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Abstract
We examine exchange rate predictability using time-varying and constant parameter models that are conditioned on three variants of Taylor rules as well as six additional alternative models, namely, monetary model (MM); purchasing power parity (PPP); uncovered interest rate parity (UIRP) and three different factor (F1, F2 and F3) models, for BRICS countries. Monthly consumer price index, industrial production index, interest rate, broad money and exchange rates were used to construct the alternative fundamentals for exchange rate predictability for the period of January 1999 and March 2020. The out-of-sample forecast performances of the contending models were evaluated at the forecasting horizons of 1, 4, 8 and 12 using RMSFE and DM statistics, under the full, pre-GFC and post-GFC sample periods. We find that models conditioned on the Taylor rule fundamentals with homogeneous coefficients without interest rate smoothing as well as PPP- and UIRP-based fundamentals offer better exchange rate predictability of the BRICS than the random walk model across the forecast horizons. In addition, constant parameter models offer superior forecasting ability relative to the time-varying parameter models. Our results are sensitive to the data sample, frequency and the choice of fundamentals captured in the predictive model of exchange rate.

Keywords: Exchange Rate Predictability, BRICS, time-varying parameter (TVP) model, Taylor rule, random walk

JEL Classifications: F31, F37

1. Introduction

Given the importance of exchange rate in the economy, predicting exchange rate has become important issue in international economics since Meese and Rogoff (1983). Specifically, Mees and Rogoff estimate whether macroeconomic fundamentals (such as the flexible-price

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monetary (Frenkel (1976)-Bilson (1978)) model, the sticky-price monetary (Dornbusch (1976)-Frankel (1979)) model, and a sticky-price asset (Hooper-Morton (1982)) model) can outperform the random walk model using out-of-sample method and fail to find that the suggested models outperformed the random walk model. Since then, many competing theoretical models are introduced. Among them, Rossi (2013) surveys the literature and summarizes that the Taylor rule fundamentals display significant out-of-sample forecasting ability at short horizon; and panel monetary models display some forecasting ability at long horizons. On the other hand, Engel et al. (2015) and Byrne et al. (2018) use the factor models to forecast the exchange rates. Regarding empirical methods, Byrne et al. (2016) estimate the exchange rate predictability by accounting for structural instability with time-varying parameter (TVP) model and compare the results with random walk model.

According to Deutsche Welle (2019), BRICS (Brazil, Russia, India, China, and South Africa) countries account for 42% of the global population, 23% of GDP, 30% of the territory and 18% of trade. Exchange rate is one of the most important macroeconomics variables for those countries and greatly affects the economy not only through trade channel but also financial channel. There is only a handful of research regarding the forecastability of the exchange rates for BRICS countries. Salisu et al. (2020) estimate the oil-based model and find that oil-based model outperforms the random-walk model in predicting exchange rate. Salisu et al. (forthcoming), based on Uncovered Equity Parity, examine whether stock returns contain useful information in predicting exchange rate for BRICS countries. They find that stock returns improve the predictability of exchange rates for BRICS countries.

Unlike other studies on exchange rate predictability for BRICS countries, we extensively examine exchange rate predictability using time-varying and constant parameter models that are conditioned on three variants of conventional Taylor rules as well as six additional alternative models namely monetary model (MM); purchasing power parity (PPP); uncovered interest rate parity (UIRP) and three different factor (F1, F2 and F3) models for BRICS countries.

The rest of the paper proceeds as follows. The next section discusses estimation equations, forecasting evaluation strategy, and the data. Section 3 presents our main empirical findings. Section 4 provides concluding remarks.

2. Methodology

Relying on the hypothesis that Taylor rule fundamentals such as interest rate, inflation, output contain predictive contents for exchange rate movements (Bryne et al., 2016), we formulate variants of these fundamentals in the analysis of BRICS exchange rates. This is also consistent with the asset pricing setting such as the Arbitrage Pricing Theory (Ross, 1976) where movements in asset prices can be linked to macroeconomic variables (French, 2017). In line with the Taylor (1993) rule, the monetary authority is expected to raise (lower) the policy rate when inflation is above (below) the target and/or output is above (below) its potential level. From the perspective of policy setting for exchange rates (see Engel & West, 2004, 2005, 2006; Engel et al., 2007; Mark, 2009; Molodtsova & Papell, 2009, 2013; and Bryne et al., 2016), it is assumed that both the home and the foreign central banks conduct monetary policy following a Taylor rule, and therefore are concerned about inflation and output deviations from their target values. Further, the home country also targets real exchange rate in addition to the conventional fundamentals of the Taylor rule (Engel & West, 2005) in which interest rate differential between the home and foreign countries plays a crucial role in this regard (see Golit et al., 2019; Penzin & Salisu, 2020; Sani et al., 2020; and Abdullah et al., 2021).[1] Consequently, we construct an equation for interest rate differentials by subtracting the foreign Taylor rule from that of home and the resulting equation is expressed as (see Bryne et al., 2016):

$$i_t - i_t^* = \gamma_0 + \gamma_1 \pi_t - \gamma_1^* \pi_t^* + \gamma_2 \bar{y}_t - \gamma_2^* \bar{y}_t^* + \gamma_3 e_t + \gamma_4 i_{t-1} - \gamma_4^* i_{t-1}^* + \varepsilon_t \quad (1)$$

where i_t is the short term interest (policy) rate set by the central bank, π_t is the inflation rate, $\bar{y}_t$ is the output gap, e_t is the real exchange rate computed as $e_t = s_t + p_t^* - p_t$, s_t is the nominal spot exchange rate, p_t is the log of the price level and variables with (without) asterisks denote the foreign (home) variables while U.S. is used as a proxy for foreign country while ε_t is the regression error term that is assumed to follow Gaussian distribution.[2] The model parameters γ_i

[1] The link between monetary policy and exchange rate is well situated within the Uncovered Interest Rate Parity (UIRP) under distortions in beliefs (Engel, 1996; Gourinchas & Tornell, 2004; Molodtsova & Papell, 2009, 2013; Bryne et al., 2016) where an increase in the home country's interest rate relative to the foreign can lead a currency appreciation.

[2] For technical details on the derivation of equation (1), see Bryne et al. (2016, 2018).

and γ_i^* $(i=1,2,3,4)$ are for the home and foreign variables respectively. We account for interest rate smoothing as central banks tend smooth interest rate in the short run in order to limit interest rate variability (Goodfriend, 1991; Mehra, 2002; Engel et al., 2007; Mark, 2009; Molodtsova & Papell, 2009). This is done by adjusting the actual interest rate to minimize the gap between the current interest rate target and its immediate past level while the adjustment parameters γ_4 and γ_4^* measure the degree of interest rate smoothing in home and foreign countries, respectively.

One key assumption in equation (1) is that all the parameters are assumed constant over time, however, given the vulnerability of the Taylor rule fundamentals to structural instabilities owing to changing macroeconomic conditions (Barnett & Duzhak, 2019), we reformulate equation (1) to account for time-variation in the parameters as follows:

$$i_t - i_t^* = \gamma_{0t} + \gamma_{1t}\pi_t - \gamma_{1t}^*\pi_t^* + \gamma_{2t}\bar{y}_t - \gamma_{2t}^*\bar{y}_t^* + \gamma_{3t}e_t + \gamma_{4t}i_{t-1} - \gamma_{4t}^*i_{t-1}^* + \varepsilon_t \qquad (2)$$

where the subscript t on γ_i and γ_i^* $(i=1,2,3,4)$ allows for time-variation in the parameters. Given that the behavior of spot exchange rate (s_t) is driven by the Taylor rule fundamentals expressed in equation (2) and denoted as Ω, then, its deviations from its implied fundamental value, which is crucial when forecasting exchange rates, can be expressed as:

$$\tilde{s}_t = \Omega_t - s_t \qquad (3)$$

where $\tilde{s}_t$ is the deviation from the fundamental's implied level. It then follows from equation (3) that when the spot exchange rate is lower (higher) than the level implied by the fundamentals, i.e., $s_t < (>) \Omega_t$, then the spot rate is expected to increase (decrease) suggesting currency appreciation(depreciation). The implied fundamental value (Ω_t) is computed after estimating equation (2), and using the information in equation (3), as follows:

$$\Omega_t = \hat{\gamma}_{0t} + \hat{\gamma}_{1t}\pi_t - \hat{\gamma}_{1t}^*\pi_t^* + \hat{\gamma}_{2t}\bar{y}_t - \hat{\gamma}_{2t}^*\bar{y}_t^* + \hat{\gamma}_{3t}e_t + \hat{\gamma}_{4t}i_{t-1} - \hat{\gamma}_{4t}^*i_{t-1}^* + s_t \qquad (4)$$

where the variables are as previously defined except that the time varying-parameter estimates are used here. The same procedure is followed in equation (1) to obtain the implied fundamental value with the constant-parameter estimates. In order to test the validity of constant and time varying parameters as well as the need to account for interest rate smoothing in exchange rate forecasting, we consider the following variants of the Taylor rule fundamentals such as those expressed in equations (2)[3]:

Case I: Assumes (i) Homogenous coefficients between home and foreign countries with respect to the traditional fundamentals of Taylor rule, that is, inflation and output gap, where $\gamma_{1t} = \gamma_{1t}^*$; and $\gamma_{2t} = \gamma_{2t}^*$; (ii) Asymmetric Taylor rule specification, that is, apart from these traditional fundamentals targeted by both countries, the home country also targets the real exchange rate; and (iii) central banks do not smooth interest rate, that is, $\gamma_{4t} = \gamma_{4t}^* = 0$. Given these assumptions, equation (2) becomes[4]:

$$i_t - i_t^* = \gamma_{0t} + \alpha_{1t}\left(\pi_t - \pi_t^*\right) + \alpha_{2t}\left(\bar{y}_t - \bar{y}_t^*\right) + \gamma_{3t} e_t + \varepsilon_t \quad (5)$$

where $\alpha_{1t} = \gamma_{1t} = \gamma_{1t}^*$; $\alpha_{2t} = \gamma_{2t} = \gamma_{2t}^*$ and $\gamma_{4t} = \gamma_{4t}^* = 0$. For easy reference, equation (5) is code-named TR_{ON} ("TR" denotes Taylor Rule; subscripts "O" and "N" denote homogenous rule and no interest rate smoothing respectively).

