented here 2 years ago) , we have shown that this is a tough competitor in terms of RER and NER forecasiting.

> Faust and Wright (2013) have used it for inflation forecasting.

> Important lesson that a simple gliding path between a good initial forecast and a good end point forecast it is difficult to beat!

Evaluation of forecasts

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Bird's eye view on the results for RER

➤ BVAR models perform poorly, particularly DBVAR

➤ DSGE model with no trend in RER performs much better than the DSGE which allows for the trend.

➤ AR fixed and DSGE (without trend) models beat overwhelmingly the RW for the EA, US and UK and perform in a comparable way for CAN and AUS.

➤ AR fixed is tougher a-theoretical benchmark than the RW.

Overall AR fixed and DSGE have a similar performance. We will discuss relative strengths and weaknesses.
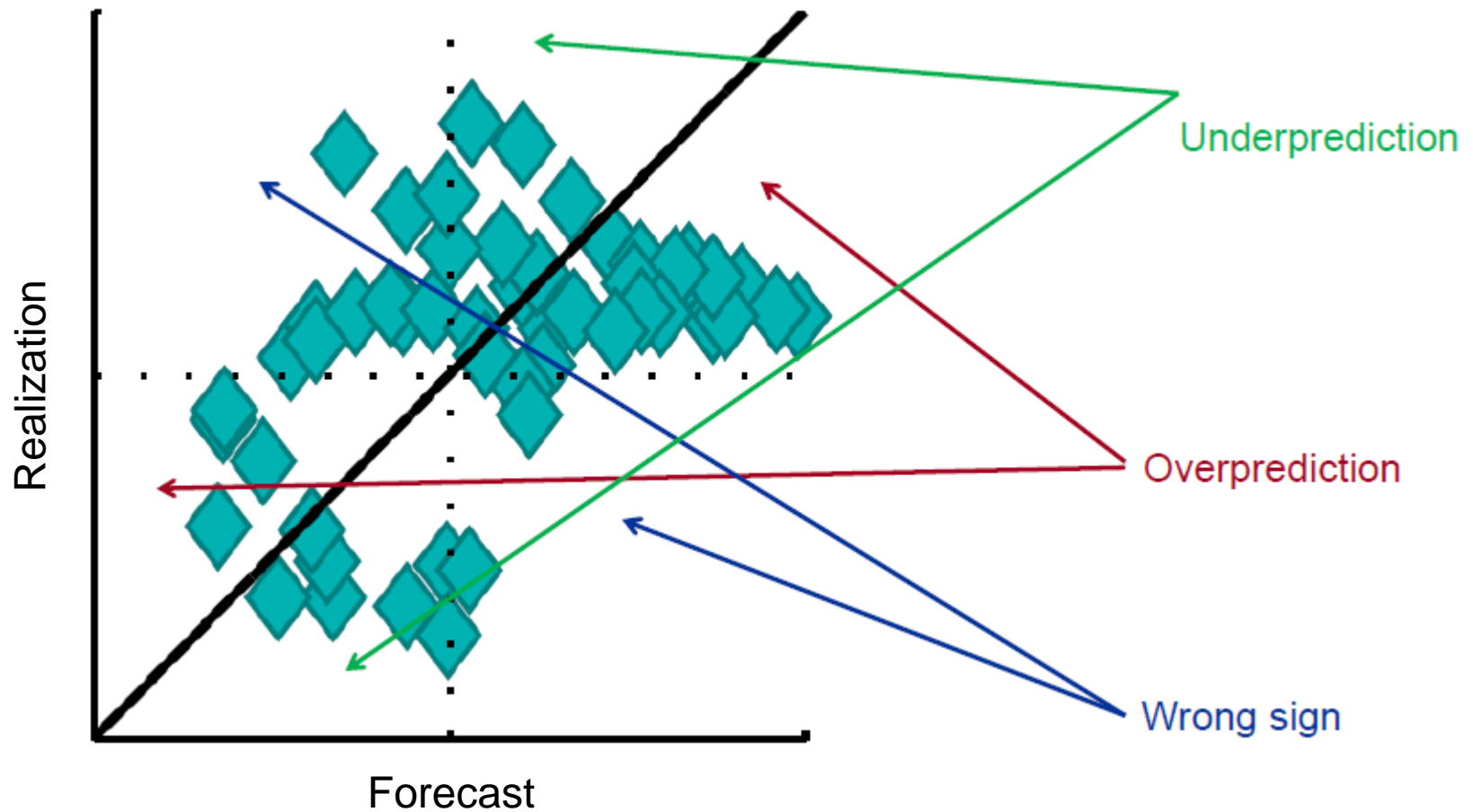
Root Mean Squared Forecast Error RER

