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ABSTRACT

Countries have increased significantly their public-sector borrowing since the Global Financial Crisis, potentially changing debt service costs sensitivity to tightening monetary policy. In this context, we test for greater fiscal dominance over 2000-2017 under Inflation Targeting (IT) and non-IT regimes. We find that evidence consistent with the presence of fiscal dominance varies across countries and debt configurations. Higher ratios of public debt-to-GDP may appear associated with lower policy interest rates in Advanced Economies. However, we find that the pattern of lower rates and higher debt in these countries is largely explained by a declining natural rate of interest. The most robust evidence of fiscal dominance lies among Emerging Markets under non-IT regimes, composed mostly of exchange rate targeters. For these countries, policy interest rates are non-linearly associated with public debt levels, depending on both the level of hard-currency public debt-to-GDP and the currency composition of public debt. Sorting countries into low, medium, and high nominal exchange rate volatility bins, we also find that Emerging Market economies with more flexible exchange rates and high commodity exposure exhibit a robust association between public debt levels and policy interest rates.

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1. Introduction and Overview

A notable outcome of the Global Financial Crisis (GFC) has been the search for yields by OECD investors, manifested by their growing demand for debt issued by Emerging Market Economies (EMEs). The QE policies adopted by the US and the Eurozone in the aftermath of the GFC induced a sharp decline of interest rates and risk premia, propagating 'yield chasing' by institutional investors, increasing thereby the demand for EMEs' hard and local currency sovereign debt. These developments mitigated the 'original sin' concerns identified by Eichengreen, Hausmann, and Panizza (2007) – the inability of most EMEs to borrow abroad in their currency.[1] The resultant rise of the external debt of EMEs led to an unprecedented increase in their debt/GDP, putting to the fore concerns about growing debt overhang and fragility, including the possibility of fiscal dominance. This possibility is the case when growing debt/GDP constrains the conduct of monetary policy, inducing the central bank to pay growing attention to reducing the costs of serving the public debt, and the country's external debt [Blanchard (2004)].[2] Our paper investigates fiscal dominance channels, with a particular focus on EMEs and Developing Countries before and after the GFC.

[1] The share of EMEs debt in local currency is estimated at 87.1 percent of total EMEs debt ($21.9 trillion) in 2017. The local currency debt outstanding has also increased from 40 percent of GDP in the early 2010s to almost 60 percent of GDP recently (IMF, 2018).

[2] The distinction between fiscal and monetary dominance regimes is due to Sargent and Wallace (1981). If the government adjusts the primary deficit to limit debt accumulation, the central bank is not forced to inflate away the debt, allowing the central bank to focus on inflation targeting, in line with monetary dominance. Long period of large fiscal deficits and high public debt-to-GDP ratios raises the concerns of growing fiscal dominance by heightening the links between fiscal policy, monetary policy and government debt management. This may be the case when higher policy interest rates or depreciating currencies raise concerns about debt sustainability, limiting monetary independence. Possible manifestations of these concerns include the 'fear of floating,' fiscal pressure to mitigate rises of policy interest rates, financial repression, and the like.

A clear example of fiscal dominance challenges is Inflation Targeting (IT) regimes in countries with large hard currency external debt/GDP, possibly Turkey in recent years, and a fair share of Latin American economies in past decades. Their policymakers are exposed to growing 'fear of floating' (Calvo & Reinhart, 2002). Specifically, real exchange rate depreciation increases the costs of serving their hard currency external debt by the debt/GDP times the depreciation rate (the cost measured as a fraction of the country's GDP). This condition, in turn, may induce the Central Bank to put a higher weight on stabilizing the real exchange rate. While the original inflation targeting and Taylor Rule ignored the real exchange rate as a policy goal in OECD countries, the research dealing with Emerging Market Economies put it to the fore (Aizenman, Hutchison, Noy (2011); Berganza, Carlos, Broto (2012); Ghosh, Ostry, Chamon (2016)). Indeed, exchange rate targeting (aka exchange rate stabilization) may be accomplished in a hybrid Inflation Targeting regime by putting higher policy weight on stabilizing the real exchange rate, possibly by proactive management of sizable buffers of international reserves (IR) and sovereign wealth funds (SWFs).[3]

The impact of growing local currency debt overhang on Inflation Targeting countries and managed flexible exchange rate regimes may be more intricate. One expects their policy interest rates to go up with increasing debt overhang, reflecting higher risk premia. The higher interest rate may also be associated with nominal depreciation and more significant inflationary pressure.

[3] Russia provides vivid examples of such a policy before and after the GFC, hoarding IR at times of improving terms of trade, mitigating thereby the real appreciation associated with higher oil prices. This policy was reversed during the collapse of oil prices; Russia sold third of the accumulated IR at times of deteriorating terms of trade, thereby mitigating the real depreciation induced by declining oil prices and lowering the cost of serving Russia's large hard currency external debt. Such a policy stabilizes the real exchange rate, reducing the odds of external debt crises in countries with large debt overhang and exposure to larger terms of trade shocks [see Edwards (1989), Aizenman, Edwards, Riera-Crichton (2012), Aizenman and Sun (2012), Frankel (2017), Aizenman and Jinjarak (2020)].

Countries with sizable IR may also opt to mitigate these effects by selling IR to lean against the currency depreciation.[4]

We conclude this section with a road map of the main results. In section 2, using de jure Inflation Targeting classification, we find evidence of fiscal dominance among Developed Market Economies (DMEs) under IT, where interest rates tend to be negatively associated with rising public debt levels. However, amid a battery of robustness tests, we find that this negative association is primarily driven by the secular decline in risk-free rates. Among EMEs under non-IT regimes, we find a negative interest rate effect accounted for by a higher foreign currency public debt/GDP ratio. Additionally, for EMEs under non-IT regimes, the composition of public debt matters, as larger proportions of debt denominated in foreign currency are associated with higher interest rates: a risk premium effect. These offsetting effects imply that the fiscal dominance effect among EMEs following non-IT regimes is non-linear and depends on both debt composition and the hard currency public debt-to-GDP ratio.

In Section 3, under a simple de facto classification binning groups of countries by their nominal exchange rate volatility into low, moderate and high exchange rate volatility groups, we find evidence of fiscal dominance among both DMEs and EMEs. Among DMEs, total public debt/GDP tends to suppress policy rates on average, and the effect size is more substantial for high NEER volatility countries, composed mostly of de facto inflation targeters. Among EMEs, the channel is more nuanced. Again, the fiscal dominance effect transmits through the foreign-denominated debt, and the impact on interest rates is non-linear as it also depends on the total level of public debt/GDP and the composition of public debt, which themselves are both a function of the level of foreign currency-denominated debt. A common feature of our results is the salient impact of larger hard currency external debt overhang on the policy interest rate, possibly mitigated by proper IR adjustment. Among EMEs, our de facto analysis highlights that interest rates of high NEER volatility countries (de facto Inflation Targeting) are more sensitive to the fiscal position of the country. This is at odds with the de jure analysis, though we show in

[4] Alternatively, policy makers may opt for greater financial repression, as a funding mechanism that increases the tax base associated with a given inflation, mitigating the possible interest rate and depreciation pressure associated with growing debt overhang.

the following section that this effect is completely driven by EMEs with significant commodity exposure, highlighting a key role of commodity fluctuations in fiscal dominance effects among EMEs. As exchange rates are determined by many factors, this exercise highlights the challenges brought with monetary regime classification. Ignoring the de facto analysis and solely referencing the de jure classification would assume that central banks explicitly adhere to what they express. As evidenced by 'Fear of Floating,' we know this is not always the case.

By stratifying EMEs further by commodity intensity in Section 4, we find that inflation plays a much larger role in interest rate policy for commodity-intensive countries compared to non-commodity EMEs. When we do not condition on the monetary regime, we find that commodity-intensive EMEs also consider fluctuations in the real exchange rate and international reserves when determining interest rates while non-commodity intensive EMEs do not. Under the de jure classification, the output gap plays a noticeably larger role in interest rate setting for commodity-intensive inflation targeters, but not for their non-commodity IT counterparts. We also find that under the de jure classification, evidence of fiscal dominance is present among non-commodity inflation targeting EMEs. De facto classification based on exchange rate volatility tells a different story. Output gaps are associated with higher interest rates among high NEER volatility non-commodity EMEs (de facto inflation targeters) but not among high NEER volatility commodity-intensive EMEs. Changes in the real exchange rate are negatively (positively) associated with interest rates in commodity (non-commodity) inflation targeting - or high NEER volatility - EMEs. Finally, fiscal variables are highly significant among commodity-based EMEs with high NEER volatility, but not among their non-commodity EME counterparts. Non-linear effects of hard currency debt accumulation are present, as fiscal dominance effects of lower interest rates offset risk premium effects of higher interest rates. We also observe that commodity intensity is positively associated with exchange rate volatility. This association makes it crucial to stratify the high volatility group of emerging market countries on commodity intensity. Even among EMEs with high exchange rate volatility, it is those who are commodity-intensive that show the most persuasive evidence of debt levels influencing policy interest rates.

Section 5 focuses on analysis and discussion regarding the non-linear association between public debt and policy rates in Emerging Markets. In Section 6, we provide a battery of robustness tests. We consider alternative ways to measure fiscal space, the simultaneity issue

between public debt and policy rates, periods where countries suffered from collapsing currency regimes, controlling for the secular decline in interest rates, and alternative regression specifications. Finally, the final section concludes, and Appendix B provides a case study specific to the Euro Zone.

2. Inflation Targeting and Fiscal Dominance

We collect quarterly frequency data on a variety of macroeconomic variables across both Developed and Emerging Market Economies. While this study pays particular attention to EMEs, investigating the effects of limited fiscal space in developed countries provides for an additional benchmark of comparison. The data among some (mostly DME) countries begin in the mid 90's, and our baseline analysis spans the period 2000 Q1 to 2017 Q4. Data among EMEs were sparsely populated until more recent decades and in large part the public debt and foreign-currency-denominated public debt statistics start in the early 2000s. De jure Inflation Targeting classifications are taken from the IMF. There are 23 IT de jure Targeters in our sample, of which 18 adopted the policy by 2002 (see Figure 1). While the United States began explicit Inflation Targeting in 2012, we rely on the fact that the monetary authority has implicitly targeted inflation since 1999.[5] In total, our data set is composed of 29 countries, 18 of which are classified as EMEs (according to IMF WEO classification). The key dependent variable of interest is the short-term nominal interest rate or policy rate, and covariates include inflation, real GDP gap, real effective exchange rate (REER) changes, changes in international reserves, public debt/GDP, foreign currency-denominated public debt/GDP and currency composition of public debt (foreign currency-denominated debt/total public debt). All changes and growth rates are quarterly. Note that a positive change in the NEER/REER corresponds to exchange rate *appreciation*. We've also collected data on government tax revenues, which we substitute for GDP in debt ratio construction as a robustness check. Additional details, including sources of the data, are provided in the appendix (Table A1).

[5] See Goodfriend (2003) and Rose (2007).

2.1 Preliminaries

Tables A2 and A3 describe and summarize the main variables across 4 strata: Developed Market Inflation Targeting and Non-IT, and Emerging Market Inflation Targeting and Non-IT. The IT statistics are constructed from country-quarter observations that fall within the IMF *de jure* classification, while Non-IT statistics consist of data from countries that either never pursued explicit inflation targeting or data preceding the beginning of Inflation Targeting for countries that currently do. In our data, there are 11 countries that adopted IT within the sample period (on or after 2000 Q1), including South Africa, Thailand, Mexico, Norway, South Korea, Hungary, Indonesia, Turkey, Japan, Russia and India; in our estimation we use both de jure and de facto measures to address such potential attrition bias in the analysis. Figures 2 and 3 provide density plots for the main variables.

Notice that there is an interesting heterogeneity between Emerging Market Inflation Targeters and Non-Inflation Targeters. As shown in Figure 3 and corresponding t-tests (Table A3), inflation and interest rates tend to be lower and less volatile in IT EMEs compared to Non-IT EMEs. The output gap is about three times more volatile in Non-IT EMEs. International reserves growth mean and variation are larger under Non-IT regimes. Both total public debt/GDP ratios and foreign currency-denominated public debt/GDP ratios tend to be lower under IT regimes. Similarly, the raw distributions across DME Inflation Targeters versus Non-Inflation Targeters (Figure 2) show that interest rates and inflation rates tend to be higher in IT regimes. International reserves are accumulated at a faster rate, and total public debt/GDP ratios are larger under Non-IT regimes among DMEs.

We conduct two separate panel unit root tests (Table A4) across each variable to assess the time-series properties of our series and determine the appropriate estimation strategy. We incorporate the test described in Levin, Lin, and Chu (2002) along with Im, Pesaran, and Shin (2003) as each test offers different alternative hypotheses. Both tests reject the unit root hypothesis for all variables except for the public debt/GDP ratio, which is rejected by the LLC test at the 10% level while IPS fails to reject the null.

2.2 Baseline Results

To establish our baseline results, we follow Aizenman et al. (2011) in which the authors estimate augmented Taylor Rule regressions to investigate whether fluctuations in exchange rates or international reserves factor into a country's monetary policy rule.[6] The literature on Taylor Rules is extensive, originating from Taylor (1993). Consistent with the literature, we assume that the monetary authority follows a policy reaction function in the form:

$$i_t = \rho i_{t-1} + \alpha(y_t - y_t^*) + \beta(\pi_t - \pi_t^*) + \gamma X_t.$$

The monetary authority sets the nominal (short-term) interest rate based on the output gap and the inflation deviation from the target inflation rate. Additionally, we introduce policy inertia in the form of a lagged interest rate variable, which incorporates the assumption that the policymaker smooths the interest rate over time (see English and Sack (2002)). Finally, X_t includes additional variables that may potentially enter the interest rate rule. For example, in Aizenman et al. (2011), these variables included the real exchange rate and international reserves. We include these international target variables and further augment the regressions with debt-related measures mentioned previously to test for evidence of fiscal dominance (public debt/GDP, foreign currency-denominated public debt/GDP, and currency composition of public debt). Note that the above specification is a single time-series. Our panel consists of advanced and developing economies, under both IT and Non-IT regimes. Therefore, we properly modify the specification above:

$$i_{i,t} = \mu_i + \rho i_{i,t-1} + \alpha\left(y_{i,t} - y_{i,t}^*\right) + \beta\pi_{i,t} + \gamma X_{i,t} + \epsilon_{i,t},$$

[6] They find that IT emerging markets follow a "mixed strategy" whereby both inflation and real exchange rates are important determinants of policy interest rates. However, the response of IT emerging markets to real exchange rates is more constrained than in non-IT regimes. The response to real exchange rates is strongest in those countries following IT policies that are relatively intensive in exporting basic commodities.

where the inflation target $\pi^*_{i,t}$ is assumed to be time-invariant and therefore absorbed by the country-specific fixed effect μ_i. As such, our (baseline) sample is subject to sample attrition corresponding to the de jure adoption of inflation targets $\pi^*_{i,t}$ shown in Figure 1. We subsequently conduct further tests using the de facto grouping of country bins according to exchange rate volatility. We estimate the following model via fixed-effects least squares (LSDV),[7] and estimate the model on four subgroups of the data to allow for flexibility across all coefficients: EME IT, EME Non-IT, DME IT and DME Non-IT. The results are displayed in a format comparing EME IT versus EME Non-IT, and DME IT to DME Non-IT, though interesting comparisons can be made between inflation targeting in Emerging Markets and inflation targeting Developed Countries as well.

Foreign currency denominated debt is a key risk factor and feature among EMEs. Hence in the case of EMEs, we sharpen our analysis by including external variables for not just total public debt but also foreign currency denominated public debt (reported in Table A7). Moreover, we control for debt composition measured as the percent of hard currency public debt to total public debt. Including public debt/GDP, foreign currency denominated public debt/GDP, and debt composition variables in the same regression then help identify whether the effect of hard currency debt on interest rates is non-linear; statistically, debt composition can be viewed as an interaction term between the public debt and foreign currency public debt variables.

Tables A5 and A6 present the baseline results under inflation targeting and non-inflation targeting for EMEs and DMEs, respectively. Regarding fiscal rules, these regressions examine the impact of total public debt on interest rates. Columns 1 and 5 present the benchmark model without the inclusion of any external variables. Columns 2 and 6 introduce changes in the REER

[7] The specification taking the form of a dynamic panel model is well known to suffer from Nickell (1981) bias when the time dimension is small. However, our quarterly sample provides T ranging from mid-50 to mid-70 depending on the subsample and country. Judson and Owen (1999) show through Monte-Carlo studies that the LSDV estimator performs well in comparison with GMM and other estimators when T=30.

and international reserves as external variables, while columns 3 and 7 additionally include both the ratio of Public Debt-to-GDP. To control for the effect of debt/GDP driven by output growth, columns 4 and 8 include nominal GDP growth as a control. The high explanatory power of these regressions can be accounted for by country-specific fixed effects and the inclusion of the lagged policy, as the interest rate series display significant persistence. The contribution of either feature varies by specification and subgroup, but the country fixed effects or lagged policy rate can separately account for anywhere between 20% to 50% of the variation, depending on the specification.

Potential Biases due to Collinearity

The EME specification has raised concerns in the discussion which we believe is worth a brief clarification. By including FX public debt/GDP, total public debt/GDP, and FX public debt/public debt, one may be concerned with collinearity issues. Consider what these variables look like in the regression:

$$i_{it} = \cdots + \gamma_a \left(\frac{FXD_{it}}{GDP_{it}}\right) + \gamma_b \left(\frac{TPD_{it}}{GDP_{it}}\right) + \gamma_c \left(\frac{FXD_{it}}{TPD_{it}}\right),$$

Where the first, second and third term refers to the key variables of interest, respectively. Notice that the product of the second and third term equal to the first term:

$$i_{it} = \cdots + \gamma_a \left(\frac{TPD_{it}}{GDP_{it}} \times \frac{FXD}{TPD_{it}}\right) + \gamma_b \left(\frac{TPD_{it}}{GDP_{it}}\right) + \gamma_c \left(\frac{FXD_{it}}{TPD_{it}}\right).$$

Thus, the third regressor could be described as an interaction of the other two regressors. Here, the term (1) = term (2) x term (3), equivalent to the general multiple regression model with interaction:

$$Y_{it} = B_1 X_{it} + B_2 Z_{it} + B_3 X_{it} Z_{it} + e_{it}.$$

All interaction terms are multiplicatively dependent but not linearly dependent. Hence there is no issue of induced collinearity here; rather, we are simply estimating a regression model with an interaction term.

Limitations of the Taylor Rule Specification

Before moving on to the baseline results, it is crucial to discuss the limitations and potential drawbacks of our econometric design. While we attempt to control for key determinants of interest rate policy, bear in mind that our reported estimates should be considered associations. Given the data limitations we face, our tests are not designed to identify a causal effect of public debt on policy rates[8]. Therefore, we wish to stress that the evidence we present maybe, at best, *consistent with the presence of Fiscal Dominance*, and this is as far as our claims may go. We are careful not to argue any causal claims. Three major issues we face which may cause our estimates to be biased, are 1) simultaneity, 2) omitted variables and 3) model misspecification. We do our best to reduce these risks but view it as crucial to acknowledge these limitations of our study.

Regarding simultaneity, there are several channels which enable debt levels to contemporaneously influence policy interest rates, but also for policy interest rates to contemporaneously influence debt levels. Low policy rates imply relatively cheap debt which might fuel debt issuance by countries. Some may argue that this is not a severe issue in our specific case under the assumption that policy rates are 'fast moving' while public debt is 'slow moving' (Bernanke and Mihoff (1998)). Regardless, one can overcome this issue to some degree by introducing public debt with a lag, which we do as a robustness check. Another concern is the potential endogeneity between the real exchange rate and policy rates. Again, causality can run both ways. Similarly, we attempt to mitigate this issue by omitting country-quarter periods of currency collapses and crises as an additional robustness check. While this is not a guaranteed way to cleanse the endogeneity issues between the exchange rate and policy rate, we continue to keep the exchange rate as an independent variable as we know there have been several cases throughout history where the monetary authority responds to exchange rate fluctuations with interest rate changes.

