1. Introduction

The real effective exchange rate (REER), which measures the development of the price (or cost) level adjusted value of a country's currency against a basket of the country's trading partners, is a frequently used indicator in theoretical and applied economic research and policy analysis. It is used for a wide variety of purposes, including assessing the equilibrium value of a currency, the change in price or cost competitiveness, large number of countries included in our dataset allows us to calculate the REER relative to a broader set of trading partners than in other datasets, providing a more comprehensive picture of the development of the real value of currencies.

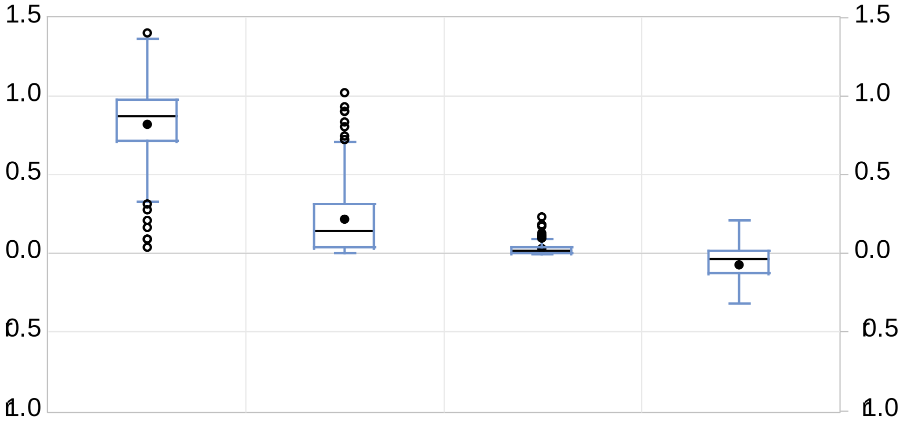
Figure 1: Availability of monthly consumer-price based REER indicators in the various datasets on 4 December 2021 (number of countries)

Source: Bruegel based on data collected from websites of the five institutions listed in the legend. Note: Only REERs for countries are included. Additionally, all datasets but the World Bank include the euro area, while the World Bank dataset

is the price level of county j, w_{ij} is the weight of trading partner j and N is the number of trading partners considered. The weights sum to one, ie $\sum_{j=1}^{N} w_{ij} = 1$. We use geometrically weighted averages, the most frequently used method in the literature, because a geometrically weighted average treats increases and decreases in the exchange rate symmetrically and is not affected by the choice of the base year (Ellis, 2001).

2.2 Drivers of REER change variance

Figure 2: Contribution to the variance of the monthly real effective exchange rate change: distribution across 177 countries and the euro area



alternative predictions for such missing data[3]. These include two naïve forecasts (unchanged 1-month or 12-month inflation rates), an autoregressive model and the forecasts made by the IMF. We do not

2.3.3 Prediction based on an autoregressive model for the inflation rate

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where lowercase L... indicates the natural logarithm 2..., and ¿ Üí ? æí is an autoregressive forecast of ¿ Üí ? æ from a model estimated over the sample P 1, 2, ... , 6 F: G

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Forecasts for January-December of year ì:

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while inflation started to increase

$$(10) \qquad MAPFE_h = 100 \cdot \sum_{t=T-N+1}^{T} \frac{1}{N} \cdot \frac{\left| P_{i,t+h} - \hat{P}_{i,t+h|t} \right|}{P_{i,t+h}}$$

where $\hat{P}_{i,t+h|t}$ is the h-period ahead forecast of the price level of country i made at time t, N is the total number of forecasts made and $h = 1, 2, \ldots, 24$ is the forecast horizon. The other is the root mean squared percent forecast error (RMSPFE):

$$(11) \qquad RMSPFE_h = 100 \cdot \sqrt{\sum_{t=T-N+1}^{T} \frac{1}{N} \cdot \left(\frac{P_{i,t+h} - \hat{P}_{i,t+h|t}}{P_{i,t+h}} \right)^2}$$

We test whether the forecast is unbiased using the version of the traditional test that is regarded more satisfactory by Clements *et al* (2007), which is based on the regression:

$$(12) \qquad P_{i,t+h} - \hat{P}_{i,t+h|t} = \alpha + \varepsilon_t$$

where α is a parameter to estimate and ε_t is the regression error which follows a MA(k-1) process. The null hypothesis of unbiasedness corresponds to the test of $\alpha = 0$. We estimate regression (12) with ordinary least squares using the Newey and West autocorrelation and heteroskedasticity consistent covariance matrix.