	H=1	H=2	H=4	H=8	H=12	H=24
	United States					
RW	2.73	4.43	6.48	9.94	11.65	17.36
AR fixed	0.99	0.98	0.94	0.89	0.87	0.73**
DBVAR	1.04	1.15	1.13	1.19	1.13	1.28
LBVAR	1.01	1.09	1.15	1.29*	1.36*	1.03
DSGE with trend	1.12*	1.15	1.22	1.21	1.21	1.01
DSGE no trend	1.03	1.02	1.00	0.92	0.83	0.66***
	Euro Area					
RW	3.04	4.88	7.59	11.15	14.17	19.42
AR fixed	1.00	1.00	0.97	0.92	0.87	0.76**
DBVAR	1.05	1.12*	1.20***	1.30***	1.36***	1.36**
LBVAR	1.05	1.12	1.22	1.31	1.25	0.93
DSGE with trend	0.99	0.98	0.98	1.01	1.00	0.90
DSGE no trend	0.99	0.98	0.96	0.95	0.91	0.77**
	United Kingdom					
RW	2.56	4.17	6.48	9.92	11.74	13.96
AR fixed	1.00	0.98	0.95	0.88**	0.86**	0.83***
DBVAR	1.06	1.18	1.23**	1.31**	1.43***	1.82***
LBVAR	1.12**	1.21**	1.24*	1.14	1.13	1.23*
DSGE with trend	1.01	0.98	0.94	0.84**	0.80***	0.86**
DSGE no trend	1.02	0.99	0.94	0.84	0.78**	0.67***

Root Mean Squared Forecast Error RER

	H=1	H=2	H=4	H=8	H=12	H=24
	Canada					
RW	2.95	4.76	6.79	8.84	11.13	17.70
AR fixed	1.01	1.00	1.00	1.03	1.02	0.80
DBVAR	0.99	1.07*	1.15*	1.31*	1.41**	1.61**
LBVAR	1.04	1.09*	1.13**	1.09	1.03	1.10
DSGE with trend	1.02	1.02	1.03	1.08	1.08	1.04
DSGE no trend	1.03	1.03	1.04	1.08	1.05	0.79
	Australia					
RW	4.63	7.28	10.22	13.66	16.24	23.11
AR fixed	1.01	1.00	1.00	1.02	1.03	0.88
DBVAR	1.03	1.10	1.12	1.05	0.98	1.18
LBVAR	1.02	1.06	1.09	1.07	1.07	1.22**
DSGE with trend	1.07*	1.10	1.18**	1.34***	1.46***	1.55***
DSGE no trend	1.03	1.03	1.04	1.10	1.14	1.01

