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EXCHANGE RATES AND THE SPEED OF ECONOMIC RECOVERY: THE ROLE OF FINANCIAL DEVELOPMENT

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Exchange Rates and the Speed of Economic Recovery: The Role of Financial Development

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Abstract:
We study the influence of the exchange rate on the speed of economic recovery in a sample of 67 developed and developing economies over the years 1989-2019. First, using a cross-sectional sample of 341 economic recoveries, we study the effect of nominal depreciation and real undervaluation on the length of economic recovery. Our findings indicate that both nominal depreciation and real undervaluation increase the speed of economic recovery. However, this finding only holds for smaller depreciations/ undervaluations. Second, we use an interacted panel VAR (IPVAR) model to investigate the effect of real undervaluation on the speed of economic recovery after external shock. While we once again find evidence that undervalued domestic currency increases the speed of economic recovery, its positive effect seems limited in size. Furthermore, we also explore the role of financial development in influencing the effectiveness of undervalued domestic currency in stimulating the economic recovery. We find that the higher level of financial development seems to limit the negative effect of an overvalued currency on the speed of economic recovery, but not to influence the effect of an undervalued currency on economic recovery.

JEL: F10, F30, F31, F43
Keywords: Economic recovery, exchange rate, currency depreciation, real undervaluation, financial development, interacted panel VAR (IPVAR)

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1 Introduction

The study of economic downturns remains at the core of economic research. Ample volume of empirical studies have investigated the factors that contribute to economic downturns. On the other hand, only a limited number of empirical investigations study the determinants of economic recovery. Nevertheless, in light of the unprecedented slump in global economy in 2020-2021, the question of what factors determine a robust and sustainable recovery from an economic crisis has gained prominence. According to standard international macroeconomics textbooks exchange rate developments, by affecting international competitiveness and international trade, have a significant influence on macroeconomic performance – especially in smaller and more open economies. Therefore, currency undervaluation or depreciation is often argued to improve economic performance, and it might thus, also speed up (i.e., reduce the length of) an economic recovery. Indeed, several empirical studies have focused on exploring the effect of exchange rate depreciation on economic growth (Habib et al., 2017; Leigh et al., 2017). These studies usually find that currency depreciations have positive consequences for the real economy. However, almost all empirical analyses have thus far focused on studying the relationship between the exchange rate and economic performance in general – that is, they do not focus specifically on the economic recovery periods.

In this paper, we argue that during economic recovery periods, the relationship between the exchange rate and economic performance might differ from their general relationship, as firms might lack the resources to increase their production and exports or might be more risk averse and thus unable to fully benefit from a weaker or undervalued domestic currency. Therefore, we hypothesize that a weak or undervalued domestic currency might not be as efficient at increasing the speed of economic recovery as it is at increasing the economic growth during economic expansions. Furthermore, it might take some time for the competitiveness gains of weaker/undervalued domestic currency to materialize – and thus, the positive consequences of weaker/undervalued domestic currency might materialize only after the economy had already recovered. To date, only very few empirical papers have studied the determinants of the strength/length of economic recoveries and have also included the exchange rate among the studied determinants (Ambrosius, 2017; Eichengreen and Sachs, 1985; Takats and Upper, 2013; Tsangarides, 2012). These earlier studies have also predominantly been conducted in cross-sectional settings on somewhat small samples of economic crises. As a result, in this paper, we first identify a large sample of episodes of economic recovery from output gap recessions and we study the effect of weaker/undervalued domestic currency on the length/duration of these economic recovery episodes. Furthermore, we explore non-linearities in the effect of exchange rate on the length/speed of economic recovery. Such an approach, however, might not fully capture the macroeconomic dynamics *during* the economic recovery period. As a result, in this research, we further study the role of a weaker/undervalued domestic currency in increasing the speed of an economic recovery in a panel framework. The estimation using a panel framework entails several advantages: it allows us to i) include a larger number of economic contractions, ii) capture the macroeconomic dynamics during economic recovery periods, and iii) incorporate a heterogeneous group of economies in the empirical analysis.

While the standard assumption in international macroeconomics is that the exchange rate influences the real economy via the 'trade channel', there is also an emerging strand in the empirical literature that emphasizes the importance of the 'financial channel' in the macroeconomic effect of a weaker domestic currency: domestic currency depreciation is likely to increase the cost of cross-border borrowing, increase the domestic-currency value of external liabilities and lead to a contraction of overall cross-border borrowing (Bruno and Shin, 2015; Fisera et al., 2021; Georgiadis et al., 2021). The findings of these studies underscore the importance of the financial sector in the overall macroeconomic effect of the exchange rate. Indeed, a higher level of financial development might be argued to be an important determinant of the effectiveness of a weaker/undervalued domestic currency in stimulating economic growth: a more developed financial sector might be more efficient at providing external sources of financing to exporters, enabling them to increase their exports and benefit more from weaker/undervalued domestic currency. While the importance of a well-developed financial sector in facilitating a positive effect of a weaker/undervalued domestic currency on the domestic economy has already been highlighted, the empirical evidence remains limited: Acevedo et al. (2015) have found some empirical evidence that higher private sector credit growth might increase the probability of an expansionary external devaluation, while Leigh et al. (2017) have found that tighter financing conditions reduce the responsiveness of exports to exchange rates. However, empirical evidence on how the level of financial development influences the macroeconomic consequences of a weaker/undervalued domestic currency remains absent. Therefore, in this research, we additionally explore the conditionality on the level of financial development with respect to the effect of a weaker/undervalued domestic currency on the speed of economic recovery.

Our paper extends the current empirical literature in several aspects. First, we use the zero-truncated negative binomial regression to study the determinants of the speed of economic recovery using a large sample of economic recoveries, while allowing for non-linearity in the effect of exchange rate. Second, to the best of our knowledge, ours is the first empirical study that investigates the conditionality of the speed of economic recovery on the exchange rate of the domestic currency in a panel setting – with this approach enabling us to capture developments *within* the economic recovery periods. Third, we explore how the level of financial development influences the effect of the exchange rate on the speed of economic recovery – thus extending the emerging literature on the 'financial channel' of the macroeconomic effects of the exchange rate.

To study the effect of weaker/undervalued domestic currency on the speed of economic recovery, we first identify 341 economic recoveries from output gap recessions. By focusing on recoveries from output gap recessions, we are able to maximize the sample of economic recoveries. We use the zero-truncated negative binomial regression approach on a cross-sectional data for the identified economic recovery episodes to model the determinants of the length of economic recovery. In general, we fail to find evidence that the nominal exchange rate movements influence the speed of economic recovery, but we find some evidence that real undervaluation of the domestic currency cuts the length and thus increases the speed of economic recovery. However, this effect seems to be limited in size. By including quadratic terms in our regression framework, we are also able to explore the non-linearity in the effect of exchange rate on the length of economic recovery. Our findings indicate that smaller nominal exchange rate depreciations might cut the length of economic recovery and therefore, increase its speed. But once again, this positive effect seems to be somewhat small in size. Conversely, larger nominal depreciations, exceeding 12 %, increase the length of economic recovery. On the other hand, the exchange rate appreciation does not seem to influence the length of economic recovery. In this case, our findings for real under-/overvaluations are broadly similar to the findings for nominal depreciations/appreciations.

Next, to study the role of the domestic currency exchange rate and the interaction of the exchange rate and financial development in influencing the speed of economic recovery from an external shock in a panel framework, we estimate the interacted panel VAR (IPVAR) model of Towbin and Weber (2013).[1] This empirical approach enables

[1] In this research, we focus on studying the response of real output to external shocks only, not domestic shocks (e.g., monetary policy or credit shocks). We argue that this is approach enables us to better capture the conditionality of the response of real output, since we are able to explore how real output in different countries responds to a single type of shock, conditional on the domestic currency exchange rate and the financial development level. That is, we are able to explore how the transmission of a shock affecting numerous countries simultaneously differs across these heterogeneous countries. Furthermore, given this choice, we do not have to control for country-specific characteristics that might influence the transmission of domestic shocks (e.g., for monetary policy shocks, different monetary policy frameworks across countries might affect the transmission of such shocks to domestic output).

us to study not only how real output responds to macroeconomic shocks (and how quickly real output returns to potential output – i.e., the speed of economic recovery) but also what influences this response. Importantly, it also allows us to capture cross-time variation in the conditional variables and their effect on the response of real output. Using quarterly data for a panel of 66 advanced and emerging economies over the years 1989-2019, we find that while an undervalued domestic currency increases the speed of economic recovery this effect does not seem to be very large. This finding is in line with the results of our preliminary motivational empirical analysis, which indicated that while undervalued domestic currency does have a positive effect on economic growth in general, this effect is much smaller during the period of economic recovery. Furthermore, we find that higher financial development does not influence the impact of an undervalued domestic currency on real output during the economic recovery period. On the other hand, higher financial development seems to limit the negative effect of an overvalued domestic currency on the speed of economic recovery. Our results thus indicate that the response of real output to external shocks in countries with higher financial development and an overvalued domestic currency is not statistically significantly different from that in countries with an undervalued currency (and either high or low financial development). Therefore, we conclude that our results underline the greater importance of financial development than an undervalued domestic currency in stimulating an economic recovery.