For each country, we select the model to use which results in the lowest RMSPFE indicator for the particular forecasting horizon corresponding to the number of missing observations as indicated in Table 1. There are various tests for comparing the forecast accuracy of alternative models, such as the ones developed by Diebold and Mariano (2002) and Clark and West (2007). Since our primary aim is predicting the few missing observations of the price level and not a ranking of the alternative forecasting models, it is not interesting for us, for example, whether the model with lowest RMSPFE is a statistically significantly better forecaster than the model with the second lowest RMSPFE. Thus, we do not report formal tests for c

- Using the latest available data (collected on 4 December 2021), we do out-of-sample forecasting for the period 2015-2021 in order to measure the magnitude of the REER approximation error resulting only from our price level forecasts;
- We collected real-time data from October 2020-December 2021 and use that to measure REER revisions resulting from all possible sources, in comparison with the World Bank's REER estimate revisions over the same period.

3. Data

We collect consumer price index and US dollar exchange rate data from publicly available data sources for the longest available time periods and for the largest number of countries and the euro area. We collect exchange rate against the US dollar and use them to calculate the bilateral rates between all countries[8]. Our main data sources are the Global Economic Monitor[9]

We also check for data recording errors. For example, on a few occasions, a price level time series with

For both the monthly and annual frequencies, we calculate two versions of the REER: a broader one covering 120 trading partners at the monthly frequency (available from January 1993) and 170 trading partners at the annual frequency (available from 1992), and a narrower one covering 51 trading partners at the monthly frequency (available from January 1960) and 65 trading partners at the annual frequency (available from 1960). For the monthly frequency, we selected the countries to be included in the basket of trading partners by considering three criteria:

1) Price level and exchange rate data should be available from January 1960 (for our narrow index) or from January 1993 (for our broad index),
2) The mean absolute percent forecast error of the consumer price level over the 2015-2021 out-of-sample evaluation period should be less than 1 percent (see section 4.1)[11],

information is not taken into account. However, IMF forecasts relative to the other methods improve with the forecast horizon: at the one-month forecasting horizons, there is only one country for which the IMF forecasts proved to be the best among the methods we considered, there are 12 such countries at the 6-month forecasting horizons, 24 countries at the 1-year horizon and 26 countries at the 2-year horizon.

Tables 2 and 3 show the median across countries, though the ranking of the forecasting models can differ for individual countries. Considering the relevant forecasting horizons indicated in Table 1 (eg for 90 countries only one-month ahead forecast has to be made, for 10 countries two-month ahead forecast have to be made, and so on, up to the 24-month horizon), the most accurate forecasting model was a version of the recursively estimated autoregressive model for 63 countries, a version of the five-year rolling estimated autoregressive model for 52 countries, a version of the ten-year rolling estimated autoregressive model for 23 countries, the IMF forecast for eight countries, while the method assuming unchanged one-month inflation rate was most accurate for four countries and the method assuming unchanged twelve-month inflation rates was most accurate for one country.

By considering the most accurate method at the relev

Table 2: Out-of-sample price level forecasts in 2015-2021, mean absolute percent forecast error (MAPFE), median values across 170 countries

	Forecast horizon (in months)													
Model	1	2	3	4	5	6	7	8	9	10	11	12	18	24
Unchanged monthly inflation	0.34	0.65	0.92	1.21	1.45	1.71	1.98	2.24	2.55	2.80	3.05	3.37	5.05	6.74
Unchanged 12-month inflation	0.41	0.65	0.83	0.95	1.05	1.18	1.26	1.35	1.45	1.49	1.53	1.58	2.24	2.78
AR(1) - 5-year rolling	0.28	0.45	0.58	0.71	0.82	0.95	1.10	1.20	1.29	1.				