[8] More data and a longer sampling period would be useful to sharpen identification. Debt maturity profile, the extent, and effectiveness of capital controls, more detailed data on local currency public and private debt would allow sharper identification of the forces at work.

Regarding omitted variables, unobserved shocks may drive trends in the policy rate and public debt jointly. A simple example: Aggregate supply/demand shocks may jointly influence the price and quantity of public debt. Our panel specification is advantageous in this respect as country-specific fixed effects allow us to control for unobserved time-invariant, cross-country variation in policy rates. However, unobserved shocks that are common across countries but vary over time may also jointly drive policy rates and debt dynamics. To account for such unobserved common trends, we control for various measures of the natural rate of interest as an additional robustness check.

Finally, our regression model may mis-specified. While this is a relevant concern for virtually every empirical study, testing for Fiscal Dominance specifically may be possible under a variety of empirical designs. We choose a simple linear Taylor Rule specification due to its parsimony. Our baseline specification tests for a direct association between public debt and the policy rate. However, it may be that the effects of Fiscal Dominance operate indirectly by affecting the way central banks respond to domestic objectives under limited fiscal space. As a robustness check, we estimate alternative specifications that allow domestic objective coefficients (inflation, output gap, real exchange rate, international reserves) to vary as a function of the level of public debt. We also consider both de jure and de facto classifications of Inflation Targeting.

2.3 Developed Market Economies

Among DMEs, the coefficient on inflation (ranging from 0.148 to 0.217) is highly significant under Inflation Targeting and contrasts starkly with the broadly insignificant effect of inflation in the policy rule under the Non-IT regime. The short-run response of the interest rate to a 1 percentage change in quarterly inflation (which would increase the annual inflation rate by 0.25 percentage points) is estimated to be a rise in the policy rate of about 0.20 percentage points – nearly a 1-to-1 response. Given the persistence in policy rates dynamics, the cumulative response in the policy rate over 4 quarters (t through $t+3$) after a 1% rise (0.25% increase in annual inflation) in period t inflation is estimated to be 61 basis points (based on the short-run coefficient of 0.181), indicating a considerably aggressive monetary policy over the following year. Under the Non-IT regime, similar policy responses to inflation are absent. We find that under Inflation Targeting, the output gap is significantly associated with interest rates, but this is

generally not the case for DME's under Non-IT regimes. Under IT, the coefficient on the output gap is roughly half of that on inflation.

External variables also show significant contrasts in importance under IT and Non-IT regimes. For DMEs, interest rates are positively associated with REER appreciation under the IT regime, while the coefficient on REER changes is negative and mostly insignificant under Non-IT regimes. Under IT, over one year, a 1 percent appreciation in the REER is associated with interest rates, which are 17 basis points higher before controlling for GDP growth. Conditional on output growth, the same 1 percent appreciation in the REER is associated with a 5 basis point rise in interest rates over one year. Once the control for GDP growth is included, the coefficient on REER changes drops considerably (from 0.05 to 0.015), suggesting that underlying economic growth is jointly influencing the co-movement of monetary policy and exchange rates in DMEs undertaking IT. Alternatively, this effect is consistent with Uncovered Interest Rate Parity, as higher interest rates (or the anticipation of) appreciate the nominal exchange rate today hence lowering the expected return going forward.[9] Among non-IT DMEs, the evidence points slightly to Fear of Floating, with REER depreciation associated with higher interest rates (a coefficient of -0.022). DMEs consider international reserves when setting interest rates under both IT and non-IT regimes. Among non-IT DMEs, reducing international reserves is associated with higher interest rates (with estimates ranging from -0.010 to -0.008): A 10 percent reduction (accumulation) of international reserves is associated with a cumulative 1-year increase (decrease) in the policy rate of about 30 basis points. This response is consistent with the Fear of Floating, where the policy rate and international reserves serve as tools for exchange rate stabilization. In contrast, column 6 shows that DMEs under IT regimes respond about half as aggressively as the non-IT group in terms of easing (tightening) monetary policy in response to international reserve inflows (outflows).

[9]Alternatively, REER appreciation can also be driven by an increase in the country's price index and therefore, a positive policy response could also be linked to REER appreciation as a response to inflation. The facts 1) that short-term REER volatility is dominated by the nominal component and 2) our specification already controls for inflation, suggest that the former explanation is more consistent than the latter.

Column 3 documents evidence of fiscal dominance in developed countries under IT regimes in the form of negative effects of public debt on interest rates – this is generally *not* the case among non-IT DMEs. The effect remains significant after controlling for GDP growth (column 4); hence the variation in the debt/GDP ratio that is influencing monetary policy is not driven by the denominator. The ratio of public debt/GDP is statistically significant at the 5% level under IT (coefficient estimate of -0.009) and these effects are economically significant: Over a 4-quarter period, an increase in public debt/GDP ratio of 6% (1-standard deviation of debt/GDP growth) is associated with a cumulative cut in interest rates of (-18 basis points). Note that this is the effect of a one-period transitory fiscal shock. A permanent 6% rise in the debt/GDP ratio would further impact monetary policy, with interest rates expected to be 46 basis points lower after 4 quarters. The sensitivity to fiscal space under IT suggests debt matters for monetary policy: The commitment to target inflation appears to loosen with rising debt levels.

2.4 Emerging Market Economies

Table A6 reports analogous results for EMEs under IT and Non-IT regimes, focusing on total public debt. Total public debt does not appear informative in the case of EMEs, whether under an IT or non-IT regime. Table A7 deepens the analysis and investigates the effects of foreign currency-denominated public debt. The latter is of particular focus as hard-currency borrowing through international capital markets is a distinctive feature of EMEs. Moreover, borrowing in foreign currency adds layers of additional risk to the balance sheet associated with exchange rate and interest rate fluctuations. Columns 1 and 7 introduce baseline Taylor Rule variables, with columns 2 and 8 introducing changes in REER and international reserves for IT and non-IT EMEs, respectively. Columns 3 and 9 introduce foreign currency-denominated public debt/GDP, with columns 4 and 10 controlling for total public debt/GDP, columns 5 and 11 controlling for debt currency composition (foreign-denominated public debt/total public debt), and finally columns 6 and 12 additionally controlling for nominal GDP growth.

In Table A7, interest rate policy in EMEs under IT is significantly smoother than under Non-IT regimes, with coefficient estimates (about 0.86) being well aligned with their DME IT counterparts compared to Non-IT EMEs (coefficients ranging from 0.407-0.471). Unlike DMEs,

both IT and Non-IT regimes see significant importance put on inflation rates for interest rate setting. Coefficient estimates are stable and range between 0.45 and 0.50 under IT, while coefficients range between 0.70 to 1.13 under Non-IT regimes specifications. These estimates suggest that short-run responses to a 1% increase in quarterly inflation (0.25% increase in annual inflation) are particularly aggressive in EMEs relative to their DME counterparts, as the implied policy response is greater than 1-for-1. The 4-quarter cumulative response to a 1% rise in quarterly inflation translates to nominal interest rates approximately 1.5 and 1.36 percentage points higher under IT and Non-IT, respectively (short-run response to a 1% rise in inflation are +46 and +77 basis points, respectively). The aggressive response to combat inflationary pressures in EMEs could result from several explanations. In EMEs where the expected inflation is not well-anchored, risks of accelerated inflation, leading to out-of-control inflationary processes, and capital flight warrant the aggressive interest rate responses to inflation observed among EMEs compared to their DME counterparts. In the presence of significant foreign currency balance sheet exposure, aggressive interest rate responses can additionally stabilize financial conditions via valuation effects and this, in turn, can help reduce the risk of a vicious cycle turning into a financial crisis.

Under the Non-IT regime, the introduction of the exchange rate and international reserves variables cut the coefficient on inflation in nearly half (from column 7 to 8), implying a significant degree of exchange rate targeting in non-IT EMEs, which is generally *not* the case under IT regimes. A real exchange rate depreciation of 1% is associated with an immediate rise in the interest rate of 0.43 percentage points after controlling for GDP growth, with a 1-year cumulative response of +76 basis points, offsetting three-quarters of the exchange rate depreciation within 4 quarters. International reserves also play a significant role in policy rate setting among Non-IT EMEs but *not* among EMEs under the IT regime. Interestingly, IR accumulation plays a significant role among DMEs under Non-IT regimes as well (a negative effect on interest rates), but the sign of the coefficient is switched: For EMEs under Non-IT regimes, changes in international reserves are positively associated with higher interest rates. It is important to note that the significance of IR is contingent on whether REER changes enter the regression or not: When removing REER from the regression, the effect of IR becomes

statistically insignificant. Hence, the interaction of managing international reserves and exchange rate stability must be taken jointly in the determination of policy rates under non-IT regimes.

Foreign currency-denominated public debt bears negative effects across all regressions, yielding significant estimates under non-IT regimes once total debt and composition are controlled for (column 12, a coefficient estimate of -0.367). Among non-IT EMEs, controlling for debt composition also has a significant and positive effect (coefficient of 0.213), implying that the larger the proportion of public debt that is denominated in foreign currency, the higher the interest rate, all else fixed. A one percentage point increase in the proportion of public debt that is foreign currency-denominated is associated with a +21 basis point rise in the interest rate in the same period and +37 basis points over 4 quarters. This finding can be interpreted as a possible risk premium effect, as exchange rate exposure has first-order effects on the credit risk of the institution; hence international lenders require additional compensation to bear such risks. Countries most susceptible to rises in debt composition are those who do not hold a large amount of hard currency debt initially. The hypothetical country which already holds all debt in hard currency is not expected to be hit with this risk premium effect in the interest rate (since the proportion cannot exceed 100% of total public debt). Once we control for this debt composition effect, we see significant negative effects on non-IT EME interest rates associated with the total hard currency debt held (in relation to GDP). Possible evidence of fiscal dominance is found among non-IT EMEs, with a one percentage point increase in hard currency public debt associated with interest rates which are 37 basis points lower the same period, and 63 basis points lower after 4 quarters. Non-IT EMEs have significant coefficients on both foreign currency public debt/GDP and the debt composition variables, hence through such interactions, the overall impact on interest rates from hard currency debt is non-linear. While coefficient signs are consistent among EMEs under de jure inflation targeting, we do not find statistical significance.

To summarize, extending the baseline Taylor Rule model is important in characterizing the monetary reaction function, as observed by significant associations between variation in a variety of external variables and interest rates among inflation targeters and non-IT countries alike. Using de jure inflation targeting classification, we find evidence consistent with fiscal dominance among DMEs under IT, where interest rates tend to be negatively associated with

rising public debt levels. In the case of EMEs under non-IT regimes, we also find that the composition of public debt matters, as larger proportions of debt denominated in foreign currency, are associated with higher interest rates: a risk premium effect. The interest rate effect evidenced among EMEs following non-IT regimes is non-linear and depends on both debt composition and total hard currency debt/GDP ratio. In the following section, we investigate whether a different classification method of IT versus non-IT regimes paints a different picture. Thus far, we have relied on the IMF's explicit de jure classification. In practice, however, countries may target inflation, or operate hybrid monetary regimes without explicitly stating so. The following section takes a de facto approach, ranking countries in terms of their Fear of Floating manifested by their nominal exchange rate stability patterns. Classifying groups by exchange rate stability provides an alternative approach for identifying groups of countries for which debt overhang may interact with monetary policy.

Moreover, we want to emphasize that the fiscal dominance and risk premium effects are possible interpretations of the above results (and subsequent results), and more data and a longer sampling period would be required to test these interpretations fully. For example, additional data on debt maturity profile, sovereign spreads, and the extent of capital controls would be necessary. Countries committed not to default will hold larger reserves and work harder to have longer debt maturity. Also, data on local currency public and private debt would be necessary to control for the effects of financial repression.[10]

3. IT, Exchange Rate Stability, and Fiscal Dominance

In the previous section, we employ a de jure method of monetary regime classification and uncovered mixed evidence of fiscal dominance across the sample. However, many countries implicitly follow an inflation targeting rule without a public announcement. By taking a de facto

[10] The interdependence of active research management, foreign currency debt, and fiscal capacity could also give rise to multiple equilibria in the financial stability; see Bocola and Lorenzoni (2018). Therefore, while we keep these interpretations for consistency, it is important to keep an open mind to other possible explanations.

approach to monetary regime classification, we aim to circumvent this issue and provide an additional set of results to complement those from the previous section.

Our de facto approach involves classifying countries by the volatility of their nominal effective exchange rate (NEER). Figure 4 shows sorted quarterly NEER return volatility by country. The idea is that countries with low exchange rate volatility are more likely to follow a de facto exchange rate targeting rule. Analogously, countries with high exchange rate volatility are de facto currency floaters, which suggests that such countries target an alternative nominal anchor – the interest rate to control inflation. Alternatively, and particularly for EMEs, countries with volatile exchange rates are subject to greater variance in valuation effects when holding foreign currency liabilities. Therefore, in these countries, monetary policy may be subject to greater fiscal pressures in an effort to stabilize the balance sheet.

It goes without saying that exchange rate volatility is determined by many things aside from monetary regime, hence a clean de facto proxy for IT is difficult to identify. For example, exchange rate volatility among EMEs is largely impacted by global commodity price fluctuations (something we condition on in Section 4). Chief among unobserved factors are the actual foreign exchange intervention (FXI) and the perceived credibility of the central banks. Several papers highlight the impact of FXI on exchange rate volatility (See Boris and Shin (2019), Adler, Lisack, and Mano (2019), and Fratzcher et al. (2019)). Adler, Lama, and Medina (2019) show in a small open economy model that where the central bank is perfectly credible, FXI can improve macroeconomic outcomes by successfully stabilizing both output and inflation in response to foreign disturbances, but without credibility, the FXI policies entail a trade-off by reducing output volatility at the expense of inducing higher inflation volatility. Davis, Fujiwara, and Wang (2018) provide reduced-form empirical results showing that as central banks become less credible, they are more likely to adopt a pegged exchange rate, and the tendency to peg depends on trade openness, while in a model with "loose commitment," as credibility falls, either an inflation target or a pegged exchange rate is more likely to be adopted. Further research should benefit from several case studies with detailed FXI data and institutional analysis of central bank credibility.

We first separate the sample into developed and emerging market countries. The second step is to then sort within each group, countries into three quantiles based on their nominal

exchange rate volatility. This yields a low, medium, and high volatility "bin" of countries for both DMEs and EMEs. Table A9a shows countries by volatility bin. Among DMEs, bins 1 and 2 (the low and mid-volatility bins) are comprised of four countries each. Bin 3, the high-volatility bin, contains three countries: Australia, Japan, and New Zealand. Notably, Australia and New Zealand are commodity-intensive DMEs. The United States is classified as a low-NEER volatility country (bin 1) reflecting the challenges of de facto monetary regime classification as it is debatable whether the U.S. is true de facto non-IT. Aside from being the dominant reserve currency, the U.S. may not fit the standard IT model as more than 2/3rds of global GDP come from countries that use the U.S. Dollar as a de facto anchor (See Carney (2019)). This may be a key reason for the low REER volatility of the US.

The three bins for EMEs contain six countries each. The low-volatility bin contains China, Czech Republic, India, Israel, Malaysia, Thailand, while the high NEER volatility bin, bin 3, is composed of: Argentina, Brazil, Colombia, Russia, South Africa, and Turkey. Table A9b reports median statistics of key variables across respective volatility quantiles. An interesting pattern among EMEs is that foreign currency-denominated public debt ratios, inflation, and policy rates all rise monotonically with NEER volatility. Comparing statistics in the high-volatility quantiles (bin 3) between EMEs and DMEs, median statistics are strictly larger in the high-volatility EME group, as not only are they more leveraged compared to their high-volatility DME counterparts, they also tend to experience higher inflation, interest rates, and nominal GDP growth.

With de facto groups in hand, we estimate the full Taylor Rule regression model, which includes public debt variables. For the DMEs, we use public debt/GDP measures, analogous to specifications 4 and 8 of Table A5. For the EMEs, we report results using foreign currency-denominated debt measures and controls[11] similar to specifications 6 and 12 of Table A7. Tables

[11] We also estimate the EME regressions using total public debt/GDP only, without foreign currency debt variables, but results are not reported since it is not the focus of the study. As shown in the de jure analysis, total public debt is not as important of a factor for Fiscal Dominance among emerging markets relative to foreign currency denominated debt holdings.

A8 and A9 (and Figures 5 and 6) report regression results by NEER volatility bins for DMEs and EMEs, respectively.

3.1 Developed Market Economies

In Table A8 (Figure 5), we report the results for developed market economies across volatility bins. The persistence of the lagged interest rate is stable across groups while the coefficients on inflation (ranging from 0.008 to 0.20) are highest for the high-volatility bin. The interest rate response to a 1% increase in quarterly inflation over four quarters is 67 bps for this group (high volatility). A 1 percent jump in quarterly inflation is equal to a 0.25 percent increase in annual inflation, hence de facto "inflation targeters," or high-NEER volatility DMEs, aggressively respond on a greater-than 1-for-1 basis. A statistically significant coefficient (estimate of 0.09) is also reported for Bin 1, the low-volatility group. This group contains the U.S. and Hong Kong –which pegs its exchange rate to the U.S. Dollar and therefore also mimics its inflation-targeting monetary policy. This group has a four-quarter response about half as strong as the high volatility group: a 1 percent jump in quarterly inflation is met with a 31 basis point rise in the interest rate over the following year, which is slightly greater than a 1-for-1 response. While bin 2, the mid-volatility DMEs do not show a significant coefficient on inflation, they are the only group of countries with a highly significant estimate on the GDP gap (estimate of 0.092).

Changes in the real exchange rate show significant effects and interesting heterogeneity across bins. DMEs with low exchange rate volatility (bin 1) tend to respond to exchange rate depreciation with higher interest rates while DMEs in bin 2 respond to depreciation with lower interest rates (coefficients on REER change are -0.027, 0.029, -0.005, for bin 1, 2 and 3, respectively). The negative association between exchange rates and interest rates in bin 1 may be due to the concentration of exchange rate targeters: Hong Kong, Singapore, and Switzerland all have histories of intervening via policy to stabilize the currency. Bin 2, containing Canada, Norway, and Sweden, all of which are oil-exporting countries, are more likely to see exchange rate appreciation with a rise in commodity prices; therefore a positive interest rate response to currency appreciation may be an attempt to curb future inflation and overheating related to a positive terms-of-trade shock. A 1-year cumulative interest rate response to a quarterly REER depreciation of 1 percent is +9.4 and -9.7 basis points for bin 1 and 2, respectively (the

coefficient is statistically insignificant for bin 3). While the coefficient on REER is insignificant for bin 3, we do find a significant interest rate response to changes in international reserves (estimate of -0.003). The negative effect suggests easing monetary policy in response to inflows of international reserves. A 1-year cumulative interest rate response to a 10 percent increase in international reserves would amount to a rate cut of -10 basis points.

Among DMEs, the effect of the public debt/GDP ratio on interest rates is more negative for higher volatility bins, with statistically significant coefficients among bins 2 and 3. It appears monetary policy is most constrained by debt positions among de facto inflation targeters, or countries lying in bin 3. For these high-NEER volatility DMEs, larger public debt/GDP ratios tend to suppress interest rates, and the effect is statistically significant, consistent with the analysis in Section 2 which finds the monetary policy of DMEs under de jure IT regimes sensitive to debt levels. Public Debt/GDP ratios are insignificant among low-NEER volatility DMEs, and statistically significant among the middle group (coefficients are 0.004, -0.009, -0.011, respectively). Taking estimates from the high-volatility group (bin 3), the 4-quarter interest rate response to a *transitory* 6% increase in the public debt/GDP ratio (1-standard deviation) is -22 basis points. However, a *permanent* 6% increase in the debt ratio implies an expected monetary easing of -59 basis points over a similar horizon. In contrast, the low-volatility group has a coefficient on public debt/GDP, which is statistically indifferent from zero.

