International Business Cycles in Emerging Markets Data and On-line Appendix

Jacek Rothert

Department of Economics, U.S. Naval Academy, United States

Abstract

This document replicates the empirical section from "International Business Cycles in Emerging Markets" and provides an appendix with robustness results to different measures of the nominal interest rate, expected inflation, real exchange rates, and/or sample of countries (corresponding to Aguiar and Gopinath 2007 sample).

JEL classification: F41, F44

Keywords: business cycles, real exchange rates, emerging markets, country risk, trend shocks, Backus-Smith puzzle

1 Empirical motivation - RERs in emerging economies

The data used in this paper comes from three sources: the International Monetary Fund's (IMF) International Financial Statistics (IFS), IMF's Balance of Payments Statistics (BoP), and OECD's Quarterly National Accounts (OECD). The analysis covers 36 countries: 15 developed and 21 emerging. I classify each country as "emerging" or "developed" following the IMF classification.[1] If a country switched its classification at some point (from emerging

---

[1]The exact list of countries included in each group differs across papers in the literature, mostly due to data availability of specific time series. Aguiar and Gopinath (2007) consider a sample of 13 emerging and 13

to developed), I classify it as "emerging" to be consistent with the literature.[2] The complete sample of countries in each group is listed in Table 1.

1.1 Variables, series, and data coverage

In this section, I focus on the business cycle behavior of six variables: real GDP, real consumption expenditures, real investment expenditures, the ratio of trade balance to GDP (both nominal), real interest rate, and RER. As the starting point of the analysis for each country, I use the first quarter of 1980 or the earliest date available (if it's after 1980). If the series for a variable does not have at least a 15-year-long continuous span, I drop that variable, and consequently, the country. All data is quarterly and seasonally adjusted. Appendix A.4.2 provides the details on the data coverage.

1.1.1 Series used

The series for GDP, consumption, investment, and the ratio of trade balance to GDP are fairly standard. The original series for both real consumption and real investment have been obtained using their own price indices. If the original series for real consumption and/or real investment are not available, I divide nominal consumption and nominal investment expenditures by the GDP deflator. The benchmark series for the RER is the real effective

developed economies, while Neumeyer and Perri (2005) have only five countries in each group. García-Cicco et al. (2010), on the other hand, have a sample of 22 countries that only partially overlaps with those in Aguiar and Gopinath (2007). Finally, Michaud and Rothert (2018) have a sample of 30 countries, including some that are not in the Aguiar and Gopinath (2007) sample, but excluding a few that are.

[2]The countries that switch classification are: Czech Republic, Estonia, Iceland, Israel, Korea, Latvia, Lithuania, and Slovak Republic.

exchange rate (REER). If a 15-year-long series for REER is not available, I construct a bilateral RER against the US dollar. Appendix A.4.2 provides the details on the exact names and description of series used and the sources used for each country.

Consistent series across countries for the real interest rate are the hardest to obtain. A popular approach for an emerging economy would be adding the Emerging Market Bond Index (EMBI) country spread on the dollar-denominated bond to the rate for the US three-month Treasury Bill and subtracting the expected inflation in the United States. By using the nominal return on the dollar-denominated bond, the exchange rate risk of the emerging economy is eliminated. At the same time, however, the real interest rate in a typical developed economy would be computed by taking that country's nominal interest rate on government or corporate bonds, denominated in the local currency, and subtracting the expected inflation in that country, which does not eliminate the exchange rate risk.[3] I chose to use the same measure of nominal interest rate in every country and the same measure of inflation in every country. The benchmark series for the nominal interest rate is the average lending rate in the economy, as reported in IFS. The benchmark series for expected inflation is the actual inflation from the next quarter, calculated using the GDP deflator. The results that use an alternative measure of the nominal interest rate and/or expected inflation are very similar to the benchmark results and are presented in Appendix A.2.[4]

---

[3]See, for example, Neumeyer and Perri (2005).

[4]Four countries listed in Table 1 do not have series for the lending rate available. Those countries are excluded from the analysis in this section, but included in Appendix A.2.

Table 1: List of countries	
Emerging	*Argentina*, Brazil, Chile, Colombia, Costa Rica, Czech Republic, Estonia, Hungary, Iceland*, India, Indonesia, Israel, Korea, Latvia, Lithuania, Mexico, Russia, Slovak Republic, Slovenia, South Africa, Thailand*
Developed	*Australia, Austria*, Belgium, Canada, Denmark, Finland*, Greece, Ireland, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland*

* — business cycle statistics included in the Appendix only

1.2 Business cycle statistics

1.2.1 Summary statistics

Table 2 provides a summary of similarities and differences in business cycle statistics between emerging and developed economies in general, and between Mexico and Canada in particular. On average, in emerging economies, we observe higher volatility of output and interest rates, excess (relative to output) volatility of consumption, counter-cyclical interest rates, and more pronounced counter-cyclicality of the trade balance. These features were the main focus of major models of emerging markets business cycles.[5]

In addition to those "traditional" statistics, Table 2 documents important differences in the cyclical behavior of RERs between the two groups. First, RERs are pro-cyclical in an average emerging economy, and mildly counter-cyclical in an average developed economy. Second, RERs are more volatile in an average emerging economy. Third, consumption and

---

[5]The literature has been primarily motivated by the excess volatility of consumption, because such behavior is at odds with the permanent income hypothesis. Most importantly, it cannot be accounted for by simple restrictions on borrowing and lending. In fact, in most frameworks, access to financial markets is necessary for the consumption to be more volatile than GDP.

RER fluctuations are positively correlated in an average emerging economy, while in an average developed economy, these two variables are orthogonal.

The differences between Mexico and Canada mostly follow the differences between the group averages, with a few exceptions. First, the correlation of the RER with the real interest rate is strongly negative in Mexico, and close to zero in an average emerging economy. Second, the correlations of the trade balance with GDP and RER are both positive in Canada, and mildly negative in the average developed economy. Third, the pro-cyclicality of the real interest rate is much stronger in Canada than in an average developed economy. In addition, some differences (e.g., cyclicality of the RER) are more pronounced, while other (e.g., excess volatility of consumption) are less.

While there are clear differences in the business cycle behavior between the two groups of countries, there is also substantial heterogeneity within each group. A handful of developed countries behave like an average emerging economy, and a handful of emerging economies behave like an average developed economy (at least along a few dimensions). Section **??** in the Appendix presents tables and bar charts with statistics for individual countries.

1.2.2 RER and other moments

The variation in the business cycle statistics within the groups of emerging and developed economies is not random. This is shown in Figures 1 and 2, which document the relationships between the cyclicality/volatility of the RER, and other statistics.

Figure 1 shows that the pro-cyclicality and larger volatility of the RER are linked to the

Table 2: Business cycle statistics: emerging vs. developed

	Emerging	Developed	Mexico	Canada
$sdev(Y)$	2.26	1.54	2.23	1.43
$sdev(C)/sdev(Y)$	1.11	0.90	1.08	0.74
$sdev(R)/sdev(Y)$	1.84	0.93	3.01	1.08
$sdev(I)/sdev(Y)$	3.05	3.40	3.92	2.76
$sdev(NX)/sdev(Y)$	0.98	0.95	0.80	0.65
$sdev(RER)/sdev(Y)$	3.38	2.37	4.51	2.89
$corr(C,Y)$	0.72	0.66	0.88	0.75
$corr(I,Y)$	0.76	0.68	0.88	0.75
$corr(NX,Y)$	-0.35	-0.16	-0.50	0.11
$corr(R,Y)$	-0.16	0.06	-0.53	0.47
$corr(RER,Y)$	0.26	-0.06	0.61	-0.06
$corr(RER,C)$	0.27	0.03	0.63	-0.04
$corr(RER,I)$	0.22	0.12	0.66	0.26
$corr(RER,NX)$	-0.16	-0.08	-0.62	0.18
$corr(RER,R)$	-0.06	0.06	-0.73	0.15
$corr(RER_t,RER_{t-1})$	0.72	0.79	0.80	0.82
$corr(RER,IR)$	-0.36	-0.40	-0.47	-0.34

NOTES: All business cycle statistics were calculated on residuals from an HP-filter, using quarterly data, seasonally adjusted. All series except the trade balance were in logs. Statistics for emerging and developed economies are simple, un-weighted, cross-country averages within each group. Y denotes real GDP, I denotes investment, R denotes real interest rate, NX denotes the ratio of trade balance to GDP (both nominal), and the import ratio IR is the ratio of imports to the difference between GDP and exports (all three nominal). Tables ?? and ?? in the Appendix provide statistics for individual countries. Tables 6 through 9 in the Appendix provide details of the data coverage for each country.

three well-established stylized facts about emerging markets. The three panels on the left present scatter plots of relative volatility of consumption, cyclicality of the trade balance, and cyclicality of the real interest rate against the cyclicality of the RER. The three panels on the right present similar scatter plots but with standard deviation of the RER on the horizontal axis. The figure indicates clearly that more pro-cyclical and more volatile RERs correspond to (1) larger relative volatility of consumption, (2) more counter-cyclical trade balances, and (3) more counter-cyclical real interest rates. The relationship between excess volatility of consumption and cyclicality of the RER is the strongest of the six, with the R^2 from a linear fit exceeding 0.30.