Table 3: Out-of-sample price level forecasts in 2015-2021, root mean squared percent forecast error (RMSPFE), median values across 170 countries

	Forecast horizon (in months)													
Model	1	2	3	4	5	6	7	8	9	10	11	12	18	24
Unchanged monthly inflation	0.51	0.92	1.30	1.73	2.02	2.36	2.79	3.19	3.55	3.87	4.35	4.81	7.05	9.22
Unchanged 12-month inflation	0.59	0.88	1.07	1.23	1.38	1.52	1.62	1.71	1.83	1.				

Table 4: The ratio of mean absolute percent forecast error (MAPFE) from out-of-sample price level forecasts to the mean absolute percent change of the nominal effective exchange rate in 2015-2021, median values across countries

Missing CPI data points	Number of countries	CPI forecast error/NEER 51 change	CPI forecast error/NEER 120 change
1	90	0.31	0.29
2	10	0.46	0.46
3	11	0.40	0.40
4	2	0.30	0.31
5	8	0.38	0.38
6	2	0.49	0.39
7	2	0.45	0.38
8	6	0.75	0.72
9	0		
10	1	0.34	0.35
11	5	0.68	0.72
12	3	0.28	0.27
13	0		
14	1	0.42	0.40
15	1	0.35	0.36
16	1	0.25	0.22
17	0		
18	1	0.13	0.12
19	0		
20	3	0.46	0.46
21	3	1.35	1.38
22	0		
23	2	0.30	0.31
24	0		
All	152	0.34	0.36

Source: Bruegel. Note: the January 2015 – November 2021 period is used to evaluate out-of-sample price level forecasts and to calculate the change in the exchange rate. For each country, we calculate the ratio of mean absolute percent price level forecast error to the mean absolute percent change of the nominal effective exchange rate, both calculations were done over the horizon of missing price level data (i.e. one-month is considered for those 90 countries for which one -month CPI data was missing, see Table 1, and so on). This calculation considers 152 countries and not the full sample of 177 countries, because the 18 countries with no missing observations and the 7 countries with more than 24 missing observations are not included. NEER51 refers to the nominal effective exchange rate considering 51 trading partners, while NEER120 refers to the nominal effective exchange rate considering 120 trading partners.

To conclude, the findings of unbiased forecasts and the relatively small typical forecast errors compared to nominal exchange rate volatility suggests that an approximation of the REER with partially forecasted price levels could result in relatively small REER approximation errors.

4.2 Measuring the REER approximation error

We measure the REER approximation error resulting from our CPI forecast methodology using out-of-sample forecasts that we evaluate for the January 2015 – November 2021 period. For this exercise, we assume that in each month during this period, the number of missing recent CPI observations was the same as on 4 December 2021, the date of our most recent data collection. Thus, we assume that in each month from 2015 to 2021, for 18 countries no recent CPI observations were missing, for 60 countries only one recent CPI observation was missing, for 10 countries two observations were missing, and so, as indicated by Table 1. For example, for the first out-of-sample evaluation date, January 2015, we use the actual January 2015 CPI data for 18 countries, we make CPI forecasts using data up to December 2014 for 90 countries, we make CPI forecasts using data up to November 2014 for 10 countries, and so on, and use this CPI data (actual for 18 countries and forecast for all other countries) and actual nominal exchange rate data to calculate the REER. We compare these estimates to the estimates based on actual data from the most recent data collection.

For the 18 countries with no recent missing CPI observations, REER forecast errors result only from the forecasts of the missing CPI observations of trading partners.