3.2 Emerging Market Economies

Table A9 (Figure 6) reports the results of the de facto classification analysis for EMEs. Again, the countries are sorted into three bins by NEER volatility, with bin 1 (3) containing EMEs with the lowest (highest) NEER volatility over the sample period. While we do observe coefficients on inflation monotonically increasing with NEER volatility (coefficients are 0.12, 0.36, 0.93, respectively and statistically significant), we don't observe similar patterns with GDP Gap (coefficients are 0.018, 0.100, -0.034). Upon inspecting the countries within each bin, the pattern in inflation coefficients is consistent with the country characteristics across bins: Bin 1 contains countries that are mostly manufacturing-based (China, India, Malaysia, Thailand, etc.), with anchored inflation, with limited need for NEER changes. Bin 2 is composed of a mixed composition (Chile, Indonesia, South Korea, Mexico, etc.) with greater exposure to terms-of-trade shocks, and with lesser anchored inflation, while bin 3, the high-volatility bin, tend to be

countries with governance challenges (Argentina, Brazil, Russia, Turkey, etc.), with a history of inflation and limited anchoring, constraining thereby reactions dealing with output (see Vegh et al. (2017)). This view is supported in Table A9b, reporting that both median foreign currency-denominated debt levels and inflation rates are highest among bin 3 (and lowest among bin 1).

A 1% rise in quarterly inflation corresponds with a 4-quarter interest rate increase of +42, +110, +200 basis points, for the low, medium and high NEER volatility bins, respectively (contemporaneous, short-run responses are equivalent to the coefficient estimates: +12, +36, +93 basis points). More aggressive responses from high NEER volatility EMEs are consistent with those countries following de facto inflation targeting, although these responses are considerably larger than those of de facto inflation targeting DMEs. One explanation for this may be the additional risk premium EMEs require to incorporate into their policy rates when battling higher inflation rates. This scenario can be related to the relatively weaker anchoring of inflation expectations in EMEs compared to DMEs, warranting both more aggressive responses by the monetary authority and higher risk premia demanded by investors facing hyperinflationary risks. GDP gaps enter statistically significant among bin 1 and bin 2 (coefficients of 0.018 and 0.100), while bin 3, the high volatility bin, has an insignificant coefficient estimate. Bin 2, the set of EMEs bearing relatively high terms-of-trade exposure, sensibly puts more importance on output gap fluctuations when setting monetary policy compared to the other subgroups of emerging markets.

Changes in the REER enter as highly significant among high-volatility EMEs, but not bins 1 or 2. The coefficient for bin 3 is -0.28, which implies that these EMEs tend to increase interest rates by about 28 basis points for a 1% depreciation in the real exchange rate in the short-run, with a 1-year interest rate response of +59 basis points. International reserves do not enter significantly into any specification. Under de jure IT classifications, both the real exchange rate and international reserves entered significantly for EMEs under non-IT regimes. It's interesting to note that in contrast, the de facto analysis paints a different picture. We find that de facto inflation targeters, or EMEs with high NEER volatility (bin 3), respond strongly to exchange rate depreciation, compared to de facto non-IT (low NEER volatility) EMEs (bin 1).

Foreign currency-denominated debt enters significantly and negatively across all bins (i.e., significant fiscal dominance effects found in both de facto non-IT and IT EMEs) and is

increasing in exchange rate volatility with a large increase from bin 2 to bin 3 (coefficients of -0.19, -0.21, and -0.45, respectively). Controls for total public debt/GDP (coefficients of 0.007, 0.014, 0.19) and the proportion of public debt denominated in foreign currency (coefficients of 0.066, 0.064, and 0.23) enter significantly and positively for bin 3, the high-volatility subgroup of EMEs. Again, these results closely resemble those of the non-IT EME group under the de jure classification. However, when we classify based on a simple de facto rule like binning by exchange rate volatility, those more likely to act as inflation targeters (i.e., high-NEER volatility EMEs) appear to have monetary policy more constrained by fiscal factors.[12] As noted before, this result is at odds with the findings of the de jure analysis, where de jure IT EMEs exhibit no evidence of fiscal dominance. In Section 4, we find that commodity-intensity is the primary driver of fiscal dominance effects being found across high NEER volatility EMEs. Stratifying the high NEER volatility group by commodity intensity shows that non-commodity intensive EMEs (with high NEER volatility) do not exhibit significant fiscal dominance effects.

Total public debt and the composition of public debt, both having positive coefficients, can be interpreted as a risk premium effect. Possible fiscal dominance effects of foreign currency-denominated debt/GDP is negative and offsets the risk premium effect as the level of hard currency debt rises. The significant coefficients across these debt variables reflect a non-linear relationship between foreign currency-denominated debt and monetary policy among this set of EMEs. As mentioned in the previous section, as the composition of total public debt approaches 100% hard currency, the fiscal dominance effect tends to dominate any risk premium effect on the interest rate. Under this scenario, a 1 percentage point increase in the hard currency debt/GDP ratio would also increase the total public debt/GDP ratio by 1 percentage point. Because the coefficient estimates on foreign currency debt are larger than that on total public debt in absolute value, the net effect on the interest rate will be negative. In a later section, simulations are run to estimate the total effect of a transitory increase in the hard currency debt/GDP ratio for bin 3, the high NEER volatility group (see Figure 7). Bins 1 and 2 have statistically significant estimates on foreign currency debt/GDP but not on controls for total

[12] A sharper identification of this possible channel requires additional data, including debt maturity profile, sovereign spreads, the extent and efficacy of macro prudential regulations capital controls, international reserve levels, etc.

public debt or debt composition, hence the effect is relatively linear for these countries: a 1 percentage point *transitory* increase in the hard currency debt/GDP ratio corresponds with interest rates roughly -65 basis points lower over a 4-quarter period for both bins (-170 basis points lower from a *permanent* increase).

To summarize, under our simple de facto classification in which we bin groups of countries by their nominal exchange rate volatility, we find evidence of possible fiscal dominance among both DMEs and EMEs, as monetary policy is constrained by fiscal space (or lack thereof). Among DMEs, total public debt/GDP is associated with lower policy rates on average, and the effect size is larger for high exchange-rate volatility countries, the de facto inflation targeters. Among EMEs, the channel is more nuanced, but the negative effects of debt on interest rates are significant across all volatility bins. The fiscal dominance effect specifically transmits through the level of *foreign-denominated* debt, and the impacts on interest rates are non-linear as they also depend on the total level of public debt/GDP and the composition of public debt (which are both functions of the level of foreign currency-denominated debt).

The de facto analysis bears some similarities with the de jure analysis, while also highlighting key differences and challenges that come with classifying monetary regimes. Particularly, among EMEs, the de facto analysis highlights that interest rates under de facto IT (or high NEER volatility EMEs) may be more sensitive to the fiscal position of the country. This does not align with the results from the de jure analysis, which shows that under de jure IT, EMEs don't show significant evidence of fiscal dominance. To reconcile the contrasting results among EMEs under de jure IT vs. de facto IT, recall that NEER volatility isn't a clean monetary regime proxy for EMEs, as exchange rate volatility is determined by a variety of factors including in large part exposure to commodity fluctuations. To account for this, in the following section, we separate EMEs into commodity-intensive and non-commodity intensive countries and show that the large fiscal dominance effect among high NEER volatility EMEs is completely driven by commodity-intensive economies. That is, after controlling for commodity intensity, the high NEER volatility group does not report significant fiscal dominance effects, which aligns with the results found among EMEs under de jure IT.

4. Fiscal Dominance, IT and Commodity Exposure in Emerging Markets

Within emerging markets, there is large heterogeneity across economies in terms of their reliance on key commodities. Moreover, our de facto classification using NEER volatility is subject to confounding, as many factors other than monetary regime drive exchange rate volatility. Commodity exposure is one of these key factors. In addition, our NEER volatility classification differs from the extent of exchange rate misalignment. For commodity-intensive countries, the unhedged risks of commodity-price volatility for the EME countries in our sample could imply that the optimal monetary policy may substantially deviate from inflation targeting in the presence of incomplete financial markets; see Senay and Sutherland (2019) for a theoretical discussion on models with a single asset and multiple assets. This could explain why our results for the EME sample are subject to the classification of IT, as seen in Section 2 and 3, depending on whether we use the de jure or the de facto approaches.

To pin down drivers of fiscal dominance across EMEs, we further split our EME sample into two subgroups: commodity-intensive countries and countries which are not commodity-intensive. A country is defined as commodity-intensive if at least 25% of exports are in commodities[13]. By leveraging the IMF data on commodity-exporting countries along with UN Comtrade statistics, we compile our list of commodity-intensive EMEs: Argentina, Brazil, Chile, Colombia, Indonesia, Mexico, Russia, and South Africa. The first cut of the analysis ignores the monetary regime and estimates the Taylor Rule regression specification (which includes foreign currency-denominated debt, the same specification as Table A6) on non-commodity and commodity EMEs separately. The second set of results incorporate de jure inflation targeting regimes, thus investigating how monetary policy setting differs between commodity and non-commodity inflation targeters. Finally, the third set of results apply our de facto classification of the monetary regime via realized NEER volatility bins. We compare commodity versus non-commodity EMEs, which have the highest realized exchange rate volatility – countries that fall within the third quantile (bin 3, high volatility) from the previous analysis. Because EME bin 3 coincidentally contains all commodity-intensive countries except for Turkey, the non-commodity

[13] We apply a definition similar to that found in Aizenman et al. (2011).

intensive comparison group constituents are Turkey plus non-commodity EMEs from bin 2, second highest quantile in terms of exchange rate volatility.

Table A10 reports regression estimates upon splitting the EMEs into commodity-intensive and non-commodity countries. All three pairs of results suggest that commodity-intensive countries follow an interest rate rule, which puts much more weight (ranging from a factor of 1.5 to 3) on inflation rates compared to non-commodity EMES. Given commodity countries and their exposure to international market volatility, spillovers through terms-of-trade shocks can be an important source of inflation that these central banks are required to lean against with aggressive monetary policy.

The first two columns of Table A10 are not conditional on the monetary regime; rather, we look at EMEs based on commodity-intensity and ignore whether the country targets inflation or the exchange rate. The role of international reserves and exchange rate fluctuations in setting monetary policy among EMEs is driven specifically by the commodity-intensive countries. Changes in the REER and international reserves are statistically significant for commodity-intensive EMEs, and moreover, the effects are significantly different from their non-commodity counterparts. A negative coefficient (estimate of -0.22) on REER changes and a positive coefficient (estimate of 0.046) in international reserves suggest that commodity EMEs respond with higher interest rates in the face of exchange rate depreciation and inflows of international reserves. Positive global commodity price shocks can lead to capital inflows, overheating and inducing inflationary pressures in such economies, hence the positive coefficient on international reserves may reflect the joint response of reserve accumulation to prevent an over-strengthening of the exchange rate in the presence of capital inflows plus the interest rate response to inflationary pressures. We do *not* see a significant effect of international reserves on interest rates among non-commodity EMEs. Finally, foreign currency debt/GDP is significant and negatively associated with interest rates for both commodity and non-commodity EMEs (estimate of -0.34 for commodity EMEs, -0.15 for non-commodity EMEs), and the effect size is quantitively larger for commodity-intensive EMEs. Controlling for public debt composition, we see that the proportion of debt that is denominated in hard currency is also statistically significant across both subgroups of countries (estimate of 0.21 for commodity EMEs, 0.041 for non-commodity EMEs), but quantitatively larger among commodity-intensive EMEs. Hence, both

fiscal dominance and risk premium effects of hard currency debt accumulation on interest rates are relatively stronger in commodity-intensive emerging markets.

The second pair (columns 3 and 4) of Table A10 conditions on de jure inflation targeting regimes via IMF classifications. Under the de jure classification, both commodity-intensive EME under IT and non-commodity intensive EMEs under IT have significant responses to lagged policy rates and inflation, with commodity-intensive EMEs responding more aggressively to inflation compared to non-commodity intensive EMEs (inflation coefficients of 0.504 vs. 0.369, respectively). While commodity-intensive inflation targeters respond significantly to output gaps (estimate of 0.066), this is generally not the case for non-commodity intensive inflation targeters (based on the de jure classification). Conditioning on de jure inflation targeting regimes renders the coefficient on the real exchange rate statistically insignificant for both commodity and non-commodity EMEs. The estimate on international reserves (coefficient of 0.019) however, remains significant at the 10% level for commodity EMEs but is not significantly different from zero for non-commodity EMEs. Interestingly, foreign currency public debt/GDP is significant and negative (estimate of -0.18) among non-commodity EME inflation targeters, but not significant among commodity-intensive inflation targeters. It is important to note that these results are under the de jure classification of inflation targeting. Under our simple de facto classification, a very different picture emerges.

The final pair (columns 5 and 6) of Table A10 applies our de facto inflation targeting classification defined by NEER volatility bins with high levels of exchange rate volatility. Here, we take the commodity EMEs with the high NEER volatility and compare them against non-commodity EMEs also with high NEER volatility. Again, lagged interest rates and inflation enter significantly, with the coefficient on inflation twice as large among commodity countries than non-commodity countries. The GDP gap does not enter significantly for either group. Commodity EMEs under de facto IT respond to exchange rate depreciation with higher interest rates (coefficient of -0.25) while non-commodity EMEs under IT is statistically unresponsive. Finally, a sharp difference under the de facto IT classification is that fiscal variables are statistically significant for commodity-intensive, high NEER volatility EMEs, while this is generally *not* the case for non-commodity, high NEER volatility EMEs. Hence, after conditioning on commodity intensity, the de facto results match those of the de jure analysis

(which found that EMEs under IT did not show evidence of fiscal dominance, while non-IT EMEs did). Evidence of possible fiscal dominance can be displayed by the coefficient on foreign currency-denominated debt/GDP (estimate of -0.45 for commodity-intensive countries), with higher hard currency debt levels associated with lower interest rates. Risk premium effects are evident as positive coefficients on controls for total public debt/GDP and debt composition (0.17 and 0.28, respectively). Comparable estimates are insignificant in the non-commodity group.

To summarize, by stratifying EMEs further by commodity intensity, we sharpen our analysis and identify an additional potential factor that drives possible fiscal dominance effects in emerging market economies. Inflation plays a much larger role in interest rate policy for commodity-intensive countries compared to non-commodity EMEs. When we do not condition on the monetary regime, we find that commodity-intensive EMEs also consider fluctuations in the real exchange rate and international reserves when determining interest rates while non-commodities do not. We then condition on monetary regime using both de jure IT classification and de facto NEER volatilities. Under the de jure classification, the output gap plays a noticeably larger role in interest rate setting for commodity-intensive inflation targeters, but not for their non-commodity inflation targeting counterparts. We also see that under the de jure classification, evidence of fiscal dominance is present among non-commodity inflation targeting EMEs. De facto classification based on exchange rate volatility tells a different story. Exchange rate depreciations are associated with higher interest rates in commodity-intensive, high-NEER volatility EMEs but not the non-commodity intensive group. Finally, fiscal variables are highly significant among commodity-based, high-NEER volatility EMEs, but not among high-NEER volatility, non-commodity EMEs (aligning with the de jure analysis). Consistent with the previous sections, non-linear effects of hard currency debt accumulation are present, as fiscal dominance effects of lower interest rates offset risk premium effects of higher interest rates. One note is the association between exchange rate volatility, our de facto measure of the monetary regime, and commodity intensity. We observe that commodity intensity is positively associated with exchange rate volatility. This association makes it crucial to stratify the high volatility group of emerging market countries on commodity intensity as done in this exercise.

Importantly, we find that among high exchange rate volatility EMEs, it is those who are commodity-intensive that show the strongest evidence of debt levels influencing policy interest rates (non-commodity intensive, high-NEER volatility EMEs do not). This result reconciles the issue of 'flipped' estimates for de jure IT (Section 2) and de facto IT EMEs (Section 3) in the previous sections and suggests that for EMEs, commodity exposure is a key factor separate from the monetary regime, motivating fiscal dominance driven monetary policy.

5. Non-Linear Effects of Foreign-Denominated Public Debt on Interest Rates

Thus far, the non-linear effects of public debt on the policy rate have been mentioned in several sections. This is particularly the case among EMEs, as many of the results suggest that while foreign currency-denominated public debt/GDP has a negative effect on interest rates, total public debt/GDP and the debt composition (percentage of total public debt that is denominated in foreign currency) tend to have positive effects. Moreover, because these variables are interrelated (foreign currency debt cannot change without changing total public debt or changing the debt composition - except in the limiting case where 100% of public debt is foreign currency-denominated debt), total effects are not obvious. Table A14 and Figure 8 show the distribution FX Debt/Total public debt by EME, for the beginning and end of the sample, while Figure 9 plots the EME average over time. To sharpen our analysis, we compute now the total (short-run) effect on the policy rate across a spectrum of foreign currency debt/total public debt levels (or 'debt composition' ratios). The simulation is carried out for three separate iterations covered in the previous sections: We compare de jure IT Vs. Non-IT EMEs, de facto high-NEER volatility EMEs Vs. de facto low-NEER volatility EMEs, and high-NEER volatility commodity-intensive EMEs Vs. high-NEER volatility non-commodity-intensive EMEs. The total effect of a rise in FX denominated public debt/GDP can be derived from the regression coefficients and fiscal values taken from final three terms in the EME regression specification (excluding the error term for simplicity):

$$i_{it} = \cdots + \gamma_a \left(\frac{FXD_{it}}{GDP_{it}}\right) + \gamma_b \left(\frac{TPD_{it}}{GDP_{it}}\right) + \gamma_c \left(\frac{FXD_{it}}{TPD_{it}}\right),$$

where FXD/GDP is FX denominated public debt/GDP, TPD/GDP is total public debt/GDP, and FXD/TPD is the debt composition, or FX denominated public debt/total public debt ratio. The

coefficients $\{\gamma_a, \gamma_b, \gamma_c\}$ are their associated estimated regression coefficients. To compute the change in the policy rate for a unit rise in FX denominated public debt/GDP; first, we rewrite the RHS expression as

$$\gamma_a \left(\frac{FXD_{it}}{GDP_{it}}\right) + \gamma_b \left(\frac{FXD_{it}}{GDP_{it}}\right)\left(\frac{TPD_{it}}{FXD_{it}}\right) + \gamma_c \left(\frac{FXD_{it}}{TPD_{it}}\right),$$

and then differentiating with respect to $\frac{FXD}{GDP}$ yields us the effect of a change in the FX debt/GDP ratio on the interest rate as a function of the proportion of FX debt to total public debt, or

$$\frac{di_{it}}{d\left(\frac{FXD_{it}}{GDP_{it}}\right)} = \gamma_a + \gamma_b \frac{1}{\left(\frac{FXD_{it}}{TPD_{it}}\right)} + \gamma_c \left(\frac{FXD_{it}}{TPD_{it}}\right).$$

The expression above allows us to easily see that the estimated total effect of rising FX debt on the interest rate is non-linear in the *proportion* of FX-denominated debt held. Additionally, the total effect can be positive (e.g., dominating 'risk premium effects') or negative (e.g., dominating 'fiscal dominance effects) depending on the signs of the coefficients.

In our simulation study, we constrain the proportion of FX debt to total Public debt to lie between 10% and 75%, as the maximum observation within the sample is Argentina in Q2 2002 which realized an FX debt to total Public Debt ratio of 71%. This period was around the end of Argentina's currency board, a period of fixed exchange rate where the policy interest rate was mostly passive or non-existent until the collapse. Figure 7 reports the interest rate responses to a 1 percentage point rise (that is, an increase in the ratio of 0.01, not to be confused with a 1% increase which would depend on the initial level of FX debt/GDP) in the FX public debt/GDP ratio as a function of FX public debt/Total public debt.

5.1 De Jure IT Vs. Non-IT EMEs

The left-most chart shows that under IT, the sensitivity of interest rates to fiscal variables is much lower than under non-IT regimes. In contrast, non-IT regimes can have economically large positive responses to rising FX debt/GDP (e.g., +25 basis points when 20% of total public debt is FX-denominated) or negative responses (e.g., -20 basis points when 60% of total public debt is FX-denominated). The wide range of effects highlights the importance of debt composition under non-IT regimes in predicting whether rising FX debt leads to higher or lower policy rates.

5.2 High NEER Volatility Vs. Low NEER Volatility EMEs

The center chart examines countries separated by our de facto classification, high versus low NEER volatility. The high NEER volatility group has a monotonically decreasing interest rate responses to rising FX debt/GDP; the effect is significantly (statistically and economically) large. A 20% FX debt proportion would predict a +50 basis point increase in the policy rate for a 1 percentage point rise in the FX debt/GDP ratio. In contrast, 60% FX debt proportion implies a --13 basis point cut in the policy rate for the same rise in FX debt/GDP. The low NEER volatility group shows a relatively stable interest rate response function. A negative (-13 to -20 basis points) response to a 1 percentage point rise in FX debt/GDP is implied regardless of the FX debt proportion of total public debt.