Figure 2 documents additional regularities related to the cyclical behavior of RERs. The two panels in the top row look at the co-movement of RER with consumption expenditures. This co-movement is positive in an average emerging economy, and almost absent in an average developed economy (see also Table 2). The lack of negative correlation between consumption and RER is a well-known Backus-Smith puzzle, established in the sample of developed countries (Backus and Smith, 1993).[6] The top two panels of Figure 2 then reveal that the puzzle is even more pronounced within emerging economies. Most importantly,

---

[6]Theory predicts a strong, negative correlation between ratio of consumption expenditures and bilateral RERs between two countries (when an increase in RER means real appreciation). Backus and Smith (1993) found that in a sample of developed OECD economies that correlation is zero, or mildly positive. The Backus-Smith puzzle is thus even more pronounced among emerging economies, where cyclical correlation between consumption and RER is positive. Appendix A.1 shows that these patterns remain essentially the same when, instead of domestic consumption and the real effective exchange rate, we use the ratio of domestic to U.S. consumption, and the bilateral RER against the U.S. dollar.
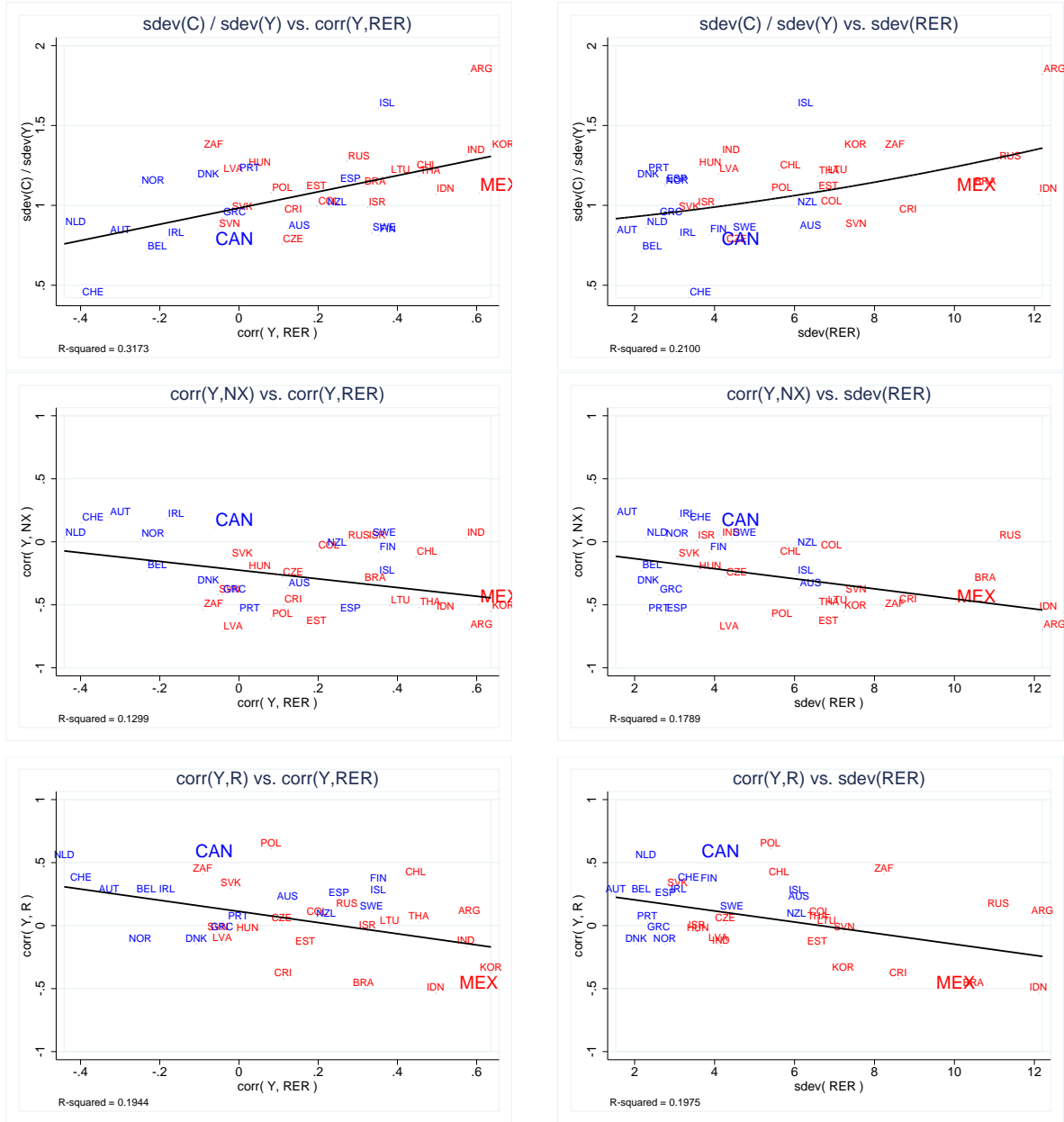
NOTES: Cross-country correlations of quarterly business cycle statistics computed using residuals from an HP-filter. Y refers to real GDP, NX refers to the ratio of trade balance to GDP. In each case, a linear fit was imposed (R^2 below each graph). Color coding: emerging economies in red, developed economies in blue.

Figure 1: Stylized facts about emerging markets vs. cyclicality and volatility of RER

there is a very strong correlation between the cyclicality/volatility of RER and the co-movement of the RER with consumption. Figure 2 also reveals negative correlation between the cyclicality/volatility of the RER and the its co-movement with the trade balance, and between volatility of RER and its co-movement with the real interest rate. Interestingly, the relationship between cyclicality of the RER and its co-movement with the real interest rate appears to be hump-shaped.

1.2.3 Dynamics

Figure 3 illustrates the dynamic relationship between the RER and GDP, consumption, the real interest rate, and the trade balance, both in the average emerging/developed economy and in Mexico/Canada. The difference in the co-movement of the RER with GDP between the two groups is statistically significant up to one lead and lag. The differences in the co-movement of the RER with other variables are not significant.