The rest of the paper is organized as follows: Section 2 discusses the related literature. Section 3 presents the empirical methodology, while Section 4 outlines our dataset. We report our results of cross-sectional regressions in Section 5, while Section 6 outlines the results of panel regressions. Finally, Section 7 concludes the paper. The results of additional robustness checks are available in the Appendix.

2 Related Literature

In this paper, we follow several strands of empirical literature. First, there are numerous studies on the effect of the exchange rate on economic performance. Such papers include, for example, Habib et al. (2017) and Leigh et al. (2017). A second strand of literature investigates the impact of real undervaluation on the real economy (Aguirre and Calderon, 2005; Cuestas et al., 2020; Fisera and Horvath, 2022; Nouira and Sekkat, 2012; Rodrik, 2008). These studies investigate whether deviations of the actual real exchange rate from its equilibrium (or long-term) value might influence economic performance. This strand of literature usually arrives at conflicting conclusions – with some studies finding evidence of positive macroeconomic effects of undervaluation (Rodrik, 2008), and others finding no impact (Fisera and Horvath, 2022; Nouira and Sekkat, 2012) or even a negative effect of an undervalued domestic currency (Cuestas et al., 2020). Numerous empirical analyses also find substantial nonlinearities in the relationship between real undervaluation and economic growth (Aguirre and Calderon, 2005; Fisera and Horvath, 2022).

Third, the strand of literature that we follow most closely includes studies on the determinants of the strength or length of economic recoveries. However, the number of such empirical studies is somewhat limited. Eichengreen and Sachs (1985) represent an early example, and they conclude that countries that experienced stronger currency devaluations during the Great Depression in the early 1930s also exhibited stronger recoveries. They argue that currency depreciations in the 1930s affected countries' economic recoveries through four main channels: real wages, profitability, international competitiveness and world interest rates. Takats and Upper (2013) focus on a sample of economic recoveries after financial crises and find that real exchange rate depreciations before the recovery period facilitated faster recovery. Ambrosius (2017) study recoveries from banking crises and find that, among others, real currency overvaluation leads to later recovery (i.e., increases the length of the recovery). Tsangarides (2012) focus on the role of exchange rate regimes in fostering recovery, finding some limited evidence that countries with fixed exchange rates experienced a slower recovery from the global financial crisis of 2008-2009 (GFC). Furthermore, Hausmann et al. (2005) investigate the determinants of growth accelerations and find real depreciation to be among the factors increasing the probability of such accelerations. Nevertheless, the periods of growth acceleration on which Hausmann et al. (2005) focus do not always correspond with economic recovery periods. Other empirical studies have investigated the factors that facilitate stronger or shorter recoveries but have not included the exchange rate among the predictors (Dao, 2017).

3 Empirical Methodology

3.1 Identifying Episodes of Economic Recoveries

In identifying the economic recovery episodes, we follow the 'growth cycle' approach of Grigoli and Hakura (2010). Therefore, we first identify economic downturns as situations, when the negative output gap exceeded 0.5 % of the potential GDP. Then, we define economic recovery as a period starting one quarter after the upturn/through (i.e., most negative output gap during each of the economic downturn episodes) and ending once the output gap turns positive. Furthermore, we focus only on economic recoveries that lasted at least one quarter. That is, we exclude any brief episodes when the output gap turned positive in the quarter immediately following the upturn. The obvious drawback of this approach is that in essence, we focus on economic recoveries from output gap recessions and not on economic recoveries from actual recessions. However, an important advantage of this approach to the identification of economic recoveries is that it enables us to maximize the sample size and thus, make our inferences more robust. Furthermore, we argue that the focus on economic recoveries from output gap recessions might provide us with interesting insights – since we are able to explore the determinants of the speed of economic recovery following periods when the economy had previously underperformed.

3.2 Determinants of the Length of Recovery

To study the role of the exchange rate in influencing the speed of economic recovery, we first conduct our empirical analysis in a cross-sectional framework – relying on the dataset of economic recovery episodes that were identified using the approach outlined above. To capture the speed of economic recovery, we define our dependent variable as the length of economic recovery expressed in quarters – a shorter recovery episode indicates a higher speed of economic recovery. Therefore, we estimate the following simple regression:

$$Length_i = \alpha_0 + \alpha_1 \Delta ER_i + \sum_{j=0}^{m} \beta_j X_i + \sum_{j=0}^{n} \gamma_j Z_i + \lambda_t + \epsilon_i \tag{1}$$

where $Length_i$ stands for the length of economic recovery episode i in quarters. ER is the logarithm of the exchange rate[2], X is a vector of control variables that control for the characteristics of the downturn preceding the economic recovery, Z is a vector of macroeconomic characteristics that might influence the duration of the economic recovery episode, while $lambda_t$ are year fixed effects that enable us to capture the common factors, such as global GDP growth, that might influence the length of all the economic recoveries that commenced during the same year. To deal with endogeneity issues, all the explanatory variables from equation 1 take the values at through – i.e., in a quarter preceding the start of the economic recovery episode. In equation 1, the coefficient of interest is α_1, which enables us to study the effect of annual exchange

[2]In an alternative specification, we replace the nominal exchange rate measure with a measure of real currency misalignments.

rate change at through on the length of the subsequent recovery. In other words, the coefficient α_1 enables us to study whether a depreciation of the domestic currency just before the start of economic recovery cuts the duration and increases the speed of the subsequent economic recovery.

Given that our dependent variable *Length* is a count variable that exhibits overdispersion and which can not take the value of 0, we estimate the equation 1 as the zero-truncated negative binomial regression by maximum likelihood.

Additionally, as we hypothesize that the effect of the exchange rate on the length of economic recovery might be non-linear[3], we follow the approach of Bussiere (2007) and introduce a quadratic term to the equation 1 to capture the non-linearities in the effect of the exchange rate on the length of economic recovery:

$$Length_i = \alpha_0 + \alpha_1 \Delta ER_i + \alpha_2 D_{dep} * (\Delta ER_i)^2 + \alpha_3 D_{dep} + \sum_{j=0}^{m} \beta_j X_i + \sum_{j=0}^{n} \gamma_j Z_i + \lambda_t + \epsilon_i \quad (2)$$

$$Length_i = \alpha_0 + \alpha_1 \Delta ER_i + \alpha_2 D_{ap} * (\Delta ER_i)^2 + \alpha_3 D_{ap} + \sum_{j=0}^{m} \beta_j X_i + \sum_{j=0}^{n} \gamma_j Z_i + \lambda_t + \epsilon_i \quad (3)$$

where D_{dep} is a dummy variable for domestic currency depreciation at through, while D_{ap} is a dummy variable for domestic currency appreciation at through. We estimate the equations 2 and 3 separately. Furthermore, we interact the quadratic term of the exchange rate measure with dummy variables for depreciations and appreciations, respectively, as this approach does not impose the same slope on the non-linearities on both the exchange rate depreciations and appreciations. The inclusion of (non-interacted) dummy variables D_{dep} and D_{ap} in equations 2 and 3, respectively, allows for different intercept between depreciations and appreciations.