5.3 High NEER Volatility: Commodity-Intensive Vs. Non-Commodity-Intensive EMEs

The chart displayed on the right compares high NEER volatility EMEs, stratified based on whether they are commodity-intensive or not. The results confirm what was reported in previous sections: commodity-intensive EMEs are driving the overall effects found among high NEER volatility EMEs. The interest rate response function follows a similar pattern as the high vs. low NEER volatility char, with economically risk premium effects dominating in the form of higher policy rates when the FX debt composition is small - and negative fiscal dominance effects dominating as the FX debt composition increases.

5.4 Discussion

Our baseline simulations point to the economic significance of monetary-regime choice on the currency composition of external debts. Ogrokhina and Rodriguez (2019, 2018) find in the data that financially integrated inflation-targeting countries have lower foreign currency shares in their external debt compared to non-targeting countries. They find such a reduction of the foreign currency share in foreign-held total sovereign debt but no effect on domestic-held debt or non-US dollar share, i.e., the euro share. Note that the currency composition of external debts also depends on the macroprudential policies in place. Using structural panel vector autoregressions that identify both monetary and macroprudential policy actions, Kim and Mehrotra (2018) show that tighter macroprudential policies used to contain credit growth also have a significant negative impact on macroeconomic aggregates such as real GDP and the price level; as such the similar effects of monetary and macroprudential policies may suggest a complementary use of

the two policies at normal times. We are currently studying the association between monetary regimes, macroprudential policies, and both sovereign and private external debts, focusing on systemically-relevant borrowers.

6. Robustness checks

Debt/Tax Base in Emerging Market Economies

Among emerging markets, the tax base is often an alternative measure used to assess fiscal space as it is more representative of the underlying country [see Aizenman et al. (2019)]. To establish the robustness of our findings, the baseline regressions using de jure and de facto classifications are re-estimated for EMEs, but traditional debt overhang variables that were normalized by GDP are instead normalized by tax revenue. We take 5-year moving averages of tax revenues to reduce seasonality and ensure that the variation of debt overhang is dominated by the fluctuations in debt rather than economic growth.

Table A11 and A12 report similar baseline regressions on EMEs analogous to A6 and A7 but replacing foreign currency denominated public debt/GDP and total public debt/GDP replaced with foreign currency denominated public debt/tax base (5-year moving average of the tax base) and total public debt/tax base, respectively. Using tax base yields results consistent with the original analysis. Under the de jure classification, emerging markets under non-IT regimes still respond significantly and negatively to higher levels of foreign currency denominated debt (columns 11 and 12 of Table A11) and positively to the proportion of foreign currency denominated debt to total public debt.

Table A13 shows the results under de facto classification similar to the initial analysis reported in A9. Again, results remain consistent with the initial analysis: Significant negative coefficients on the foreign currency public debt variables for the subgroups of EMEs with high NEER volatility (our de facto inflation targeters), along with significant positive effects (risk premium effects) of public debt/tax and debt composition on interest rates. In Table A9, possible fiscal dominance effects were present in the lower volatility subgroups too, with significant negative coefficients on foreign currency debt/GDP among bins 1 and 2 – though to a far lesser extent than the effect size in bin 3. The significant effects among bins 1 and 2 are not present

when replacing GDP with tax revenue, though overall, our main results remain consistent regardless of using GDP or tax revenue.

Lagged Debt Variables

In the main analysis, fiscal variables are contemporaneous, as policy rates are regressed on debt ratios of the same period. As a robustness check, we run two sets of exercises where lagged fiscal variables are used instead, with the hope of alleviating some potential endogeneity issues arising from the contemporaneous specification. The first set of exercises introduce fiscal variables lagged by 1 quarter, and the second set of exercises lag fiscal variables by 4 quarters. The standard de jure IT/non-IT regressions are then re-run (Tables A15 and A16), along with the standard de facto NEER volatility regressions (Tables A17 and A18).

In Table A15, the benchmark de jure analysis is repeated using lagged debt variables for DMEs. The significant negative effect of public debt/GDP on interest rates among DMEs disappears when substituting the contemporaneous variable with either 1-quarter or 4-quarter lags. However, when repeating the de jure analysis for EMEs, the effect of FX public debt/GDP remains highly significant and negative under either 1-quarter or 4-quarter lags (Table A16).

The de facto analysis, where countries are grouped by NEER volatility, is repeated with lagged debt variables. For DMEs (Table A17), the significant negative effect among bin 3 (the high NEER volatility group) disappears when lagging Public debt/GDP by 1 or 4 quarters, while the negative effect within bin 2 (the mid NEER volatility group) remains statistically significant and negative under lagged debt variables – consistent with the bin 2 results found in the initial analysis. The de facto analysis for EMEs is robust under lagged debt variables. Both 1-quarter and 4-quarter lagged specifications result in statistically significant, negative coefficients on FX debt/GDP for bin 2 and bin 3. Bin 3, the high NEER volatility group, has the largest negative coefficients, consistent with the initial analysis. Bin 1, the low NEER volatility EMEs, reported a statistically significant and negative effect of FX debt/GDP on the interest rate over the initial analysis where debt variables entered contemporaneously. Under lagged debt variables, the significant effect on bin 1 EMEs disappears.

Overall, the robustness check with lagged variables suggests that the results of EMEs are most stable. Both in the de jure and de facto analyses, substituting lagged debt variables did not generally change the sign or significance of the effect of FX debt/GDP on policy rates. The one

exception is in the de facto analysis, the significance of the effect on the low NEER volatility group disappears. The robustness check presents mixed performance among DMEs, with the de jure analysis results rendered insignificant when substituting in lagged debt variables while the de facto analysis maintained some degree of stability among the coefficient estimates of interest.

Collapsing Currency Regimes

Among EMEs within the sample, some experienced currency crises resulting in sharp movements in real exchange rates and other macroeconomic variables. Using the Ilzetzki, Reinhart, and Rogoff (2017) exchange rate regime classification, we identify periods of 'free-falling' exchange rates. Argentina experienced a collapsing currency from December 2001 to November 2002, and more recently from December 2015 to September 2016. Turkey experienced an episode of collapsing currency from February 2001 to March 2003. Arguably, both regimes had a spell of 'fear of floating' related to both fiscal and inflationary concerns, but both failed in the management of these fears and paid the price in terms of inflation being out of line with the pre-set target. In Argentina, before 2001-2002, the effective target was close to that of United States inflation. With a lag, the collapse of the fixed exchange rate in Argentina and Turkey had a clear fiscal cost: economic default on the local currency debt (inflating a big share of it, at rates well above the expected inflation), and a sovereign debt crisis. Arguably, both countries failed due to the questionable quality of institutions, e.g., de-facto the lack of Central Bank independence among other things.

As an additional robustness check, we omit these episodes of currency collapse and re-estimate the baseline regressions. Results for the de jure analysis are reported in Table A19, with Table A20 reporting results from the de facto analysis. The de jure analysis shows estimates of FX debt/GDP as economically large and negative (estimate of -0.21, column 12), but the coefficient loses significance upon controlling for Public debt/GDP – which enters as significant and positive. Moreover, while the coefficient on REER changes under non-IT remains significant and negative, the effect size drops drastically (from -0.43 to -0.11) after omitting collapsing currency episodes. Table A20 reports the de facto analysis, where EMEs are grouped into NEER volatility bins. Even after removing collapsing currency regimes, Argentina and Turkey both fall into the high NEER volatility bin (bin 3). Among bin 3, the negative coefficient on REER changes weakens after removing collapsing regimes (from -0.28 to -0.075) but the statistical

significance rises. For bin 3, The effect of FX debt/GDP remains economically large but loses significance (coefficient estimate falls from -0.450 to -0.356).

Despite losing statistical significance, the economic significance of the fiscal dominance effects related to FX debt/GDP remains large (though smaller) after removing observations related to collapsing currency regimes. Meanwhile, the effect of REER changes on interest rates maintains statistical significance, but the effect size diminishes. The fact that including crisis periods in the sample causes the effect sizes to rise helps emphasize the pervasiveness of 'fear of floating' and fiscal dominance during currency crises. As the historical context suggests, these climactic episodes also serve as periods of desperation where the trade-off between defending the exchange rate via higher interest rates (i.e., 'fear of floating') and avoiding sovereign default via lower interest rates (i.e., fiscal dominance) might become particularly pronounced.

Secular Trends in the Risk-Free Rate

There is a clear trend over the sample period of a dropping nominal and real 'risk-free' rate in the U.S. and more broadly, the world. This secular decline in interest rates accompanies the upward trend in public debt accumulation to a large degree. Therefore, a potential endogeneity issue particular to Developed Market Economies arises where our regression estimates might be capturing the downward adjustment of policy rates in response to a lower risk-free rate – an omitted variable – rather than the association between policy rates and public debt. If this is the case, the support for any fiscal dominance effect among DMEs becomes diminished. However, even if it is simply the case that lower risk-free rates and higher public debt/GDP coincide due to secular trends, the net outcome is, arguably, that going forward, there will be greater resistance to increasing the interest rate. It is key to clarify this issue, and therefore we run an auxiliary robustness check to test whether the significant negative effects of rising public debt/GDP found among DMEs are robust to controlling for the risk-free interest rate. We control the world risk-free rate in four ways. We augment the baseline regression with The nominal U.S. policy rate, the real U.S. policy rate, or the Holston et al. (2017)[14] estimate of

[14] The authors' approach defines R-star as the real short-term interest rate expected to prevail when an economy is at full strength and inflation is stable. Estimates of R-star are published by the Federal Reserve Bank of New York.

the U.S. or E.U. natural rate of interest (R-star). The former two specifications exclude the United States from the data, as we use the U.S. policy rate as an explanatory variable, while the latter two specifications include all DMEs. We rely most heavily on results that consider R-star as the control as we believe this is the most reliable and conservative estimate of the world risk-free rate[15].

Tables A21 and A22 report the de jure and de facto analysis for DMEs but include the various measures to control for the risk-free rate. The de jure analysis (A21) first introduces the U.S. policy rate as an explanatory variable (column 1 and 5) and subsequently the real U.S. rate (the U.S. policy rate less the annualized quarterly inflation, columns 2 and 6) and then finally the U.S. and E.U. R-stars in columns 3 and 7; 4 and 8, respectively. The results using the de jure IT classification show, that while the negative impact of public debt/GDP on policy rates remains significant (and the size of the effect is stable) under IT in columns 1 (nominal U.S. rate) and 2 (real U.S. rate), the coefficient on public debt is rendered insignificant when introducing R-star as a control (columns 3 and 4), while the coefficient on R-star is highly significant. That is, to the extent which R-star captures the broader common trend of falling risk-free rates across Developed Markets (non E.U), the negative relationship found between rising public debt/GDP and policy rates among Developed Market Economies disappears. While the association between higher public debt loads and suppressed policy rates in Developed Markets disappears upon controlling for the natural rate of interest, the significant coefficient on R-star suggests that monetary policy in these countries may be constrained in a different way: when R-star is exceedingly low (as in the post-2008 era, where R-star dropped about 200 basis points from 2.5% to 0.5%). The coefficient estimate on R-star suggests a non-negligible trend effect among

[15] One issue to keep in mind which is relevant to our R-star measures, is that the United States is a federal union - the 50 US states are constrained in terms of debt/GDP and expect to get their share of federal transfers and fiscal demand. In contrast, the E.U. does not have this feature, which may account for the more aggressive stance of the ECB in terms of its policies. Hence, the E.U. may be more under the cloud of Fiscal Dominance. While we do not consider the E.U. in our DME sample since they share the same policy interest rate, Appendix B provides a case study on select E.U. countries around the 2010 Debt Crisis showing the fiscal impact of E.U. policies on the cost of serving the IIPS (Ireland, Italy, Portugal, Spain) debt.

the policy rates of inflation targeting Developed Markets: On average for these countries, about 40 percent of a 100 bps change in the natural rate passes through to domestic policy rates. We find that this is generally *not* the case for non inflation targeting DMEs.

Table A22 reports supplementary results from the de facto binned analysis, where DME countries are grouped by low, mid, and high NEER volatility, controlling for the secular decline interest rates with the US R-star. Recall that in the benchmark de facto analysis, statistically significant negative coefficient estimates on public debt/GDP were found among bin 2 and bin 3 (-0.009 and -0.011, respectively). When we introduce R-star as a regressor to control for any secular trend in the risk-free rate, the estimated coefficient on public debt under bin 2 remains statistically significant, but the effect under bin 3 loses statistical significance (bin 2 DMEs are: Canada, Norway, Sweden, U.K. and bin 3 DMEs are: Australia, New Zealand, Japan).

Therefore under both specifications, the secular trend in the risk-free rate does seem to explain away some of the fiscal dominance effects initially found in both the de jure and de facto analysis, suggesting that for DMEs, controlling for the secular trend in risk-free rates is crucial for disentangling any signs of Fiscal Dominance. We also test whether R-star weakens the Fiscal Dominance effects found among Emerging Markets (particularly de jure non-IT)[16]. We find no loss of significance upon adding R-star as a control, confirming our belief that across Emerging Markets, a declining R-star is a less potent factor in interest rate determination. While this weakens the evidence of Fiscal Dominance among DMEs conditional on the secular trend in the risk-free rate, we want to re-emphasize that such conditions are still consistent with greater resistance to increasing the interest rate going forward.

Alternative Regression Specifications

Our parsimonious regression specification is one of several potential ways to test the association between public debt and policy interest rates. We acknowledge that a drawback of our simple approach may be that our empirical model is misspecified. For this reason, we consider both de jure and de facto classifications, but this still may not be enough. In this subsection, we consider additional variants to our baseline regression. First, we augment the regression model with interaction terms which explicitly tests whether public debt levels influence interest rates *through*

[16] We do not report these estimates, but they are available upon request.

their effect on domestic policy targets. To do this, we test whether a country's Taylor Rule coefficients on inflation, the output gap, the real exchange rate, or foreign reserves depend on the country's debt level. A simple yet effective method to test for this is to extend the baseline regression model by including interaction terms between public debt and the four domestic objective variables. Aside from the main effects of the regressors, the interaction terms will capture heterogeneity in domestic policy objectives which depends on a country's fiscal position. The second approach is similar but may have more structural appeal. Rather than interacting domestic target variables with public debt, we classify countries as "low debt" (below median) and "high debt" (above median) and estimate the baseline de jure regressions. After we sort on debt, we additionally sort on de jure IT/non-IT, yielding 4 separate sets of estimates. At the cost of fewer observations per regression, this specification essentially allows all coefficients to vary conditional on low or high debt.

Regression with Debt Interactions

For EMEs, our regressions contain three different public debt variables; hence we focus on Foreign Currency Public Debt/GDP as the debt variable we interact with. For DMEs, we only have one variable – public debt/GDP, so naturally, this is the variable we interact with domestic objectives. If the main effect of a domestic variable on policy rates is positive (e.g., inflation), a negative coefficient estimate on the interaction of [inflation x public debt/GDP] is consistent with the presence of Fiscal Dominance. An interpretation of this effect is that: all else fixed, if two countries face the same level of inflation, the country with higher levels of public debt is more likely to have a lower policy rate.

The first two columns of Table A23 reports estimated coefficients on the main effect of Public Debt/GDP and the interaction terms under the de jure IT classification for DMEs. For DMEs under IT, only the coefficient on foreign reserves is significant at the 10% level, suggesting that for a given level of foreign reserves accumulation, DMEs with higher levels of public debt will tend to exhibit lower policy interest rates. While not statistically significant, interestingly, the remaining interaction terms also show negative coefficients. For DMEs under non-IT regimes (column 2), the main effect of public debt on policy rates becomes highly statistically significant and negative upon including the interactions (coefficient of -0.045, t-statistic of -6.21). The interaction terms paint a mixed picture. First, the coefficient on [inflation

x public debt/GDP] is negative, suggesting that non-IT countries weaken their stance on combating inflation as the level of public debt rises – consistent with Fiscal Dominance. However somewhat counter-intuitively, the coefficient on [output gap x public debt/GDP] is significant and positive, suggesting that the policy response to a positive output gap is even stronger in non-IT countries with higher public debt levels. Unique to non-IT DMEs mostly composed of exchange rate targeters, a statistically significant and positive estimate is found on [REER change x public debt/GDP]. Note that the main effect on a REER change is negative (-0.06) suggesting 'Fear of Floating' behavior where real depreciations occur in tandem with higher policy rates. The positive interaction term, however, suggests that in the presence of an equivalent real depreciation, the policy response of higher interest rates significantly weakens as the public debt burden rises. This phenomenon would be akin to 'Fear of Floating' turning into a 'Fear of higher interest rates' driven by Fiscal Dominance.

Columns 3 and 4 of Table A23 report analogous estimates for Emerging Markets under the de jure IT classification. For de jure IT EMEs, none of the estimates are statistically significant. The main effect of FX public debt/GDP is negative, which is consistent with the baseline results of Table A7, where Foreign Currency public debt/GDP is statistically insignificant yet negative for EMEs under IT. For EMEs under non-IT, the main effect of FX public debt/GDP is highly significant and positive upon including interaction terms. This contrasts with the baseline analysis (Table A7) which finds a highly significant negative estimate (in the absence of any interactions). Two interactions stand out. First, [GDP gap x FX public debt/GDP] is highly significant and negative, suggesting that for this subgroup of countries, the policy response to positive output gap deviations weakens as the debt burden rises – consistent with Fiscal Dominance. Second, [REER change x FX public debt/GDP] is highly significant and negative. In the baseline analysis (Table A7), note there is a significant and negative association between REER and policy rates, suggestive of 'Fear of Floating.' Under the specification which includes interaction terms, the main effect on REER change turns insignificant (not reported), while [REER change x FX public debt/GDP] is highly significant and negative. One possible interpretation is that under non-IT regimes, 'Fear of Floating' occurs in the presence of (and strengthens with) rising FX denominated public debt positions. This point is often argued qualitatively, while we present here quantitative evidence of such a phenomenon. Under real deprecation, policy rate responses will tend to be higher in countries with greater debt burdens,

while amid real appreciations, countries with higher debt positions will tend to keep policy rates lower. The latter scenario may be suggestive of Fiscal Dominance.

Regressions Grouped by Low and High Debt

Table A24 report results for DMEs under the grouped debt specification. For DMEs, we consider a threshold on public debt/GDP to classify whether country-quarter observations are high or low debt (above or below median). Inflation Targeters with "High Debt" (column 2), the main effect of public debt remains significant and is also under Inflation Targeters under "Low Debt" (column 1), but the coefficients on Inflation and GDP gap actually strengthen under "High Debt," *counter* what we'd expect in the presence of Fiscal Dominance. Results for non-IT DMEs (columns 3 and 4) are broadly similar to the baseline analysis.

Table A25 reports analogous results for EMEs. The variable we threshold is FX public debt/GDP, where "Low Debt" and "High Debt" are assigned to country-quarters where FX public debt/GDP is below or above the median, respectively. Under IT (columns 1 and 2), the main effect of FX public debt/GDP is significant and negative for Inflation Targeting Emerging Markets under "High Debt" (column 2) but not "Low Debt" IT (column 1) - consistent with the presence of Fiscal Dominance. However, under "High Debt" IT, we also see larger coefficients on domestic targets (Inflation and GDP gap) which is not necessarily in line with the Fiscal Dominance hypothesis, which implies weaker coefficients on domestic targets in the presence of limited fiscal space. For Emerging Markets that do not target inflation (non-IT) composed mostly of exchange rate targeters, High Debt (column 4) has stronger coefficients on Inflation, REER, and Reserves, compared to Low Debt (column 3) suggesting that Fiscal Dominance may operate in non-IT EMEs in a way such that high FX public debt loads increase the sensitivity of monetary policy to phenomena like Fear of Floating[17].