Mexico differs qualitatively from an average emerging economy along two dimensions. First, the RER in Mexico leads the cycle. The remaining emerging economies are almost evenly split along this dimension. Overall, among the 21 emerging economies with a pro-cyclical RER, 10 have the RER lead the cycle. Second, in an average emerging economy, there seems to be no correlation between the RER and the real interest rate. Conversely, in Mexico, the correlation between these two variables is strongly negative, even up to one lead and lag. Other differences between Mexico and the average emerging economy appear to be quantitative in nature and seem to follow from the fact that the pro-cyclicality of the RER
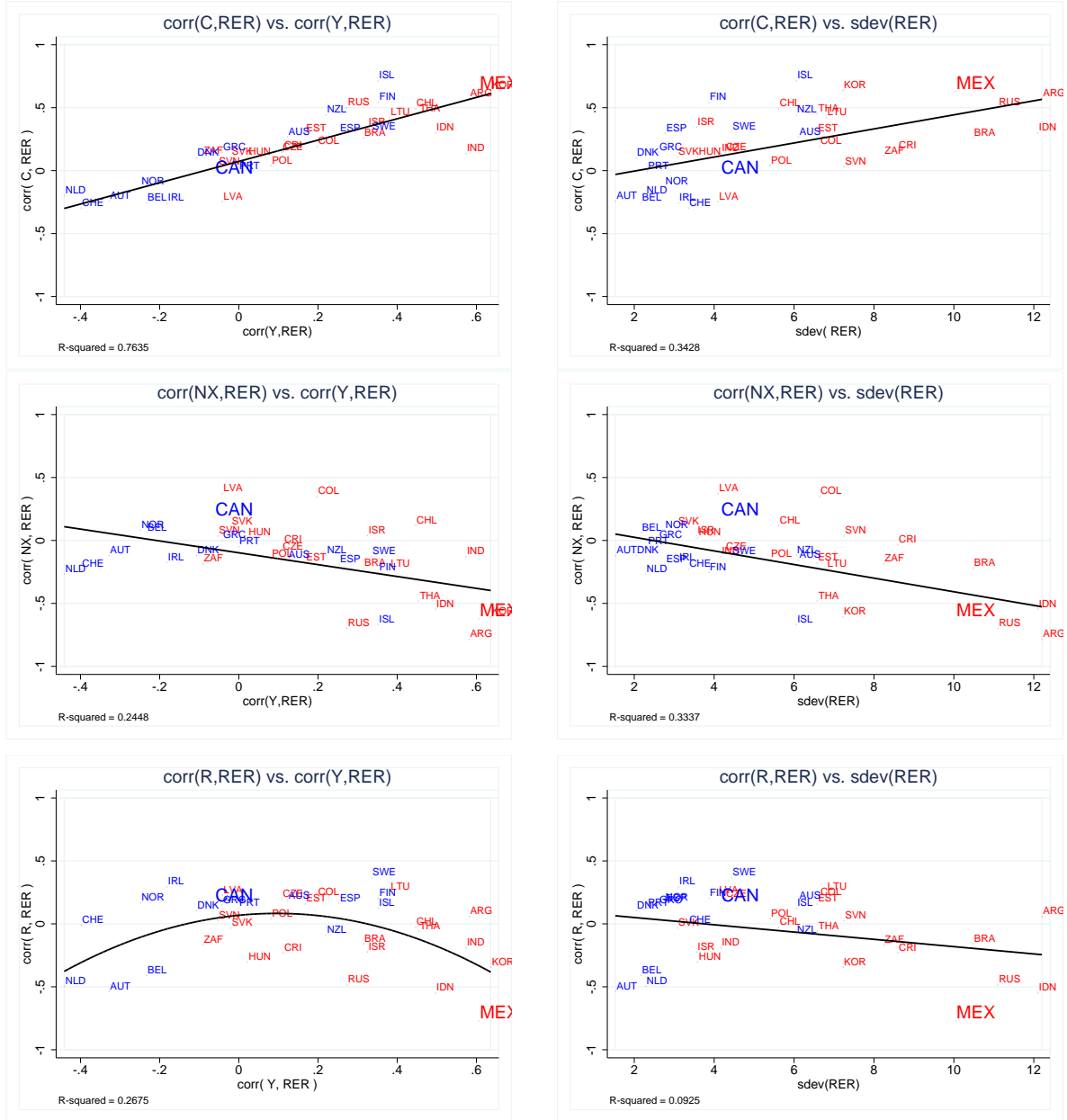
NOTES: See Figure 1. R^2 from a linear fit is presented below each graph, except for the bottom left panel, where the quadratic term was significant at 1 percent level.

Figure 2: Cyclicality and volatility of RER vs. co-movement with other variables

in Mexico is the strongest among all emerging economies.

1.2.4 Summary

Overall, the analysis in this section reveals two key patterns in the data. First, on average, RERs are pro-cyclical in emerging economies and mildly counter-cyclical in developed countries. Second, the pro-cyclicality and volatility of RERs are linked to other stylized facts about emerging economies, most notably the excess volatility of consumption. As such, RERs can provide important additional information about the sources and the nature of macroeconomic fluctuations in emerging markets. The remainder of this paper will explore this question using a workhorse international business cycle model.

References

AGUIAR, M. AND G. GOPINATH, "Business Cycles in Emerging Economies. The Cycle is the Trend," *Journal of Political Economy* 115 (2007), 69–102.

BACKUS, D. K. AND G. W. SMITH, "Consumption and real exchange rates in dynamic economies with non-traded goods," *Journal of International Economics* 35 (November 1993), 297–316.

GARCÍA-CICCO, J., R. PANCRAZI AND M. URIBE, "Real Business Cycles in Emerging Countries?," *American Economic Review* 100 (2010), 2510–31.

corr(GDP$_t$,RER$_{t+j}$)

corr(NX$_t$,RER$_{t+j}$)

corr(C$_t$,RER$_{t+j}$)

corr(R$_t$,RER$_{t+j}$)

jth lead / lag

Developed — Emerging — Mexico — Canada
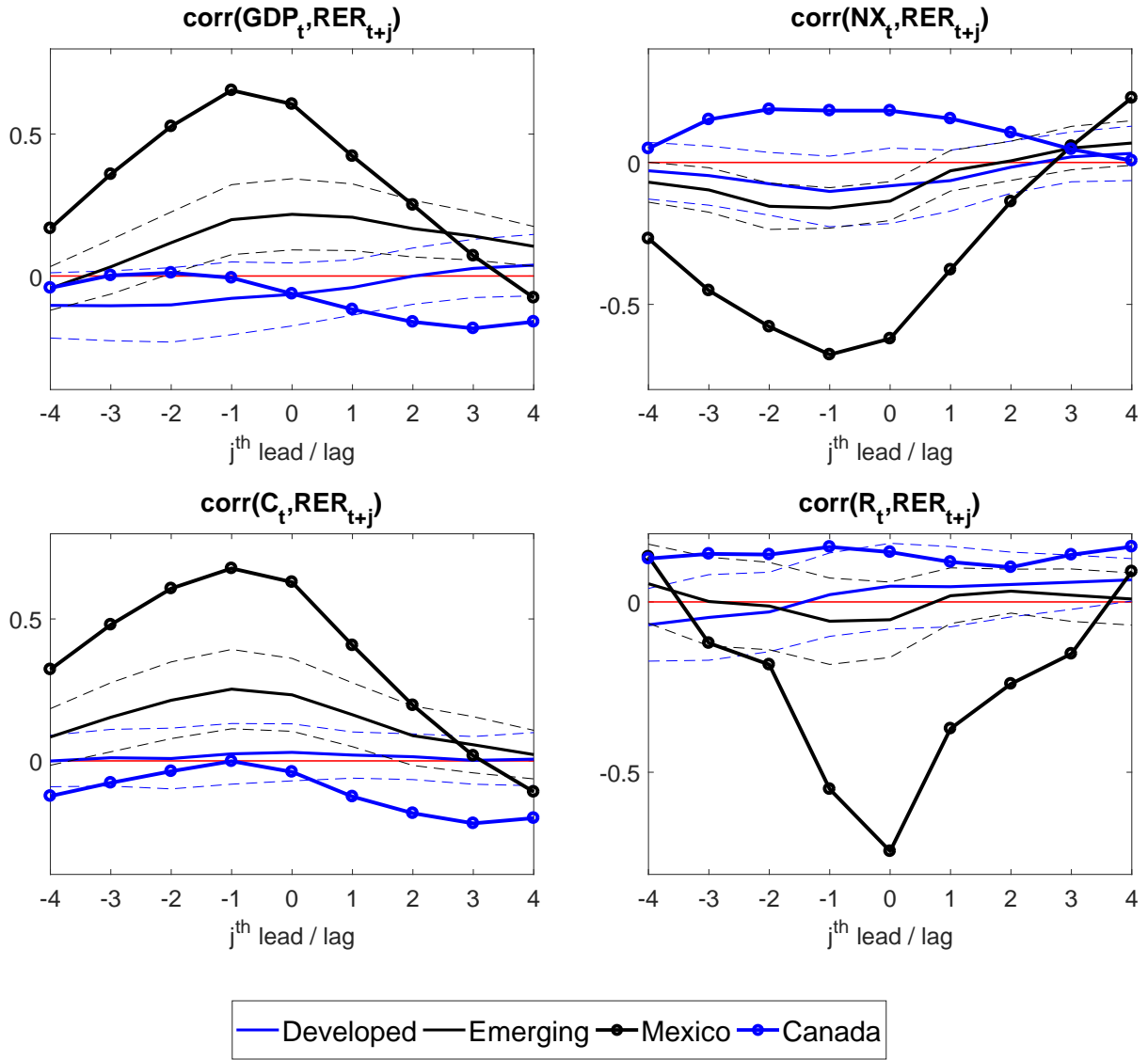
NOTES: Correlations computed using residuals from an HP-filter. All original series were in logs, except for NX, which was the ration of trade balance to GDP. Dashed lines denote 95 percent confidence bounds for group averages. See Table 1 for the list of countries in each group.