Scatter-plot of realizations vs. forecasts

Scatter-plot of forecast vs. realization for H=24

Comparison of forecasts and realizations for H=24

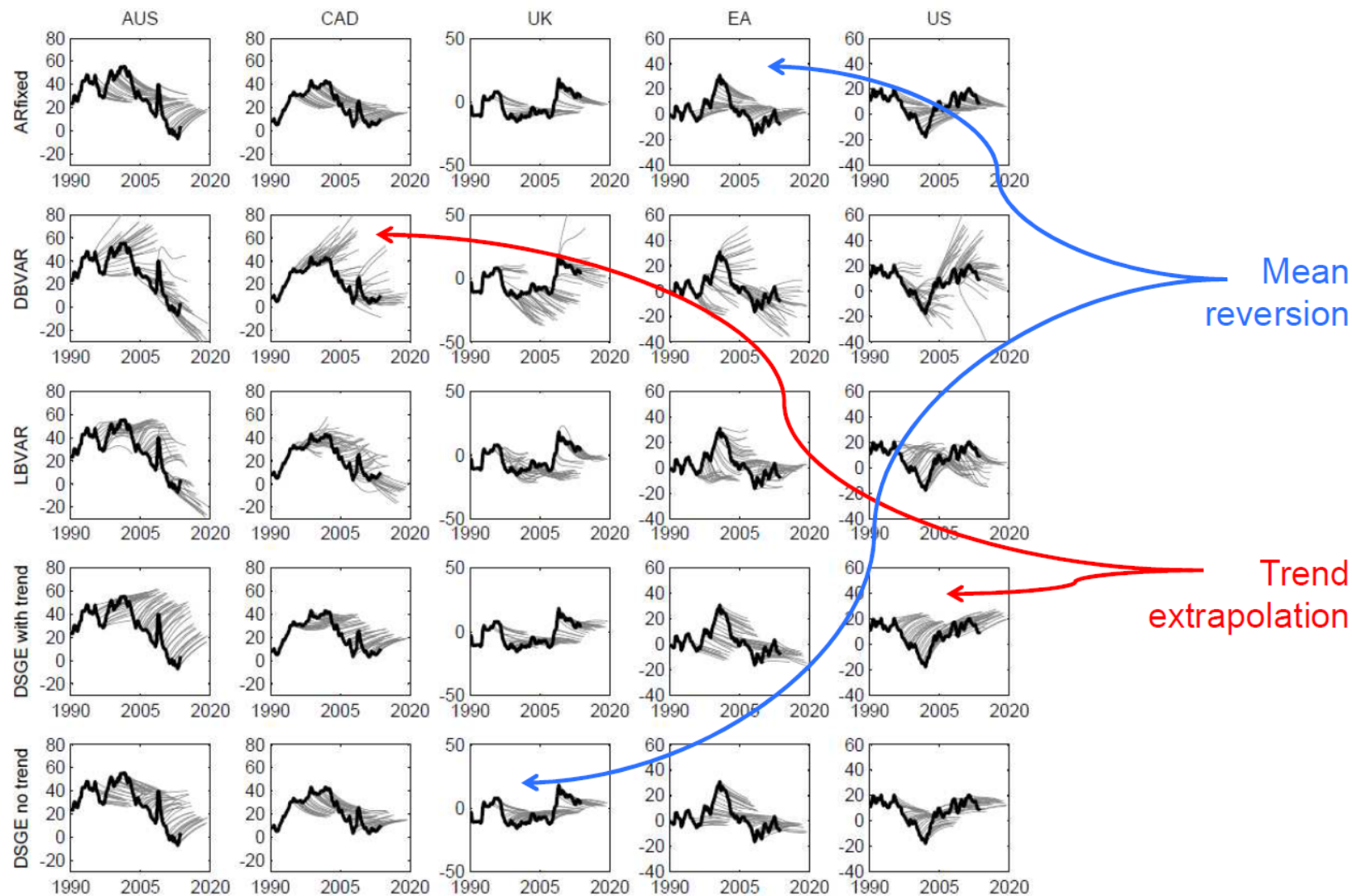|		US	EA	UK	CAN	AUS
AR fixed	wrong sign	30.2	30.2	13.2	35.8	45.3
	underprediction	64.2	62.3	69.8	47.2	45.3
	overprediction	5.7	7.5	17.0	17.0	9.4
	relative volatility	37%	40%	31%	68%	48%
	correlation	79%	77%	65%	25%	3%
DBVAR	wrong sign	24.5	47.2	84.9	52.8	47.2
	underprediction	28.3	26.4	11.3	18.9	41.5
	overprediction	47.2	26.4	3.8	28.3	11.3
	relative volatility	135%	66%	106%	92%	49%
	correlation	42%	-75%	-48%	-9%	21%
LBVAR	wrong sign	49.1	47.2	66.0	52.8	62.3
	underprediction	22.6	32.1	30.2	35.8	32.1
	overprediction	28.3	20.8	3.8	11.3	5.7
	relative volatility	79%	45%	44%	44%	38%
	correlation	27%	24%	-5%	39%	31%
DSGE with trend	wrong sign	26.4	24.5	20.8	49.1	77.4
	underprediction	17.0	62.3	67.9	45.3	18.9
	overprediction	56.6	13.2	11.3	5.7	3.8
	relative volatility	106%	46%	27%	25%	68%
	correlation	69%	31%	67%	17%	-11%
DSGE no trend	wrong sign	7.5	20.8	3.8	30.2	56.6
	underprediction	84.9	64.2	64.2	52.8	43.4
	overprediction	7.5	15.1	32.1	17.0	0.0
	relative volatility	40%	32%	60%	70%	36%
	correlation	94%	75%	72%	23%	-5%

Understanding the results

When models fail to predict RER well?