[17] The subgroup corresponding to EMEs under non-IT with High Debt (column 4) shows a particularly high coefficient on inflation (1.3). This result is driven by Argentina, a member of the sub-group. The country consistently struggles with inflation, often responding sensitively to inflation with the policy interest rate (in this case, we estimate about 1-for-1) despite being de jure non-IT. Note that the persistence parameter is also quite low (estimate of 0.21) for this sub-sample. The coefficient drops from

To summarize, we present two additional specifications where we allow the level of public debt to influence the policy rate through domestic variables. This yields a rich set of supplementary results for both DMEs and EMES under de jure IT and non-IT. The key takeaway from these robustness tests align with the baseline analysis – the most convincing evidence supportive of Fiscal Dominance, where high public debt positions may potentially push policy rates away from their ideal targets, is found among Emerging Markets under non-IT regimes, composed mostly of exchange rate targeters. The evidence is much weaker across Developed Market Economies.

Conclusion

Advanced countries and emerging markets have increased substantially their public-sector borrowing as a share of GDP since the Global Financial Crisis. This trend has been driven by the low risk-free interest-rate, as well as by other challenges associated with the GFC. In our study, we find that the negative association between total public debt levels and policy interest rates in Advanced Economies is largely driven by the secular decline in risk-free interest rates. A possible interpretation of this finding is that the GFC induced public-sector bailouts, socializing private sector losses. QE and other policies resulted in the secular decline of interest rates and growing fiscal dominance. This may be a modern incarnation of financial repression, as succinctly pointed out in Reinhart (2012).[18] Accordingly, the US and the Eurozone post GFC

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over 0.40 to 0.21 after controlling for inflation and GDP growth. If we remove Q1 2002-Q1 2003 (Argentinian currency crisis), inflation and GDP growth, the persistence coefficient rises to above 0.6.

[18] "One of the main goals of financial repression is to keep nominal interest rates lower than would otherwise prevail. This effect, other things being equal, reduces governments' interest expenses for a given stock of debt and contributes to deficit reduction. However, when financial repression produces negative real interest rates and reduces or liquidates existing debts, it is a transfer from creditors (savers) to borrowers and, in some cases, governments. This amounts to a tax that has interesting political-economy properties. Unlike income, consumption, or sales taxes, the repression tax rate is determined by factors such as financial regulations and inflation performance, which are opaque—if not invisible—to the highly politicized realm of fiscal policy. Given that deficit reduction usually involves highly unpopular spending cuts and/or tax increases, the stealthier financial-repression tax may be a more

policies reduced drastically the cost of serving sovereign debt, in ways that reflect political economy constraints. Figure 10 (Appendix B) illustrates these trends for the cost of serving the sovereign debt of Italy, Ireland, Portugal and Spain [IIPS] before and during the first 5 years of the Euro crisis.

Rising foreign currency public debt adds downward pressure to interest rates in Emerging Market Countries. Using a de jure measure of inflation targeting, we find that EMEs under non-IT regimes (mostly exchange rate targeters) are less likely to raise interest rates when foreign currency debt levels are higher. In contrast, the overall effect of debt (local and foreign denominated) on monetary policy is more nuanced as the risk premium effect of larger total debt loads encourages higher policy rates to match any increase in risks associated with higher debt. In addition to inflation and output fluctuations (and, of course, debt levels), real exchange rate depreciations are significantly associated with higher interest rates. Sorting countries by nominal exchange rate volatility, we find that the high-volatility group of EMEs have the most robust and negative debt-interest rate relationship, This significant effect is entirely attributed to commodity-intensive EMEs while high NEER volatility, non-commodity intensive EMEs do not show significant negative effects of higher FX public debt/GDP on interest rates (consistent with the null finding for de jure IT EMEs). This highlights the importance of commodity exposure alongside monetary regime as possible determinants of fiscal dominance in Emerging Markets. Finally, to assess the non-linear impact of FX public debt on policy rates in EMEs, simulations of a 0.01 rise in the FX public debt/GDP ratio depicts starkly differing response paths dependent on monetary regime. The interest rate response is shaped by the currency composition of public

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politically palatable alternative. ... Critical factors explaining the high incidence of negative real interest rates after the crisis are the aggressively expansive stance of monetary policy and heavy central bank intervention in many advanced and emerging economies. This raises the broad question of whether current interest rates are more likely to reflect market conditions or whether they are determined by the actions of official large players in financial markets. A large role for nonmarket forces in interest-rate determination is a central feature of financial repression." Reinhart (2012).

debt, tying into the recent theoretical literature on inflation targeting, sovereign borrowing debt composition, and macroprudential policy.

Fiscal dominance and risk premium effects are possible interpretations of the above results. Thereby, more data and a longer sampling period would be useful to test these interpretations thoroughly. Debt maturity profile, the extent, and effectiveness of capital controls, more detailed data on local currency public and private debt would allow sharper identification of the forces at work. These issues are left for future research.

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APPENDIX

TABLE A1: DATA DETAILS

Variable	Definition	Source
Foreign Reserves Change	First-difference of log foreign reserves	IMF IFS
FX Denominated Public Debt/GDP Ratio	Value of public debt denominated in foreign currency divided by nominal GDP.	BIS, IMF IFS
FX Denominated Public Debt/GDP Growth	First-difference of log FX Denominated Public Debt/GDP Ratio	BIS, IMF IFS
FX Denominated Public Debt/Tax Revenue Ratio	Value of public debt denominated in foreign currency divided by Tax Revenue.	BIS, IMF IFS, OECD
FX Denominated Public Debt/Tax Revenue Growth	First-difference of log FX Denominated Public Debt/Tax Revenue Ratio	BIS, IMF IFS, OECD
GDP Gap	Real GDP relative to trend calculated with a Hodrick-Prescott filter	IMF IFS
Inflation	First-difference of log CPI	BIS
De Jure Inflation Targeting Classification	Dummy variable indicating quarters in which country prescribed inflation targeting regime	IMF
Interest Rate	Nominal short-term interest rate or central bank policy rate	IMF IFS
Public Debt/GDP Ratio	Value of public debt divided by nominal GDP	IMF IFS
Public Debt/GDP Growth	First-difference of log Public Debt/GDP Ratio	IMF IFS
Public Debt/Tax Revenue Ratio	Value of public debt divided by tax revenue	IMF IFS, OECD
Public Debt/Tax Revenue Growth	First-difference of log Public Debt/Tax Revenue Ratio	IMF IFS, OECD
Real Exchange Rate Change	First-difference of log real effective exchange rate	BIS

Market value of debt used for countries with available data. In other cases, the face value of debt is used.

TABLE A2: DESCRIPTIVE STATISTICS FOR DEVELOPED MARKET ECONOMIES

	IT Sample (552 obs.)		Non-IT Sample (284 obs.)			
variable	mean	std.dev	mean	std.dev	t-stat for difference between samples	
Interest Rate	0.026	0.022	0.014	0.018	8.667	***
Inflation	0.005	0.007	0.002	0.009	4.181	***
Output Gap	1.000	0.019	1.001	0.035	-0.383	
REER Change	0.000	0.034	-0.001	0.028	0.218	
NEER Change	0.000	0.035	0.002	0.027	-1.048	
Foreign Reserves Change	0.013	0.091	0.026	0.07	-2.317	**
Debt/GDP	0.396	0.225	0.543	0.284	-7.482	***
Debt/GDP Growth	0.003	0.057	0.007	0.06	-0.977	
Debt/Tax	3.053	2.637	5.652	1.881	-14.926	***
Debt/Tax Growth	0.004	0.062	0.001	0.049	0.731	
FX Debt/GDP	0.017	0.025	0.003	0.003	11.492	***
FX Debt/GDP Growth	-0.019	0.222	-0.005	0.124	-0.923	
FX Debt/Tax	0.144	0.21	0.004	0.004	14.156	***
FX Debt/Tax Growth	-0.019	0.222	-0.017	0.112	-0.117	

Mean and standard deviation for all variables. Differenced variables are quarterly changes

*,**,*** indicate significance at the 10%, 5% and 1% level, respectively

Positive values for REER/NEER change correspond with exchange rate appreciation

TABLE A3: DESCRIPTIVE STATISTICS FOR EMERGING MARKET ECONOMIES

	IT Sample (964 obs.)		Non-IT Sample (404 obs.)			
variable	mean	std.dev	mean	std.dev	t-stat for difference between samples	
Interest Rate	0.058	0.043	0.101	0.103	-7.709	***
Inflation	0.010	0.011	0.019	0.026	-6.83	***
Output Gap	0.999	0.029	1.001	0.061	-0.643	
REER Change	0.001	0.049	-0.001	0.066	0.521	
NEER Change	-0.003	0.051	-0.014	0.073	2.868	***
Foreign Reserves Change	0.021	0.059	0.031	0.086	-2.052	**
Debt/GDP	0.379	0.210	0.465	0.245	-5.871	***
Debt/GDP Growth	0.004	0.068	-0.005	0.096	1.684	*
Debt/Tax	2.074	0.745	3.900	2.684	-11.71	***
Debt/Tax Growth	0.004	0.072	-0.004	0.123	1.069	
FX Debt/GDP	0.048	0.044	0.071	0.134	-3.072	***
FX Debt/GDP Growth	0.006	0.142	-0.015	0.200	1.743	*
FX Debt/Tax	0.261	0.207	0.719	1.524	-5.317	***
FX Debt/Tax Growth	0.005	0.144	-0.014	0.227	1.401	

Mean and standard deviation for all variables. Differenced variables are quarterly changes

*,**,*** Indicate significance at the 10%, 5% and 1% level, respectively

TABLE A4: UNIT ROOT TESTS

	LLC		IPS	
Foreign Reserves Change	-40.632	***	-43.716	***
FX Denominated Public Debt/GDP Ratio	-7.457	***	-2.813	***
FX Denominated Public Debt/GDP Growth	-28.468	***	-30.191	***
FX Denominated Public Debt/Tax Revenue Ratio	-2.737	***	-2.246	**
FX Denominated Public Debt/Tax Revenue Growth	-30.233	***	-29.962	***
GDP Gap	-9.234	***	-14.065	***
Inflation	-10.455	***	-20.918	***
Interest Rate	-4.3	***	-2.44	***
Public Debt/GDP Ratio	-1.421	*	0.729	
Public Debt/GDP Growth	-40.7	***	-40.361	***
Public Debt/Tax Revenue Ratio	-3.158	***	-2.272	**
Public Debt/Tax Revenue Growth	-32.694	***	-32.462	***
Real Exchange Rate Change	-48.166	***	-48.804	***

The resulting test statistics are based on Levin et al. (2002) and Im et al. (2003) tests. As is true for all other panel unit root tests, these tests should be interpreted with caution. The LLC test assumes a common process, while the IPS test assumption is more general, where the rejection of the null can be interpreted as providing evidence in favor of rejecting the unit root hypothesis for a non-zero fraction of panel members. Data sets were balanced before performing unit root tests, thus removing earlier dates, which only contained data for select countries. *, ***, *** indicate rejection at the 10%, 5%, 1% significance level, respectively.

Table A5

ESTIMATED TAYLOR RULES: DEVELOPED MARKET ECONOMIES

Variable	IT				Non-IT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest Rate (t-1)	0.898***	0.906***	0.867***	0.868***	0.866***	0.864***	0.843***	0.851***
	(0.011)	(0.011)	(0.036)	(0.032)	(0.075)	(0.075)	(0.086)	(0.086)
Inflation	0.217***	0.181***	0.178***	0.148***	-0.007	0.007	0.013	0.028
	(0.039)+++	(0.050)+++	(0.047)+++	(0.047)+	(0.044)	(0.046)	(0.045)	(0.048)
GDP Gap	0.084***	0.095***	0.099***	0.096***	0.006	0.008	0.006	-0.010
	(0.013)+++	(0.012)+++	(0.015)+++	(0.013)+++	(0.015)	(0.014)	(0.013)	(0.019)
REER Change		0.049***	0.050***	0.015**		-0.016	-0.015	-0.022*
		(0.009)+++	(0.009)+++	(0.007)+++		(0.013)	(0.013)	(0.013)
Reserves Change		-0.005	-0.004	-0.006*		-0.008*	-0.008*	-0.010*
		(0.003)	(0.003)	(0.003)		(0.004)	(0.005)	(0.005)
Public Debt/GDP Ratio			-0.010*	-0.009**			-0.005	-0.005
			(0.005)	(0.004)			(0.006)	(0.006)
GDP Growth				0.039***				0.022***
				(0.004)+++				(0.004)
Observations	542	542	535	535	279	279	277	277
Adj. R-Squared	0.87	0.88	0.89	0.89	0.87	0.87	0.87	0.87

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A6

ESTIMATED TAYLOR RULES: EMERGING MARKET ECONOMIES

Variable	IT				Non-IT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest Rate (t-1)	0.859***	0.860***	0.856***	0.857***	0.407**	0.471***	0.471***	0.475***
	(0.027)+++	(0.027)+++	(0.029)+++	(0.028)+++	(0.159)	(0.120)	(0.112)	(0.115)
Inflation	0.492***	0.497***	0.476***	0.446***	1.132*	0.698***	0.701***	0.597**
	(0.089)	(0.089)	(0.088)	(0.074)	(0.595)	(0.244)	(0.231)	(0.233)
GDP Gap	0.038**	0.037**	0.031*	0.048***	-0.062	-0.026	-0.026	0.064
	(0.017)	(0.017)	(0.017)	(0.016)	(0.159)	(0.082)	(0.088)	(0.050)
REER Change		-0.014	-0.010	0.008		-0.495***	-0.496***	-0.394***
		(0.01)+++	(0.009)+++	(0.019)+++		(0.104)	(0.112)	(0.063)
Reserves Change		0.005	0.006	0.010		0.088*	0.089**	0.127***
		(0.009)+	(0.009)+++	(0.009)+++		(0.048)	(0.036)	(0.034)
Public Debt/GDP Ratio			-0.004	-0.005			-0.002	-0.010
			(0.011)	(0.012)			(0.060)	(0.058)
GDP Growth				-0.023				-0.167**
				(0.017)++				(0.069)
Observations	928	928	921	921	343	343	342	341
Adj. R-Squared	0.82	0.82	0.82	0.82	0.36	0.53	0.53	0.55

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A7

ESTIMATED TAYLOR RULES: EMEs, FOREIGN DENOMINATED PUBLIC DEBT

Variable	IT						Non-IT					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Interest Rate (t-1)	0.859***	0.860***	0.859***	0.859***	0.856***	0.856***	0.407**	0.471***	0.471***	0.467***	0.449***	0.460***
	(0.027)+++	(0.027)+++	(0.029)+++	(0.029)+++	(0.033)+++	(0.033)+++	(0.159)	(0.120)	(0.122)	(0.097)	(0.086)	(0.091)
Inflation	0.492***	0.497***	0.488***	0.487***	0.485***	0.457***	1.132*	0.698***	0.764***	0.780***	0.919***	0.771***
	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)+	(0.076)	(0.595)	(0.244)	(0.259)	(0.197)	(0.223)	(0.200)
GDP Gap	0.038**	0.037**	0.033*	0.032*	0.032*	0.047***	-0.062	-0.026	-0.03	-0.04	-0.036	0.04
	(0.017)	(0.017)	(0.019)	(0.017)	(0.018)	(0.017)	(0.159)	(0.082)	(0.098)	(0.085)	(0.099)	(0.054)
REER Change		-0.014	-0.012	-0.012	-0.012	0.005		-0.495***	-0.519***	-0.531***	-0.519***	-0.429***
		(0.01)+++	(0.008)+++	(0.008)+++	(0.008)+++	(0.019)+++		(0.104)	(0.107)	(0.098)	(0.089)	(0.047)
Reserves Change		0.005	0.005	0.005	0.005	0.009		0.088*	0.098**	0.073***	0.066***	0.103***
		(0.009)+	(0.009)+	(0.009)+++	(0.009)+++	(0.009)+++		(0.048)	(0.049)	(0.016)	(0.013)	(0.014)
FX Public Debt/GDP Ratio			-0.016	-0.014	-0.105	-0.113			-0.052	-0.171	-0.412***	-0.367***
			(0.044)	(0.047)	(0.096)+	(0.100)			(0.039)	(0.108)	(0.126)	(0.136)
Public Debt/GDP Ratio				-0.002	0.011	0.011				0.082	0.152*	0.128
				(0.011)	(0.015)	(0.015)				(0.094)	(0.087)	(0.091)
FX Public Debt/Public Debt Ratio					0.043	0.045					0.242***	0.213***
					(0.031)+++	(0.032)+++					(0.037)	(0.051)
GDP Growth						-0.021						-0.151*
						(0.016)						(0.082)
Observations	928	928	905	905	905	905	343	343	298	298	298	298
Adj. R-Squared	0.82	0.82	0.82	0.82	0.82	0.83	0.365	0.53	0.54	0.55	0.56	0.57

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A8

ESTIMATED TAYLOR RULES: DMEs, GROUPED BY NEER

Variable	DME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.910***	0.880***	0.880***
	(0.047)	(0.043)	(0.022)
Inflation	0.090**	0.008	0.200***
	(0.036)	(0.062)	(0.056)
GDP Gap	-0.012	0.092***	0.036
	(0.016)	(0.014)	(0.037)
REER Change	-0.027**	0.029***	-0.005
	(0.012)	(0.005)	(0.003)
Reserves Change	-0.013	-0.005	-0.003**
	(0.008)	(0.005)	(0.001)
Public Debt/GDP Ratio	-0.004	-0.009*	-0.011**
	(0.004)	(0.005)	(0.005)
GDP Growth	0.019***	0.041***	0.031***
	(0.005)	(0.005)	(0.006)
Observations	295	295	221
Adj. R-Squared	0.885	0.92	0.9

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A9

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY NEER VOLATILITY

Variable	EME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.910***	0.810***	0.580***
	(0.016)	(0.039)	(0.096)
Inflation	0.120*	0.360***	0.930***
	(0.066)	(0.069)	(0.210)
GDP Gap	0.018*	0.100***	-0.034
	(0.010)	(0.037)	(0.089)
REER Change	-0.011	0.007	-0.280**
	(0.014)	(0.027)	(0.120)
Reserves Change	0.003	0.007	0.037
	(0.005)	(0.007)	(0.026)
FX Public Debt/GDP Ratio	-0.190*	-0.210**	-0.450***
	(0.100)	(0.088)	(0.074)
Public Debt/GDP Ratio	0.007	0.014	0.190***
	(0.009)	(0.017)	(0.045)
FX Public Debt/Public Debt Ratio	0.066	0.064	0.230***
	(0.041)	(0.043)	(0.050)
GDP Growth	0.012	-0.021*	-0.024
	(0.008)	(0.011)	(0.042)
Observations	360	419	423
Adj. R-Squared	0.90	0.86	0.62

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A9a

COUNTRY GROUPINGS BY NEER VOLATILITY

Country	Group	Quantile
Hong.Kong.SAR	DME	1
Singapore	DME	1
Switzerland	DME	1
United.States	DME	1
Canada	DME	2
Norway	DME	2
Sweden	DME	2
United.Kingdom	DME	2
Australia	DME	3
Japan	DME	3
New.Zealand	DME	3
China	EME	1
Czech.Republic	EME	1
India	EME	1
Israel	EME	1
Malaysia	EME	1
Thailand	EME	1
Chile	EME	2
Hungary	EME	2
Indonesia	EME	2
Korea	EME	2
Mexico	EME	2
Poland	EME	2
Argentina	EME	3
Brazil	EME	3
Colombia	EME	3
Russia	EME	3
South.Africa	EME	3
Turkey	EME	3

Table A9b

MEDIAN STATISTICS BY NEER VOLATILITY QUANTILE

Quantile	Group	FX Debt/GDP	Public Debt/GDP	Inflation	Interest Rate	GDP Growth
1	DME	0.000	0.613	0.006	0.008	0.010
2	DME	0.017	0.367	0.004	0.020	0.013
3	DME	0.004	0.293	0.004	0.025	0.010
1	EME	0.017	0.367	0.005	0.030	0.025
2	EME	0.042	0.299	0.009	0.048	0.018
3	EME	0.056	0.383	0.016	0.095	0.028

Inflation and (nominal) GDP growth are measured at the quarterly frequency. Interest Rate is annualized.