Figure 3: Real Exchange Rates: leading and lagging correlations

MICHAUD, A. AND J. ROTHERT, "Redistributive fiscal policies and business cycles in emerging economies," *Journal of International Economics* 112 (2018), 123 – 133.

NEUMEYER, P. A. AND F. PERRI, "Business cycles in emerging economies: the role of interest rates," *Journal of Monetary Economics* 52 (March 2005), 345–380.

A Robustness

A.1 Bilateral Real Exchange Rate vs. USA

First, I consider the robustness of the patterns in Figures 1 and 2 to an alternative measure of the real exchange rate — the bilateral real exchange against the US dollar, defined as:

$$(1) \qquad rx^{i,USA} := \frac{P^i}{P^{USA}} \cdot E_{\$/\text{currency}^i}$$

so that again an increase means real appreciation of country i's currency against the US dollar. Figure 1 is reproduced as Figure 4, Figure 2 as Figure 5. The patterns remain the same. One caveat to point out is that the top-left panel of Figure 5 has the cyclical correlation of the bilateral real exchange rate defined in (1) with the HP-filtered ratios of real GDPs and real consumptions between each country and USA (to make the figure more in line with studies that focus on the Backus-Smith puzzle).

A.2 Different measures of the real interest rate

Next, I show how the patterns presented earlier (Tables 2, **??**, and **??**; Figures 1 and 2) change when I consider alternative measures of the real interest rate. Figure 6 presents results when different nominal interest rate is used (average money market rate). Figure 7 presents results when different expected inflation is used (average of today's and the preceding three quarters).
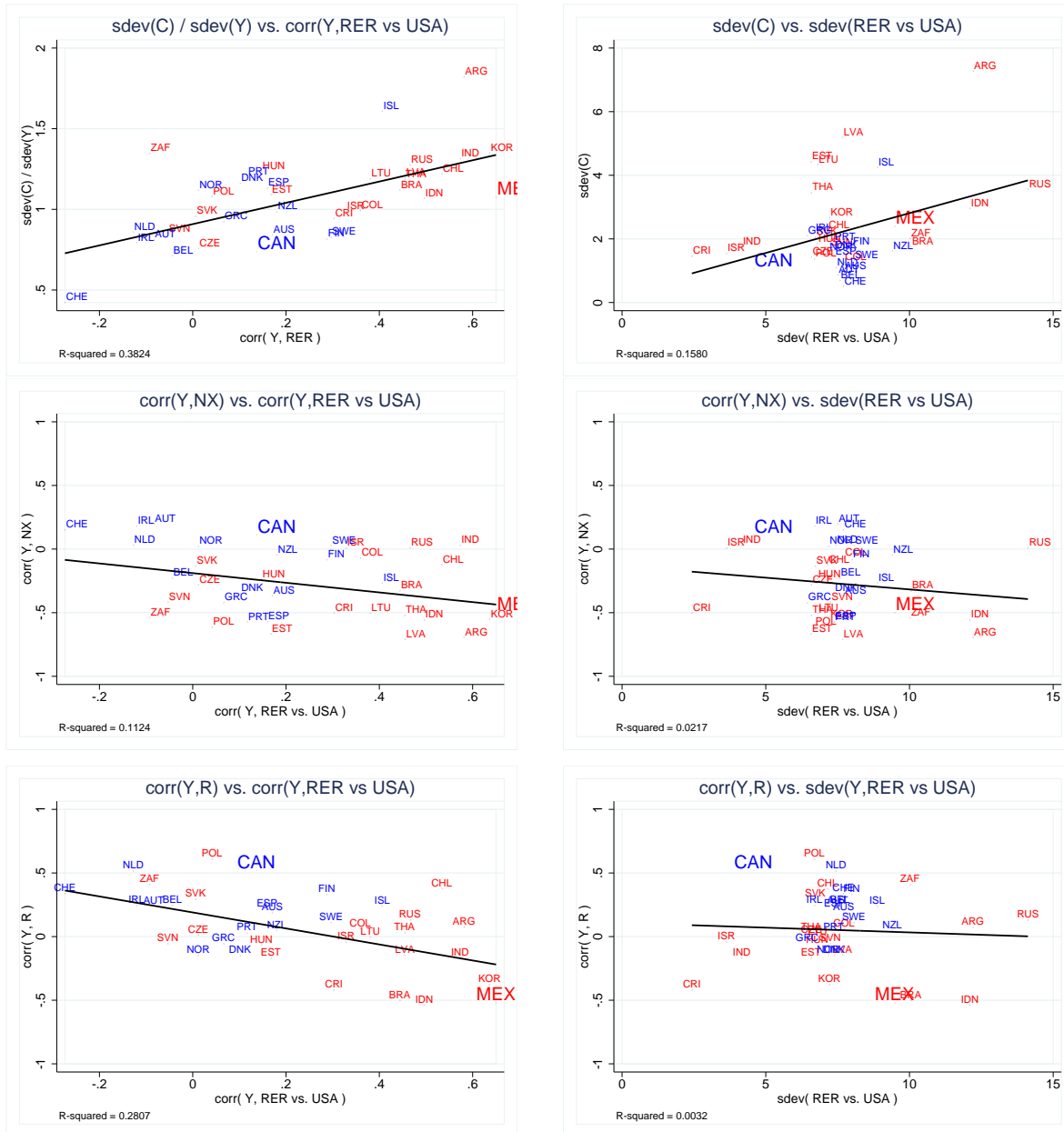
NOTES: Cross-country correlations of quarterly business cycle statistics computed using residuals from an HP-filter. NX refers to the ratio of trade balance to GDP. "RER vs. USA" as defined in (1).
Color coding: developed economies in blue, emerging economies in red.