Table 5 shows that the absolute value of the typical REER forecast error for the 18 countries with no missing recent CPI observations is 0.05 percent. That is, if value of an initial estimate of the REER was 100, this estimate is likely revised to either 100.05 or 99.95, which is a very minor revision. The typical REER forecast error for the 90 countries with one missing CPI observations is 0.23 percent, still a very low number. REER forecast errors tend to increase with the number of missing CPI observations and with the rate of inflation (last column of Table 5).

Overall, for the bulk of the countries, the REER forecast errors arising from CPI level forecasts is relatively small, while the error is larger only for a few countries characterised by higher inflation rates. Nevertheless, even for most of these countries, the REER forecasts are unbiased.

An important question is whether we should also report REER estimates for those countries for which the forecast error is relatively large, or set a forecast error threshold above which we do not report REER estimates. Since there is no straightforward way to set a threshold, we report REER estimawe sn 75 -1.73TJ-8ble 5).

- The number of recent months with missing price level data and thus the time periods for which price level forecasts were made,
- The price level forecast method,
- The MAPFE and RMSPFE statistics for price level forecasting from our January 2015 – November 2021 out-of-sample forecasting exercise,
- The MAPFE and RMSPFE statistics for REER forecasting from our January 2015 – November 2021 out-of-sample forecasting exercise.

This can help users to assess the uncertainty of our REER estimates in the periods for which forecasts were made.

Another question is whether we should report estimates for the seven countries for which more than 24 recent monthly price level observations are missing. We did not include these countries in our out-of-sample forecasting exercise, because the available sample period is significantly shortened by the missing observations. However, the IMF WEO includes annual price level data for these countries either up to 2020 (Sao Tome and Principe, Libya, Tonga,

Table 5: The mean absolute percent forecast error (MAPFE) and root mean squared percent forecast error (RMSPFE) from out-of-sample REER forecasts in 2015-2021, median values across countries

Missing CPI observations	Number of countries	MAPFE	RMSPFE	Average 12-month inflation
0	18	0.05	0.07	2.4
1	90	0.23	0.32	2.7
2	10	0.77	1.00	2.2
3	11	0.62	0.77	1.8
4	2	1.16	1.56	7.4
5	8	0.70	0.88	0.8
6	2	0.76	1.05	3.1
7	2	0.65	0.80	1.8
8	6	2.26	3.05	3.9
9	0			
10	1	1.52	1.90	4.0
11	5	2.13	2.66	1.6
12	3	1.46	1.71	4.0
13	0			
14	1	1.59	1.98	4.9
15	1	4.13	4.95	13.1
16	1	0.86	1.17	1.1
17	0			
18	1	0.66	1.02	0.4
19	0			
20	3	3.31	4.58	3.0
21	3	3.10	4.26	1.5
22	0			
23	2	3.21	3.93	1.1
24	0			
all	170	0.30	0.44	2.2

Source: Bruegel. Note: Out-of-sample forecast errors were calculated over the sample of January 2015 – November 2021. For each month within this period and for each country, a forecast for the particular month was made for the national price level by assuming that the number of recent missing CPI observation is the same as at the 4 December 2021 data collection. The REER was calculated using the forecast price levels, or the actual price level for those 18 countries for which no missing observations are assumed. These REER forecasts are compared to the latest REER estimation using data downloaded on 4 December 2021. Those 170 countries are considered for which no more than 24 recent observations are missing, see Table 1. For each country, the model proved to be the best CPI forecaster for the time horizon of missing data was used. Results refer to the broad REER index relative to 120 trading partners; results for the narrow REER index are rather similar.

4.3 Comparing REER estimate revisions from alternative sources

We compare our REER estimate revision with the World Bank and IMF REER estimate revisions, using the real-time data we collected between early October 2020 and early December 2021. Thus, this out-of-sample evaluation period is much shorter than the 2015-2021 evaluation period considered so far.

The World Bank publishes REER indicators in a timely manner: for all our real-time data collection dates, on average on the sixth day of each month, the REER estimate for the preceding month was already available. IMF REER publication is delayed by one month. Thus, when comparing our real-time estimates with the World Bank estimates, we compare the estimates for the latest month (eg for the data collected on 4 October 2020, we look at the revision in the estimates made for September 2020), while for the comparison with the IMF, we assess estimates for the preceding month (eg for the data collected on 4 October 2020, we look at the revision in the estimates made for August 2020).