Table A10

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY COMMODITY INTENSITY

Variable	Commodity	Non-Commodity	Commodity: De Jure IT	Non-Commodity: De Jure IT	Commodity: High NEER Vol	Non-Commodity IT: High NEER Vol
Interest Rate (t-1)	0.510***	0.870***	0.827***	0.817***	0.478***	0.856***
	(0.100)+++	(0.013)	(0.038)	(0.032)	(0.085)+++	(0.021)
Inflation	0.910***	0.320***	0.504***	0.369***	1.023***	0.470***
	(0.310)+	(0.099)	(0.079)	(0.097)	(0.326)	(0.172)
GDP Gap	-0.022	0.030*	0.066***	0.04	-0.048	0.038
	(0.097)	(0.017)	(0.021)	(0.031)	(0.113)	(0.037)
REER Change	-0.220**	-0.006	-0.005	0.018	-0.252**	-0.006
	(0.110)+	(0.034)	(0.010)	(0.037)	(0.113)++	(0.051)
Reserves Change	0.046**	-0.004	0.019*	-0.002	0.048	-0.009
	(0.022)++	(0.006)	(0.010)+	(0.007)	(0.033)+	(0.009)
FX Public Debt/GDP Ratio	-0.340***	-0.150***	0.112	-0.180***	-0.450***	-0.020
	(0.120)	(0.043)	(0.082)+++	(0.052)	(0.101)+++	(0.065)
Public Debt/GDP Ratio	0.13	0.005	-0.012	0.018	0.172**	-0.013
	(0.079)	(0.009)	(0.013)	(0.016)	(0.081)++	(0.016)
FX Public Debt/Public Debt Ratio	0.210***	0.041*	0.006	0.021	0.282***	-0.014
	(0.055)+++	(0.023)	(0.028)	(0.024)	(0.039)+++	(0.055)
GDP Growth	-0.052	-0.005	-0.018	-0.012	-0.061	-0.001
	(0.041)	(0.012)	(0.011)	(0.017)	(0.057)	(0.023)
Observations	556	647	423	481	358	286
Adj. R-Squared	0.52	0.94	0.85	0.83	0.52	0.95

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between Commodity and Non-Commodity intensive estimates at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

De facto IT classification based on nominal exchange rate volatility. De facto IT classified as high-volatility quantile

Commodity-intensive EMEs: Argentina, Brazil, Chile, Colombia, Indonesia, Mexico, Russia, South Africa

Table A11

ESTIMATED TAYLOR RULES: EMERGING MARKET ECONOMIES USING TAX REVENUE

Variable	IT				Non-IT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest Rate (t-1)	0.859***	0.860***	0.859***	0.860***	0.407**	0.471***	0.418***	0.434***
	(0.027)+++	(0.027)+++	(0.027)+++	(0.027)+++	(0.159)	(0.120)	(0.108)	(0.110)
Inflation	0.492***	0.497***	0.486***	0.461***	1.132*	0.698***	1.100***	0.974***
	(0.089)	(0.089)	(0.089)+++	(0.075)+++	(0.595)	(0.244)	(0.191)	(0.149)
GDP Gap	0.038**	0.037**	0.036*	0.050***	-0.062	-0.026	-0.118*	-0.053*
	(0.017)	(0.017)	(0.018)+++	(0.017)+++	(0.159)	(0.082)	(0.063)	(0.029)
REER Change		-0.014	-0.013	0.002		-0.495***	-0.488***	-0.427***
		(0.01)+++	(0.009)+++	(0.019)+++		(0.104)	(0.068)	(0.025)
Reserves Change		0.005	0.005	0.009		0.088*	0.076**	0.101***
		(0.009)+	(0.009)+	(0.009)+++		(0.048)	(0.037)	(0.036)
Public Debt/Tax Ratio			0.002	0.002			-0.005***	-0.006***
			(0.001)+++	(0.002)+++			(0.001)	(0.001)
GDP Growth				-0.019				-0.104
				(0.016)				(0.089)
Observations	928	928	907	907	343	343	238	238
Adj. R-Squared	0.82	0.82	0.82	0.82	0.36	0.53	0.60	0.61

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A12

ESTIMATED TAYLOR RULES: EMEs, FOREIGN DENOMINATED PUBLIC DEBT USING TAX REVENUE

Variable	IT						Non-IT					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Interest Rate (t-1)	0.859***	0.860***	0.862***	0.860***	0.860***	0.861***	0.407**	0.471***	0.434***	0.420***	0.402***	0.417***
	(0.027)+++	(0.027)+++	(0.028)+++	(0.027)+++	(0.027)+++	(0.026)+++	(0.159)	(0.120)	(0.089)	(0.117)	(0.093)	(0.092)
Inflation	0.492***	0.497***	0.488***	0.487***	0.487***	0.461***	1.132*	0.698***	1.025***	1.090***	1.223***	1.108***
	(0.089)	(0.089)	(0.087)+++	(0.087)+++	(0.088)+++	(0.075)+++	(0.595)	(0.244)	(0.136)	(0.216)	(0.264)	(0.202)
GDP Gap	0.038**	0.037**	0.035*	0.036*	0.036**	0.050***	-0.062	-0.026	-0.130*	-0.119*	-0.123	-0.07
	(0.017)	(0.017)	(0.019)++	(0.019)+++	(0.018)++	(0.018)+++	(0.159)	(0.082)	(0.069)	(0.062)	(0.080)	(0.043)
REER Change		-0.014	-0.011	-0.013	-0.013	0.002		-0.495***	-0.502***	-0.490***	-0.458***	-0.411***
		(0.010)+++	(0.008)+++	(0.008)+++	(0.008)+++	(0.018)+++		(0.104)	(0.078)	(0.063)	(0.055)	(0.024)
Reserves Change		0.005	0.005	0.005	0.005	0.009		0.088*	0.056**	0.073*	0.041	0.064
		(0.009)+	(0.009)+	(0.009)	(0.009)	(0.009)		(0.048)	(0.025)	(0.042)	(0.042)	(0.048)
FX Public Debt/Tax Ratio			0.004	0.003	0.003	0.002			-0.008***	-0.001	-0.030**	-0.028*
			(0.007)+	(0.007)	(0.014)+	(0.014)			(0.001)	(0.007)	(0.013)	(0.014)
Public Debt/Tax Ratio				0.001	0.001	0.001				-0.005	0.007	0.006
				(0.002)	(0.002)	(0.002)				(0.005)	(0.007)	(0.008)
FX Public Debt/Public Debt Ratio					-0.001	0.002					0.293***	0.273***
					(0.030)+++	(0.031)+++					(0.091)	(0.099)
GDP Growth						-0.019						-0.085
						(0.016)						(0.084)
Observations	928	928	905	905	905	905	343	343	238	238	238	238
Adj. R-Squared	0.82	0.82	0.82	0.82	0.82	0.82	0.365	0.53	0..60	0.61	0.62	0.62

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A13

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY NEER VOLATILITY USING TAX REVENUE

Variable	EME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.918***	0.874***	0.551***
	(0.027)	(0.019)	(0.128)
Inflation	0.134	0.412***	1.001***
	(0.087)	(0.106)	(0.288)
GDP Gap	0.021**	0.097***	-0.119
	(0.009)	(0.027)	(0.087)
REER Change	-0.005	-0.007	-0.261**
	(0.012)	(0.033)	(0.112)
Reserves Change	0.002	0.004	0.015
	(0.005)	(0.008)	(0.036)
FX Public Debt/Tax Ratio	-0.026	0.014	-0.036***
	(0.021)	(0.025)	(0.006)
Public Debt/Tax Ratio	0.0005	-0.0004	0.014***
	(0.002)	(0.001)	(0.004)
FX Public Debt/Public Debt Ratio	0.069	(0.032)	0.236***
	(0.061)	(0.041)	(0.087)
GDP Growth	0.008	(0.003)	0.002
	(0.007)	(0.019)	(0.031)
Observations	319	419	405
Adj. R-Squared	0.83	0.86	0.62

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A14

DEBT COMPOSITION OF EMERGING MARKET ECONOMIES

Country (EME)	1st Period	FX Public Debt/Total Public Debt, 1st Period	Last Period	FX Public Debt/Total Public Debt, Last Period	Difference
Argentina	2000	0.543	2017	0.297	-0.246
Brazil	2000	0.146	2018	0.028	-0.118
Chile	2000	0.047	2018	0.208	0.161
China	2000	0.021	2018	0.000	-0.020
Colombia	2000	0.275	2018	0.159	-0.116
Czech.Republic	2000	0.025	2018	0.095	0.071
Hungary	2000	0.093	2018	0.179	0.086
Indonesia	2002	0.003	2018	0.240	0.237
Israel	2000	0.025	2018	0.086	0.061
Korea	2000	0.099	2018	0.011	-0.088
Malaysia	2000	0.065	2017	0.033	-0.032
Mexico	2000	0.434	2018	0.179	-0.256
Poland	2000	0.103	2018	0.232	0.129
Russia	2000	0.089	2018	0.163	0.074
South.Africa	2000	0.063	2018	0.096	0.033
Thailand	2000	0.069	2018	0.001	-0.068
Turkey	2001	0.192	2018	0.331	0.139

India does not have data on FX denominated debt.

Table A15

ESTIMATED TAYLOR RULES: DEVELOPED MARKET ECONOMIES
USING LAGGED DEBT VARIABLES

Variable	IT		Non-IT	
	(1)	(2)	(3)	(4)
Interest Rate (t-1)	0.948***	0.887***	0.905***	0.860***
	(0.013)	(0.023)	(0.063)	(0.082)
Inflation	0.111***	0.152***	0.015	0.020
	(0.031)+	-0.051+	(0.046)	(0.048)
GDP Gap	0.051***	0.094***	-0.010	-0.007
	(0.007)+++	-0.013+++	(0.023)	(0.024)
REER Change	0.004	0.010	-0.027***	-0.027*
	(0.006)+++	-0.008++	(0.010)	(0.014)
Reserves Change	-0.001	-0.007***	-0.005	-0.008
	(0.002)	(0.003)	(0.005)	(0.006)
Public Debt/GDP Ratio (t-1)	0.001		0.005	
	(0.001)		(0.005)	
Public Debt/GDP Ratio (t-4)		-0.001		0.004
		(0.006)		(0.004)
GDP Growth	0.043***	0.045***	0.019***	0.021***
	(0.004)+++	-0.006+++	(0.007)	(0.005)
Observations	528	518	275	270
Adj. R-Squared	0.96	0.88	0.88	0.85

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A16

ESTIMATED TAYLOR RULES: EMEs, FOREIGN DENOMINATED PUBLIC DEBT
USING LAGGED DEBT VARIABLES

Variable	IT		Non-IT	
	(1)	(2)	(3)	(4)
Interest Rate (t-1)	0.907***	0.853***	0.540***	0.482***
	(0.010)+++	(0.032)+++	(0.100)	(0.142)
Inflation	0.344***	0.467***	0.595***	0.607**
	(0.078)	(0.086)	(0.226)	(0.251)
GDP Gap	0.049***	0.061***	0.022	0.035
	(0.012)	(0.016)	(0.057)	(0.037)
REER Change	-0.021**	0.006	-0.401***	-0.407***
	(0.011)+++	(0.017)+++	(0.048)	(0.050)
Reserves Change	0.002	0.004	0.102***	0.128***
	(0.004)+++	(0.009)+++	(0.010)	(0.026)
FX Public Debt/GDP Ratio (t-1)	0.032		-0.433***	
	-0.055+++		(0.115)	
Public Debt/GDP Ratio (t-1)	-0.003		0.138**	
	-0.009+++		(0.056)	
FX Public Debt/Public Debt Ratio (t-1)	-0.008		0.246***	
	(0.017)+++		(0.073)	
FX Public Debt/GDP Ratio (t-4)		-0.053		-0.317**
		(0.072)		(0.160)
Public Debt/GDP Ratio (t-4)		-0.006		0.072
		-0.008		(0.080)
FX Public Debt/Public Debt Ratio (t-4)		0.021		0.214*
		(0.020)		(0.109)
GDP Growth	0.003	-0.019	-0.156***	-0.145**
	(0.008)+++	(0.017)++	(0.051)	(0.056)
Observations	895	875	295	285
Adj. R-Squared	0.91	0.82	0.63	0.62

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A17

ESTIMATED TAYLOR RULES: DMEs, GROUPED BY NEER VOLATILITY
USING LAGGED DEBT VARIABLES (t-1)

Variable	DME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.960***	0.930***	0.980***
	(0.018)	(0.011)	(0.021)
Inflation	0.062***	0.056	0.140***
	(0.016)	(0.051)	(0.029)
GDP Gap	-0.018	0.067***	0.003
	(0.014)	(0.004)	(0.018)
REER Change	-0.032***	0.023***	-0.009**
	(0.006)	(0.007)	(0.004)
Reserves Change	-0.008	0.001	-0.00001
	(0.007)	(0.004)	(0.001)
Public Debt/GDP Ratio (t-1)	0.003***	-0.002*	0.002
	(0.001)	(0.001)	(0.006)
GDP Growth	0.021***	0.040***	0.037***
	(0.005)	(0.004)	(0.008)
Observations	292	292	219
Adj. R-Squared	0.93	0.97	0.96

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

ESTIMATED TAYLOR RULES: DMEs, GROUPED BY NEER VOLATILITY
USING LAGGED DEBT VARIABLES (t-4)

Variable	DME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.900***	0.870***	0.950***
	(0.055)	(0.041)	(0.030)
Inflation	0.098***	0.01	0.180**
	(0.037)	(0.064)	(0.075)
GDP Gap	-0.011	0.097***	0.026
	(0.020)	(0.016)	(0.035)
REER Change	-0.034***	0.026***	-0.012***
	(0.013)	(0.005)	(0.003)
Reserves Change	-0.013	-0.007	-0.004***
	(0.010)	(0.007)	(0.001)
Public Debt/GDP Ratio (t-4)	-0.001	-0.010***	0.015
	(0.007)	(0.003)	(0.018)
GDP Growth	0.019***	0.043***	0.044***
	(0.005)	(0.006)	(0.011)
Observations	286	286	214
Adj. R-Squared	0.86	0.91	0.90

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A18

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY NEER VOLATILITY
USING LAGGED VARIABLES (t-1)

Variable	EME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.930***	0.890***	0.570***
	(0.005)	(0.016)	(0.110)
Inflation	0.150*	0.240***	0.930***
	(0.083)	(0.073)	(0.230)
GDP Gap	0.013	0.080***	-0.049
	(0.010)	(0.023)	(0.082)
REER Change	-0.025*	-0.022	-0.240**
	(0.015)	(0.021)	(0.110)
Reserves Change	-0.003***	0.003	0.018
	(0.001)	(0.008)	(0.029)
FX Public Debt/GDP Ratio (t-1)	-0.056	-0.042**	-0.590***
	(0.034)	(0.020)	(0.110)
Public Debt/GDP Ratio (t-1)	0.001	0.002	0.230***
	(0.003)	(0.005)	(0.050)
FX Public Debt/Public Debt Ratio (t-1)	0.023	0.009	0.310***
	(0.016)	(0.008)	(0.074)
GDP Growth	0.016***	0.003	(0.040)
	(0.006)	(0.010)	(0.036)
Observations	358	415	420
Adj. R-Squared	0.93	0.93	0.66

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY NEER VOLATILITY
USING LAGGED VARIABLES (t-4)

Variable	EME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.910***	0.790***	0.540***
	(0.011)	(0.025)	(0.150)
Inflation	0.160*	0.360***	0.870***
	(0.088)	(0.061)	(0.300)
GDP Gap	0.018**	0.100***	-0.044
	(0.009)	(0.034)	(0.110)
REER Change	-0.017	0.004	-0.250**
	(0.019)	(0.025)	(0.130)
Reserves Change	0.003	0.004	0.071**
	(0.004)	(0.010)	(0.033)
FX Public Debt/GDP Ratio (t-4)	0.011	-0.130***	-0.390***
	(0.081)	(0.047)	(0.069)
Public Debt/GDP Ratio (t-4)	0.007**	0.001	0.150***
	(0.003)	(0.017)	(0.022)
FX Public Debt/Public Debt Ratio (t-4)	(0.006)	0.004	0.190***
	(0.031)	(0.012)	(0.048)
GDP Growth	0.012	(0.016)	(0.025)
	(0.008)	(0.011)	(0.031)
Observations	349	407	408
Adj. R-Squared	0.89	0.84	0.60

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A19

ESTIMATED TAYLOR RULES: EMEs, FOREIGN DENOMINATED PUBLIC DEBT EXCLUDING PERIODS WITH COLLAPSING CURRENCY

Variable	IT						Non-IT					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Interest Rate (t-1)	0.859***	0.860***	0.859***	0.859***	0.856***	0.856***	0.790***	0.800***	0.777***	0.708***	0.708***	0.708***
	(0.027)	(0.027)	(0.029)	(0.029)	(0.033)	(0.033)	(0.112)	(0.120)	(0.126)	(0.112)	(0.111)	(0.111)
Inflation	0.492***	0.497***	0.488***	0.487***	0.485***	0.457***	0.463	0.459	0.498	0.538*	0.545	0.552
	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)	(0.076)	(0.332)	(0.301)	(0.342)	(0.326)	(0.338)	(0.353)
GDP Gap	0.038**	0.037**	0.033*	0.032*	0.032*	0.047***	0.038	0.036	0.044	0.038**	0.038**	0.035
	(0.017)	(0.017)	(0.019)	(0.017)	(0.018)	(0.017)	(0.032)	(0.026)	(0.027)	(0.018)	(0.017)	(0.034)
REER Change		-0.014	-0.012	-0.012	-0.012	0.005		-0.092	-0.103	-0.107*	-0.107*	-0.110**
		(0.010)	(0.008)	(0.008)	(0.008)	(0.019)++		(0.066)	(0.072)	(0.062)	(0.062)	(0.052)
Reserves Change		0.005	0.005	0.005	0.005	0.009		0.007	0.024	0.012	0.015	0.012
		(0.009)	(0.009)	(0.009)	(0.009)	(0.009)		(0.033)	(0.028)	(0.029)	(0.027)	(0.035)
FX Public Debt/GDP Ratio			-0.016	-0.014	-0.105	-0.113			-0.058**	-0.254**	-0.208	-0.210
			(0.044)	(0.047)++	(0.096)	(0.100)			(0.028)	(0.098)	(0.144)	(0.144)
Public Debt/GDP Ratio				-0.002	0.011	0.011				0.107**	0.098*	0.099*
				(0.011)++	(0.015)	(0.015)				(0.050)	(0.057)	(0.058)
FX Public Debt/Public Debt Ratio					0.043	0.045					-0.052	-0.052
					(0.031)	(0.032)					(0.103)	(0.103)
GDP Growth						-0.021						0.006
						(0.016)						(0.043)
Observations	928	928	905	905	905	905	321	321	276	276	276	276
Adj. R-Squared	0.82	0.82	0.82	0.82	0.82	0.83	0.70	0.70	0.71	0.74	0.74	0.74

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Excluded Periods: Argentina before Q1 2003 and after Q4 2015. Turkey before Q2 2003.

Table A20

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY NEER VOLATILITY
EXCLUDING PERIODS WITH COLLAPSING CURRENCY

Variable	EME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.908***	0.812***	0.755***
	(0.016)	(0.039)	(0.110)
Inflation	0.121*	0.361***	0.830***
	(0.066)	(0.069)	(0.238)
GDP Gap	0.018*	0.102***	0.037
	(0.010)	(0.037)	(0.034)
REER Change	-0.011	0.007	-0.075***
	(0.014)	(0.027)	(0.019)
Reserves Change	0.003	0.007	-0.011
	(0.005)	(0.007)	(0.018)
FX Public Debt/GDP Ratio	-0.190*	-0.213**	-0.356
	(0.100)	(0.088)	(0.224)
Public Debt/GDP Ratio	0.007	0.014	0.152*
	(0.009)	(0.017)	(0.090)
FX Public Debt/Public Debt Ratio	0.066	0.064	0.097
	(0.041)	(0.043)	(0.093)
GDP Growth	0.012	-0.021*	0.037
	(0.008)	(0.011)	(0.028)
Observations	360	419	401
Adj. R-Squared	0.90	0.86	0.79

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Excluded Periods: Argentina before Q1 2003 and after Q4 2015. Turkey before Q2 2003.