Finally, to capture the conditionality of the effect of exchange rate changes on the length of economic recovery on financial development, we simply interact the measure of exchange rate with our measure of financial development:

[3]Namely, the effect of exchange rate appreciation and exchange rate depreciation on the speed of economic recovery might be differentiated. Moreover, the effect of depreciations/appreciations might vary with different magnitudes of depreciations/appreciations – for instance, some of the downturns preceding the recovery might be associated with quite large depreciations, which are less likely to have a positive effect on the real economy and thus to increase the speed of economic recovery than smaller depreciations.

$$
\begin{aligned}
Length_i = \alpha_0 + \alpha_1 D_{dep} * \Delta ER_i + \alpha_2 D_{ap} * \Delta ER_i + \alpha_3 D_{dep} * \Delta ER_i * FD_i \\
+\alpha_4 D_{ap} * \Delta ER_i * FD_i + \sum_{j=0}^{m} \beta_j X_i + \sum_{j=0}^{n} \gamma_j Z_i + \lambda_t + \epsilon_i
\end{aligned} \tag{4}
$$

where FD is our measure of financial development. Considering the non-linearities discussed above, in this empirical analysis, we also distinguish between appreciations and depreciations – by adding two interaction terms to the equation 4 and multiplying them by appreciation and depreciation dummy variables, respectively.

3.3 Interacted Panel VAR

To capture the heterogeneity in the responses of real output to external shocks, we use the interacted panel VAR (IPVAR) model that was first introduced by Towbin and Weber (2013)[4] and enables assessment of the effect of exogenous structural characteristics on the responses of macroeconomic characteristics to macroeconomic shocks. To the best of our knowledge, ours is the first study to utilize this approach to study the conditionality of the exchange rate effect on the speed of economic recovery. We argue that this empirical approach is beneficial in our context, as it allows us not only to capture the heterogeneity in real output responses to external shocks conditional on the exchange rate but also – owing to our calculation of impulse responses – to uncover how the real output response varies over time. Additionally, the use of IPVAR enables us to control for changes in our main conditioning variable (i.e., exchange rate) over time.[5] Moreover, we can also study the conditionality of real output responses on financial development and its interaction with the exchange rate.

The structural form of the IPVAR model is represented by the following equation:

[4]This approach has also been used by, for instance, Sa et al. (2014), Georgiadis (2014) and Leroy and Lucotte (2015).

[5]As opposed to simply splitting the sample into countries with above-average and below-average values of the conditioning variable.

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ \alpha^{21}_{0,it} & 1 & 0 & 0 \\ \alpha^{31}_{0,it} & \alpha^{32}_{0,it} & 1 & 0 \\ \alpha^{41}_{0,it} & \alpha^{42}_{0,it} & \alpha^{43}_{0,it} & 1 \end{pmatrix} \begin{pmatrix} SHOCK_t \\ INVEST_{it} \\ GDP_{it} \\ CPI_{it} \end{pmatrix} = \sum_{l=1}^{L} \begin{pmatrix} \alpha^{11}_{l,it} & \alpha^{12}_{l,it} & \alpha^{13}_{l,it} & \alpha^{14}_{l,it} \\ \alpha^{21}_{l,it} & \alpha^{22}_{l,it} & \alpha^{23}_{l,it} & \alpha^{24}_{l,it} \\ \alpha^{31}_{l,it} & \alpha^{32}_{l,it} & \alpha^{33}_{l,it} & \alpha^{34}_{l,it} \\ \alpha^{41}_{l,it} & \alpha^{42}_{l,it} & \alpha^{43}_{l,it} & \alpha^{44}_{l,it} \end{pmatrix} \begin{pmatrix} SHOCK_{t-1} \\ INVEST_{it-1} \\ GDP_{it-1} \\ CPI_{it-1} \end{pmatrix} + \begin{pmatrix} \delta^{11} & \delta^{12} \\ \delta^{21} & \delta^{22} \\ \delta^{31} & \delta^{32} \\ \delta^{41} & \delta^{42} \end{pmatrix} \begin{pmatrix} I_i \\ X_{it-1} \end{pmatrix} + \epsilon_{i,t} \tag{5}$$

where $SHOCK$ stands for our measure of external shocks, $INVEST$ are investments, GDP is real GDP, and CPI stands for inflation. i denotes the country, t stands for time and L refers to the number of lags. I_i is a country-specific constant. X_{it-1} is a vector of exogenous conditioning variables, and $\epsilon_{i,t}$ is a vector of uncorrelated error terms. The vector of exogenous variables includes the exchange rate measure, the financial development measure and the interaction between them.

The distinguishing feature of the interacted panel VAR framework is that the structural parameters $\alpha_{l,it}$ vary over time and across countries with the levels of our exogenous variables, as the autoregressive coefficients of the endogenous variables are functions of the time-varying level of the exogenous variables:

$$\alpha^{jk}_{l,it} = \beta^{jk}_{l,1} + \beta^{jk}_{l,2} ER_{it-1} + \beta^{jk}_{l,3} FD_{it-1} + \beta^{jk}_{l,4} ER_{it-1}.FD_{it-1} \tag{6}$$

where ER stands for our exchange rate measure, while FD represents our financial development measure. Nevertheless, in our baseline specification, we hypothesize that the exogenous conditioning variables affect only the transmission of external shocks to real GDP. As a result, we set restrictions on our framework by considering a parameter matrix where only the autoregressive coefficients of real GDP to the external shock are interacted with the three conditioning variables. More specifically, in equation 5, only the coefficients $\alpha^{31}_{l,2}$, $\alpha^{31}_{l,3}$, and $\alpha^{31}_{l,4}$ are associated with the external shocks. All the remaining restrictions are hard set to zero; that is, we assume that our exchange rate and financial development measures have no conditioning impact on the remaining respective impulse response functions (IRFs).

In line with Towbin and Weber (2013), we estimate the interacted panel VAR equation by equation with OLS, as the error terms are uncorrelated across the equations by construction. Furthermore, we include country fixed effects in the interacted panel VAR. The fixed effects enable us to control for country-specific unobserved time-invariant characteristics across the countries in our sample. While the inclusion of fixed effects in dynamic models leads to the well-known Nickell bias of Nickell (1981), the bias decreases with the length of the sample period.[6] The number of lags for the IPVAR framework is selected in line with Leroy and Lucotte (2015) and Fisera and Siranova (2021) by taking the average number of lags suggested by the Akaike and Schwarz information criteria in country-specific VARs. Based on this approach, the number of lags included in our baseline estimations is 3. The selection and ordering of the macroeconomic variables in the panel VAR model are in line with the earlier literature that uses panel VAR models to study the transmission of shocks to the real economy (Loayza and Raddatz, 2007; Towbin and Weber, 2013; Georgiadis, 2014). As the procedure used to recursively disentangle structural shocks is based on Cholesky decomposition, in line with Fisera and Siranova (2021), we prefer to keep the basic structure of the panel VAR simple and thus we keep the number of variables limited.

After the estimation of the IPVAR model, we generate the cumulative impulse responses, which are a nonlinear function of the OLS estimates. We evaluate the impulse responses of real output to external shocks at high and low values of the exogenous variables (i.e., the exchange rate and financial development measures). The high and low levels of the exogenous conditioning variables, at which we assess the impulse responses correspond to their 75th and 25th percentile values, respectively. The confidence intervals are drawn from a normal distribution and symmetric confidence bands for 90 % confidence levels are reported. The number of simulations for the bootstrapped confidence intervals is 200.

4 Data

In the following section we outline our data. First, we outline the cross-sectional dataset and second, we discuss our panel dataset that is used for the IPVAR analysis.

4.1 Cross-Sectional Dataset

Using the approach outlined in the sub-section 3.1 we identify 341 episodes of economic recovery from output gap recessions in a sample of 67 countries over the years 1989-2019.

[6] Thus, considering the use of quarterly data in our framework and the resulting high number of observations over time, Nickell bias is less likely to substantially influence our results. Additionally, Rebucci (2003) finds, using Monte Carlo simulations, that in standard macro panels, panel VARs with fixed effects outperform the alternative mean group estimators – unless the slope heterogeneity is very high. Moreover, the IPVAR approach enables the slope coefficients to vary with exogenous country-level characteristics thanks to the interaction terms, limiting the bias to the estimates with a common slope, which arises due to heterogeneity in the slope coefficients across countries, as identified by Pesaran and Smith (1995).

The list of countries is reported in Table A1 i the Appendix. For each economic recovery episode, we identify its length. The length of economic recovery is measured as the number of quarters between the quarter following the through (i.e., the deepest point of the recession) and the quarter when the output gap turns positive (i.e., the economy recovers). The standard Hodrick-Prescott (HP) filter was used to calculate the output gap. Data on real GDP that was used to identify the output gap was taken from the International Financial Statistics database of the International Monetary Fund (IMF).