The World Bank publishes REER data for 107 countries, but the most recent data is January 2018 for 61 counties and updated estimates only are published for the remaining 45 countries. These 45 countries include Venezuela, a country currently experiencing hyperinflation. The latest monthly inflation data we were able to collect for Venezuela is for April 2019 and thus we did not include Venezuela in our REER revision calculations. We therefore compare the revision in our and the World Bank REER estimates for the remaining 44 countries in the September 2020 – November 2021 out-of-sample evaluation period. We find that our estimates have slightly lower forecast errors that the World Bank estimates: the median across 44 countries of the MAPFE statistic for the latest month is 0.33 for our REER considering 120 trading partners, 0.34 for our REER considering 51 trading partners, and 0.36 for the World Bank REER. Considering the RMSPFE statistics, the values are 0.42, 0.43 and 0.46, respectively. Among the 44 countries, the revisions in our estimates are smaller than World Bank revisions for 31 countries, while for 13 countries World Bank revisions are smaller.

The IMF publishes data for 94 countries but the latest estimate for Venezuela is for December 2016. For the other 93 countries, the median of the MAPFE statistic for the month preceding the latest month is 0.10 for our REER considering 120 trading partners, 0.11 for our REER considering 51 trading partners, and 0.41 for the IMF REER. Considering the RMSPFE statistics, the values are 0.16, 0.15 and 0.54, respectively. Thus, on average, IMF REER estimate revisions are considerably larger than the revisions in our estimates. Among the 93 countries, the revisions in our estimates are smaller than IMF revisions for 81 countries, while for 12 countries IMF revisions are smaller.

5. How much does monthly price level variation matter for the REER in certain economic analyses?

The use of the forecast price level implicitly assumes smooth monthly inflation rates. An important question is to what extent the neglect of the actual dynamics of the price level distorts the conclusions from economic analyses using the REER. It seems reasonable to presume that when only one month of price level data is forecasted and actual price level data is used for the rest of the sample, there would be hardly any difference in results compared to the case when even the last price level observation was an actual data. Yet, when more recent observations are missing and hence a longer horizon forecast has to be made for the price level, results of economic analyses might differ compared to the case when only actual data is used for calculating the REER.

To assess the relevance of the neglect of monthly price level dynamics for REER calculation, we take two widely analysed economic topics, testing for a unit root in real exchange rates and forecasting the nominal exchange rate with the REER. We compare the results based on alternative versions of the REER, which are all based on the actual nominal exchange rates (as we do for the calculation of our REER indicators), but differ in terms of the price level data used:

- Actual monthly consumer prices for the full period;
- Actual monthly consumer prices for the full period except for last year, for which constant monthly inflation rate (corresponding to the actual annual inflation rate) is assumed;
- Actual monthly consumer prices for the full period except for the last 5 years, for which a constant monthly inflation rate (corresponding to the actual annual inflation rate) is assumed within each year;
- Approximated monthly consumer prices for the full period, for which a constant monthly inflation rate (corresponding to the actual annual inflation rate) is assumed within each year.

Whenever we use approximated data, we use the actual December values for each year and interpolate the values for the 11 months between two Decembers by assuming a constant monthly inflation rate.

5.1 Testing for a unit root in real exchange rates

There are numerous tests for unit roots. We employ the popular method developed by Phillips and Perron (1988), which uses a nonparametric method of controlling for serial correlation in the test equation. We include a constant, but no linear time trend in the test regression, and use the Bartlett Kernel to estimate the residual spectrum at frequency zero with the Newey-West bandwidth selection method. We test for unit root in the REER after logarithmic transformation.