Case II: Similar to Case I except that central banks are now assumed to smooth interest rate and the homogenous rule is also applicable. Therefore, the following modified Taylor rule equation (code-named as TR_{OS}, that is, Taylor rule with homogenous rule and interest rate smoothing) is derived from (2) as:

$$i_t - i_t^* = \gamma_{0t} + \alpha_{1t}\left(\pi_t - \pi_t^*\right) + \alpha_{2t}\left(\bar{y}_t - \bar{y}_t^*\right) + \alpha_{3t}\left(i_{t-1} - i_{t-1}^*\right) + \gamma_{3t} e_t + \varepsilon_t \quad (6)$$

where $\alpha_{3t} = \gamma_{4t} = \gamma_{4t}^*$ while others are as defined in Case I.

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[3] The same assumptions are imposed on the constant-parameter specification in (1), therefore, the variants of Taylor rule obtained for the time varying-parameter specification in (2) are the counterpart of the former. In this case the corresponding specifications for the three variants considered are:

A. TR_{ON}: Homogenous rule, asymmetric and without interest rate smoothing: $i_t - i_t^* = \gamma_0 + \alpha_1\left(\pi_t - \pi_t^*\right) + \alpha_2\left(\bar{y}_t - \bar{y}_t^*\right) + \gamma_3 e_t + \varepsilon_t$

B. TR_{OS}: Homogenous rule, asymmetric and with interest rate smoothing: $i_t - i_t^* = \gamma_0 + \alpha_1\left(\pi_t - \pi_t^*\right) + \alpha_2\left(\bar{y}_t - \bar{y}_t^*\right) + \alpha_3\left(i_{t-1} - i_{t-1}^*\right) + \gamma_3 e_t + \varepsilon_t$

C. TR_{EN}: Heterogeneous rule, asymmetric and without interest rate smoothing: $i_t - i_t^* = \gamma_0 + \gamma_1 \pi_t - \gamma_1^* \pi_t^* + \gamma_2 \bar{y}_t - \gamma_2^* \bar{y}_t^* + \gamma_3 e_t + \varepsilon_t$

[4] The assumption of a zero constant in line with the Taylor rule (see Engel & West, 2005) is irrelevant here since the forecasting regression usually includes a constant (Bryne et al., 2016).

Case III: This variant only differs from Case I in terms of the relaxation of the homogenous rule. In other words, like Case I, the assumptions of asymmetric rule and no interest rate smoothing are still upheld while the coefficients of the traditional Taylor rule fundamentals are now assumed to be heterogeneous between the home and foreign countries. Thus, the test equation in (2) becomes:

$$i_t - i_t^* = \gamma_{0t} + \gamma_{1t}\pi_t - \gamma_{1t}^*\pi_t^* + \gamma_{2t}\overline{y}_t - \gamma_{2t}^*\overline{y}_t^* + \gamma_{3t}e_t + \varepsilon_t \quad (7)$$

where $\gamma_{4t} = \gamma_{4t}^* = 0$. This variant of equation (2) is described as TR_{EN} ("TR" denotes Taylor Rule; subscripts "E" and "N" denote heterogeneous rule and interest rate smoothing respectively).

For the purpose of estimation, typical of TVP regression model such as equations (2) to (7), we construct a state-space model and thereafter employ Bayesian methods to estimate the parameters.[5] As previously noted, we also consider an alternative scenario where the coefficients do not exhibit time-variation as in equation (1) and we use a Fixed-Effect (FE) panel regression in this regard. The choice of this method is underscored by the results in Engel et al. (2007) and Ince (2014), which suggest superior forecasting ability of panel data methods relative to single-equation methods.

For completeness, we also consider alternative models of forecasting exchange rates such as the Monetary Model (MM) with the fundamentals given by the identity $\Omega \equiv (m_t - m_t^*) - (y_t - y_t^*)$; Purchasing Power Parity Condition (PPP) whose fundamentals are captured with the identity $\Omega \equiv p_t - p_t^*$ and the UIRP hypothesis with the fundamentals $\Omega \equiv (i_t - i_t^*) + s_t$) (see Bilson, 1978; Frankel, 1979; Molodtsova & Papell, 2009; Bryne et al., 2016). The estimation of these models follows both the constant-parameter and time varying-parameter procedures as previously explained. In addition, we estimate variants of a factor model[6] (formulated with the identity $\Omega \equiv \sum_{r=1}^{R} \lambda_{r,i} \times f_{r,t}$) by extracting factors from the MM, PPP and UIRP estimates to obtain the fundamentals for the factor model.

[5] The computational advantages of using this approach over other competing models such as the Kalman Filter with maximum likelihood are well documented in Bryne et al. (2016, 2018).

[6] We allow for one, two and three factors distinctly and estimated these variants of the factor model using the principal component analysis in line with the studies of Engel et al. (2015) and Bryne et al. (2018). We particularly refer our readers to the study of Bryne et al. (2018) for detailed estimation procedure of the variants of factor models as well as other predictive model. We also thank the authors for providing the codes used for empirical analysis in this paper.

2.1. Forecast implementation and evaluation

We employ both monthly and quarterly (for robustness) data on exchange rates prices, output, interest rate, and money supply for the BRICS countries and the United States (US). The data coverage for the full data sample periods as well as the pre-GFC and post-GFC periods are summarized in Table 1. The table shows the complete data sample period, the sample interval used for the parameterization of the priors and setting of the initial conditions for the TVP regression, and the interval for the in-sample estimation. Subsequent upon the specified in-sample period, four different out-of-sample forecast horizons are considered, which are sub-grouped into short $(h = 1 \ \& \ 4)$ and long $(h = 8 \ \& \ 12)$ horizons. In each of the sub-sample periods considered, the first twenty (20) data points are employed for the parameterization of the priors and initial conditions of the TVP regression and discarded afterwards. Hence, they are not included estimation and forecast samples.

We examine the forecast performance of nine fundamental-based models, using a recursive approach, in comparison with a benchmark model – a driftless random walk model. The fundamentals, which include three Taylor Rule constructs; monetary model (MM); purchasing power parity (PPP); uncovered interest rate parity (UIRP); and one-, two- and three- factors, are estimated using the TVP and fixed-effect panel regressions. The data in the in-sample (full (1999M09 – 2016M07), pre-GFC (1999M09 – 2005M07) and post-GFC (2009M09 – 2016M07)) periods were used for the estimation of the exchange rate regression model. The estimated models are used to generate out-of-sample forecasts, which are subsequently examined for precision in comparison with the driftless random walk model. The forecast evaluation is based on the conventional root mean square forecast error and the Diebold and Mariano (1995) test. The Theil's-U statistic, which is the ratio of the fundamental-based exchange rate regression model to the driftless random walk model, is computed. The forecast of a fundamental-based exchange rate model is considered more precise than the driftless random walk model whenever the computed Theil's-U statistic is less than unity; otherwise, the latter outperforms the former. Given also, that we are considering the exchange rate predictability in the BRICS countries, the median Theil's-U statistic is obtained and used to ascertain the frequency of precision of the forecast from the contending fundamental-based exchange rate models. On the Diebold and Mariano test statistic, we formally test the null of no difference between the forecast precision of the fundamental-based exchange rate model and the driftless random walk model; and base our decision on a 10% level of significance, with critical value 1.282. Consequently, the null is rejected at 10% level of significance whenever the computed DM is greater than the 1.282.

Table 1: Data Period Description

Sample	Complete Data	Data period used for Prior parameterization and initial conditions for the TVP regression (20 data points)	In-Sample Period
		Monthly	
Full	1998M01 – 2020M03	1998M01 – 1999M08	1999M09 – 2016M12
Pre-GFC	1998M01 – 2007M12	1998M01 – 1999M08	1999M09 – 2006M12
Post-GFC	2008M01 – 2020M03	2008M01 – 2009M08	2009M09 – 2016M12
		Quarterly	
Full	1997Q1 – 2020Q1	1997Q1 – 2001Q4	2002Q1 – 2012Q4

2.2. Data sources

We employ both monthly and quarterly data over the period indicated in Table 1 for the BRICS and the US, with the latter frequency primarily due to the usage of real Gross Domestic Product (GDP) as a measure of output for the BRICS and the US. Data on the dollar-based exchange rates, industrial production and real GDP, which are alternative metrics of output on which the Hodrick and Prescott (1997) filter is applied to obtain output gaps, Consumer Price Index (CPI) to derive (month-on-month) inflation rates, and monetary policy rates, are all derived from IHS Global Insight database, while the broad money supply is obtained from the FRED database of the Federal Reserve Bank of St. Louis. All data, barring the interest rates are in seasonally-adjusted form, with GDP and money supply in local currencies.