Figure 4: RERs against the US dollar vs. other stylized facts about emerging markets
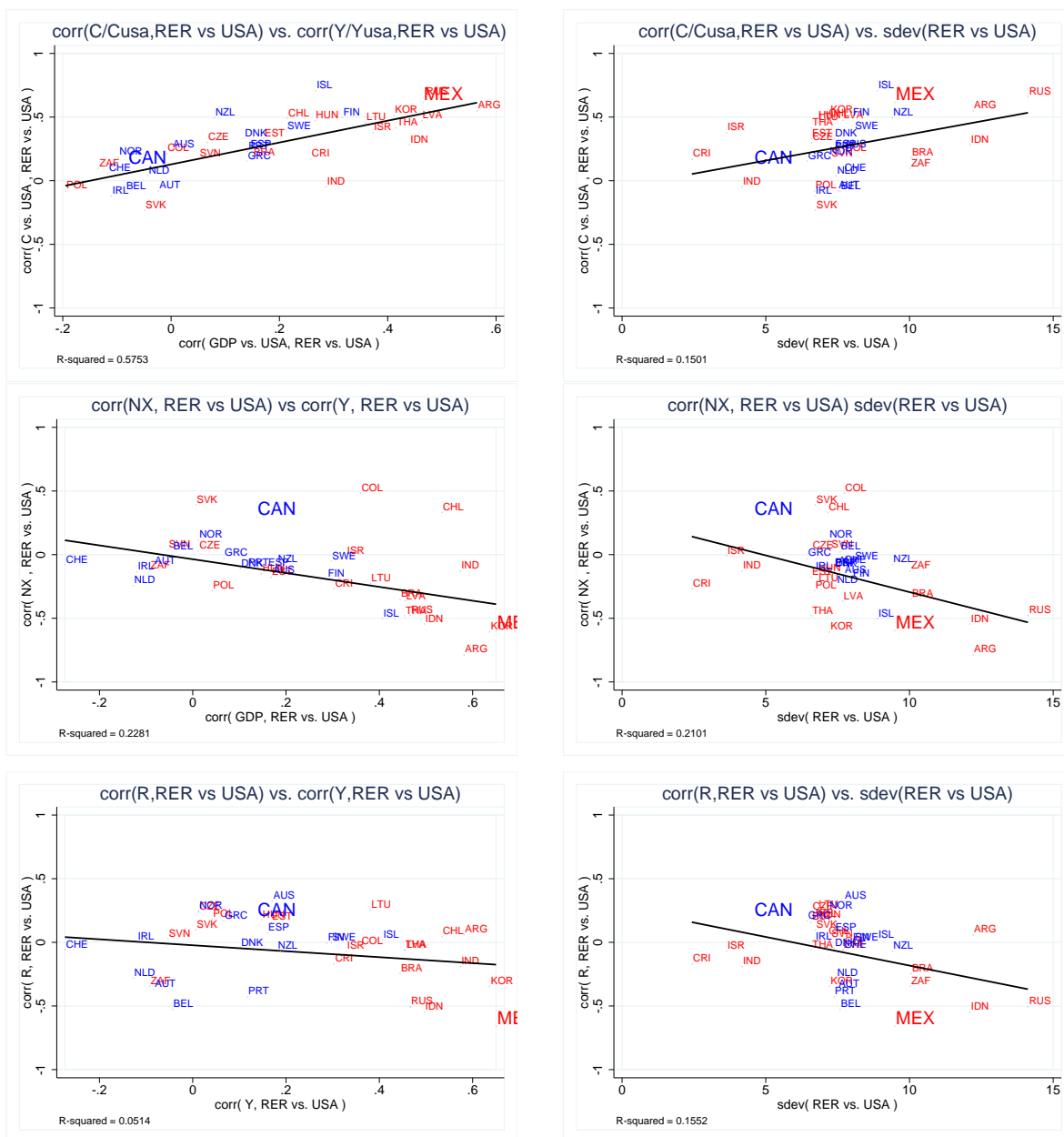
NOTES: see Figure 4.

Figure 5: RERs against the US dollar: co-movement with GDP and other variables

16
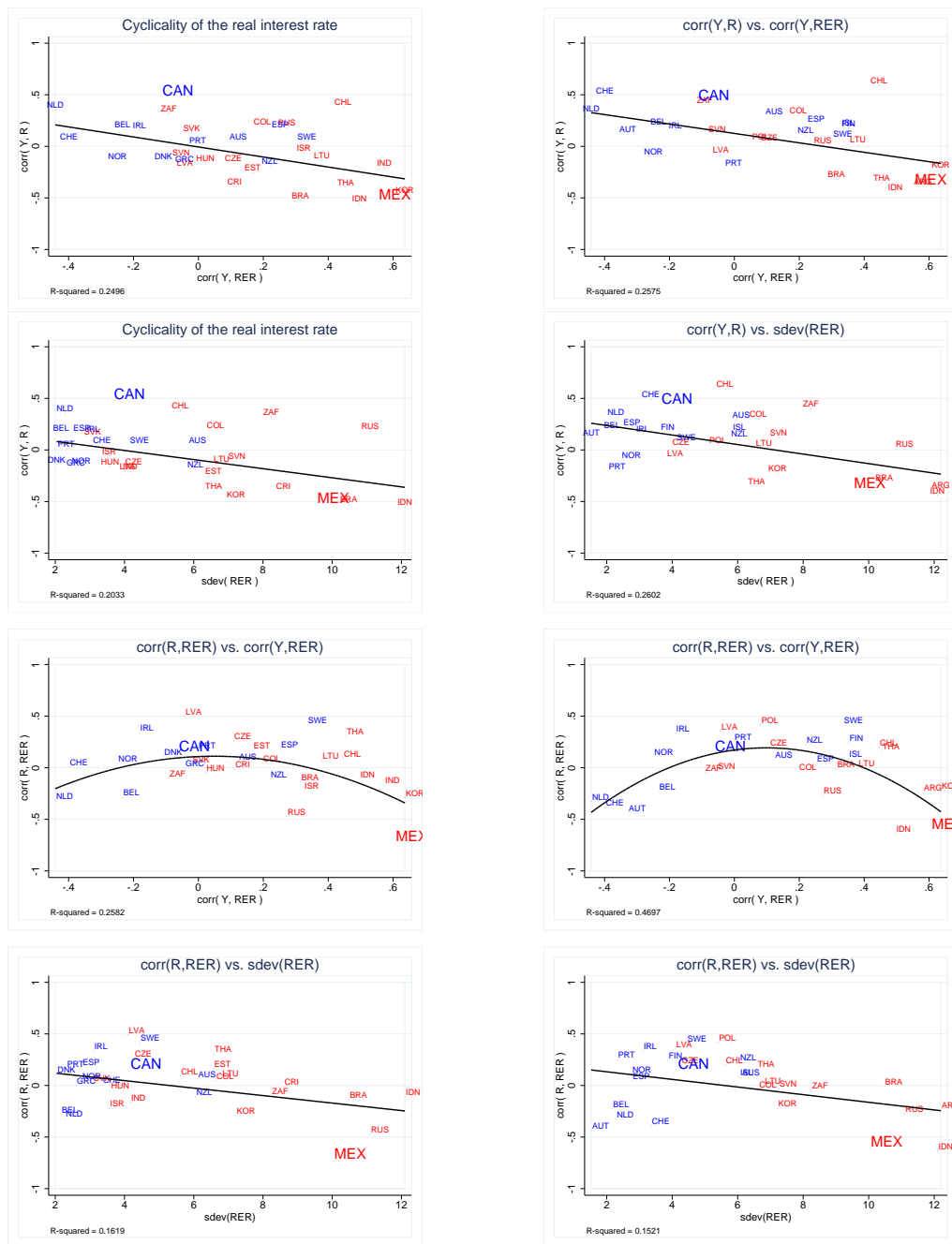
Left column: average lending rate; Right column: average money market rate;

Real interest rate computed by subtracting GDP-deflator based inflation in the next quarter from the nominal interest rate.

Figure 6: Different measures of the nominal interest rate

Left column: $E_t\pi_{t+1} = \pi_{t+1}$ (benchmark); right column: $E_t\pi_{t+1} = \frac{1}{4}\sum_{j=0}^{3}\pi_{t-j}$;
Real interest rate computed by subtracting expected inflation from the nominal interest rate.

Figure 7: Different measures of expected inflation

A.3   Aguiar and Gopinath sample

Tables 3, 4, and 5 and Figures 8 and 9 present selected statistics from Section 1, but for the sample of countries and the time period analyzed in Aguiar and Gopinath (2007). The time series on GDP, consumption, investment and trade balance are the original AG series. The patterns documented in Section 1 are still present, although certain relationships are weakened by the fact real exchange rate is extremely volatile in Ecuador and Peru over the time period analyzed in Aguiar and Gopinath (2007). The two countries are excluded from the analysis in Section 1, because not all the variables had at least 15 years of consistent coverage with no gaps.

Table 3: Business Cycle Statistics: Emerging vs. Developed

	Emerging	Developed	Mexico	Canada
$sdev(Y)$	2.74	1.34	2.49	1.64
$sdev(C)/sdev(Y)$	1.45	0.94	1.24	0.77
$sdev(R)/sdev(Y)$	1.54	0.46	4.64	0.31
$sdev(I)/sdev(Y)$	3.91	3.41	4.05	2.63
$sdev(NX)/sdev(Y)$	1.33	0.78	0.88	0.56
$sdev(RER)/sdev(Y)$	4.32	2.67	4.77	2.45
$corr(C,Y)$	-0.71	-0.42	-0.79	-0.47
$corr(I,Y)$	0.77	0.67	0.91	0.77
$corr(NX,Y)$	-0.51	-0.17	-0.74	-0.20
$corr(R,Y)$	-0.16	-0.03	-0.28	0.11
$corr(RER,Y)$	0.43	-0.03	0.65	-0.28
$corr(RER,C)$	0.45	0.10	0.65	-0.22
$corr(RER,I)$	0.36	0.14	0.70	-0.08
$corr(RER,NX)$	-0.42	-0.32	-0.78	-0.27
$corr(RER,R)$	-0.02	0.10	-0.50	0.23
$corr(RER_t, RER_{t-1})$	0.69	0.81	0.81	0.86

NOTES: Statistics for individual countries are presented in Table 4 and 5.