Table 6 summarises the cases when the null hypothesis of a unit root is rejected. The conclusion about this null hypothesis hardly changes when approximated price level data is used instead of actual price level data for calculating the REER. When approximating price level only in the latest year, the conclusion differs slightly only for one country when considering the standard 1 percent, 5 percent and 10 percent significance levels: for the Bahamas, the p-value is 4.98 percent when using full sample actual price levels and 5.06 percent when price levels of the latest year are approximated. No country changes position when approximated data is used for the last five years instead of only the last year, and very few countries change position when we use approximated price level data for the full sample.

Table 6: Testing for a unit root in real effective exchange rates (number of countries)

	REER relative to 51 trading partners				REER relative to 120 trading partners			
Price level data used:	Full sample actual	Last year approximated	Last five years approximated	Full sample approximated	Full sample actual	Last year approximated	Last five years approximated	Full sample approximated
The null hypothesis of unit root is rejected:								
* at 1%	33	33	33	34	36	36	36	32
* between 1 and 5%	16	15	15	13	15	14	14	16
* between 5 and 10%	8	9	9	11	9	10	10	5
not rejected								

Since long-horizon regressions[14] suffer from econometric problems (Berkowitz and Giorgianni, 2001; Rossi, 2007; Darvas, 2008), our longer-horizon forecasts are based on the iteration of one-period ahead forecasts using the simple two-equation model:

$$(13) \qquad \begin{aligned} s_{i,t+1} - s_{i,t} &= \beta_{1} + \beta_{2}\, x_{i,t} + \varepsilon^{(1)}_{i,t+1} \\ x_{i,t+1} &= \beta_{3} + \beta_{4}\, x_{i,t} + \varepsilon^{(2)}_{i,t+1} \end{aligned}.$$

That is, we use information up to time *t* to estimate the four parameters for each country – that we denote $\hat{\beta}_{j,t}$, *j*=1, 2, 3, 4. We then first calculate one-period ahead forecasts: $\hat{s}_{i,t+1|t} = s_{i,t} + \hat{\beta}_{1,t} + \hat{\beta}_{2,t}\, x_{i,t}$ and $\hat{x}_{i,t+1|t} = \hat{\beta}_{3,t} + \hat{\beta}_{4,t}\, x_{i,t}$, where $\hat{s}_{i,t+1|t}$ and $\hat{x}_{i,t+1|t}$ denote the one-period ahead forecasts based on time *t* information. Note that $s_{i,t}$ and $x_{i,t}$ are observed at time *t*. The two-period ahead forecasts are obtained as: $\hat{s}_{i,t+2|t} = \hat{s}_{i,t+1|t} + \hat{\beta}_{1,t} + \hat{\beta}_{2,t}\, \hat{x}_{i,t+1|t}$ and $\hat{x}_{i,t+2|t} = \hat{\beta}_{3,t} + \hat{\beta}_{4,t}\, \hat{x}_{i,t+1|t}$. Thus, the two-period ahead forecasts use information available only up to time *t*. And so on; we iterate the two equations forward based on information available only up to time *t*. The structure of model (13) is the same as analysed by Pincheira and West (2016).

The main benchmark in exchange rate forecasting is the driftless random walk, which, however, is nested in model (13). When comparing nested models, standard asymptotic tests do not apply when testing the null hypothesis of equal forecast accuracy. Clark and West (2007) suggested an adjustment of mean squared prediction error statistics, which leads to an approximately normal test. This test was based on the assumption that a long-horizon regression is used for forecasting and the out-of-sample forecasts are evaluated using a rolling-window estimation technique. However, Pincheira and West (2016) found that the Clark and West (2007) statistics also worked reasonably well when the iterated method is used to obtain multi-step forecasts and the recursive estimation scheme is used, which is our baseline setup. For the iterated method they considered a simple first-order autoregression for the predictor, in the same way as in our forecasting model (13). We therefore use the Clark and West (2007) statistics for testing the null hypothesis equal forecast accuracy of model (13) and the driftless random walk.