3. Main Results

Here, we present the results of the forecast performance of the TVP and Fixed Effect Panel regressions, conditioned on three different Taylor Rule constructs; monetary model (MM); purchasing power parity (PPP); uncovered interest rate parity (UIRP); and one-, two- and three-factors. The first Taylor rule is defined as having homogenous coefficients and no interest rate smoothing $\left(TR_{ON}\right)$; the second Taylor rule is defined as having homogenous coefficients and interest rate smoothing $\left(TR_{OS}\right)$; while the third Taylor rule is defined as having heterogenous coefficients and no interest rate smoothing $\left(TR_{EN}\right)$. The factors (F_1, F_2 and F_3, respectively) used in the factor models are the factors obtained from a principal component analysis of the exchange rates of the currencies of the BRICS countries. The forecast performance of the TVP and Fixed Effect Panel regression models are examined in comparison with the benchmark random walk model, where we consider the frequency of outperformance of the former over the latter in at least half of the countries to adjudge the former as better than the random walk model. More specifically, outperformance is based on the median of all the estimated RMSFE (Median U) being less than 1 and estimated RMSFE values being less than unity in at least half of the currencies considered. The reported number of Diebold and Mariano (DM) statistics greater than 1.282 corresponds to number of cases (BRICS countries' currencies) where the null of equality in forecast precision between our examined (TVP and Fixed Effect Panel) regression models and the benchmark random walk model is rejected at 10% level of significance. We consider four out-of-sample forecast horizons – 1, 4, 8 and 12, where the first two (1 and 4) are considered as short out-of-sample periods, while the last two (8 and 12) are considered as longer out-of-sample periods. The results are presented in three panes in Tables 2 - 4, with each pane corresponding to the full, pre-GFC and post-GFC sample periods. Note that for brevity, Tables 2 – 4 show the summary of forecast performance of the Taylor rule-type models as well other variants across the BRICS countries. In other words, we report the number of cases where the theory-based models outperform the benchmark (statistical) model. Nonetheless, the performance of the models for the individual countries' exchange rates is presented in the appendix for both the TVP method (see Table A1) and Panel Fixed Effect method (see Table A2).

3.1. Taylor Rules Results

Table 2 presents the out-of-sample forecast performances for the three earlier defined Taylor rule fundamentals estimated using the TVP regression and the Fixed Effect Panel regression, in comparison with the benchmark random walk model. Following from the TVP regression results under the full sample period, we find the TVP regression conditioned on homogenous coefficient and no interest rate smoothing $\left(TR_{ON}\right)$ to outperform the benchmark random walk model across the stated forecast horizons, with RSMFE values less than unity in more than half the considered exchange rates. The standpoint is similar with respect to the other defined Taylor rule fundaments, with outperformance observed in forecast horizons 4, 8 and 12 for TVP regression model conditioned on homogenous coefficients and interest rate smoothing (TR_{OS}); and in forecast horizons 1, 4 and 8 for the model based on fundamentals with heterogenous coefficients and no interest rate smoothing (TR_{EN}).

Table 2: Forecast Evaluation of Taylor Rules (Monthly Data)

Model	Statistics	TVP Regression				Fixed Effect Panel Regression			
		$h=1$	$h=4$	$h=8$	$h=12$	$h=1$	$h=4$	$h=8$	$h=12$
Full Sample									
TR_{ON}	No of U < 1	**4**	**5**	**5**	**3**	**4**	**5**	**5**	**4**
	No of DM > 1.282	0	1	1	0	**5**	**5**	**4**	0
	Median U	0.9929***	0.9499***	0.8751***	0.9985***	0.9942***	0.9547***	0.9219***	0.9354***
TR_{OS}	No of U < 1	2	**4**	**5**	**3**	1	**3**	**3**	**4**
	No of DM > 1.282	0	1	1	**3**	**3**	**3**	**4**	0
	Median U	1.0031	0.9872***	0.9292***	0.6255***	1.0058	0.9904***	0.9638***	0.9695***
TR_{EN}	No of U < 1	**4**	**4**	**4**	1	**4**	**5**	**5**	**4**
	No of DM > 1.282	0	1	2	0	**5**	**5**	**4**	0
	Median U	0.9979***	0.9544***	0.8450***	1.1217	0.9923***	0.9452***	0.8945***	0.9318***
Pre-GFC									
TR_{ON}	No of U < 1	**4**	**3**	**3**	**3**	2	1	1	2
	No of DM > 1.282	2	2	2	**3**	1	1	2	1
	Median U	0.9893***	0.9910***	0.9972***	0.9975***	0.9739	1.1279	1.2403	1.2661
TR_{OS}	No of U < 1	2	1	1	1	1	1	1	0
	No of DM > 1.282	0	0	0	1	1	1	0	0
	Median U	1.0741	1.1586	1.5444	2.0115	1.3073	1.6651	1.9797	2.2411
TR_{EN}	No of U < 1	1	2	2	**3**	2	0	0	1
	No of DM > 1.282	0	1	1	1	0	0	1	1
	Median U	1.0100	1.0376	1.0409	0.9984***	0.9846	1.1868	1.2333	1.1814
Post-GFC									
TR_{ON}	No of U < 1	1	**3**	**3**	**4**	1	**3**	**3**	**3**
	No of DM > 1.282	0	1	1	1	**3**	**3**	**3**	0
	Median U	1.0211	0.9727***	0.9446***	0.9320***	1.0082	0.9683***	0.9252***	1.0527
TR_{OS}	No of U < 1	0	1	1	1	0	0	0	0
	No of DM > 1.282	0	0	1	0	0	0	0	0
	Median U	1.0556	1.1609	1.1133	1.1088	1.1488	1.5152	1.9349	2.3646
TR_{EN}	No of U < 1	1	**3**	2	**3**	**3**	**3**	**4**	**4**
	No of DM > 1.282	0	1	1	1	**3**	**4**	**4**	0
	Median U	1.0074	0.9893***	1.0038	0.9692***	1.0003	0.9604***	0.8992***	1.0577

Notes: The benchmark model for both forecasting regressions is the driftless Random Walk (RW). For each regression, set of fundamentals, sample periods and forecast horizons h, the "No. of U's < 1" gives the number of cases of fundamental-based model outperformance over the RW, given that it indicates cases lower RMSFE of the former than the latter. U values less than one in at least half of the currencies in the forecast horizon then on average, the fundamental-based regression outperforms the benchmark in that window. The "No. of DM > 1.282" (number of DM statistics greater than 1.282) shows cases of rejections of the null hypothesis under the Diebold and Mariano (1995) test of equal forecast accuracy at 10% level of significance. The higher the No. of DM > 1.282, the better the average accuracy of the forecasts of the fundamental-based regression relative to the benchmark is. The "Median U" indicates the middle value of the U-statistic across the sample of *N* currencies for each forecast window and horizon. When "Median U" is less than or equal to one – marked with the symbol "***", and U's are less than one for at least half of the currencies in the window, this is also consistent with a better average forecasting performance of the fundamental-based regression relative to the benchmark.

The outperformance of the TVP regression condition on the Taylor rule, especially the fundamental with homogenous coefficients and no interest rate smoothing is consistent across the pre- and post-GFC sub-samples, with outperformance over the benchmark random walk model in all (higher) forecast horizons with respect to the former and the latter, respectively. While TR_{OS} does not seem to improve upon the benchmark random walk model in the pre-GFC and post-GFC subsamples, we find TR_{EN} to outperform the random walk model in pre-GFC ($h=12$) and post-GFC ($h=4$ and $h=12$) subsamples. The results from the fixed effect panel regression under the full sample pane are similar to those of the TVP regression model for corresponding Taylor rule fundamentals. However, the same is not the case for the pre-GFC and post-GFC, as we find no outperformance over the benchmark random walk in the former and only forecast horizons $h=4$ and $h=8$ in the post-GFC subsample. Overall, the Taylor rule fundamentals based on homogeneous coefficients and no interest rate smoothing performed best among the three Taylor rule fundamentals, regardless of the regression model considered. However, the results may be dependent on the sample period considered. Also, it appears that the among the cases of outperformance of the TVP and Fixed effect panel regression models over the benchmark random walk model, Fixed effect panel is statistically preferred over the TVP regression model. This is evidenced by the number of cases in which the estimated Diebold and Mariano statistics are greater than 1.282, which indicate statistical significance at 10% level.

3.2. Monetary Model, PPP and UIRP Results

Here, we consider three additional fundamentals as predictors in the TVP and Fixed Effect Panel regression models, under three (full, pre-GFC and post-GFC) sample periods and four out-of-sample forecast horizons and examine their forecast performance in contrast to the benchmark random walk model. In semblance to the case in the Taylor rule fundamentals, we present the estimated median U, number of U that are less than unity as well as number of DM statistics greater than 1.282. The results are presented in Table 3 in three panes corresponding to the full, pre-GFC and post-GFC samples. Under the full sample, the TVP and fixed effect panel regressions that incorporate PPP as a predictor is found to outperform the benchmark random walk model across all four out-of-sample forecast horizons, while the models incorporating UIRP are preferred over the benchmark random walk model at higher forecast horizons ($h=4$, 8 and 12). The stance of the monetary model is, however, dependent on the regression model being considered as outperformance of the benchmark random walk model is observed in all but one forecast horizon under the TVP regression and in just one-period ahead forecast under the fixed effect panel regression. Although the stances of outperformance by forecast horizons appear to be quite different when the pre-GFC and the post-GFC sample periods are considered, the fixed effect panel regression model with MM and PPP are outperform the random walk model in more cases and are statistically preferred under the pre-GFC and post-GFC sample periods, respectively. The models incorporating UIRP under both pre-GFC and post-GFC seem not to improve upon the benchmark random walk model across the four out-of-sample forecast horizons. While this is in direct contrast to the full sample period stance, it appears that the shortness of the number of data points used do not provide adequate information to outperform the benchmark model. Overall, a formal comparison of the TVP regression model with the fixed-effect panel regression model shows the latter to be statistically preferred over the former, given the number of cases in which the DM statistics is greater than the 10% critical value.