Table 4: Business Cycle Statistics in Emerging Economies - Aguiar and Gopinath (2007) sample

| | | Standard Deviations | | | | | Correlations w/ GDP | | | | | Correlations w/ RER | | | |
| | | Relative to sdev (GDP) | | | | | | | | | | | | | |
Country	GDP	C	I	$\frac{NX}{GDP}$	R	RER	C	I	$\frac{NX}{GDP}$	R	RER	C	I	$\frac{NX}{GDP}$	R
Argentina	3.68	1.38	2.53	0.70	0.78	4.07	0.90	0.96	-0.70	-0.36	0.41	0.70	0.30	-0.89	-0.61
Brazil	1.98	2.01	3.08	1.32	0.84	5.91	0.41	0.62	0.01	-0.25	0.50	0.32	0.18	-0.10	0.00
Ecuador	2.44	2.39	5.56	2.31	3.05	12.86	0.73	0.89	-0.79	0.39	0.76	0.76	0.74	-0.75	0.54
Israel	1.95	1.60	3.42	1.08	6.51	1.93	0.45	0.49	0.12	0.00	0.05	-0.04	0.04	0.16	0.18
Korea	2.47	1.23	2.50	0.95	0.43	2.99	0.84	0.77	-0.62	-0.38	0.65	0.74	0.58	-0.73	-0.34
Malaysia	3.10	1.70	4.82	1.71	0.60	1.71	0.76	0.86	-0.74	-0.19	0.58	0.72	0.61	-0.56	-0.12
Mexico	2.49	1.24	4.05	0.88	4.64	4.77	0.92	0.91	-0.74	-0.28	0.65	0.65	0.70	-0.78	-0.50
Peru	3.68	0.92	2.37	0.34	n/a	7.69	0.78	0.85	-0.24	n/a	0.49	0.63	0.27	-0.19	n/a
Philippines	3.00	0.62	4.66	1.07	0.89	2.08	0.59	0.76	-0.41	-0.41	-0.03	0.00	-0.01	0.11	0.49
Slovak Republic	1.24	2.04	7.77	3.47	1.33	2.84	0.42	0.46	-0.44	-0.21	0.28	-0.29	0.09	-0.05	-0.22
South Africa	1.63	1.61	3.87	1.52	0.63	4.99	0.71	0.75	-0.55	0.20	0.00	0.36	0.04	-0.30	0.42
Thailand	4.36	1.09	3.49	1.05	0.38	1.93	0.92	0.91	-0.83	-0.27	0.59	0.70	0.60	-0.72	-0.06
Turkey	3.57	1.09	2.71	0.91	n/a	2.37	0.89	0.83	-0.69	n/a	0.60	0.60	0.53	-0.70	n/a
Average	2.74	1.45	3.91	1.33	1.82	4.32	0.72	0.77	-0.51	-0.16	0.43	0.45	0.36	-0.42	-0.02
Median	2.49	1.38	3.49	1.07	0.84	2.99	0.76	0.83	-0.62	-0.25	0.50	0.63	0.30	-0.56	-0.06

NOTES: All business cycles statistics were calculated on residuals from an HP filter, using benchmark series, quarterly data, seasonally adjusted. Group averages are the un-weighted averages of numbers reported in each column.

n/a — sufficiently long time series without gaps was not available

Table 5: Business Cycle Statistics in Developed Economies - Aguiar and Gopinath (2007) sample

| | Standard Deviations | | | | | | Correlations w/ GDP | | | | | Correlations w/ RER | | | |
| | | Relative to sdev (GDP) | | | | | | | | | | | | | |
Country	GDP	C	I	$\frac{NX}{GDP}$	R	RER	C	I	$\frac{NX}{GDP}$	R	RER	C	I	$\frac{NX}{GDP}$	R
Australia	1.40	0.69	3.66	0.77	0.46	4.47	0.48	0.80	-0.43	0.07	0.13	0.32	0.26	-0.53	0.25
Austria	0.89	0.87	2.75	0.73	0.66	1.92	0.74	0.75	0.10	-0.02	-0.53	-0.47	-0.48	-0.29	-0.09
Belgium	1.02	0.81	3.72	0.89	0.45	2.42	0.67	0.62	-0.04	0.05	-0.28	-0.29	-0.05	-0.28	-0.06
Canada	1.64	0.77	2.63	0.56	0.31	2.45	0.88	0.77	-0.20	0.11	-0.28	-0.22	-0.08	-0.27	0.23
Denmark	1.02	1.19	3.90	0.87	0.56	2.25	0.36	0.51	-0.08	-0.28	-0.06	0.26	-0.03	-0.22	0.07
Finland	2.19	0.94	3.25	0.51	0.25	2.10	0.85	0.88	-0.45	-0.17	0.50	0.65	0.59	-0.53	0.20
Netherlands	1.21	1.06	2.94	0.58	0.34	2.11	0.72	0.71	-0.18	0.09	-0.46	-0.10	-0.18	-0.30	0.01
New Zealand	1.56	0.90	4.38	0.88	0.36	4.08	0.76	0.82	-0.26	-0.15	0.53	0.60	0.53	-0.33	0.23
Norway	1.41	1.33	4.30	1.23	0.45	1.72	0.63	-0.01	0.12	-0.33	-0.28	-0.20	0.12	0.05	0.09
Portugal	1.34	1.02	2.88	0.87	0.48	2.09	0.75	0.70	-0.11	0.04	0.33	0.43	0.41	-0.37	0.30
Spain	1.12	1.11	3.70	0.77	0.65	3.00	0.83	0.83	-0.60	0.06	0.43	0.53	0.54	-0.59	0.09
Sweden	1.52	0.97	3.66	0.62	0.52	3.07	0.35	0.68	0.01	-0.09	-0.02	-0.07	0.27	-0.17	0.26
Switzerland	1.12	0.51	2.56	0.86	0.44	3.00	0.58	0.69	-0.03	0.19	-0.35	-0.15	-0.08	-0.39	-0.24
Average	1.34	0.94	3.41	0.78	0.46	2.67	0.66	0.67	-0.17	-0.03	-0.03	0.10	0.14	-0.32	0.10
Median	1.34	0.94	3.66	0.77	0.45	2.42	0.72	0.71	-0.11	0.04	-0.06	-0.07	0.12	-0.30	0.09

NOTES: All business cycles statistics were calculated on residuals from an HP filter, using benchmark series, quarterly data, seasonally adjusted. Group averages are the un-weighted averages of numbers reported in each column.

n/a — sufficiently long time series without gaps was not available

A.4 Data - sources, series, and coverage

A.4.1 Sources, and series used

All IMF series are from International Financial Statistics, except for nominal exports and imports which are from the Balance of Payments data set. All OECD series are from the Quarterly National Income Accounts data set.

Nominal GDP OECD series for nominal GDP is *Gross domestic product - expenditure approach (National currency, current prices, annual levels, seasonally adjusted)* (indicator code `B1_GE CARSA`). IMF series for nominal GDP is (indicator code `NGDP_SA_XDC`).

Real GDP OECD series for real GDP is *Gross domestic product - expenditure approach (National currency, volume estimates, OECD reference year, annual levels, seasonally adjusted)* (indicator code `B1_GE VOBARSA`). IMF series for real GDP is *Gross Domestic Product, Real, Spliced Historical Series, Seasonally adjusted, Domestic Currency* (indicator code `NGDP_R_K_SA_IX`.