We use two alternative measures of exchange rate – the nominal effective exchange rate (NEER) and the real currency misalignment. NEER is defined as annual percentage change of NEER at through (i.e., quarter before the start of the economic recovery). The NEER data are taken from the IMF's International Financial Statistics database. As our real currency misalignment measure, we use data on real currency misalignment taken from the EQCHANGE database, which is compiled by the Centre d'Etudes Prospectives et d'informations Internationales (CEPII) based on Couharde et al. (2017).[7] We set both our exchange rate measures, as well as all the other control variables, at their values at through to address endogeneity concerns.

We also introduce various control variables in our regressions – to control both for the characteristics of the recession that preceded the economic recovery, as well as for country-level macroeconomic characteristics. These control variables are chosen based on the earlier empirical literature, which studied the determinants of economic recovery (Ambrosius, 2017; Takats and Upper, 2013; Tsangarides, 2012). The characteristics of the recession include i) recession magnitude – measured as the percentage value of the negative output gap at through, and ii) recession length – measured as the number of quarters during which the output gap was negative. The macroeconomic characteristics include GDP in purchasing power parity (PPP) terms as a proxy for the size of the economy, GDP (PPP) per capita as a measure of economic development, government debt to control for the fiscal policy and in particular for its room to maneuver, as highly indebted countries are likely to possess only a limited room for fiscal expansion that might stimulate the economic recovery. We include the gross fixed capital creation among the explanatory variables, as investments are usually assumed to be among the main determinants of economic growth – and so, countries with higher investments might recover faster. We also control for the annual rate of inflation at through – to control for inflationary pressures that might be triggered by the depreciation of the domestic currency during the recession.

[7] Both NEER and real currency misalignment are expressed in indirect quotation and thus, an increase in their values corresponds to nominal appreciation and real overvaluation, respectively.

Finally, as our measure of financial development, we use the financial development index of Svirydzenka (2016). However, financial development is highly endogenous to the level of economic development (see Figure A1 in the Appendix). Namely, the level of financial development is systematically higher in more developed countries. As a result, our findings on the role of the financial development could be driven simply by different characteristics of economic recoveries in advanced and developing economies. To address this concern, we first regress the composite index of financial development on the logarithm of GDP (PPP) per capita in the same panel sample of countries that was used to identify economic recovery periods.[8] Next, we use the residuals from this regression as our primary financial development measure. This financial development measure captures the difference between the actual level of financial development in a country and the level of financial development that would on average be associated with a country at the same level of economic development.

The data on control variables are taken from the International Monetary Fund (IMF), World Bank and from the Bank for International Settlements (BIS). We report the summary statistics for the cross-sectional dataset in Table A2 in the Appendix, while Table A3 in the Appendix reports the correlation among the variables. We report the detailed description of the variables and data sources in the Table A4 in the Appendix.

4.2 Panel Dataset

In our second empirical analysis, we use quarterly data for a panel of 67 advanced and emerging economies over the years 1989-2019. The panel dataset is unbalanced; however, we include only countries for which we have at least 24 continuous quarterly observations (i.e., six years of data) in our dataset. Our country selection is primarily driven by the availability of quarterly data. We also exclude any observations for which the annual rate of inflation exceeded 300 %. Finally, in line with Towbin and Weber (2013) we drop the United States from our sample, as the assumption of exogeneity of external shocks might not hold in the case of the United States. The list of countries included in our analysis is reported in Table A1 in the Appendix.

In this analysis, we use two measures of external shocks. First, in line with Towbin and Weber (2013), we use the foreign real interest rate as our primary measure of external shocks. This indicator is defined as the short-term interest rate[9] in the foreign economy adjusted for the annual CPI inflation rate in the foreign economy. The

[8] We also include year time effects in this panel regression.

[9] The money market rate, or, if this is not available, the treasury bills rate.

foreign economy is assumed to be the United States.[10] Data on the nominal interest rate and CPI inflation in the foreign economy are taken from the International Financial Statistics Database of the IMF. Second, as a robustness check, we use the measure of intra-day gold price change of Piffer and Podstawski (2018) as another proxy for external shocks. This measure represents the intra-day change in the gold price between the two auctions that occurred during narratively selected global risk shock events[11], and it has been used as a proxy for global risk or uncertainty shocks by, for instance, Georgiadis et al. (2021). Indeed, measures of global risk have already been found to be correlated with the global financial cycle (Rey, 2016), and global risk or uncertainty shocks have been found to contribute to global economic contractions by Baker et al. (2016) and Georgiadis et al. (2021). Data on intra-day price changes during days with global risk or uncertainty events are taken from Piffer and Podstawski (2018) and Bobasu et al. (2021), who provide a subsequent update of the data for the years 2016-2019. In line with the approach of Gertler and Karadi (2015) and Georgiadis et al. (2021), we obtain quarterly data on gold price surprises by taking the quarterly average of the intra-day gold price change.

To determine the role played by the exchange rate in the speed of economic recoveries, we use a measure of real currency misalignment – that is, the deviation between the actual real effective exchange rate and its equilibrium value. We use this measure instead of the nominal exchange rate to address the issue of endogeneity. Namely, the nominal exchange rate is significantly influenced by the economic cycle. For instance, economic recessions are generally accompanied by exchange rate depreciations. The use of real currency misalignment as our proxy for the exchange rate enables us to address this issue as the level of medium-term real currency misalignment is not substantially driven by short-term exchange rate movements.[12] Furthermore, the use of real currency misalignment as our exchange rate measure entails several additional advantages: i) currency misalignments calculated based on the real effective exchange rate (REER)

[10]However, in a robustness check, we use an alternative measure of the foreign real rate, where for each country in our sample, the foreign economy is identified based on Ilzetzki et al. (2019), who identified an anchor or reference (for countries with floating exchange rate regimes) currency for each country quantitatively based on the variability of the exchange rate of the domestic currency and the anchor (reference) currency, external debt denomination, foreign trade invoicing currency and denomination of FX reserves. That is, for each country in our sample, the foreign economy is the economy of the anchor or reference currency. For countries, for which the euro is the anchor or reference currency, we set Germany as the foreign economy. For Germany itself, the foreign economy is the United States.

[11]The intra-day gold price change is calculated as the percentage change in the gold price between the last auction before the news about the global uncertainty/risk event and the first auction afterwards.

[12]Nonetheless, since the exogeneity of real currency misalignment might be considered quite a strong assumption, we address this issue in several robustness checks.

also exhibit some variability for countries with fixed exchange rate regimes; and ii) as economic recessions are associated with depreciations of the domestic currency for most countries, the level of currency over-/undervaluation might better capture the heterogeneity in economic recoveries across countries.[13] The REER, which is used to calculate real currency misalignment, is expressed in indirect quotation: that is, an increase in its value represents a real appreciation. As currency misalignment is expressed as the difference between the actual REER and its equilibrium, positive values of currency misalignment represent overvaluation, while negative values represent undervaluation. Similar to the cross-sectional analysis, data on real currency misalignment are taken from the EQCHANGE database compiled by the CEPII based on Couharde et al. (2017).[14]

Real GDP is GDP at constant prices in the domestic currency. However, for the purpose of this empirical analysis, we use the standard Hodrick-Prescott (HP) filter to obtain the cyclical component of real GDP, which we use as the primary measure of output in our estimations. In particular, we argue that expressing output with a measure of the output gap instead of real GDP enables us to better capture the characteristics of economic recovery.[15] The output gap is expressed as a percentage of potential GDP (i.e., the HP-filtered trend component of real GDP). Investments represent gross fixed capital formation expressed as a percentage of GDP. We derive our measure of inflation from the consumer price index (CPI). Similar to the cross-sectional analysis, as our primary financial development measure, we use the composite financial development index of Svirydzenka (2016) adjusted for the level of economic development. Data on real GDP, investments, CPI, interest rates and financial development are taken primarily from IMF databases. When data for some of the variables were missing for some countries, the

[13] For instance, if two countries experience a domestic currency depreciation of similar magnitude but one of the countries has an overvalued currency while the other has an undervalued currency, the macroeconomic effects of the depreciations are likely to be different.

[14] Couharde et al. (2017) construct this measure of real currency misalignment based on a behavioral equilibrium exchange rate (BEER) model, which was introduced initially by Clark and MacDonald (1998). The advantage of the BEER approach is that it is based on the long-term relationship between the REER and its determinants and consequently, unlike for instance, the FEER approach, it is not based on any assumptions about the internal or external equilibrium of the economy. As a result, BEER models are often used in empirical analyses to identify real currency misalignments (Aguirre and Calderon, 2005; Gnimassoun and Mignon, 2015; Cuestas et al., 2020; Fisera and Horvath, 2022). Some papers also utilize the purchasing power parity (PPP) adjusted for productivity differentials (i.e., the Balassa-Samuelson effect) to estimate the level of real currency misalignment (Rodrik, 2008; Baxa and Paulus, 2020). However, real over-/undervaluation estimated with this approach might be considered to be more of a long-term character and thus less useful for the purpose of policy analysis in the medium term (Egert et al., 2005).