Table 3: Forecast Evaluation of the Monetary Model, PP and UIRP (Monthly Data)

Model	Statistics	TVP Regression				Fixed Effect Panel Regression			
		$h=1$	$h=4$	$h=8$	$h=12$	$h=1$	$h=4$	$h=8$	$h=12$
				Full Sample					
MM	No of U < 1	**3**	**3**	**3**	2	**3**	**3**	2	1
	No of DM > 1.282	0	2	2	1	**3**	2	1	0
	Median U	0.9982***	0.9903***	0.9701***	1.0125	0.9990***	1.0132	1.0695	1.2018
PPP	No of U < 1	**4**	**4**	**5**	**4**	**3**	**5**	**5**	**4**
	No of DM > 1.282	0	2	2	2	**5**	**5**	**4**	0
	Median U	0.9961***	0.9755***	0.9022***	0.9280***	0.9957***	0.9569***	0.9045***	0.8947***
UIRP	No of U < 1	1	**4**	**4**	**3**	1	**3**	**3**	**4**
	No of DM > 1.282	0	1	2	**3**	**3**	**3**	**4**	0
	Median U	1.0047	0.9877***	0.9291***	0.6337***	1.0058	0.9911***	0.9642***	0.9708***
				Pre-GFC					
MM	No of U < 1	**3**	2	1	2	**4**	**3**	1	1
	No of DM > 1.282	2	1	1	2	**3**	1	1	2
	Median U	0.9667***	1.0512	1.0597	1.3955	0.9469***	0.9815***	1.0747	1.2006
PPP	No of U < 1	**3**	2	**3**	2	**3**	2	2	2
	No of DM > 1.282	2	2	**3**	2	2	2	2	2
	Median U	0.9971***	1.0504	0.9490***	1.1489	0.9557***	1.1076	1.3479	1.4763
UIRP	No of U < 1	2	0	1	1	1	1	1	0
	No of DM > 1.282	0	0	0	1	1	1	0	0
	Median U	1.0746	1.1648	1.6312	2.2903	1.2991	1.6379	1.9454	2.2041
				Post-GFC					
MM	No of U < 1	**3**	1	0	0	2	**3**	**3**	**3**
	No of DM > 1.282	0	0	0	0	**3**	**3**	**3**	0
	Median U	0.9990***	1.0278	1.3202	1.2460	1.0047	0.9861***	0.9926***	1.1803
PPP	No of U < 1	2	**3**	2	1	1	**5**	**5**	**4**
	No of DM > 1.282	0	1	0	0	**5**	**5**	**4**	0
	Median U	1.0043	0.9869***	1.5910	1.8141	1.0067	0.9784***	0.9373***	1.0452
UIRP	No of U < 1	0	1	0	1	0	0	0	0
	No of DM > 1.282	0	0	0	0	0	0	0	0
	Median U	1.0499	1.1312	1.0965	1.3361	1.1524	1.5182	1.9201	2.3042

Notes: The benchmark model for both forecasting regressions is the driftless Random Walk (RW). For each regression, set of fundamentals, sample periods and forecast horizons h, the "No. of U's < 1" gives the number of cases of fundamental-based model outperformance over the RW, given that it indicates cases lower RMSFE of the former than the latter. U values less than one in at least half of the currencies in the forecast horizon then on average, the fundamental-based regression outperforms the benchmark in that window. The "No. of DM > 1.282" (number of DM statistics greater than 1.282) shows cases of rejections of the null hypothesis under the Diebold and Mariano (1995) test of equal forecast accuracy at 10% level of significance. The higher the No. of DM > 1.282, the better the average accuracy of the forecasts of the fundamental-based regression relative to the benchmark is. The "Median U" indicates the middle value of the U-statistic across the sample of *N* currencies for each forecast window and horizon. When "Median U" is less than or equal to one – marked with the symbol "***", and U's are less than one for at least half of the currencies in the window, this is also consistent with a better average forecasting performance of the fundamental-based regression relative to the benchmark.

3.3. Factor Models' Results

On the factor model, we present the results from three different constructs incorporating in different models: with one, two or three factors generated from principal component analysis. The out-of-sample forecasts of the TVP regression and fixed-effect panel regression models conditioned on one, two or three factors, over the benchmark random walk model, are examined. The results in Table 4 are presented by sample periods, forecast horizons and model constructs. Under the full sample and the pre-GFC sample periods, there appears to be no clear evidence of outperformance of the TVP and fixed-effect panel regression models conditioned on one or two or three factors over the benchmark random walk model. This being as a result of the inability for the models conditioned on the factor fundamentals to outperform the random walk model in at least half of the cases. This stance is observed across model constructs (F1, F2 and F3), forecast horizons ($h=1$, $h=4$, $h=8$ and $h=12$) and regression model type (TVP and fixed-effect panel regression models). We only observed median U to be less than unity in a few cases under the fixed-effect panel regression when full sample was used. However, in the post-GFC case, the TVP regression model with three factors outperformed the random walk model in the 4 and 8 periods ahead forecast horizons, while the fixed-effect panel regression model conditioned on one-factor (when $h=8$) and two-factor ($h=4$ and $h=8$) models were better than the random walk model. However, the statistical validation provided by the DM statistics gives preference to the fixed-effect panel regression model conditioned on two factors, with forecast horizons $h=4$ and $h=8$ as we find at least half the examined cases with DM statistics greater than the 1.282 critical value.

Overall, we present a more concise summary of the forecast evaluation results in Table 5, depicting the performances of the different models based on some fundamentals over the benchmark random walk model in the short- and long-run. We define the short-run period to be forecast horizons $h=1$ and $h=4$ while the long run period consists of $h=8$ and $h=12$. The stance of outperformance of TVP and fixed-effect panel regression models over the benchmark random walk model, under the defined summarized horizons is depicted by "Yes", and "No" if the reverse be the case. Regardless of the regression model that is employed, TR, PPP and UIRP, consistently outperform the benchmark random walk model across the forecast horizons, while the factor model failed to outperform the random walk model under any forecast horizon. This summary result is based on the full sample period.

Table 4: Forecast Evaluation of Factor Model (Monthly Data)

Model	Statistics	TVP Regression				Fixed Effect Panel Regression			
		$h=1$	$h=4$	$h=8$	$h=12$	$h=1$	$h=4$	$h=8$	$h=12$
Full Sample									
F1	No of U < 1	0	1	2	0	0	0	0	0
	No of DM > 1.282	0	1	1	0	0	0	0	0
	Median U	1.0127	1.0703	1.0562	1.4002	1.0133	1.1004	1.1775	1.2271
F2	No of U < 1	1	1	1	0	1	2	2	1
	No of DM > 1.282	0	1	1	0	2	2	1	0
	Median U	1.0098	1.0335	1.0653	1.3960	1.0153	0.9961	1.0229	1.3127
F3	No of U < 1	1	2	2	1	1	2	2	1
	No of DM > 1.282	1	1	2	0	2	2	1	0
	Median U	1.0061	1.0104	1.0388	1.0992	1.0074	0.9870	0.9927	1.2166
Pre-GFC									
F1	No of U < 1	0	1	1	2	0	0	1	1
	No of DM > 1.282	0	1	1	2	0	1	1	0
	Median U	1.0290	1.0291	1.0631	1.2631	1.1887	1.4330	1.5862	1.6173
F2	No of U < 1	0	1	1	1	1	0	0	0
	No of DM > 1.282	0	1	1	1	0	0	0	0
	Median U	1.0361	1.0359	1.0509	1.0860	1.1842	1.5454	1.8937	2.0152
F3	No of U < 1	2	1	1	1	1	0	0	0
	No of DM > 1.282	0	1	1	1	0	0	0	0
	Median U	1.0112	1.0804	1.0379	1.0559	1.2723	1.6951	2.1560	2.2706
Post-GFC									
F1	No of U < 1	1	2	0	1	2	2	3	1
	No of DM > 1.282	0	0	0	0	2	3	1	0
	Median U	1.0218	1.0485	1.1071	1.1537	1.0084	0.9988	0.9754***	1.1364
F2	No of U < 1	1	1	1	2	2	4	3	3
	No of DM > 1.282	0	1	1	1	4	3	3	0
	Median U	1.0098	1.0378	1.0468	1.2126	1.0003	0.9591***	0.9354***	1.0805
F3	No of U < 1	2	**3**	**3**	2	1	2	1	1
	No of DM > 1.282	0	0	1	0	2	1	1	0
	Median U	1.0135	0.9911***	0.9771***	1.0307	1.018	0.997	1.051	1.234

Notes: The benchmark model for both forecasting regressions is the driftless Random Walk (RW). For each regression, set of fundamentals, sample periods and forecast horizons h , the "No. of U's < 1" gives the number of cases of fundamental-based model outperformance over the RW, given that it indicates cases lower RMSFE of the former than the latter. U values less than one in at least half of the currencies in the forecast horizon then on average, the fundamental-based regression outperforms the benchmark in that window. The "No. of DM > 1.282" (number of DM statistics greater than 1.282) shows cases of rejections of the null hypothesis under the Diebold and Mariano (1995) test of equal forecast accuracy at 10% level of significance. The higher the No. of DM > 1.282, the better the average accuracy of the forecasts of the fundamental-based regression relative to the benchmark is. The "Median U" indicates the middle value of the U-statistic across the sample of *N* currencies for each forecast window and horizon. When "Median U" is less than or equal to one – marked with the symbol "***", and U's are less than one for at least half of the currencies in the window, this is also consistent with a better average forecasting performance of the fundamental-based regression relative to the benchmark.

Table 5: Overall Model's Ability to Outperform the Benchmark

Fundamentals	TVP Regression		Fixed-effect Panel Regression	
	Short-Run	**Long-Run**	**Short-Run**	**Long-Run**
TR	Yes	Yes	Yes	Yes
MM	Yes	Yes	Yes	No
PPP	Yes	Yes	Yes	Yes
UIRP	Yes	Yes	Yes	Yes
Factors	No	No	No	No

Notes: This Table summarizes the overall performance of the TVP regression and the Fixed-effect Panel regression conditioned on TR, MM, PPP, UIRP or factors (F). Refer to Table 2 for details about the form of the forecasting regressions and how fundamentals are computed or estimated. The benchmark model for all regressions is the driftless Random Walk (RW). The Table provides the answer to the question: "Does the regression conditioned on any of the fundamentals outperform the benchmark for at least half of the currencies in most forecast windows, at short or long-horizon forecasts?" The short-horizon comprises h=1 or h=4 quarters, while the long-horizon includes h=8 or h=12 quarters.