Table A21

ESTIMATED TAYLOR RULES: DEVELOPED MARKET ECONOMIES
CONTROLLING FOR TREND IN THE RISK-FREE RATE

Variable	IT				Non-IT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interest Rate (t-1)	0.758***	0.869***	0.681***	0.724***	0.745***	0.856***	0.813***	0.831***
	(0.056)	(0.034)	(0.051)	(0.046)	(0.085)	(0.089)	0.091	0.100
Inflation	0.064*	0.146**	0.114**	0.124**	0.003	0.015	0.017	0.020
	(0.038)	(0.059)+	(0.041)	(0.049)	(0.045)	(0.043)	(0.049)	(0.052)
GDP Gap	0.050***	0.089***	0.113***	0.104***	-0.021	-0.004	-0.005	-0.007
	(0.006)+++	(0.011)+++	(0.020)+++	(0.017)+++	(0.017)	(0.016)	(0.021)	(0.021)
REER Change	0.015	0.016*	0.015*	0.017**	-0.012*	-0.017	-0.018*	-0.0205*
	(0.010)++	(0.009)++	(0.008)++	(0.008)++	(0.007)	(0.012)	(0.010)	(0.021)
Reserves Change	-0.005	-0.005*	-0.005*	-0.005*	-0.007	-0.010*	-0.008	-0.009*
	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.005)	(0.005)	(0.005)
Public Debt/GDP Ratio	-0.011***	-0.010**	-0.003	-0.005	-0.005	-0.005	-0.003	-0.004
	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)	(0.006)	(0.004)	(0.005)
Nominal US Rate	0.207***				0.124**			
	(0.040)				(0.062)			
Real US Rate		0.015*				-0.012		
		(0.008)+++				(0.008)		
US R-Star (HLW, 2017)			0.467***				0.094	
			(0.086)+++				-0.061	
EU R-Star (HLW, 2017)				0.416***				0.064
				(0.101)++				(0.095)
GDP Growth	0.032***	0.042***	0.022***	0.025***	0.023***	0.021***	0.019***	0.020***
	(0.004)	(0.004)+++	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
Observations	461	461	535	535	277	277	277	277
Adj. R-Squared	0.92	0.89	0.92	0.90	0.88	0.87	0.87	0.87

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

De jure IT classification based on IMF.

Table A22

ESTIMATED TAYLOR RULES: DMEs, GROUPED BY NEER VOLATILITY
CONTROLLING FOR TREND IN THE RISK-FREE RATE

Variable	DME Groups by NEER Volatility		
	(1)	(2)	(3)
Interest Rate (t-1)	0.850***	0.660***	0.850***
	(0.071)	(0.095)	(0.074)
Inflation	0.074***	0.010	0.160***
	(0.026)	(0.041)	(0.041)
GDP Gap	-0.001	0.096***	0.042
	(0.020)	(0.022)	(0.050)
REER Change	-0.023*	0.030***	-0.006**
	(0.012)	(0.006)	(0.002)
Reserves Change	-0.01	-0.004	-0.004***
	(0.008)	(0.005)	(0.001)
Public Debt/GDP Ratio	-0.001	-0.010***	0.01
	(0.001)	(0.002)	(0.011)
GDP Growth	0.013*	0.020***	0.031***
	(0.008)	(0.004)	(0.007)
R-Star (HLW, 2017)	0.160	0.470***	0.250*
	(0.100)	(0.140)	(0.150)
Observations	295	295	221
Adj. R-Squared	0.89	0.94	0.91

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Groups based on quantiles sorted by historical nominal exchange rate volatility, with (1) being the lowest volatility group, and (3) being the highest.

Table A23

ALTERNATIVE SPECIFICATION WITH PUBLIC DEBT INTERACTED WITH DOMESTIC OBJECTIVES

DEVELOPED MARKET ECONOMIES			EMERGING MARKET ECONOMIES		
Variable	IT	Non-IT	Variable	IT	Non-IT
	(1)	(2)		(3)	(4)
Public Debt/GDP Ratio	0.005	-0.045***	FX Public Debt/GDP Ratio	-0.267	1.606***
	(0.077)	(0.007)		(0.394)	(0.381)
Inflation x Public Debt/GDP Ratio	-0.102	-0.350*	Inflation x FX Public Debt/GDP Ratio	1.59	0.254
	(0.147)	(0.182)		(2.210)	(0.943)
GDP Gap x Public Debt/GDP Ratio	-0.013	0.041***	GDP Gap x FX Public Debt/GDP Ratio	0.140	-2.136***
	(0.077)	(0.009)		(0.351)	(0.350)
REER Change x Public Debt/GDP Ratio	-0.008	0.099**	REER Change x FX Public Debt/GDP Ratio	-0.146	-0.645***
	(0.011)	(0.044)		(0.138)	(0.173)
Reserves Change x Public Debt/GDP Ratio	-0.017*	0.005	Reserves Change x FX Public Debt/GDP Ratio	0.113	0.332
	(0.009)	(0.018)		(0.085)	(0.291)
Observations	535	277	Observations	905	298
Adj. R-Squared	0.89	0.87	Adj. R-Squared	0.83	0.68

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

+,++,+++ Indicate significance of the difference between IT and Non-IT estimate at the 10%, 5%, and 1% level, respectively.

Specification includes all main variables as the baseline specification, but we report just Public Debt interactions and main effects for brevity.

De jure IT classification based on IMF.

Table A24

ESTIMATED TAYLOR RULES: DMEs, GROUPED BY PUBLIC DEBT/GDP

Variable	DME de jure Inflation Targeters		DME de jure Non-Inflation Targeters	
	Low Debt	High Debt	Low Debt	High Debt
Interest Rate (t-1)	0.850***	0.560***	0.850***	0.890***
	(0.019)	(0.059)	(0.110)	(0.035)
Inflation	0.190***	0.300***	0.190***	-0.007
	(0.065)	(0.046)	(0.029)	(0.014)
GDP Gap	0.100***	0.370***	-0.031	0.008***
	(0.016)	(0.065)	(0.037)	(0.001)
REER Change	0.00004	0.014***	0.031***	-0.008
	(0.006)	(0.004)	(0.010)	(0.005)
Reserves Change	-0.004	0.002	-0.030***	-0.019*
	(0.003)	(0.007)	(0.005)	(0.010)
Public Debt/GDP Ratio	-0.021**	-0.024***	-0.028***	0.002
	(0.009)	(0.004)	(0.002)	(0.003)
GDP Growth	0.045***	0.024***	0.025	0.005
	(0.002)	(0.009)	(0.030)	(0.008)
Observations	217	152	53	117
Adj. R-Squared	0.85	0.83	0.83	0.78

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Low Debt and High Debt groups based on bottom 50% and top 50% in terms of public debt/GDP levels, respectively.

Table A25

ESTIMATED TAYLOR RULES: EMEs, GROUPED BY FX PUBLIC DEBT/GDP

Variable	EME de jure Inflation Targeters		EME de jure Non-Inflation Targeters	
	Low FX Debt	High FX Debt	Low FX Debt	High FX Debt
Interest Rate (t-1)	0.820***	0.710***	0.930***	0.210***
	(0.056)	(0.085)	(0.036)	(0.029)
Inflation	0.300***	0.580***	0.060**	1.300***
	(0.062)	(0.100)	(0.027)	(0.100)
GDP Gap	0.072***	0.130**	0.001	-0.004
	(0.020)	(0.052)	(0.009)	(0.006)
REER Change	-0.028	-0.026	-0.012	-0.270***
	(0.025)	(0.034)	(0.014)	(0.009)
Reserves Change	0.009	0.004	0.007***	0.170***
	(0.015)	(0.011)	(0.001)	(0.015)
FX Public Debt/GDP Ratio	0.001	-0.720**	-0.900***	0.470***
	(0.110)	(0.370)	(0.087)	(0.002)
Public Debt/GDP Ratio	-0.003	0.190*	0.005**	-0.340***
	(0.011)	(0.110)	(0.002)	(0.000)
FX Public Debt/Public Debt Ratio	(0.002)	0.250**	0.300***	-0.150***
	(0.016)	(0.120)	(0.042)	(0.006)
GDP Growth	(0.008)	(0.014)	0.005	-0.330***
	(0.012)	(0.020)	(0.011)	(0.007)
Observations	461	530	132	79
Adj. R-Squared	0.73	0.86	0.87	0.65

Dependent variable: Nominal interest rates. Panel fixed-effects estimation. The associated standard errors are noted below each estimated coefficient in parenthesis.

*, **, *** Indicate significance at the 10%, 5%, and 1% level, respectively.

Low Debt and High Debt groups based on bottom 50% and top 50% in terms of FX public debt/GDP levels, respectively.

Figure 1: Inflation-Targeting Adoption (de jure)

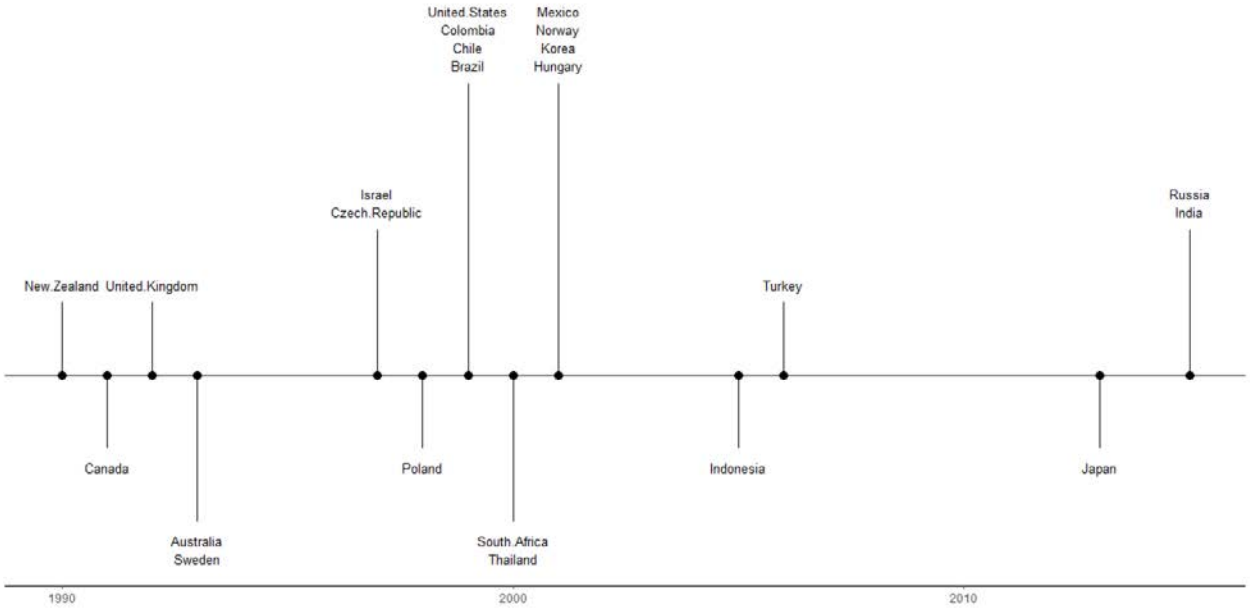


Figure 2: Developed Market Economies Summary Statistics by IT vs. non-IT (de jure)

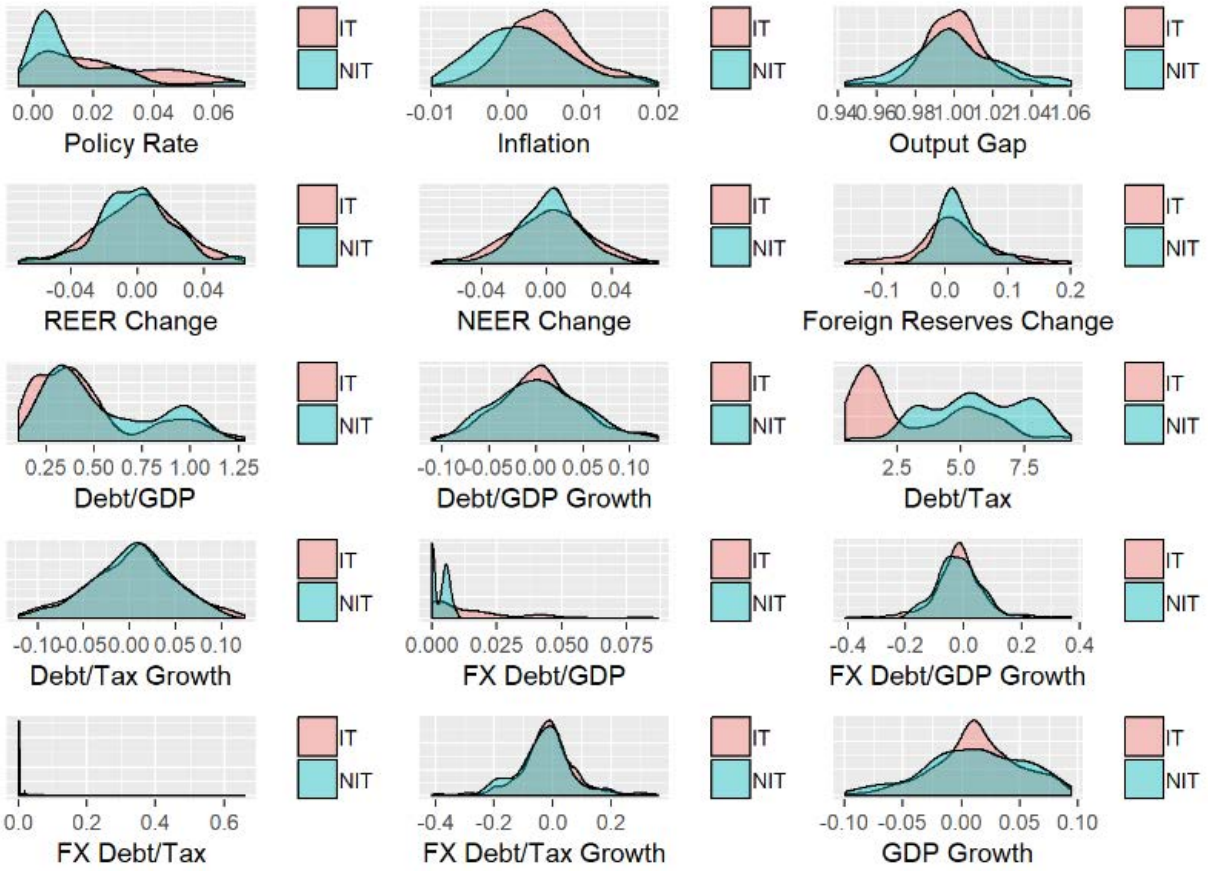


Figure 3: Emerging Market Economies Summary Statistics by IT vs. non-IT (de jure)

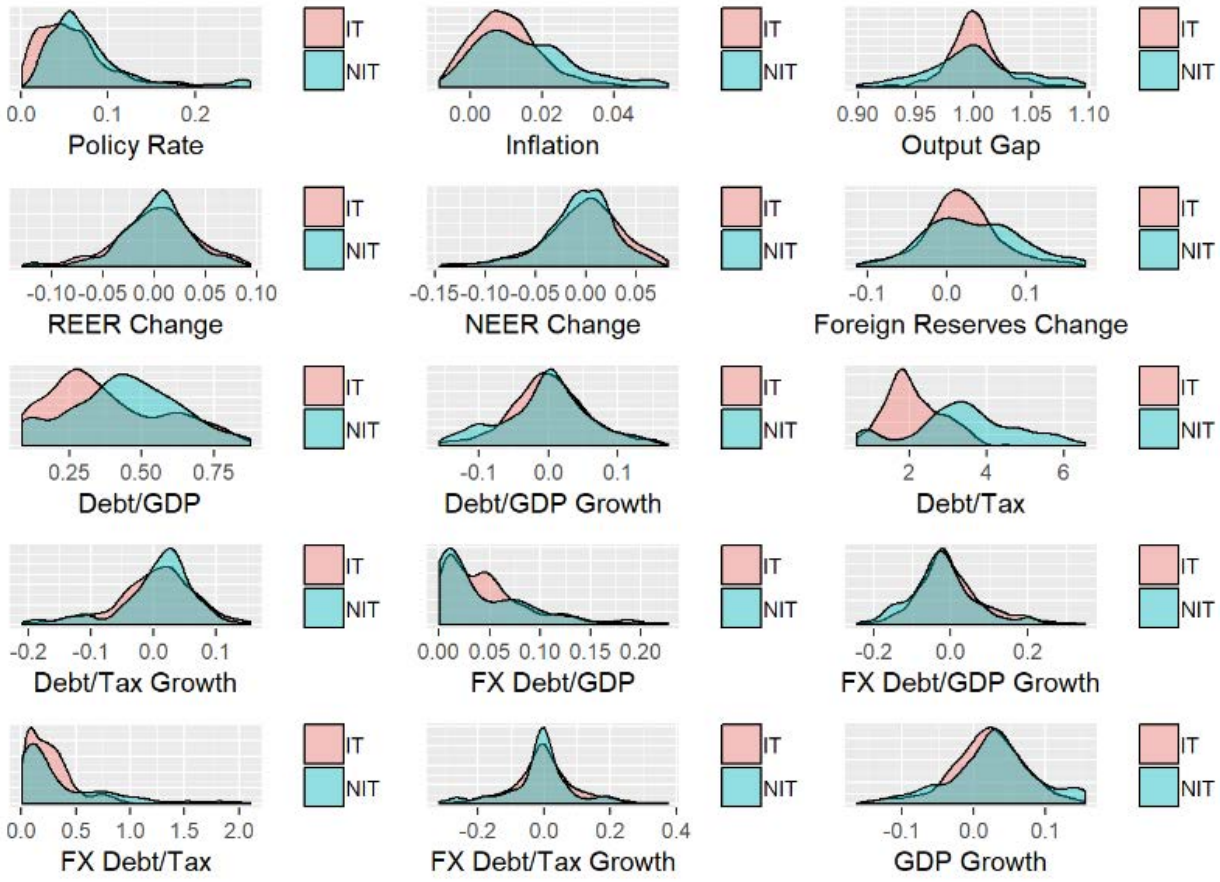


Figure 4

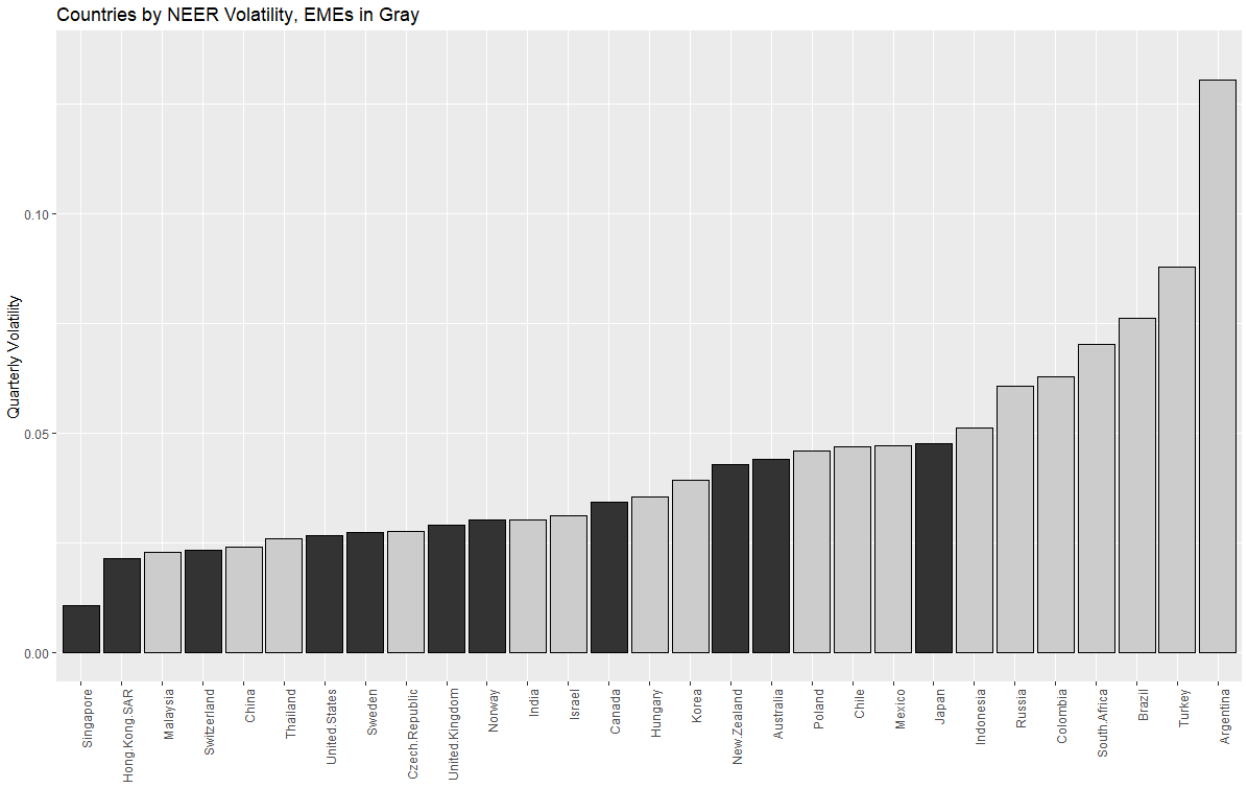

Countries by NEER Volatility, EMEs in Gray
Quarterly Volatility
0.10
0.05
0.00
Singapore
Hong.Kong.SAR
Malaysia
Switzerland
China
Thailand
United.States
Sweden
Czech.Republic
United.Kingdom
Norway
India
Israel
Canada
Hungary
Korea
New.Zealand
Australia
Poland
Chile
Mexico
Japan
Indonesia
Russia
Colombia
South.Africa
Brazil
Turkey
Argentina