[15] Indeed, the 'growth-cycle' approach represented by, for instance, Grigoli and Hakura (2010), identifies an economic recovery as the period starting just after an upturn (i.e., the maximum negative output gap over the cycle) and lasting until the output gap turns positive.

data were obtained from the BIS or Thomson Reuters databases.[16]

A detailed description of the variables and their sources is available in Table A5 in the Appendix.

5 Results: Exchange Rate and Length of Economic Recovery

In the following section, we first conduct a simple motivational preliminary analysis. Next, we report the results of our baseline cross-sectional regressions. Third, we report the results of several robustness checks.

5.1 Preliminary Analysis

We commence our empirical analysis with a motivational preliminary analysis. Namely, our baseline empirical analysis is based on an assumption that the effect of the exchange rate on real economy is different during the economic recovery period – i.e., that there is a non-linearity in the effect of the exchange rate. However, to the best of our knowledge, this assumption has, so far, not been directly investigated. Thus, we conduct a simple empirical exercise to study whether the real economy effect of the exchange rate differs during the period of economic recovery.

Therefore, using our panel dataset, we simply regress a measure of economic growth[17] on our measure of exchange rate. For brevity, we use only the measure of real currency misalignment in the preliminary analysis. The regressions also contain GDP (PPP) per capita to control for the level of economic development, output gap to control for the stage of the business cycle, as well as country and time fixed effects. To allay endogeneity concerns, we lag all the explanatory variables by one quarter.

We report the results of this preliminary empirical analysis in Table A6 in the Appendix. First, in specification (1) we study the linear effect of currency misalignment on the GDP growth and we do find the negative effect of currency misalignment on GDP growth. However, the measure of currency misalignment encompasses both real overvaluation and real undervaluation of the domestic currency. Thus, acknowledging the criticism of Nouira and Sekkat (2012) and using the approach of Fisera and Horvath

[16]The exogenous variables enter the IPVAR model in levels, while the endogenous variables enter the model in first differences – with the exception of CPI, which is expressed in first differences of the natural logarithm.

[17]Expressed as the annual rate of GDP growth.

(2022), we split our measure of currency misalignment into separate measures for overvaluation and undervaluation, which we include in the second regression specification instead of the currency misalignment measure. Our findings indicate that in general, overvalued domestic currency has a negative effect on economic growth, while undervalued domestic currency has a positive effect on economic growth – with the effect of overvaluation being larger in size.

Subsequently, we proceed to investigate, whether the stage of business cycle influences the effect of over-/undervaluation on economic growth. First, we interact both the measure of overvaluation and the measure of undervaluation with the output gap and add these two interaction terms in our regression specification. Specification (3) reports our findings: We find that the effect of overvaluation does not seem to be influenced by the stage of the business cycle, but undervaluation does seem to have a more positive effect on GDP growth when the output gap is more positive, as the coefficient of the corresponding interaction term is positive and statistically significant. As a result, we find some evidence that when the economy is below its potential, the undervalued domestic currency seems to be less effective in stimulating the economic growth. Nonetheless, our main interest lies in the economic recovery periods. Consequently, using the approach outline in sub-section 3.1, we identify the economic recovery periods and we create a dummy variable for such periods.[18] We then interact the economic recovery dummy both with our measure of undervaluation and with our measure overvaluation and we report the results in specification (4). Interestingly, we find that undervalued domestic currency has a less positive effect on economic growth during the economic recovery periods, as the coefficient of interaction of the economic recovery dummy and undervaluation is negative and statistically significant. Once again, the effect of real overvaluation on economic growth does not seem to differ during the economic recovery period.

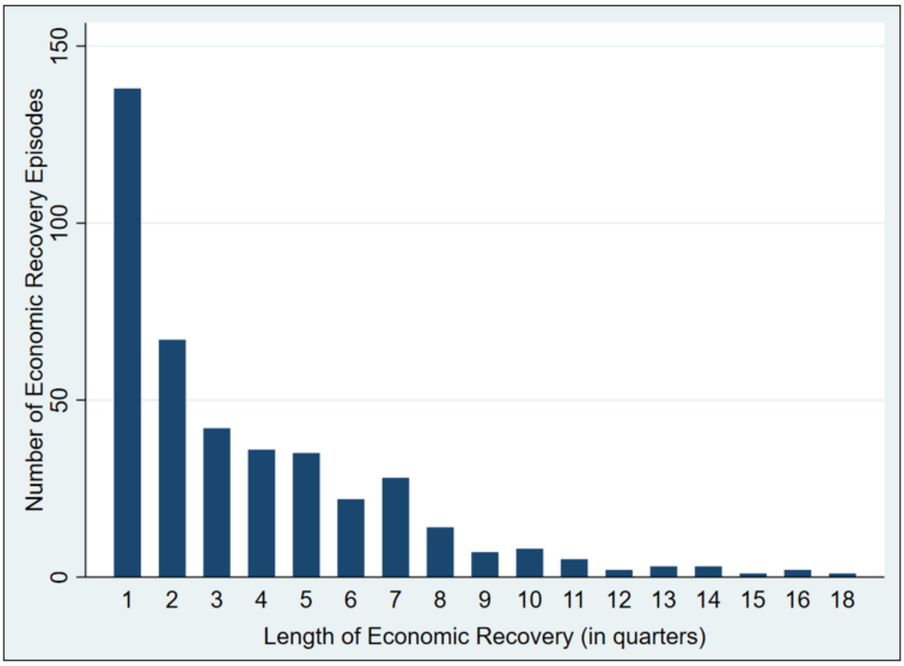
Obviously, this empirical analysis is rather simple and consequently, we take these findings with some caution. Nevertheless, this simple analysis provides us with some initial motivational evidence that the relationship between the exchange rate and economic growth might be different during the economic recovery periods when the economy is below its potential.

[18]We follow the 'growth cycle' approach of Grigoli and Hakura (2010) in identifying the periods of economic recovery. We identify the economic recovery as the period starting one quarter after upturn (i.e., most negative output gap) and ending once the output gap turns positive. We only focus on events when the negative output gap at upturn was at least -0.5 % of potential GDP and when the economic recovery lasted at least one quarter.

5.2 Baseline Results

The identification strategy described in sub-section 3.1 enabled us to identify 414 episodes of economic recovery from output gap recessions. However, due to missing data for some of the control variables, we end up with a sample of 341 economic recovery episodes over the years 1989-2019, which we use in our baseline estimations. As per Figure 1, just over third of recovery episodes in our sample lasted just 1 quarter, while the longest episode lasted 18 quarters. On average, an economic recovery period lasted slightly less than 4 quarters. The output gap recessions that preceded the economic recovery lasted on average slightly more than 3 quarters and the average negative output gap at through equaled -3.5 %.

Figure 1: Number of Economic Recovery Episodes by Length



In our baseline empirical analysis, we regress the length of economic recovery on our measures of the exchange rate and on other control variables using the zero-truncated negative binomial regression approach. We report our results in Table 1. In this analysis, we use both of our measures of exchange rate – that is NEER and real currency misalignment. First, in specification (1) we study the linear effect of nominal exchange rate on the length of economic recovery. However, we do not find any statistically significant effect of exchange rate movements on the length of economic recovery. We hypothesize that this finding could be driven by the significant non-linearities in the macroeconomic effects of exchange rates. Thus, in the next regression specification, we split our measure of nominal exchange rate into two separate measures of appreciation and depreciation[19] – but once again, we fail to find evidence of a statistically significant effect of exchange rate movements on the length of economic recovery. In specification (3) of Table 1, we also introduce interactions with financial development, which are, however, not statistically significant. We conclude that the changes in the nominal value of the domestic currency do not seem to influence the length of economic recovery – presumably because the competitiveness gains due to nominal depreciation might be counterbalanced by higher inflation. Furthermore, in line with the J-curve, the competitiveness gains (losses) associated with nominal depreciations (appreciations) might take longer to materialize – with their effects being discernible only after the economy had already recovered from the output gap recession.