3.4 Additional Analysis

Here, we conduct additional analysis on the TVP regression and fixed-effect panel regression models using a quarterly frequency data, as a way to check the robustness of the estimated results to the choice of sample frequency. The stand points are very different from the case when the monthly frequency data were employed, as in the main analysis. The TVP regression model that incorporates a Taylor rule fundamental, homogenous coefficient and no interest rate smoothing TR_{ON} performed best among the contending fundamentals and across forecast horizons, while the fixed-effect panel regression model with PPP as predictor performed best at forecast horizons $h=1$, $h=4$ and $h=8$ (see results in Table 6).

Table 6: Results for the Nine Fundamental Models (Quarterly Data)

Model	Statistics	TVP Regression				Fixed Effect Panel Regression			
		$h=1$	$h=4$	$h=8$	$h=12$	$h=1$	$h=4$	$h=8$	$h=12$
		Taylor Rules							
TR_{ON}	No of U < 1	**4**	**4**	**4**	**3**	1	**3**	**3**	**3**
	No of DM > 1.282	3	3	3	1	**3**	**3**	**3**	0
	Median U	0.9864***	0.8916***	0.7753***	0.9118***	1.0324	1.0515	1.1073	1.2397
TR_{OS}	No of U < 1	**3**	**3**	**3**	2	**3**	**3**	**3**	0
	No of DM > 1.282	5	2	2	0	**3**	**3**	0	0
	Median U	0.9944***	1.0175	1.0633	1.3947	1.0201	1.0669	1.1141	1.2808
TR_{EN}	No of U < 1	**5**	2	2	0	1	2	**3**	**3**
	No of DM > 1.282	1	0	0	0	2	**3**	**3**	0
	Median U	0.9901***	0.8683	0.5950	1.0051	1.0446	1.0735	1.1113	1.2188
		MM, PPP and UIRP Models							
MM	No of U < 1	2	1	1	0	2	2	2	2
	No of DM > 1.282	2	2	2	1	2	2	2	0
	Median U	1.0016	1.0047	1.0107	1.0112	1.0534	1.1492	1.2806	1.4598
PPP	No of U < 1	1	1	1	0	**3**	**4**	**4**	**3**
	No of DM > 1.282	**3**	**4**	**4**	2	**4**	**4**	**3**	0
	Median U	0.9895	0.9076	0.8422	0.7667	0.9997***	0.9537***	0.9381***	1.0464
UIRP	No of U < 1	**4**	**4**	**4**	2	2	**3**	**3**	0
	No of DM > 1.282	0	2	**3**	0	**3**	**3**	0	0

	Median U	0.9931***	1.0162	1.0608	1.4686	1.0216	1.0649	1.1052	1.2943
Factor Models									
	No of U < 1	0	1	**3**	1	0	0	1	1
F1	No of DM > 1.282	0	0	**3**	1	0	1	1	0
	Median U	1.1104	1.0140	0.9996***	1.2192	1.1221	1.4179	1.5352	1.9692
	No of U < 1	0	0	**3**	1	0	0	0	0
F2	No of DM > 1.282	1	1	**3**	2	0	0	0	0
	Median U	1.0314	1.0005	1.0024	1.2130	1.0537	1.2495	1.5434	2.3225
	No of U < 1	1	1	**4**	2	1	1	1	0
F3	No of DM > 1.282	0	1	1	0	1	1	0	0
	Median U	1.0001	1.0006	1.1988	1.9763	1.0205	1.1578	1.2994	2.1586

Notes: The benchmark model for both forecasting regressions is the driftless Random Walk (RW). For each regression, set of fundamentals, sample periods and forecast horizons h , the "No. of U's < 1" gives the number of cases of fundamental-based model outperformance over the RW, given that it indicates cases lower RMSFE of the former than the latter. U values less than one in at least half of the currencies in the forecast horizon then on average, the fundamental-based regression outperforms the benchmark in that window. The "No. of DM > 1.282" (number of DM statistics greater than 1.282) shows cases of rejections of the null hypothesis under the Diebold and Mariano (1995) test of equal forecast accuracy at 10% level of significance. The higher the No. of DM > 1.282, the better the average accuracy of the forecasts of the fundamental-based regression relative to the benchmark is. The "Median U" indicates the middle value of the U-statistic across the sample of *N* currencies for each forecast window and horizon. When "Median U" is less than or equal to one – marked with the symbol "***", and U's are less than one for at least half of the currencies in the window, this is also consistent with a better average forecasting performance of the fundamental-based regression relative to the benchmark.

4. Conclusion

We assess the predictive capability of time varying parameter (TVP) and fixed-effects panel (constant parameter) regression models that incorporate three variants of the Taylor rules to predict the exchange rates of Brazil, Russia, India, China, and South Africa (BRICS). Consequently, we consider a total of nine fundamentals – Taylor rule with homogeneous coefficients and no interest rate smoothing $\left(TR_{ON}\right)$; Taylor rule with homogeneous coefficients and interest rate smoothing $\left(TR_{OS}\right)$; Taylor rule with heterogeneous coefficients and no interest rate smoothing $\left(TR_{EN}\right)$; monetary model (MM); purchasing power parity (PPP); uncovered interest rate parity (UIRP) and one, two and three factors (F1, F2 and F3) obtained from principal component analysis. The intuition here is to ascertain if the incorporated fundamentals with time-evolving dynamics in the macroeconomic variables yield better forecasts of BRICS countries' exchange rates, than the benchmark random walk model.

Our data spans January 1999 to March 2020, and comprises consumer price index, industrial production index, interest rate, broad money and exchange rates, on monthly and quarterly (for robustness) frequencies. We evaluate the out-of-sample forecast performances at $h=1$, 4, 8 & 12 using RMSFE and DM statistics, under full, pre-GFC and post-GFC sample periods. We find the TVP and fixed effect panel regression models conditioned on the Taylor rule fundamental with homogeneous coefficients and no interest rate smoothing predict exchange rate better than the random walk model in more than half of the BRICS countries. Considering $h=1$ & 4 and $h=8$ & 12 as short-run and long-run, respectively, we find that the TVP and fixed effect panel regression models that incorporate TR_{ON}, PPP or UIRP fundamentals consistently outperform the benchmark random walk model, regardless of the regression model considered, while the models incorporating PCA generated factors failed to outperform the random walk model.

Interestingly, while the incorporation of relevant fundamentals would improve upon the forecast of the random walk model, the constant parameter model may be preferred to the time-varying parameter model in the prediction of the exchange rates of BRICS countries. Our results are however sensitive to the data sample, frequency, and the choice of fundamental that is incorporated into the regression model.

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Appendix

Table A1: Country-specific TVP Results

Country	Fundamentals	Stat	Quarterly				Monthly (Full)				Monthly (Pre-GFC)				Monthly (Post-GFC)			
			h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12
Brazil	TRON	U	1.015	0.892	0.676	0.659	0.988	0.894	0.804	1.434	1.108	1.919	3.108	3.740	0.975	0.830	0.805	0.728
		DM	-0.296	2.136	2.866	1.185	0.520	1.466	1.508	-0.895	-2.756	-8.562	-10.764	-8.654	0.659	1.789	2.816	2.694
	TROS	U	0.993	1.020	1.118	1.707	0.999	0.935	0.693	0.379	1.223	1.944	3.322	4.678	1.057	0.963	0.821	1.109
		DM	0.189	-0.401	-0.865	-1.639	0.046	1.338	1.899	2.180	-4.049	-6.813	-7.405	-6.383	-1.688	0.265	1.365	-1.766
	TREN	U	0.963	0.787	0.382	1.165	0.977	0.848	0.694	1.217	1.191	1.935	2.859	3.823	0.963	0.696	0.683	0.788
		DM	0.698	2.757	1.939	-1.348	0.842	1.513	1.966	-0.541	-3.361	-4.125	-5.120	-9.570	0.807	1.466	2.232	2.722
	MM	U	1.070	0.959	0.677	0.533	0.991	0.953	0.876	0.696	1.115	2.192	4.011	2.834	0.999	0.983	8.742	7.265
		DM	-1.520	0.451	1.370	2.199	0.415	1.646	1.924	1.609	-1.793	-8.458	-5.306	-3.280	0.024	1.172	-19.097	-37.135
	PPP	U	0.990	0.841	0.623	0.328	0.988	0.911	0.727	0.928	1.103	1.955	3.000	1.259	0.997	0.943	1.591	2.325
		DM	0.457	2.277	2.640	2.211	0.601	1.527	1.277	1.756	-2.421	-7.692	-7.049	-9.781	0.086	1.584	-5.135	-13.434
	UIRP	U	0.993	1.017	1.099	1.509	1.000	0.933	0.712	0.605	1.220	1.928	3.177	4.982	1.036	0.949	1.042	1.336
		DM	0.186	-0.328	-0.780	-1.520	-0.007	1.349	1.936	1.639	-4.029	-6.478	-7.153	-6.131	-1.045	0.348	-1.520	-2.450
	F1	U	1.118	1.191	1.357	2.330	1.013	1.193	1.635	1.214	1.112	1.410	1.398	0.805	0.995	0.994	3.821	2.779
		DM	-1.307	-1.714	-5.779	-3.748	-1.412	-2.363	-4.251	-3.933	-3.060	-4.292	-4.733	2.033	0.149	0.859	-13.240	-12.780
	F2	U	1.078	1.128	0.852	1.490	1.010	1.193	1.318	1.396	1.166	1.467	1.748	2.037	0.996	0.989	0.908	0.798
		DM	-1.332	-1.161	2.141	-2.669	-0.899	-2.230	-3.174	-4.662	-3.184	-3.631	-5.747	-9.148	0.118	1.457	2.063	1.864
	F3	U	0.993	0.998	1.649	3.688	1.006	0.919	0.889	1.476	1.011	1.368	1.838	2.777	0.997	0.895	0.805	0.743
		DM	0.042	0.008	-1.701	-9.313	-0.109	1.012	1.916	-8.232	-0.390	-3.892	-4.370	-9.313	0.045	1.040	1.403	1.187
Russia	TRON	U	0.977	0.927	0.864	0.772	0.991	0.941	0.855	0.758	0.829	0.627	0.467	0.307	1.043	0.915	0.812	0.930
		DM	1.573	1.329	1.796	1.806	0.352	0.598	1.062	1.254	2.403	3.190	4.562	5.345	-0.464	0.418	0.696	0.171
	TROS	U	0.994	1.017	1.063	1.163	1.074	1.046	0.823	0.583	0.949	1.110	1.544	2.011	1.075	1.260	1.596	1.447
		DM	0.197	-0.351	-1.360	-2.717	-2.225	-0.701	1.070	2.154	0.780	-0.601	-1.700	-2.475	-1.954	-0.868	-1.294	-0.981
	TREN	U	0.990	0.965	0.944	0.923	0.996	0.900	1.261	1.979	0.926	0.783	0.816	0.959	1.045	0.989	1.545	1.094
		DM	0.485	0.934	1.214	1.113	0.114	0.983	-1.314	-5.774	0.955	1.984	1.981	1.607	-0.548	0.188	-2.894	-1.089
	MM	U	0.990	0.966	1.004	5.049	0.992	10.486	10.700	10.074	0.832	61.211	51.758	36.174	0.992	1.134	1.840	1.130
		DM	0.474	0.789	-0.044	-12.899	0.283	-16.972	-19.960	-17.423	2.167	-16.185	-15.987	-18.330	0.345	-1.625	-5.708	-2.502
	PPP	U	0.973	0.908	0.842	0.767	0.992	0.930	0.830	7.140	0.822	0.633	0.458	26.043	1.004	1.039	6.932	1.185
		DM	1.505	1.679	1.846	1.460	0.215	0.588	0.756	-10.183	2.306	3.606	5.199	-33.421	-0.103	-1.016	-4.489	-2.413
	UIRP	U	0.993	1.016	1.061	1.161	1.056	1.100	0.651	0.620	0.982	1.165	1.656	2.290	1.054	1.494	1.775	1.389
		DM	0.240	-0.326	-1.309	-2.765	-2.290	-2.006	1.511	2.596	0.300	-0.950	-2.543	-6.701	-1.826	-1.326	-1.755	-0.847
	F1	U	1.027	1.071	1.088	1.219	1.004	1.118	1.279	1.661	1.151	1.426	1.464	1.771	1.025	0.996	1.017	0.987
		DM	-1.087	-1.483	-3.025	-1.903	-0.207	-1.925	-2.535	-3.598	-4.292	-5.236	-7.293	-1.665	-0.339	0.034	-1.008	0.926
	F2	U	1.031	1.333	1.128	1.213	0.998	1.019	1.312	1.883	1.123	1.278	1.389	45.631	1.009	1.038	3.754	1.479
		DM	-1.502	-1.860	-2.031	-1.412	0.081	-1.291	-2.856	-3.829	-4.009	-4.390	-6.617	-96.919	-0.240	-1.780	-18.037	-3.257
	F3	U	1.016	1.195	1.536	1.976	1.011	1.292	1.282	2.023	0.973	1.018	1.038	1.121	1.013	0.985	0.975	1.031
		DM	-0.208	-1.276	-3.192	-2.201	-0.424	-1.484	-2.389	-6.102	1.021	-0.511	-0.542	-1.148	-0.208	0.088	0.097	-0.080
India	TRON	U	0.986	0.843	0.775	1.046	1.002	0.950	0.875	0.808	0.989	1.054	1.112	1.128	1.021	0.973	0.945	0.932
		DM	0.158	0.896	0.701	-0.190	-0.030	0.531	0.845	0.915	0.669	-1.723	-2.742	-3.401	-0.284	0.143	0.267	0.214