A co-integrating relationship can be better estimated over long estimation pe exchange rate regime can the nominal exchange rate freely adjust when the real exchange rate deviates from its long-run level. We therefore exclude from our sample period the period of the Breton-Woods exchange rate system, when most countries adopted fixed exchange rates, and also exclude countries that have adopted a fixed exchange rate to the US dollar since then. We also exclude most of the 1970s from our sample period when nominal exchange rates were adjusting to the shocks caused by the collapse of the Bretton Woods system and the rise in oil prices. Based on these considerations, January 1979 seems to be a reasonable starting date for our estimation. To allow an initial estimation of model parameters, we evaluate the out-of-sample forecasts in the January 1990 – November 2021 period. There are 100 countries (plus the euro area) for which our narrow REER indicator is available from January 1979, of which 20 countries still employ a fixed rate to the US dollar. We, therefore, analyse the remaining 80 countries and the euro area.

To save space, we report detailed results for a few countries and the median for all analysed countries. We only compare the cases when either actual price level data or approximated price level data are used over the full period to calculate the REER. Results are rather robust for the use of alternative price level data (Table 7). For example, the ratio of the one-period-ahead mean squared forecast error of the nominal effective exchange rate based on model (13), to the mean squared forecast error of the random walk (and multiplied by 100), is 99.8 for the euro area when the actual price level data is used to calculate the REER and 99.7 when approximated price level data is used. The p-values of testing the null hypothesis of equal forecast accuracy are also rather similar.

Table 7 suggests mixed results for the forecasting ability of the real exchange rate model. For some countries, such as the United Kingdom, the real exchange rate model outperforms the random walk at least in long-horizon forecasts (consistent with the results of Ca'Zorzi and Rubaszek, 2020). But for others, like the United States, this is not the case. It should be noted, however, that Ca'Zorzi and Rubaszek (2020) studied bilateral exchange rates relative to the US dollar, while we analysed the nominal effective exchange rate relative to 51 trading partners, which could influence the findings.

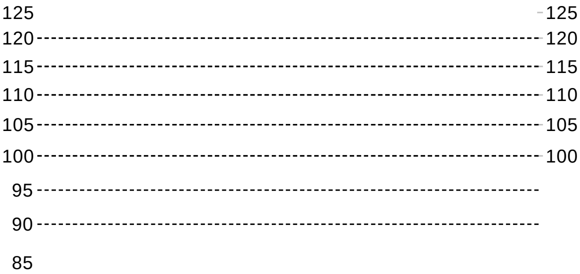
Table 7: Mean squared forecast error of the real exchange rate model (random walk = 100)

	Using actual price level data for the REER					Using approximated price level data for the REER				
	forecast horizon in months									
	1	6	12	36	60	1	6	12	36	60
Australia	100.7	101.3	102.6	106.6	105.0	100.6	101.2	102.5	106.3	104.4
	(0.559)	(0.396)	(0.35)	(0.209)	(0.096)	(0.534)	(0.371)	(0.322)	(0.181)	(0.077)
Canada	100.6	102.7	105.1	110.4	116.9	100.5	102.4	104.6	108.9	114.1
	(0.746)	(0.801)	(0.813)	(0.835)	(0.922)	(0.694)	(0.746)	(0.77)	(0.738)	(0.817)
Euro area	99.8	98.6	96.0	89.7	79.0	99.7	98.3	95.5	88.2	76.9
	(0.214)	(0.127)	(0.044)	(0.006)	(0)	(0.193)	(0.106)	(0.034)	(0.005)	(0)
India	95.8	83.0	72.6	117.4	180.4	95.9	82.9	72.7	119.2	182.9
	(0.018)	(0.009)	(0.004)	(0.001)	(0.001)	(0.018)	(0.009)	(0.005)	(0.001)	(0.001)
Japan	101.5	105.2	110.1	123.0	164.1	101.5	105.2	110.0	121.7	161.1
	(0.373)	(0.322)	(0.238)	(0.072)	(0.018)	(0.375)	(0.318)	(0.237)	(0.065)	(0.017)
Kenya	93.8	85.8	78.7	51.1	57.9	93.9	86.3	78.8	52.8	58.8
	(0.028)	(0.025)	(0.021)	(0.006)	(0.002)	(0.029)	(0.026)	(0.023)	(0.005)	(0.002)
Korea South	100.0	96.7	90.8	71.1	66.1	99.7	95.7	89.3	69.7	63.7
	(0.132)	(0.027)	(0.005)	(0)	(0)	(0.051)	(0.013)	(0.002)	(0)	(0)
Switzerland	100.7	100.3	98.2	72.1	51.7	100.8	100.7	98.7	72.7	52.7
	(0.598)	(0.255)	(0.059)	(0)	(0)	(0.623)	(0.289)	(0.079)	(0)	(0)
Thailand	101.2	105.1	109.0	116.0	116.3	101.2	104.9	108.6	115.3	114.5
	(0.671)	(0.854)	(0.865)	(0.638)	(0.404)	(0.689)	(0.854)	(0.865)	(0.66)	(0.396)
United Kingdom	100.6	98.2	95.4	86.4	83.0	100.				