Real Consumption OECD series for real consumption expenditures is *Private Final Consumption Expenditures (National currency, volume estimates, OECD reference year, annual levels, seasonally adjusted)* (indicator code `P31S14_S15 VOBARSA`). IMF series for real consumption expenditures is calculated by dividing nominal consumption expenditures (indicator code `NCP_SA_XDC`) by the GDP deflator computed using the IFS data.
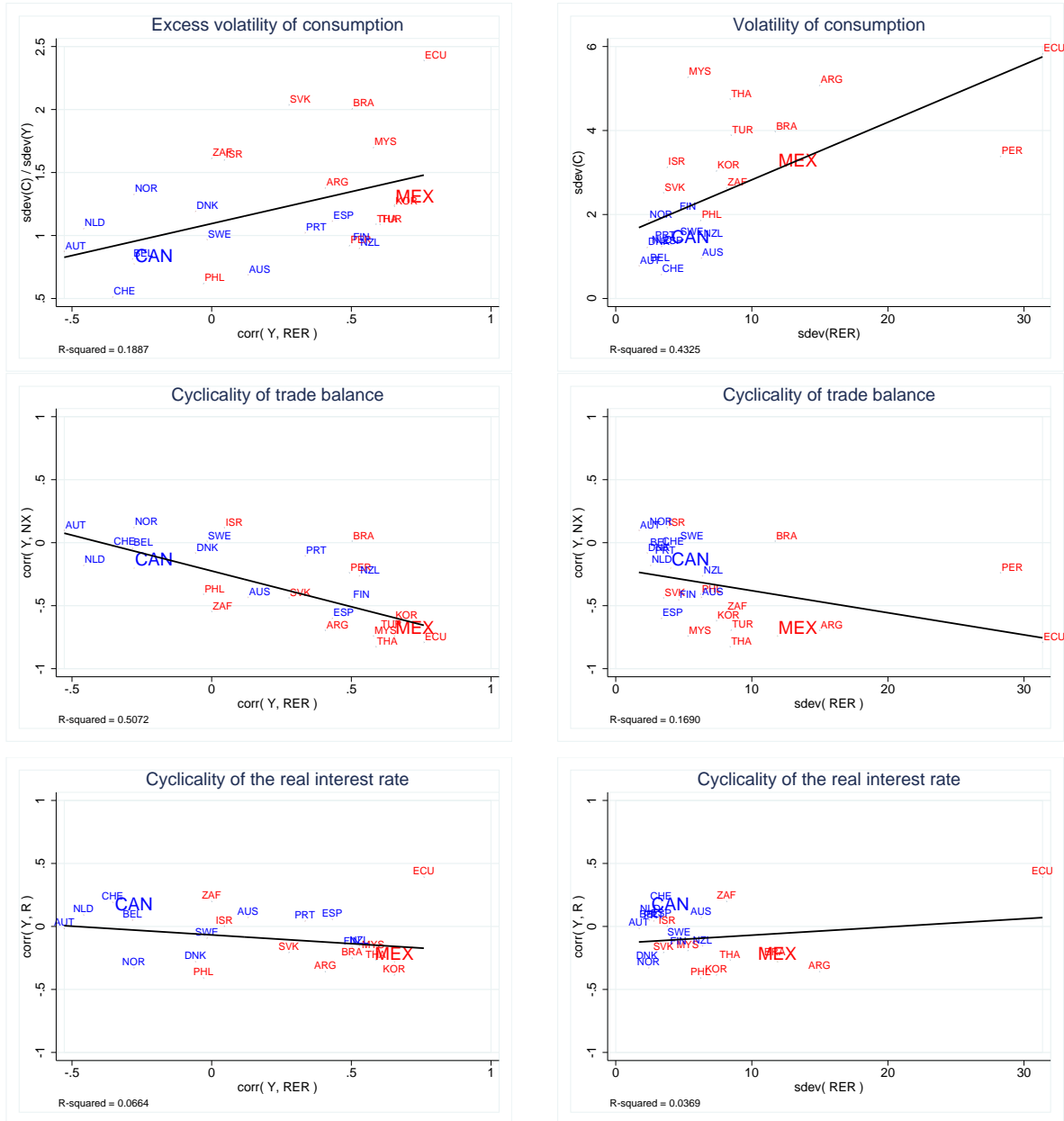
NOTES: Cross-country correlations of quarterly business cycle statistics computed using residuals from an HP-filter. "Y" refers to real GDP, "NX" refers to the ratio of trade balance to GDP. In each case a linear fit was imposed (R^2 below each graph). AG sample.

Color coding: developed economies in blue, emerging economies in red.

Figure 8: Stylized facts about emerging markets vs. cyclicality and volatility of RER

24
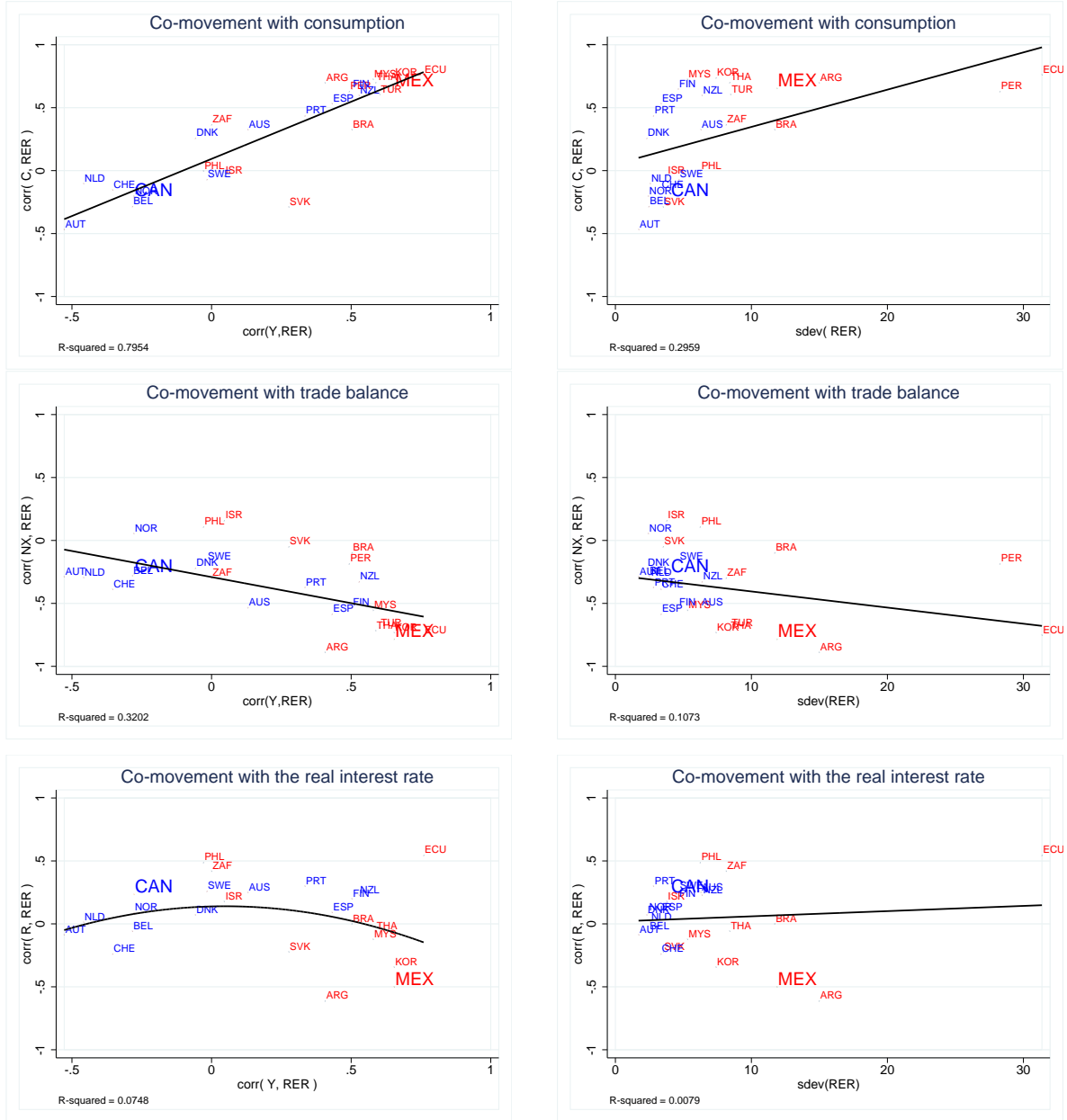
NOTES: see Figure 1. R^2 from a linear fit below each graph, except for the bottom left panel, where the quadratic fit is used. AG sample.