Thereafter, we re-run the three regression specifications described above using the real currency misalignment as an alternative measure of exchange rate. We report the results in specifications (4)-(6) of Table 1. Interestingly, we find that unlike nominal depreciation, real currency undervaluation seems to cut the length of economic recovery – as the coefficient of the undervaluation measure is negative and statistically significant. This finding indicates that real undervaluation of the domestic currency is more important for the competitiveness gains to be realized than a mere nominal depreciation, which might be counterbalanced by inflationary pressures. Nonetheless, while statistically significant, the size of the effect of an undervalued domestic currency on the length of economic recovery is rather small: An increase in the level of undervaluation by 1 p.p. reduces the length of economic recovery by only 1.5 %. For real currency misalignments, we also find some evidence that the level of financial development might play a role in influencing their consequences for the speed of economic recovery. However, contrary to our initial hypothesis, higher level of financial development does not seem to contribute to a more positive effect of undervalued domestic currency on the speed of economic recovery. Instead, we find that the coefficient of the interaction of real overvaluation and financial development is negative and statistically significant – indicating that higher level of financial development seems to cut the length of economic recovery (and increase its speed) for countries with an overvalued domestic currency. We argue that this somewhat surprising finding indicates that the higher level of financial development seems to limit the 'disadvantage' posed by an overvalued domestic currency – when compared to countries with an undervalued domestic currency. We hypothesize

[19]For ease of interpretation, we invert the value of the depreciation measure so that it attains positive values.

that this finding could be explained by the fact that firms in countries with higher level of financial development are likely to have an easier access to external sources of financing – which might then help them to limit the competitiveness losses associated with an overvalued domestic currency. Furthermore, as higher financial development is likely to be associated with higher level of external debt[20], an overvalued domestic currency reduces the real external debt burden.

The results reported in Table 1 also indicate that the longer the recession that preceded the economic recovery, the longer the subsequent recovery. On the other hand, the magnitude of the recession does not seem to influence the length of the subsequent recovery. Moreover, larger economies seem to experience longer recoveries, while higher investments seem to contribute to faster economic recoveries.

In the next step of our empirical analysis, we study further the non-linearity in the effects of exchange rate on the length of economic recovery. To this end, we estimate the equations 2 and 3 separately for both of our measures of exchange rates and we report the results in Table 2. First, in specification (1), we add an interaction of squared exchange rate change and a dummy variable for the exchange rate depreciation. Here, we find that both the coefficient of the exchange rate change and its interacted squared value are statistically significant and negative – indicating that different magnitudes of nominal depreciation might have different consequences for the speed of economic recovery. To better illustrate our results, we plot the total marginal effects (TMEs) of exchange rate depreciation on the speed of economic recovery in Figure A2 in the Appendix. The total marginal effects seem to indicate that smaller nominal depreciations of up to 12 % reduce the length and thus increase the speed of economic recovery. On the other hand, larger depreciations lead to an increase in the length of economic recovery. Consequently, we conclude that while nominal depreciation in general does not seem to lead to a shorter economic recovery, smaller nominal depreciations might have some positive consequences. The positive consequences of small nominal depreciations could be explained by the fact that they are less likely to be inflationary as larger depreciations – and so smaller depreciations are more likely to lead to real undervaluation of the domestic currency and at least to some competitiveness gains. Nevertheless, even for small nominal depreciations, the size of their effect on the length of economic recovery is still somewhat small.

In specification (2) of Table 2 we include the interaction of squared exchange rate change and a dummy variable for exchange rate appreciation, as well as (non-interacted) dummy variable for exchange rate appreciation in the regressions to study

[20]As it becomes easier for economic agents to access external sources of financing.

Table 1: Estimates of the effect of exchange rate on the length of economic recovery

	(1)	(2)	(3)	(4)	(5)	(6)
	Length of economic recovery					
ER (%)	-0.010					
	(0.007)					
ER Appreciation (%)		0.002	0.002			
		(0.006)	(0.006)			
ER Depreciation (%)		0.022	0.021			
		(0.014)	(0.014)			
CM				0.006		
				(0.005)		
CM Overvaluation					-0.006	-0.013
					(0.009)	(0.008)
CM Undervaluation					-0.015*	-0.019**
					(0.008)	(0.009)
Fin. Development adj. x ER Appreciation			0.030			
			(0.059)			
Fin. Development adj. x ER Depreciation			-0.034			
			(0.037)			
Fin. Development adj. x CM Overvaluation						-0.120**
						(0.060)
Fin. Development adj. x CM Undervaluation						0.017
						(0.064)
Recession magnitude (% of potential GDP)	0.034	0.032	0.027	0.029	0.028	0.025
	(0.031)	(0.031)	(0.034)	(0.033)	(0.034)	(0.035)
Recession length	0.126***	0.126***	0.122***	0.126***	0.126***	0.126***
	(0.026)	(0.026)	(0.027)	(0.026)	(0.026)	(0.026)
GDP (PPP) per capita (ln)	0.001	0.026	0.012	-0.032	-0.048	-0.056
	(0.081)	(0.087)	(0.093)	(0.083)	(0.085)	(0.079)
GDP (PPP) (ln)	0.073**	0.067*	0.060	0.099***	0.101***	0.085**
	(0.035)	(0.036)	(0.045)	(0.035)	(0.036)	(0.041)
Government debt (% of GDP)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
Investments (% of GDP)	-0.032***	-0.029**	-0.028**	-0.021**	-0.020**	-0.018*
	(0.011)	(0.011)	(0.012)	(0.010)	(0.010)	(0.010)
Annual inflation (%)	-0.004	-0.012	-0.012	0.008	0.009	0.011
	(0.010)	(0.012)	(0.013)	(0.007)	(0.007)	(0.008)
Fin. Development adj.			0.431			1.060
			(0.679)			(0.692)
Constant	0.213	0.022	0.284	-0.415	-0.242	0.110
	(1.162)	(1.186)	(1.296)	(1.105)	(1.136)	(1.086)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	341	341	326	339	339	324
Countries	60	60	58	60	60	58

Notes: *ER* stands for the nominal exchange rate, *CM* stands for the real currency misalignment, *(ln)* stands for natural logarithm. All the explanatory variables take the values at through (i.e., quarter before the start of economic recovery). Standard errors that are clustered at country-level are reported in parentheses. * indicates significance at 10 % level, ** at 5 % level and *** at 1 % level.

Table 2: Estimates of the effect of exchange rate on the length of economic recovery – Non-linear effect

	(1)	(2)	(3)	(4)
	Length of economic recovery			
ER (ln)	-2.025**	-1.506		
	(1.020)	(1.135)		
ER squared (ln) x Depreciation dummy (0/1)	-1.527**			
	(0.689)			
Depreciation dummy (0/1)	-0.216			
	(0.139)			
D.ER squared (ln) x Appreciation dummy (0/1)		2.653		
		(3.376)		
Appreciation dummy (0/1)		0.129		
		(0.133)		
CM			-0.986	0.306
			(0.925)	(1.061)
CM squared x Undervaluation dummy (0/1)			-9.291*	
			(5.000)	
Undervaluation dummy (0/1)			-0.206	
			(0.172)	
CM squared x Overvaluation dummy (0/1)				-1.360
				(4.252)
Overvaluation dummy (0/1)				0.111
				(0.182)
Recession magnitude (% of potential GDP)	0.039	0.033	0.028	0.029
	(0.032)	(0.032)	(0.033)	(0.032)
Recession length	0.127***	0.126***	0.127***	0.128***
	(0.027)	(0.026)	(0.026)	(0.025)
GDP (PPP) per capita (ln)	-0.016	-0.011	-0.051	-0.036
	(0.084)	(0.089)	(0.083)	(0.084)
GDP (PPP) (ln)	0.071**	0.074**	0.102***	0.099***
	(0.036)	(0.035)	(0.035)	(0.035)
Government debt (% of GDP)	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Investments (% of GDP)	-0.033***	-0.031***	-0.019**	-0.021**
	(0.011)	(0.011)	(0.010)	(0.009)
Annual inflation (%)	-0.003	-0.012	0.009	0.008
	(0.012)	(0.014)	(0.007)	(0.007)
Constant	0.537	0.329	-0.211	-0.451
	(1.209)	(1.228)	(1.111)	(1.135)
Year fixed effects	Yes	Yes	Yes	Yes
Observations	341	341	339	339
Countries	60	60	60	60

Notes: *ER* stands for the nominal exchange rate, *CM* stands for the real currency misalignment, *(ln)* stands for natural logarithm. *Depreciation dummy* and *Appreciation dummy* are dummy variables that take the value of 1 when the nominal exchange rate depreciated and appreciated, respectively, and 0 otherwise. *Undervaluation dummy* and *Overvaluation dummy* are dummy variables that take the value of 1 when the real currency misalignment was undervalued and overvalued, respectively, and 0 otherwise. All the explanatory variables take the values at through (i.e., quarter before the start of economic recovery). Standard errors that are clustered at country-level are reported in parentheses. * indicates significance at 10 % level, ** at 5 % level and *** at 1 % level.

the non-linearity in the effect of nominal appreciation on the length of economic recovery. In this case, none of the coefficients of interest is statistically significant and thus we conclude that the exchange rate appreciation does not seem to influence the length of economic recovery. Next, in specifications (3)-(4) we re-run our analysis with the measure of real currency misalignment instead of nominal exchange rate change. The results are broadly similar to our findings for the nominal exchange rate changes – albeit less significant statistically.