The implication of these results is that whenever annual price level data is available for a longer time period than monthly price level data, then for the period when monthly price level data is not available, the monthly real effective exchange rate can be well approximated with the use of actual monthly nominal exchange rate data and an approximated monthly price level data that assumes a constant within-year monthly inflation rate corresponding to actual annual inflation rate.

6. Comparing the latest REER estimate levels from alternative sources

Figure 3: Comparison of alternative REER estimates for selected countries (December 2007=100)



7. Conclusions

The real effective exchange rate is an important indicator for researchers and policymakers. Current datasets from the BIS, Eurostat, the IMF, OECD and the World Bank include all advanced and several emerging and developing countries, but data for many countries is not available and some data is released with a delay. This paper develops a methodology to estimate monthly consumer-price based real effective exchange rates for 177 countries plus the euro area without any delay (eg the indicators can be estimated on the first day of each month for the preceding month). Our dataset includes more than twice as many observations as the second most comprehensive dataset from the IMF.

Our methodology is based on the observations that short-run real exchange effective rate changes are dominated by nominal effective exchange rate changes, while inflation rates are sticky and contribute little to short-run real exchange rate changes. Thus, we use actual nominal exchange rate data and forecast price level data whenever actual price level data has not yet been published. Our out-of-sample forecasting exercise over the 2015-2021 period demonstrates that for most countries, price level forecasts and the corresponding real effective exchange rate forecasts are rather accurate. Using real-time data from October 2020-December 2021, we find that the revisions in our real effective exchange rate estimates are marginally smaller than the revisions in World Bank estimates on average for 44 countries, and our revisions are considerably smaller than the revisions in IMF estimates on average for 93 countries.

We also found that in two frequently analysed research topics, testing for a unit root in real exchange rates and forecasting the nominal exchange rate with the real exchange rate, neglect of the actual monthly dynamics of the price level for the calculation of the real effective exchange rate hardly changes the results of the analysis. This finding suggests that whenever annual price level data is available for a longer period than monthly price level data, then for the period when monthly price level data is not available, the monthly real effective exchange rate can be well approximated using actual monthly nominal exchange rate data and approximated monthly price level data that assumes constant within-year monthly inflation rate corresponding to actual annual inflation rate.

The nominal and real effective exchange rates calculated in this paper are freely downloadable at:

https://www.bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database/

The dataset will be regularly updated.

References

Bayoumi, Tamim, Jaewoo Lee and Sarma Jayanthi (2006) 'New Rates from New Weights', *IMF Staff Papers* 53(2): 272-305 http://www.imf.org/External/Pubs/FT/staffp/2006/02/pdf/bayoumi.pdf

Bayoumi, Tamin, Maximiliano Appendino, Jelle Barkema, and Diego A. Cerdeiro (2018) 'Measuring Competitiveness in a World of Global Value Chains', *Working Paper* 18/229, International Monetary Fund, https://www.imf.org/en/Publications/

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