Figure 9: Cyclicality and volatility of RER vs. co-movement with other variables

Real Investment OECD series for real investment expenditures is *Gross Fixed Capital Formation (National currency, volume estimates, OECD reference year, annual levels, seasonally adjusted)* (indicator code `P51 VOBARSA`). IMF series for real investment expenditures is calculated by dividing nominal investment expenditures (indicator code `NFI_SA_XDC`) by the GDP deflator computed using the IFS data.

Ratio of Trade Balance to GDP IMF series (from the Balance of Payments Statistics) for nominal exports and imports are *Current Account, Goods and Services, Credit, US Dollars* and *Current Account, Goods and Services, Debit, US Dollars* (indicator codes `BMGS_BP6_USD` and `BXGS_BP6_USD`), respectively. In the denominator I then use nominal GDP from the IFS data set.

Interest Rates The benchmark series for the nominal interest rate is the average lending rate (IFS indicator code `FILR_PA`). The average money market rate used to compute statistics in Appendix A.2 has the IFS indicator code `FIMM_PA`

Real Exchange Rate The series for real exchange rate are from the IMF. The indicator code for the real effective exchange rate (REER) is `EREER_IX`. The nominal exchange rate is the average price of a US dollar in a given quarter in local currency (indicator code `ENDA_XDC_USD_RATE`). The price level in each country is the GDP deflator computed using the IFS data.

A.4.2 Coverage, sources, and series used by country

Tables 6 through 9 present the details on coverage, sources, and series used for each country, for each variable.

Table 6: Data Coverage: emerging economies - GDP, Consumption, and Investment

	GDP			Consumption			Investment		
	source	start	end	source	start	end	source	start	end
Argentina	OECD	1993q1	2017q3	IMF	1993q1	2016q4	IMF	1993q1	2016q4
Brazil	OECD	1996q1	2017q3	OECD	1996q1	2017q3	OECD	1996q1	2017q3
Chile	OECD	1995q1	2017q3	OECD	1995q1	2017q3	OECD	1995q1	2017q3
Colombia	OECD	2000q1	2017q4	OECD	2000q1	2017q3	OECD	2000q1	2017q3
Costa Rica	OECD	1991q1	2017q3	OECD	1991q1	2017q3	OECD	1991q1	2017q3
Czech Republic	OECD	1994q1	2017q3	OECD	1994q1	2017q3	OECD	1994q1	2017q3
Estonia	OECD	1995q1	2017q3	OECD	1995q1	2017q3	OECD	1995q1	2017q3
Hungary	OECD	1995q1	2017q4	OECD	1995q1	2017q3	OECD	1995q1	2017q3
Iceland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
India	OECD	1996q2	2017q3	OECD	1996q2	2017q3	OECD	1996q2	2017q3
Indonesia	OECD	1990q1	2017q4	OECD	1990q1	2017q4	OECD	1990q1	2017q4
Israel	OECD	1995q1	2017q4	OECD	1995q1	2017q4	OECD	1995q1	2017q4
Korea	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
Latvia	OECD	1995q1	2017q4	OECD	1995q1	2017q3	OECD	1995q1	2017q3
Lithuania	OECD	1995q1	2017q4	OECD	1995q1	2017q3	OECD	1995q1	2017q3
Mexico	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Russia	OECD	1995q1	2017q3	OECD	1995q1	2016q4	OECD	1995q1	2016q4
Slovak Republic	OECD	1993q1	2017q4	OECD	1993q1	2017q3	OECD	1993q1	2017q3
Slovenia	OECD	1995q1	2017q3	OECD	1995q1	2017q3	OECD	1995q1	2017q3
South Africa	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Thailand	IMF	1993q1	2016q4	IMF	1993q1	2016q4	IMF	1993q1	2016q4

Table 7: Data Coverage: emerging economies - Trade Balance, RER, and Interest Rates

	Trade Balance			Real Exchange Rate			Interest Rate		
	source	start	end	measure	start	end	start	end	measure
Argentina	IMF	1993q1	2016q4	vs. USA	1993q1	2016q4	1980q1	2016q4	mmkt
Brazil	IMF	1995q1	2017q3	REER	1980q1	2016q4	1997q1	2016q4	lend, mmkt
Chile	IMF	1995q1	2017q3	REER	1980q1	2016q4	1980q1	2016q4	lend, mmkt
Colombia	IMF	2000q1	2017q3	REER	1980q1	2016q4	1986q1	2016q4	lend, mmkt
Costa Rica	IMF	1991q1	2017q3	REER	1980q1	2016q4	1982q1	2016q4	lend
Czech Republic	IMF	1995q1	2017q3	REER	1990q1	2016q4	1993q1	2016q4	lend, mmkt
Estonia	IMF	1995q1	2017q3	vs. USA	1995q1	2016q4	1992q3	2016q4	lend
Hungary	IMF	1995q1	2017q3	REER	1990q4	2016q4	1988q4	2016q4	lend
Iceland	IMF	1980q1	2017q3	REER	1980q1	2016q4	1987q1	2016q4	mmkt
India	IMF	1996q2	2017q2	vs. USA	1996q2	2016q4	1980q1	2016q4	lend
Indonesia	IMF	1990q1	2017q4	vs. USA	1990q1	2016q4	1986q1	2016q4	lend
Israel	IMF	1995q1	2017q4	REER	1980q1	2016q4	1995q1	2016q4	lend
Korea	IMF	1980q1	2017q3	vs. USA	1980q1	2016q4	1980q3	2016q4	lend, mmkt
Latvia	IMF	1995q1	2017q3	REER	1993q1	2016q4	1993q3	2013q4	lend, mmkt
Lithuania	IMF	1995q1	2017q3	vs. USA	1995q1	2016q4	1993q1	2010q4	lend, mmkt
Mexico	IMF	1980q1	2017q3	REER	1980q1	2016q4	1993q4	2016q4	lend, mmkt
Russia	IMF	1995q1	2017q3	REER	1994q1	2016q4	1994q3	2016q4	lend, mmkt
Slovak Republic	IMF	1993q1	2017q3	REER	1990q1	2016q4	1993q1	2008q4	lend
Slovenia	IMF	1995q1	2017q3	vs. USA	1995q1	2016q4	1991q4	2009q4	lend, mmkt
South Africa	IMF	1980q1	2017q3	REER	1980q1	2016q4	1980q1	2016q4	lend, mmkt
Thailand	IMF	1993q1	2016q4	vs. USA	1993q1	2016q4	1980q1	2016q4	lend, mmkt

NOTES: "REER" refers to real effective exchange rate (from OECD); "vs. USA" is the bilateral real exchange rate against the US dollar defined in 1; "lend" refers to average lending rate and "mmkt" refers to average money market rate (both interest rates from the IMF's International Financial Statistics).

Table 8: Data Coverage: developed economies - GDP, Consumption, and Investment

	GDP			Consumption			Investment		
	source	start	end	source	start	end	source	start	end
Australia	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Austria	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
Belgium	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Canada	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Denmark	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Finland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Greece	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Ireland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Netherlands	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
New Zealand	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Norway	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
Portugal	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Spain	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Sweden	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Switzerland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3

Table 9: Data Coverage: developed economies - Trade Balance, RER, and Interest Rates

	GDP			Consumption			Investment		
	source	start	end	source	start	end	source	start	end
Australia	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Austria	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
Belgium	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Canada	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Denmark	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Finland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Greece	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Ireland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Netherlands	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
New Zealand	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Norway	OECD	1980q1	2017q4	OECD	1980q1	2017q4	OECD	1980q1	2017q4
Portugal	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Spain	OECD	1980q1	2017q4	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Sweden	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3
Switzerland	OECD	1980q1	2017q3	OECD	1980q1	2017q3	OECD	1980q1	2017q3

NOTES: see notes underneath Table 7.