	TROS	U	0.986	0.894	0.846	1.508	1.005	0.978	0.929	1.110	1.074	1.159	1.263	1.320	1.051	1.285	1.113	1.019
		DM	0.148	0.540	0.451	-2.101	-0.135	0.301	0.697	-3.505	-1.715	-2.098	-3.209	-3.806	-0.753	-0.870	-0.511	-0.058
	TREN	U	0.957	0.823	0.552	0.822	0.998	0.954	0.845	0.849	1.017	1.038	1.142	1.182	1.006	0.834	0.786	0.873
		DM	0.413	1.103	1.885	1.042	0.049	0.574	1.011	0.793	-0.736	-0.903	-2.634	-4.044	-0.064	0.826	0.991	0.510
	MM	U	0.989	1.044	1.076	1.267	1.008	0.990	0.970	0.926	0.967	0.998	1.060	0.950	0.979	1.157	1.320	1.154
		DM	0.302	-1.123	-0.497	-0.973	-0.210	0.272	0.894	1.187	0.807	0.034	-2.152	1.446	0.860	-1.285	-2.667	-1.746
	PPP	U	0.966	0.875	0.680	0.490	1.010	0.976	0.918	0.925	1.012	1.108	1.149	1.149	0.997	0.966	0.913	0.914
		DM	0.608	1.050	1.750	3.020	-0.145	0.152	0.320	0.213	-0.564	-2.059	-2.669	-3.554	0.054	0.268	0.500	0.345
	UIRP	U	0.989	0.896	0.822	1.496	1.006	0.977	0.929	1.115	1.075	1.158	1.265	1.318	1.050	1.243	1.097	1.029
		DM	0.114	0.525	0.543	-1.992	-0.157	0.311	0.702	-3.796	-1.726	-2.093	-3.208	-3.806	-0.694	-0.778	-0.491	-0.104
	F1	U	1.136	0.999	0.629	1.287	1.026	1.018	1.000	1.400	1.029	1.029	1.041	1.281	1.013	1.060	1.107	1.061
		DM	-1.229	0.008	2.314	-0.687	-1.397	-2.903	0.006	-3.294	-1.677	-1.771	-2.930	-1.997	-0.466	-2.515	-1.628	-1.170
	F2	U	0.975	0.884	0.782	0.894	1.025	1.034	1.025	1.007	1.036	1.036	1.051	1.028	1.010	1.096	1.003	0.928
		DM	0.324	0.571	0.676	0.593	-1.739	-2.168	-2.172	-1.058	-1.716	-1.785	-2.904	-2.672	-0.370	-1.231	-0.121	0.437
	F3	U	1.066	0.920	0.823	2.078	1.005	1.010	1.055	0.998	1.081	1.080	1.023	1.004	0.998	0.991	0.977	0.927
		DM	-0.494	0.409	0.536	-5.319	-0.164	-0.550	-1.833	0.093	-1.990	-1.771	-0.823	-0.188	0.062	0.186	0.338	0.587
China	TRON	U	1.000	1.000	1.004	1.004	0.999	1.000	1.000	0.999	0.971	0.991	0.997	0.998	1.006	1.010	1.003	0.964
		DM	1.474	-1.648	-2.739	-5.992	0.704	0.291	0.508	1.210	3.460	4.369	7.966	24.665	-0.394	-0.545	-0.137	1.164
	TROS	U	1.000	1.001	1.009	1.007	0.999	0.999	0.997	1.238	1.000	1.000	1.000	0.999	1.025	1.039	1.011	0.973
		DM	0.722	-1.934	-2.480	-4.218	0.376	0.121	0.750	-1.798	0.473	0.025	0.090	8.574	-0.466	-0.789	-0.302	0.753
	TREN	U	1.000	1.001	1.006	1.005	1.000	1.000	0.999	1.001	1.001	0.999	0.999	0.998	1.007	1.012	1.004	0.969
		DM	0.689	-1.909	-2.569	-6.723	0.831	0.267	2.320	-0.291	-0.596	0.743	0.798	0.389	-0.415	-0.579	-0.203	1.118
	MM	U	1.002	1.005	1.011	1.011	1.001	1.321	1.724	1.691	0.844	0.835	0.422	0.444	1.011	1.028	1.075	1.246
		DM	-1.499	-1.664	-2.757	-6.655	-0.081	-1.302	-2.378	-3.468	3.542	4.264	4.338	8.384	-1.090	-2.439	-2.302	-1.632
	PPP	U	1.016	1.026	1.054	1.052	0.999	0.998	0.902	0.630	0.906	0.908	0.949	0.476	1.031	1.415	1.600	1.814
		DM	-1.727	-1.883	-2.939	-6.509	0.539	1.374	1.856	1.526	4.315	5.078	6.548	9.425	-2.060	-1.531	-2.968	-2.913
	UIRP	U	1.000	1.003	1.011	1.010	0.999	0.999	1.125	1.239	1.000	1.001	1.000	0.999	1.023	1.035	1.009	0.974
		DM	-2.078	-1.923	-2.452	-3.922	0.329	0.164	-2.724	-1.793	0.425	-1.132	0.352	4.025	-0.424	-0.719	-0.252	0.732
	F1	U	1.000	1.000	1.000	1.001	1.000	0.998	0.998	2.329	1.001	0.996	0.997	0.521	1.023	1.053	1.081	1.154
		DM	-1.838	-1.275	1.584	-2.827	-2.161	1.846	1.924	-1.551	-7.093	7.237	9.773	8.171	-0.673	-1.559	-1.714	-1.471
	F2	U	1.000	1.001	1.002	1.003	1.001	0.998	0.998	2.327	1.002	0.992	0.996	0.980	1.029	1.059	1.108	1.213
		DM	-1.308	-1.710	-2.704	-6.489	-1.983	1.857	1.918	-1.645	-7.305	7.728	10.079	11.659	-0.822	-1.653	-1.726	-1.566
	F3	U	1.000	1.001	1.005	1.005	0.997	0.999	0.999	1.007	0.998	0.993	0.994	0.986	1.031	1.062	1.120	1.236
		DM	-1.781	-1.875	-2.767	-5.582	1.505	2.017	3.228	-1.202	0.752	3.103	8.193	7.933	-0.905	-1.677	-1.676	-1.590
South Africa	TRON	U	0.946	0.794	0.663	0.912	0.993	0.954	0.918	1.007	0.995	0.919	0.831	0.614	1.032	1.031	1.079	1.913
		DM	1.489	1.756	1.618	0.253	0.296	0.875	0.722	-0.059	0.234	1.060	1.186	1.366	-0.947	-0.494	-0.471	-1.962
	TROS	U	1.029	1.113	1.211	1.395	1.003	0.987	0.956	0.625	1.077	1.249	1.602	2.488	1.056	1.161	1.200	1.743
		DM	-0.828	-1.393	-2.249	-1.232	-0.083	0.189	0.360	2.633	-0.790	-0.794	-1.407	-2.730	-1.317	-1.900	-1.404	-2.018
	TREN	U	1.014	0.868	0.595	1.468	1.007	1.005	0.843	1.122	1.010	1.064	1.041	0.890	1.032	1.140	1.014	1.680
		DM	-0.212	1.678	1.549	-1.126	-0.222	-0.067	1.218	-0.819	-0.675	-0.785	-0.224	0.395	-0.975	-1.745	-0.274	-1.702
	MM	U	1.148	1.302	1.483	0.653	0.998	0.986	0.962	1.013	1.015	1.051	1.036	1.395	1.013	1.003	1.160	6.905
		DM	-1.945	-1.765	-3.864	0.945	0.167	1.988	2.387	-0.235	-0.469	-0.324	-0.113	-0.855	-0.429	-0.073	-1.090	-14.871
	PPP	U	1.084	1.159	1.294	1.923	0.996	1.037	0.963	0.983	0.997	1.050	0.826	0.679	1.010	0.987	0.931	3.624
		DM	-1.430	-1.292	-1.728	-7.475	0.281	-0.505	2.667	0.211	0.103	-0.360	1.449	2.093	-0.344	0.224	0.703	-7.303