5.3 Robustness Checks

We conduct several robustness checks to verify the robustness of our baseline results.

In the first robustness check, we address our main measure of the speed of economic recovery. In our baseline regressions, we use the length of economic recovery as our primary economic recovery measure since this approach enables us to study how quickly the economy recovers. Nevertheless, as a robustness check, we use another commonly used measure of the speed of economic recovery – the strength of economic recovery, which had been used by several related empirical studies. We define the strength of economic recovery as the average quarterly growth rate during the economic recovery episode. We report the results of this robustness check in Table A7 in the Appendix. The results of this robustness check corroborate our baseline findings, as they indicate that undervalued domestic currency increases the strength of economic recovery – although the size of this effect remains limited. Nevertheless, for strength of economic recovery, we do not find evidence that the higher level of financial development influences the effect of an overvalued currency on the strength of economic recovery.

In the following robustness checks, we address our definition of economic recovery episodes. Namely, to maximize our sample size, we prefer to include in our baseline estimations also the economic recoveries that lasted just one quarter. However, such short recoveries might just represent temporary shocks in the economy. Thus, in a robustness check, we first exclude economic recovery episodes that lasted just one quarter and we report the results in specifications (1) and (2) in Table A8 in the Appendix. For brevity, for this robustness check, we only report the results of the regressions with currency misalignments as the exchange rate measure. The results of this robustness check are fully in line with our baseline findings. Furthermore, in the next two robustness checks, we also exclude i) economic recoveries that lasted less than three quarters, and ii) economic recoveries that lasted less than two quarters and that followed recessions that lasted less than two quarters. We report our findings in specifications (3)-(6) in Table

A8 in the Appendix. Once again, the results of these robustness checks corroborate our baseline findings, as we find that an undervalued domestic currency cuts the length of economic recovery and that higher level of financial development reduces the negative consequences of an overvalued domestic currency on the length of economic recovery.

Next, due to relatively high correlation between NEER and annual inflation, we re-run our baseline regressions without the annual inflation rate. The results of this robustness check corroborate our baseline results and are available upon request.

6 Exchange Rate and Response to External Shocks: Interacted Panel VAR Analysis

In this section, we report and discuss the results obtained from a panel of countries using the IPVAR model. We first report the baseline results. Subsequently, we outline the results of various robustness checks that we conduct to verify the robustness of our results.

6.1 Baseline Results

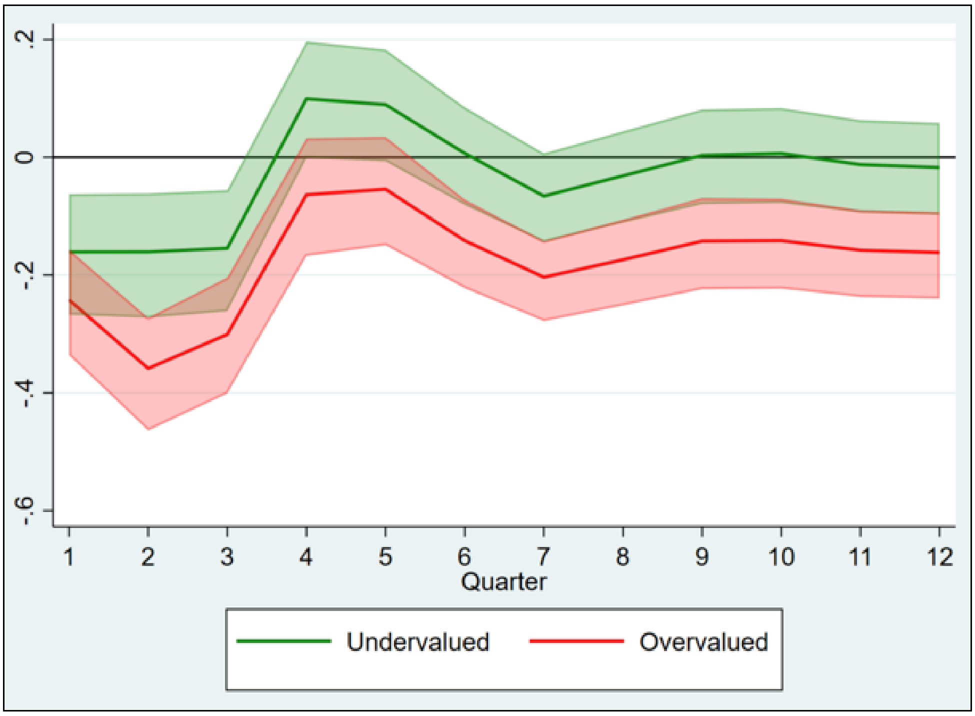
We begin this empirical analysis by estimating the IPVAR model with only our exchange rate measure (i.e., real currency misalignment) as an exogenous variable. Subsequently, we estimate the impulse responses of real output (i.e., the output gap) to a shock to foreign real rates (i.e., U.S. real rates) at high and low values of our currency misalignment measure. The high and low levels of currency misalignment correspond to the 25th and 75th percentiles of this variable.[21] We report the estimated impulse responses in Figure 2. These findings indicate that a shock to the foreign real rate does lead to a statistically significant drop in real output, as the output gap becomes negative – both for undervalued and overvalued currency. In the first quarter following the shock, the level of domestic currency over/undervaluation does not seem to influence the response of real output. Nevertheless, this changes by the second quarter after the shock, when the negative output gap for countries with overvalued exchange rates becomes more negative than for countries with undervalued exchange rate. Thus, it seems that an undervalued exchange rate limits the magnitude of real output loss following an external shock.

Furthermore, our findings indicate that an undervalued exchange rate stimulates the speed of economic recovery, as four quarters after the shock, the output gap for the

[21] In our sample, the 25th and 75th percentiles of currency misalignment correspond to real undervaluation of the domestic currency by almost 10% and real overvaluation of the domestic currency by some 10%, respectively.

countries with undervalued exchange rates becomes positive and statistically significant – eventually converging toward zero. On the other hand, with an overvalued exchange rate, the negative output gap is still substantially reduced four quarters after the shock, and it remains mildly negative even three years after the shock. Our findings, therefore, indicate that a weaker/undervalued domestic currency might increase the speed of economic recovery after an external shock but, importantly, this effect does not seem very large, as the difference between the IRFs for undervalued and overvalued exchange rates is only narrowly statistically significant at the 90% level.

Figure 2: Cumulative IRFs of Output Gap to Foreign Real Rate Shock



Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. 90 % confidence bands are reported.