Models are innacurate if:

➢ They give a lot of weight to short term dynamics in-sample, which deteriorates the out-of-sample accuracy in line with the „shrinkage principle" of Diebold
(DBVAR)

➢ They ignore mean reverting tendencies of the RER and extrapolate too much past trends
(DBVAR, DSGE with trend)

Plotting the "whiskers"

Evidence of mean reversion for EA, US, UK

	H=1	H=2	H=4	H=8	H=12	H=24
	United States					
RW	0.0	0.0	0.0	0.0	0.0	0.0
ARfixed	5.0	9.8	18.6	33.7	46.0	70.8
DBVAR	0.4	-0.1	-3.2	-9.4	-16.3	-41.0
LBVAR	4.8	11.2	27.0	62.7	95.7	131.6
DSGE with trend	2.5	4.8	8.4	12.2	13.4	12.1
DSGE no trend	2.9	5.8	10.8	17.8	22.7	33.8
Actuals, pace	1.0	3.8	8.8	23.0	22.4	123.1
Actuals, frequency	48.7	52.0	52.1	50.7	47.7	69.8
	Euro Area					
RW	0.0	0.0	0.0	0.0	0.0	0.0
ARfixed	5.0	9.8	18.6	33.7	46.0	70.8
DBVAR	-4.2	-8.1	-15.8	-29.9	-42.4	-74.5
LBVAR	2.8	6.8	16.1	30.3	38.6	45.5
DSGE with trend	1.8	3.2	5.3	7.7	8.3	5.7
DSGE no trend	3.4	6.5	12.0	20.7	27.4	41.4
Actuals, pace	0.5	2.5	6.9	20.1	31.3	122.2
Actuals, frequency	46.1	45.3	47.9	52.2	56.9	69.8
	United Kingdom					
RW	0.0	0.0	0.0	0.0	0.0	0.0
ARfixed	5.0	9.8	18.6	33.7	46.0	70.8
DBVAR	-7.2	-12.9	-22.3	-37.0	-50.2	-86.2
LBVAR	0.9	2.9	7.1	16.1	26.1	39.3
DSGE with trend	6.1	11.9	21.6	34.8	42.6	50.5
DSGE no trend	7.9	15.5	28.5	47.5	60.3	80.4
Actuals, pace	4.1	10.9	26.1	65.4	94.4	169.2
Actuals, frequency	60.5	60.0	71.2	75.4	81.5	88.7

Similar pattern for EA, US, UK:

very limited evidence of mean reversion at short horizons but much stronger at longer horizons

(even overshooting)