	UIRP	U	1.036	1.152	1.160	1.469	1.005	0.988	0.963	0.634	1.083	1.261	1.631	2.380	1.053	1.131	1.205	1.710
		DM	-0.994	-1.796	-1.271	-1.049	-0.125	0.184	0.364	2.475	-0.842	-0.832	-1.433	-2.388	-1.327	-2.449	-1.266	-1.916
	F1	U	1.110	1.014	0.705	0.390	1.026	1.070	1.056	1.204	1.008	1.029	1.063	1.263	1.022	1.048	1.930	2.218
		DM	-1.347	-0.199	1.916	1.726	-0.743	-1.097	-0.797	-0.636	-0.366	-2.790	-1.934	-0.907	-0.763	-2.274	-3.196	-2.938
	F2	U	1.073	0.963	1.004	1.965	1.023	1.073	1.065	1.051	1.011	1.026	1.047	1.086	1.020	1.033	1.047	2.181
		DM	-1.528	0.340	-0.013	-1.985	-0.827	-1.147	-0.842	-0.589	-0.405	-1.483	-2.303	-1.725	-0.815	-1.607	-0.457	-1.963
	F3	U	0.995	1.039	1.199	1.769	1.015	1.044	1.039	1.099	1.061	1.084	1.059	1.056	1.018	1.028	1.081	2.090
		DM	0.056	-0.171	-0.537	-1.355	-1.834	-1.406	-0.880	-0.358	-1.396	-1.531	-2.473	-1.543	-0.562	-0.451	-0.561	-1.848

Table A2: Country-specific Panel results

Country	Fundamentals	Stat	Quarterly				Monthly (Full)				Monthly (Pre-GFC)				Monthly (Post-GFC)			
			h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12	h=1	h=4	h=8	h=12
	TRON	U	1.026	1.050	1.098	1.317	1.009	1.025	0.976	0.952	1.039	1.405	1.672	1.768	0.985	0.847	0.717	0.612
		DM	-1.143	-1.305	-1.106	-2.107	-1.095	-1.400	1.390	2.321	-2.092	-5.526	-8.502	-11.553	0.332	1.475	2.304	2.483
	TROS	U	1.028	1.071	1.094	1.181	0.993	0.978	0.917	0.833	1.170	1.617	1.921	2.171	1.092	1.414	1.703	1.808
		DM	-1.574	-4.578	-1.709	-1.242	0.721	1.068	1.976	2.633	-3.835	-5.662	-6.028	-6.355	-2.401	-2.968	-3.469	-3.021
	TREN	U	1.023	1.037	1.085	1.305	0.998	0.967	0.911	0.802	1.057	1.383	1.523	1.594	0.998	0.954	0.817	0.848
		DM	-0.904	-1.016	-1.108	-2.108	0.388	2.079	3.160	2.949	-2.577	-3.948	-4.456	-9.846	0.034	0.546	1.247	1.084
	MM	U	1.069	1.104	1.188	1.501	0.994	0.985	1.005	1.029	0.992	1.023	1.084	1.153	0.991	0.922	0.859	0.783
		DM	-1.847	-1.930	-2.512	-8.094	0.582	1.882	-1.616	-2.703	0.362	-0.554	-4.104	-10.660	0.255	1.343	1.787	1.934
Brazil	PPP	U	1.048	0.974	0.971	1.251	1.023	1.088	1.036	0.888	1.006	1.450	2.140	2.619	0.999	0.971	0.934	0.877
		DM	-0.910	0.508	0.755	-1.375	-1.059	-3.192	-1.038	1.808	-0.243	-5.143	-13.776	-44.116	0.018	1.180	1.962	1.981
	UIRP	U	1.029	1.068	1.084	1.156	0.993	0.982	0.924	0.848	1.168	1.601	1.902	2.147	1.091	1.409	1.688	1.762
		DM	-1.559	-4.581	-1.703	-1.137	0.751	0.933	1.880	2.546	-3.832	-5.510	-5.808	-6.131	-2.397	-2.974	-3.389	-2.923
	F1	U	1.133	1.225	1.310	1.622	1.004	0.997	0.880	0.703	1.137	1.520	1.737	1.856	0.995	0.904	0.813	0.721
		DM	-2.610	-3.145	-3.090	-4.627	-0.162	0.051	1.476	2.424	-3.252	-4.678	-5.838	-8.642	0.104	1.114	1.623	1.654
	F2	U	1.021	1.140	1.210	1.465	1.042	1.147	1.163	0.915	1.142	1.627	2.026	2.237	0.995	0.888	0.765	0.639
		DM	-0.300	-1.227	-1.415	-2.367	-1.193	-1.591	-1.115	6.428	-3.652	-5.170	-5.071	-5.711	0.093	0.888	1.627	1.852
	F3	U	1.029	1.130	1.239	1.526	1.057	1.139	1.110	0.919	1.171	1.730	2.247	2.476	0.997	0.898	0.867	0.771
		DM	-0.637	-1.289	-1.263	-1.771	-1.042	-1.174	-0.715	2.017	-3.742	-5.365	-5.019	-4.348	0.057	1.113	1.192	1.138
	TRON	U	0.991	0.986	0.990	0.991	1.013	1.030	1.032	1.056	0.966	1.125	1.272	1.270	1.014	0.957	0.859	0.948
		DM	0.504	0.387	0.278	0.178	-2.611	-2.430	-2.015	-5.346	1.267	-2.342	-4.462	-5.058	-0.201	0.243	0.560	0.128
	TROS	U	0.990	0.990	0.998	1.024	1.026	1.016	1.007	0.984	1.622	2.318	3.035	3.459	1.056	1.362	1.714	1.994
		DM	0.443	0.210	0.030	-0.260	-1.091	-0.450	-0.172	0.325	-5.517	-7.072	-16.053	-65.814	-1.039	-2.674	-3.143	-2.947
	TREN	U	0.988	0.983	0.991	0.989	1.016	1.016	0.970	0.925	0.989	1.196	1.269	1.147	0.993	0.902	0.858	0.976
		DM	1.010	0.688	0.313	0.260	-1.486	-0.318	0.708	1.305	0.397	-2.037	-1.908	-1.932	0.123	0.641	0.735	0.080
	MM	U	0.991	0.962	0.895	0.851	0.991	0.956	0.924	0.908	0.844	0.984	1.310	1.637	1.002	0.949	0.890	0.969
		DM	1.010	0.968	1.653	1.260	0.422	1.189	1.628	1.596	2.004	0.154	-2.763	-5.627	-0.043	0.479	0.721	0.108
Russia	PPP	U	0.984	0.959	0.917	0.857	1.009	1.042	1.040	1.016	0.925	1.220	1.784	2.070	1.010	0.958	0.879	0.947
		DM	1.265	1.304	1.679	1.600	-0.849	-2.639	-2.883	-1.177	2.055	-2.469	-5.770	-9.022	-0.156	0.291	0.579	0.147
	UIRP	U	0.990	0.989	0.994	1.016	1.021	1.011	1.003	0.978	1.588	2.228	2.907	3.315	1.056	1.357	1.687	1.922
		DM	0.449	0.225	0.101	-0.166	-1.011	-0.350	-0.076	0.472	-5.588	-7.214	-17.907	-44.492	-1.045	-2.662	-3.064	-2.899
	F1	U	1.020	1.062	1.033	1.035	1.009	1.003	0.860	0.689	1.291	1.659	1.966	2.008	1.017	0.975	0.910	1.049
		DM	-2.829	-5.092	-3.448	-1.370	-0.668	-0.081	1.790	3.606	-5.337	-6.063	-10.896	-14.966	-0.248	0.159	0.405	-0.119
	F2	U	1.027	1.126	1.239	1.526	1.041	1.168	1.174	1.030	1.289	1.812	2.455	2.615	1.013	0.959	0.897	1.016
		DM	-0.655	-1.112	-2.034	-2.100	-0.992	-2.150	-1.558	-2.181	-6.387	-23.187	-8.973	-7.210	-0.172	0.210	0.398	-0.039
	F3	U	1.023	1.118	1.202	1.528	1.048	1.133	1.066	0.953	1.443	2.069	2.889	2.991	1.026	0.991	1.019	1.203
		DM	-0.756	-1.198	-2.428	-3.434	-0.895	-1.276	-0.496	1.007	-7.238	-11.571	-7.461	-5.211	-0.395	0.051	-0.086	-0.427
	TRON	U	1.058	0.991	0.864	0.765	1.006	1.004	1.018	1.063	1.002	1.115	1.283	1.384	1.019	1.000	0.977	0.994
		DM	-0.444	0.040	0.591	1.105	-0.824	-0.186	-0.814	-2.512	-0.143	-1.325	-2.153	-2.834	-0.255	0.003	0.101	0.017
India	TROS	U	0.995	0.965	0.960	1.318	1.019	1.063	1.079	1.098	1.139	1.350	1.610	1.854	1.178	1.729	2.330	2.773
		DM	0.076	0.250	0.123	-1.235	-0.881	-1.308	-1.691	-2.229	-2.018	-2.490	-4.074	-4.828	-1.539	-3.254	-3.873	-3.099
	TREN	U	1.082	1.009	0.786	0.624	1.006	1.015	0.943	0.874	1.031	1.204	1.265	1.245	0.985	0.909	0.899	0.876