Figure 5: Estimates from Table A8 Regressions, DME by Volatility Bin

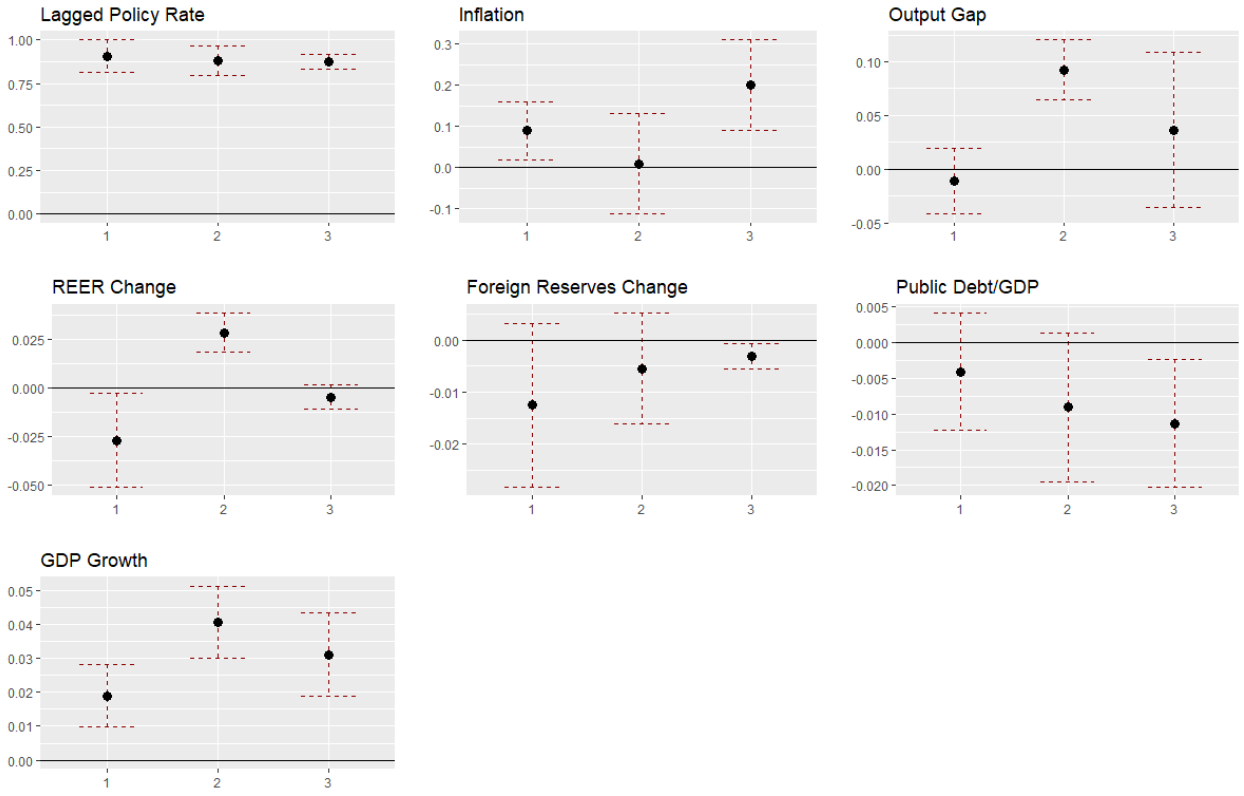


Figure 6: Estimates from Table A9 Regressions, EME by Volatility Bin

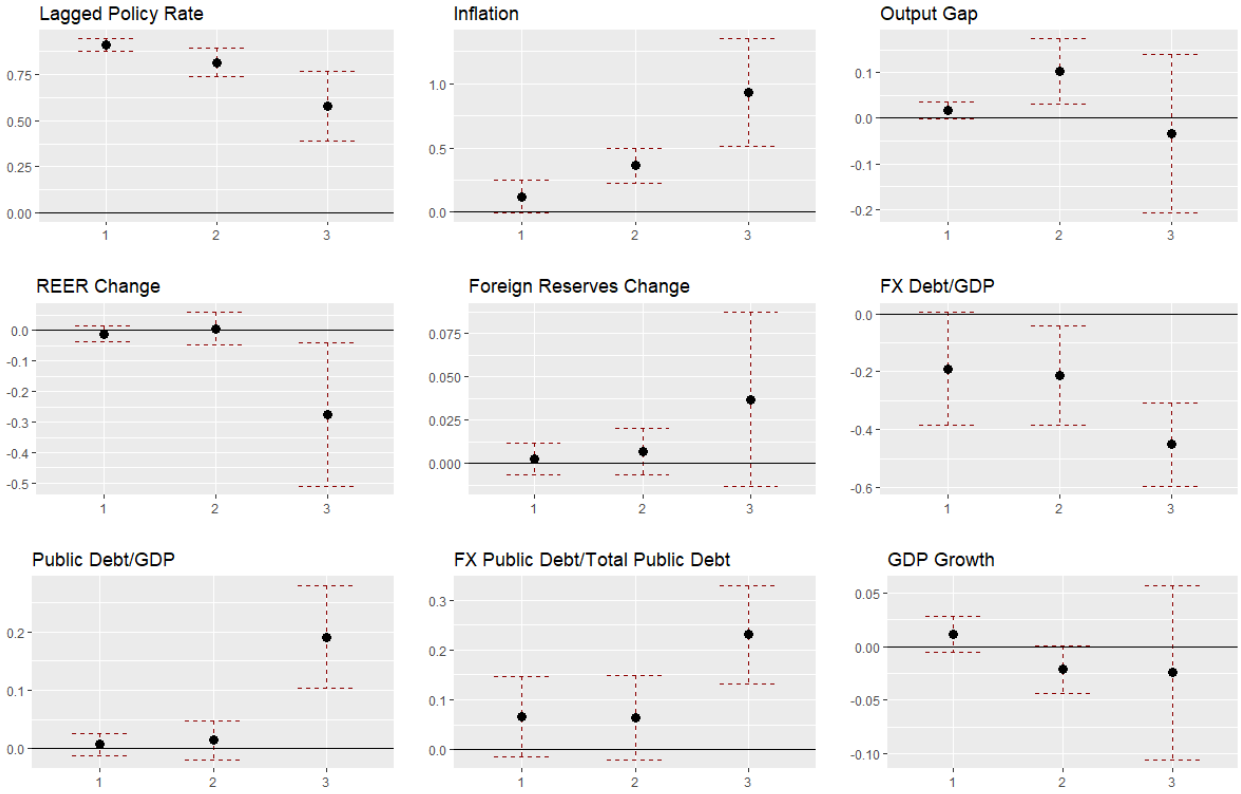


Figure 7 Policy rate response to a 0.01 increase in the FX Public Debt/GDP ratio (1 percentage point), as a function of FX Public Debt/Total Public Debt

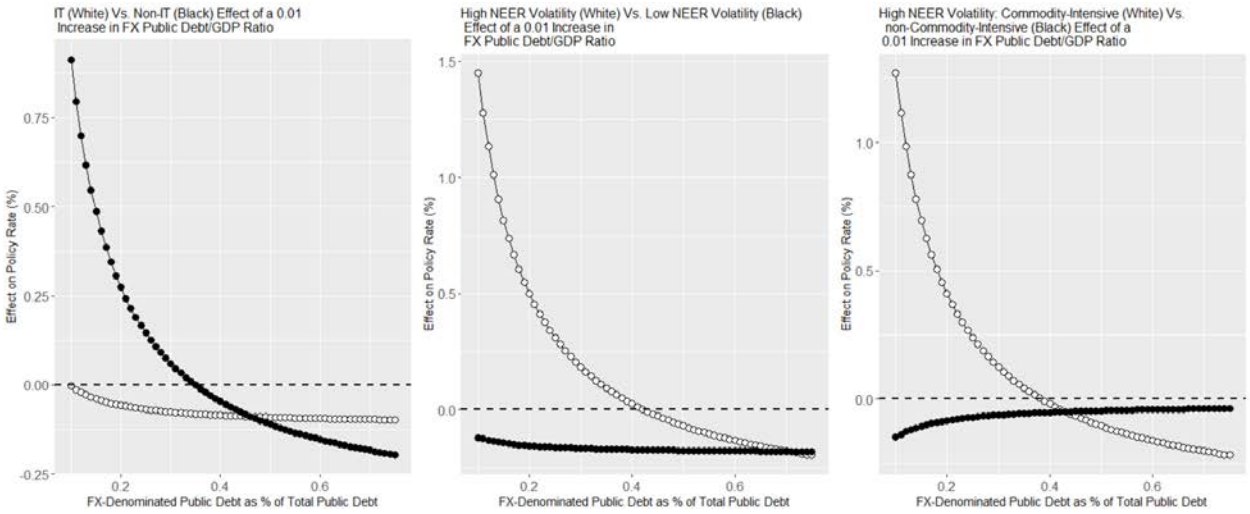


Figure 8 Distribution of FX Public Debt/Total Public Debt, First Observation (left), Last Observation (center), and change (right)

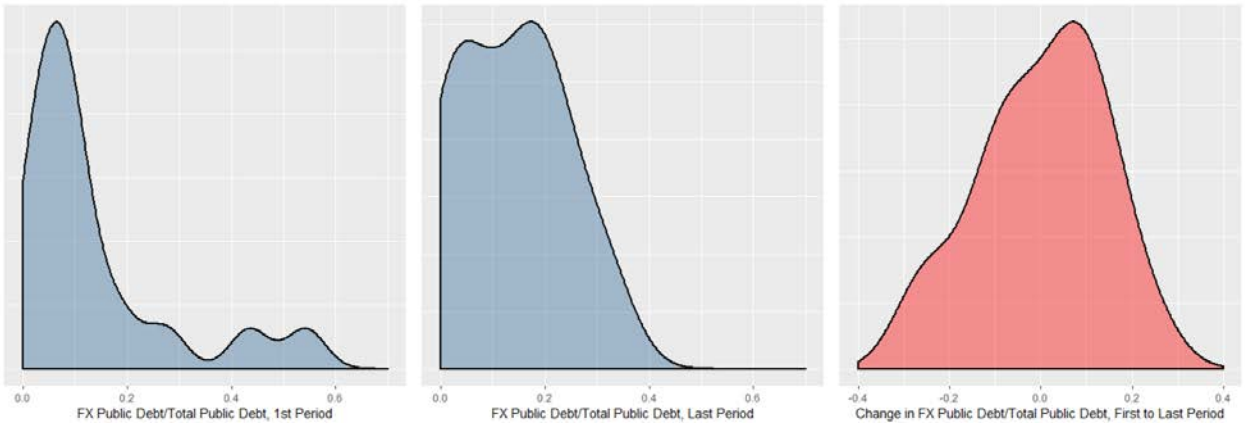
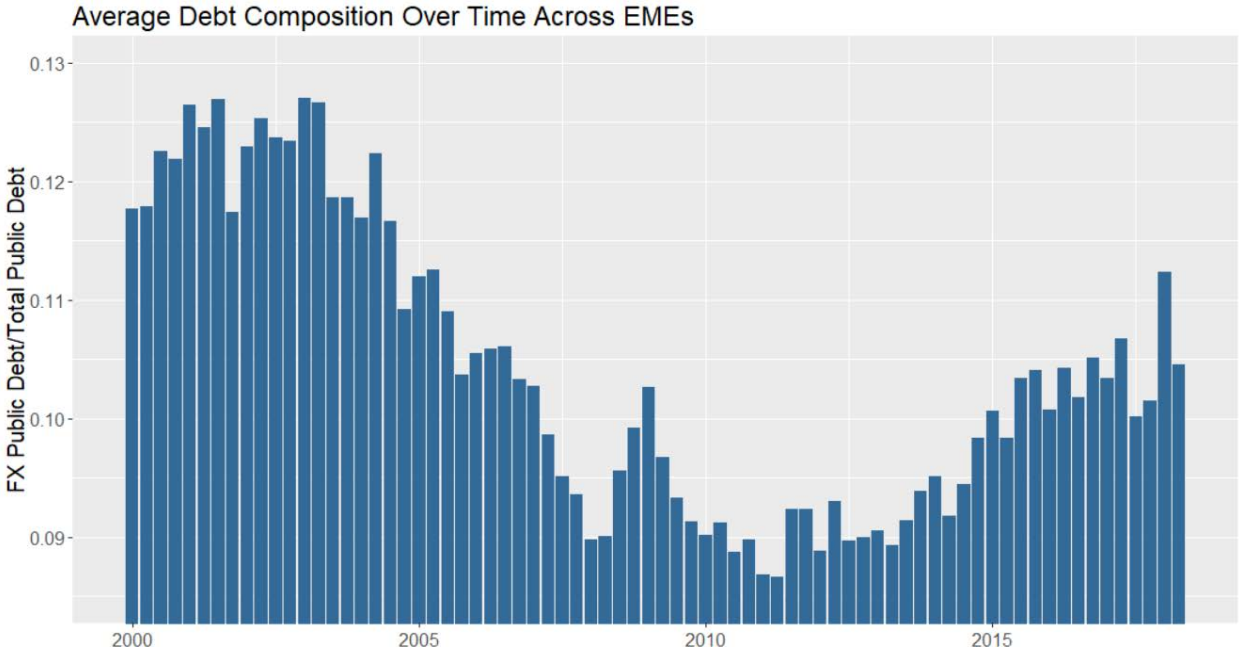
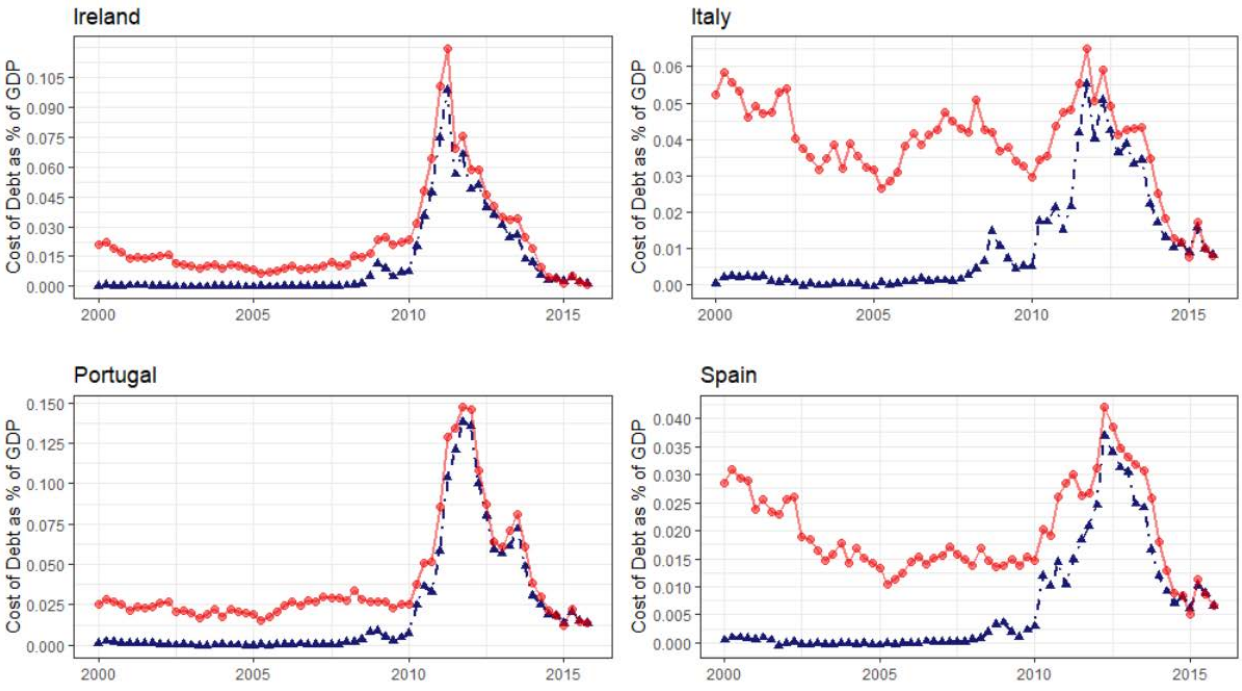


Figure 9 Historical EME Average of FX Public Debt/Total Public Debt



APPENDIX B: EURO DEBT CRISIS

Figure 10: Euro IIPS [Ireland, Italy, Portugal, Spain] annual burden of servicing the sovereign debt/GDP, including risk-free rate (red) and excluding risk-free rate (blue)



The blue and red lines in Figure 10 represent the approximate cost of serving the debt/GDP faced by IIPS governments net and gross of the risk-free rate, respectively. The blue line represents the annual cost of debt associated with expected default risk, defined by the expected probability of credit event times the percentage haircut. As an approximation, we take 5-year sovereign yields as the benchmark debt cost and multiply by the public debt/GDP ratio.[19] A more rigorous calculation of the cost of debt requires detailed information on the maturity structure of public debt. For these countries, the average maturity has ranged around 5 years and has been gradually rising. In Spain and Italy, by 2015, average maturity was equal to 6.45 years and 6.52 years, respectively. Specifically, we first construct normalized spreads, S_{it}, for each country i with respect to the German 5-year yield (the de facto risk-free rate, rf_t)[20]:

$$S_{it} = \frac{r_{it} - rf_t}{1 + r_{it}}.$$

The blue line – the annual cost of servicing the debt/GDP associated with default premia/GDP is then given by

$$S_{it} * \frac{PubDebt_{it}}{GDP_{it}}.$$

The red line, the annual cost of servicing the debt/GDP gross of the risk-free rate, is computed as

$$(S_{it} + rf_t) * \frac{PubDebt_{it}}{GDP_{it}}.$$

Before the crisis, the gross cost of debt across IIPS countries was dominated by the risk-free component. Over the euro crisis, the cost of debt became increasingly dominated by the default-risk component amidst further compression of the German 'risk-free' rate alongside the rising default risk premia among the IIPS. After the crisis, the wedge between net and gross cost of debt disappears, likely driven by the ultra-low risk-free rate. Moreover, default risk also came

[19] The 5-year sovereign bonds is the most liquid debt market for IIPS. Greece is not included in the charts due to concerns about the veracity of its sovereign debt size before the euro crisis, and the occurrence of several significant debt restructuring and haircuts after 2009.

[20] Assuming risk-neutral lenders, competitive and liquid markets, S_{it} reflects the expected default rate (the probability of default times the haircut), and is determined by the spread $r_{it} - rf_t$ normalized by country's i interest rate.

down with the risk-free rate in the post-crisis era, and periphery yields converged back down to the German yield with a lag (Figure 11). Taking these developments together, the approximate cost of debt by 2015 is roughly in line with pre-crisis levels, despite the Periphery's large accumulation in public sector debt since 2008.

Figure 11: Euro Periphery Countries and Germany: 5-year sovereign bond yield