Scarce evidence of mean reversion for CAN, AUS

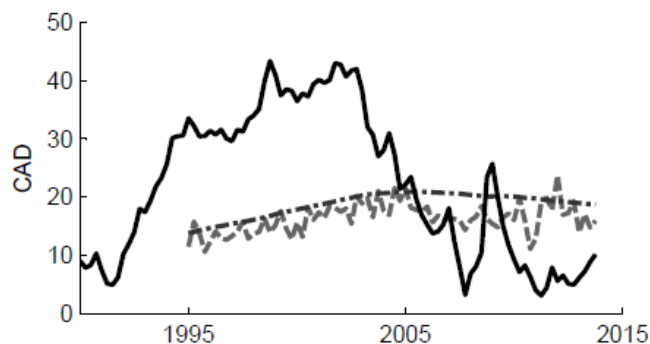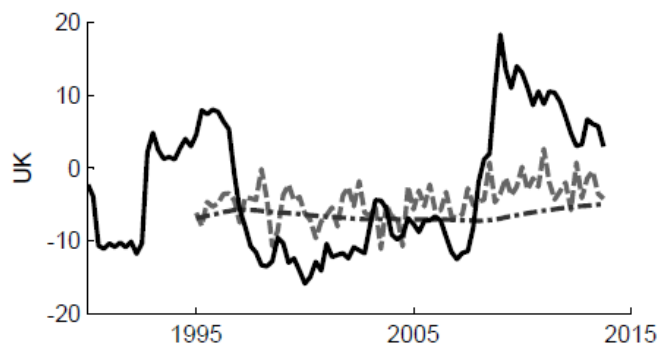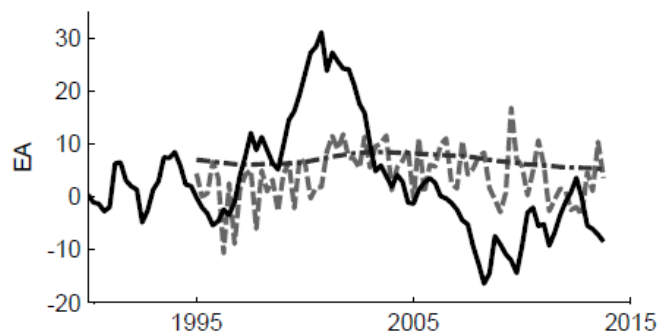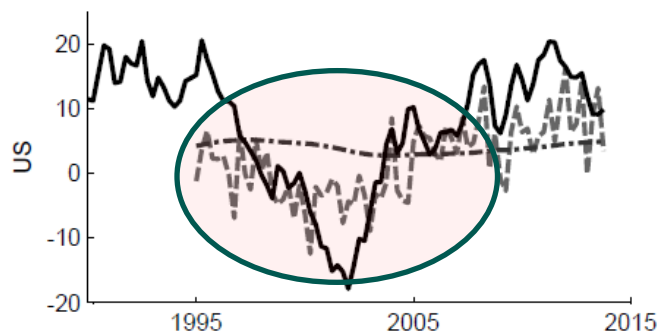|	H=1	H=2	H=4	H=8	H=12	H=24
	Canada					
RW	0.0	0.0	0.0	0.0	0.0	0.0
ARfixed	5.0	9.8	18.6	33.7	46.0	70.8
DBVAR	-2.7	-5.7	-12.5	-26.2	-37.9	-67.8
LBVAR	-2.4	-5.0	-10.0	-16.5	-18.3	-30.3
DSGE with trend	4.3	8.5	15.6	24.8	30.0	34.1
DSGE no trend	5.9	11.9	22.6	38.9	50.4	70.2
Actuals, pace	0.8	3.8	8.5	14.0	24.4	59.2
Actuals, frequency	48.7	48.0	56.2	52.2	50.8	64.2
	Australia					
RW	0.0	0.0	0.0	0.0	0.0	0.0
ARfixed	5.0	9.8	18.6	33.7	46.0	70.8
DBVAR	-4.4	-8.2	-15.1	-26.2	-37.0	-72.4
LBVAR	-2.8	-5.5	-9.7	-14.6	-17.6	-30.3
DSGE with trend	2.5	5.1	9.6	17.0	22.5	31.4
DSGE no trend	3.7	7.4	14.3	26.3	36.3	57.1
Actuals, pace	1.7	4.2	5.2	1.3	-0.4	20.4
Actuals, frequency	47.4	44.0	50.7	43.5	41.5	52.8

For Canada, and especially Australia, the evidence of mean reversion is less pronounced.

Worth comparing two best competitors: DSGE and AR fixed

Key questions:

➢ How much do they differ in terms of long run real exchange rate predictions?

➢ And how much do they differ in terms of dynamics?