		DM	-0.530	-0.039	0.971	2.282	-0.418	-0.351	1.633	1.941	-1.399	-2.664	-3.087	-3.133	0.269	1.464	1.454	1.074
	MM	U	1.208	1.701	2.259	2.989	0.987	1.047	1.193	1.412	0.966	0.978	1.023	1.072	0.978	0.934	0.937	0.985
		DM	-2.059	-3.439	-6.329	-9.908	0.740	-0.639	-1.908	-2.491	1.051	0.989	-1.524	-4.095	0.551	1.302	0.938	0.137
	PPP	U	0.967	0.864	0.756	0.953	1.014	1.044	1.044	1.047	0.994	1.029	1.078	1.072	1.012	0.975	0.918	0.910
		DM	0.350	0.641	0.795	0.219	-1.989	-3.836	-3.709	-3.022	0.596	-1.287	-2.653	-3.545	-0.169	0.180	0.418	0.290
	UIRP	U	1.003	0.976	0.999	1.510	1.017	1.050	1.068	1.088	1.139	1.345	1.603	1.842	1.188	1.745	2.326	2.720
		DM	-0.044	0.160	0.004	-1.797	-0.806	-1.107	-1.469	-1.951	-2.024	-2.472	-4.038	-4.843	-1.598	-3.304	-3.829	-3.024
	F1	U	1.148	1.426	1.210	2.153	0.971	0.864	0.714	0.579	1.125	1.309	1.476	1.521	1.017	1.016	0.999	1.066
		DM	-2.073	-2.410	-0.861	-1.427	0.866	1.361	2.417	2.921	-2.198	-2.569	-3.649	-4.388	-0.230	-0.149	0.007	-0.252
	F2	U	1.178	1.776	2.569	4.560	1.020	1.257	1.246	1.015	1.135	1.432	1.751	1.881	1.001	0.953	0.930	0.940
		DM	-1.050	-1.303	-2.054	-2.848	-0.393	-1.716	-1.370	-0.626	-1.986	-2.711	-3.709	-3.969	-0.008	0.242	0.348	0.192
	F3	U	1.031	1.466	1.853	4.048	1.053	1.285	1.196	0.981	1.181	1.555	1.979	2.120	1.032	1.025	1.127	1.195
		DM	-0.279	-0.978	-1.659	-3.300	-0.683	-1.410	-1.009	0.450	-2.102	-2.766	-3.751	-3.497	-0.477	-0.191	-0.791	-0.579
	TRON	U	1.083	1.252	1.622	2.168	0.918	1.445	1.194	0.956	0.860	1.010	1.060	0.982	1.006	1.025	1.034	1.019
		DM	-2.421	-2.308	-3.684	-6.885	0.743	-1.610	-1.397	0.482	3.349	-0.089	-0.452	0.095	-1.014	-2.607	-3.247	-0.461
	TROS	U	1.112	1.352	1.555	1.705	1.329	1.790	2.269	1.966	1.607	2.093	2.418	2.663	1.403	1.956	2.654	3.552
		DM	-1.295	-1.758	-3.071	-2.701	-1.638	-2.208	-1.854	-1.553	-5.596	-8.574	-17.263	-16.257	-2.205	-3.076	-3.546	-2.803
	TREN	U	1.126	1.369	1.758	2.253	0.970	1.932	2.162	1.762	0.843	1.118	1.070	0.917	1.001	1.004	0.887	0.864
		DM	-2.072	-2.054	-3.062	-8.098	0.213	-2.292	-1.936	-2.046	2.226	-1.065	-0.505	0.718	-0.049	-0.101	1.421	0.514
	MM	U	0.992	0.975	1.109	1.091	1.024	1.088	1.253	1.604	0.910	0.843	0.861	0.945	1.040	1.124	1.251	1.511
		DM	0.103	0.092	-0.323	-0.715	-0.891	-0.998	-1.502	-2.039	6.040	4.838	3.262	1.172	-1.065	-1.299	-1.547	-1.865
China	PPP	U	0.999	1.010	1.150	1.378	0.873	0.870	0.894	0.887	0.846	0.859	0.884	0.885	1.001	0.997	0.959	0.911
		DM	0.279	-0.443	-2.695	-3.832	1.533	1.426	1.135	0.969	3.380	5.043	8.946	8.642	-0.160	0.223	2.894	1.897
	UIRP	U	1.113	1.344	1.500	1.622	1.348	1.738	2.218	1.900	1.601	2.061	2.389	2.640	1.411	1.962	2.625	3.441
		DM	-1.305	-1.690	-2.625	-2.607	-1.651	-2.112	-1.845	-1.592	-5.583	-8.487	-17.378	-17.048	-2.247	-3.084	-3.397	-2.648
	F1	U	1.253	2.264	3.154	4.095	1.172	1.436	1.945	2.559	1.384	1.666	1.781	1.761	0.996	1.078	1.093	1.091
		DM	-1.968	-2.182	-2.580	-2.840	-2.112	-2.150	-2.333	-3.016	-6.806	-7.494	-11.701	-13.867	0.200	-0.856	-0.760	-0.649
	F2	U	1.041	1.047	1.257	1.740	1.200	1.491	1.826	1.638	1.355	1.850	2.180	2.262	0.977	0.984	1.013	0.989
		DM	-0.771	-0.252	-0.707	-3.560	-2.842	-3.278	-2.888	-2.367	-4.892	-9.572	-9.743	-9.807	0.894	0.270	-0.920	1.346
	F3	U	1.028	0.977	0.922	1.486	1.331	1.683	1.891	1.707	1.569	2.112	2.541	2.567	1.014	1.044	1.146	1.135
		DM	-0.894	0.171	0.320	-2.019	-4.163	-4.182	-3.756	-6.000	-5.650	-6.182	-7.728	-6.138	-0.415	-0.984	-1.078	-0.858
	TRON	U	1.003	0.979	0.964	0.959	1.003	0.995	1.002	0.998	1.003	0.983	0.914	0.926	1.017	1.013	1.039	1.691
		DM	-0.101	0.268	0.297	0.162	-0.249	0.312	-0.119	0.106	-0.362	0.467	1.369	1.510	-0.415	-0.148	-0.227	-1.745
	TROS	U	0.975	0.957	0.963	1.176	0.996	0.951	0.898	0.893	0.999	0.948	0.914	1.058	1.015	1.114	1.273	1.695
		DM	0.600	0.366	0.194	-0.498	0.417	2.001	1.693	1.636	0.027	0.340	0.340	-0.152	-0.441	-1.025	-1.292	-1.653
	TREN	U	1.004	0.969	0.936	0.923	1.002	0.905	0.862	0.854	1.003	1.033	1.039	1.004	1.024	1.034	1.035	1.724
		DM	-0.222	0.501	0.517	0.302	-0.118	2.786	2.883	2.361	-0.387	-1.218	-0.909	-0.133	-0.564	-0.389	-0.254	-1.982
South Africa	MM	U	1.006	1.004	0.953	0.866	1.000	0.990	0.973	1.055	1.023	1.079	1.096	1.197	1.012	1.002	1.026	1.654
		DM	-1.141	-0.316	4.292	2.553	-0.026	0.517	0.657	-0.903	-1.179	-1.323	-1.650	-1.624	-0.336	-0.023	-0.176	-1.631
	PPP	U	1.001	0.961	0.897	0.792	1.005	1.020	1.016	0.997	1.007	0.981	0.854	0.735	1.012	0.991	0.996	1.582
		DM	-0.048	1.977	3.927	2.616	-0.433	-0.860	-0.687	0.139	-1.238	0.609	1.343	1.800	-0.318	0.129	0.024	-1.559
	UIRP	U	0.973	0.948	0.950	1.167	0.995	0.958	0.906	0.901	1.000	0.954	0.926	1.076	1.016	1.117	1.274	1.677
		DM	0.642	0.432	0.259	-0.467	0.519	2.255	1.750	1.787	0.010	0.306	0.295	-0.198	-0.465	-1.032	-1.286	-1.684
	F1	U	1.057	1.113	0.969	0.941	0.995	0.988	0.924	0.880	1.006	1.010	0.972	0.941	1.018	1.021	1.061	1.755

	DM	-2.566	-2.244	0.435	0.314	0.211	0.208	0.947	0.905	-0.250	-0.114	0.204	0.342	-0.461	-0.300	-0.429	-1.692
F2	U	1.002	1.159	1.442	2.321	1.027	1.142	1.149	0.941	0.999	1.006	1.057	1.081	1.017	1.011	1.073	1.819
	DM	-0.022	-0.560	-1.343	-1.862	-0.679	-1.234	-0.989	1.380	0.035	-0.059	-0.315	-0.285	-0.359	-0.106	-0.394	-1.871
F3	U	0.991	1.098	1.281	2.206	1.042	1.154	1.126	0.962	0.998	1.010	1.124	1.198	1.019	1.026	1.098	1.867
	DM	0.132	-0.400	-1.288	-2.242	-0.866	-1.161	-0.805	1.154	0.060	-0.077	-0.545	-0.570	-0.529	-0.326	-0.772	-1.584