Differences in equilibrium exchange rates: reassuringly similar

Average differences:
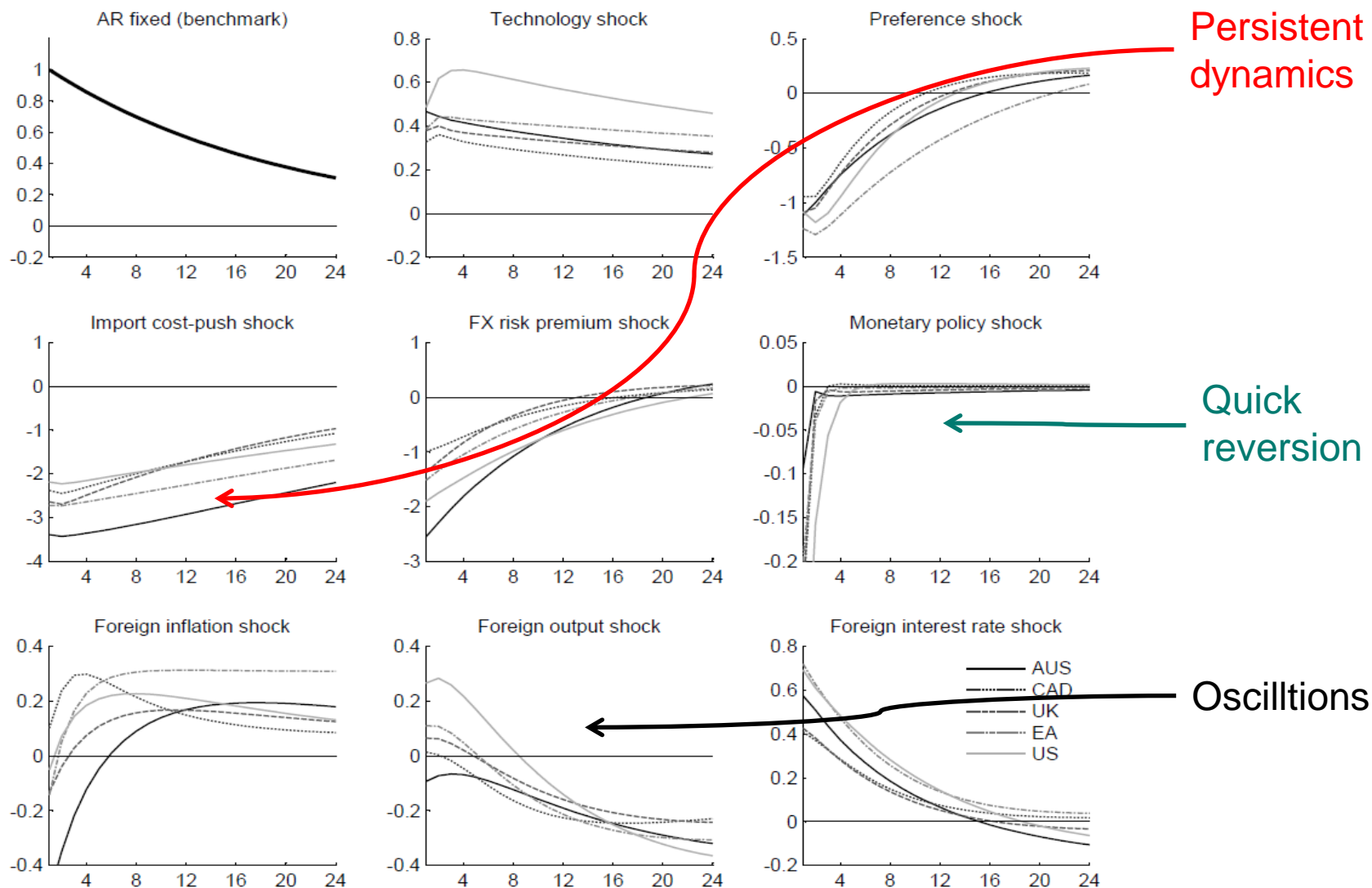US: -1.9%
EA: -2.8%
UK: 1.9%
AUS: -0.7%
CAD: -2.4%

Max difference:
US, 2001:2
16,9%

Differences in dynamics

Persistent dynamics

Quick reversion

Oscilltions

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The dynamics can also be quite different

➢ The DSGE model does not always projects an immediate convergence of the RER to the steady state: it may forecast divergence from the steady state to guarantee long term sustainability of the current account / net foreign assets (stock-flow consistency)

➢ The speed of reversion to the steady state depends on the source of the disturbance: it is hence time variant and country specific.

➢ Example: for US 2013:3 DSGE identifies 5.6% undervaluation, but forecast is 3.5% depreciation to restore external balance (current account deficit, and large foreign debt)

Worth comparing two best competitors: DSGE and AR fixed

Key questions:

➢ *How much do they differ in terms of long run real exchange rate predictions?*

A: the difference is sometimes non-negligible, but on average small

➢ *And how much do they differ in terms of dynamics?*

A: the DSGE allows for much richer transitory dynamics

Conclusions

Conclusions

➢ It is difficult to beat RW at short horizons but possible at longer horizons

➢ Models that account for the mean reverting properties of the RER tend to do well at long term horizons. This is the source of success of both our baseline DSGE model and AR fixed.

Pros and cons

➢ The AR fixed is a tough benchmark but has no story!

➢ Trade off between a coherent macro framework and tractability (AR fixed vs. DSGE).

➢ In our sample the DSGE model captures better the directional change of RER but is it worth the additional layer of complexity?

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Takeaways

➢ Do not include trends when estimating DSGEs: it might be counterproductive

➢ Do not difference data if not necessary in BVARs

➢ Forecast RERs with a mean reverting pattern, in some specific cases a DSGE model may improve your forecast (e.g. a deviation from PPP due to a critical international investment position)

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