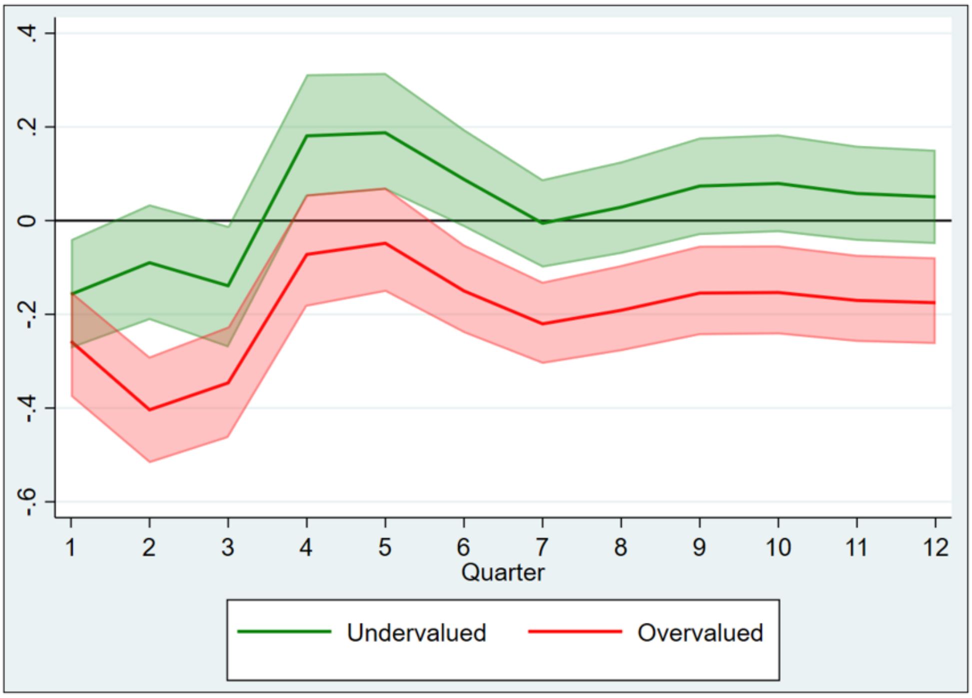
Having found some evidence that a weaker/undervalued domestic currency might speed up an economic recovery, we move on to study the role of the level of financial development in influencing this effect. To do so, we include our financial development measure and an interaction between real currency misalignment and financial development among the exogenous variables. In the baseline regressions, the impulse responses are assessed at high and low values of our measures of real currency misalignment and financial development. The high and low levels correspond to the 75th and 25th percentiles of these two variables, respectively. The interaction between currency misalignment and financial development is evaluated at the value resulting from the multiplication of individual percentiles of these two variables.

We report the results of the baseline regressions in Figures 3 and 4. In Figure 3, we report the output gap responses to a foreign real rate shock at a low level of financial development for both undervalued and overvalued exchange rates. Our findings indicate that for countries with a lower level of financial development than their level of economic development would imply, an undervalued exchange rate facilitates a faster economic recovery – with the output gap turning positive only four quarters after the external shock. On the other hand, the combination of an overvalued exchange rate and low financial development seems to be most detrimental to the speed of economic recovery, as the output gap, while recovering somewhat from the initial impact of the shock, remains negative even three years after the external shock.

Next, in Figure 4, we report the output gap responses to foreign real rate shock at a high level of financial development for both undervalued and overvalued exchange rates. Interestingly, we find that with a level of financial development above that implied by the level of economic development, an undervalued domestic currency no longer seems to facilitate a faster and stronger economic recovery in comparison to an overvalued domestic currency, as the difference between the impulse responses for overvalued and undervalued exchange rates is no longer statistically significant. For undervalued exchange rates, a higher level of financial development does not seem to contribute to faster or stronger economic recovery. However, for countries with overvalued exchange rate, the increasing level of financial development does seem to lead to an increased speed of economic recovery, as already four quarters after the shock, the output gap converges toward zero. While in this case, the output gap does not turn statistically significantly positive (as in the case of undervalued exchange rates), with higher financial development, the output gap does converge towards zero, unlike in the case of lower financial development, where the output gap remains statistically significantly negative even three years after the initial external shock.

We conclude that a higher level of financial development does seem to enhance the speed and strength of economic recovery when the domestic currency is overvalued. Presumably, higher financial development alleviates the adverse consequences of an overvalued domestic currency by providing economic agents with easier access to external sources of financing. However, interestingly, it seems that when the domestic currency is undervalued, the speed and strength of economic recovery are not conditional on the level of financial development. We hypothesize that this puzzling finding could be explained by the fact that when a currency is undervalued, higher costs of cross-border sources of financing limit the positive role of higher financial development. This hypothesis could be in line with the findings of Georgiadis et al. (2021).

Figure 3: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: Low Financial Development

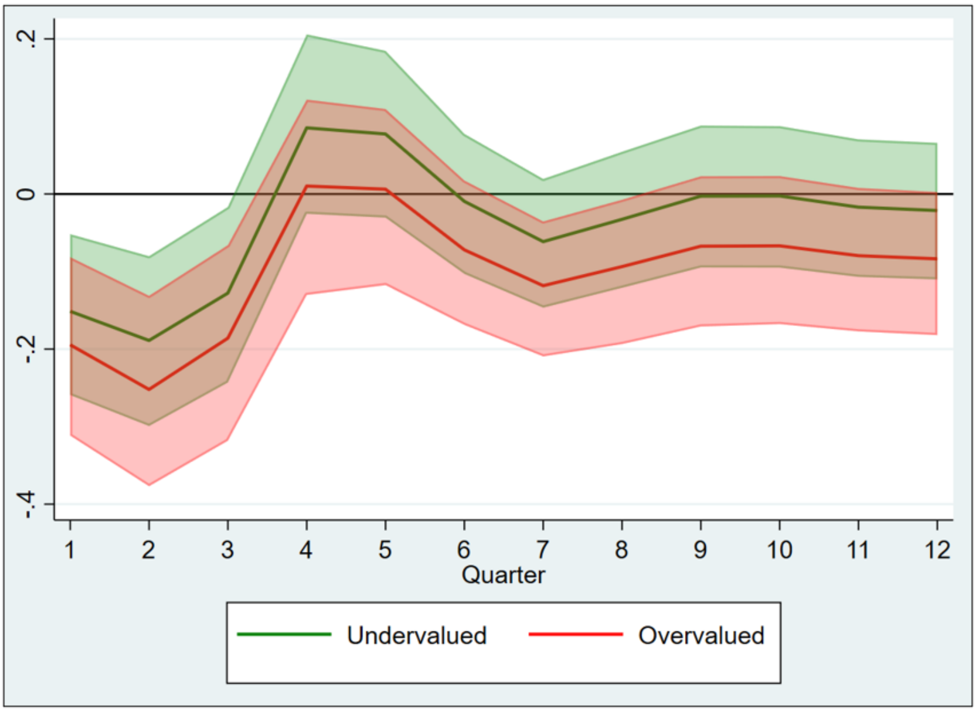


Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 25th percentile of financial development measure. 90 % confidence bands are reported.

6.2 Robustness Checks

Next, we conduct several robustness checks to verify the robustness of our baseline results. First, we verify the robustness of our results with regard to selection of the proxy for external shocks. In the baseline regressions, we proxy external shocks with foreign real interest rates, which we proxy, in turn, with U.S. real short-term interest rates. However, while U.S. interest rates and monetary policy have a disproportionate impact on the global economy, some countries are more influenced by the monetary policy and interest rates of economies other than the United States (particularly the euro area). Thus, using the U.S. real rate as our main proxy for the foreign real rate might underestimate the effect of external shocks. In this context, in the first robustness

Figure 4: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: High Financial Development



Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 75th percentile of financial development measure. 90 % confidence bands are reported.

check, we modify our foreign real rate measure: we select the foreign real rate for each country in our sample based on the anchor or reference currency identified by Ilzetzki et al. (2019).[22] The results of this robustness check corroborate our baseline findings.

In the next robustness check, we use a further measure of external shocks: the global risk shocks of Piffer and Podstawski (2018). This measure helps us study the transmission of global risk shocks to economic activity. Global risk shocks might also represent a good proxy for external shocks, as they are correlated with the global financial cycle and have a contractionary effect on global economic activity. We report the IRFs of output gap to a global risk shock in Figures A3 and A4 in the Appendix. Once again, we find that an undervalued domestic currency only seems to lead to a faster recovery when the level of financial development is low. On the other hand, higher fi-

[22]However, for most countries in our sample, the U.S. dollar serves as the reference or anchor currency and thus, for most of the countries, U.S. real rates remain the measure of foreign real rate. For the bulk of the remaining countries in our dataset, the German real rate serves as the foreign real rate (as a proxy for the euro area real rate).

nancial development seems to limit the adverse consequences of an overvalued domestic currency, as for countries with higher level of financial development, the difference in output gap responses between an undervalued and an overvalued domestic currency disappears. Thus, the results of this robustness check do corroborate our baseline findings. Nonetheless, interestingly, we find that global risk shocks lead to a deeper contraction than foreign real rate shocks and this contraction seems to be somewhat persistent, as the output gap remains negative even 12 quarters after the shock.

Subsequently, we address the issue of endogeneity in our measure of real currency misalignment. Specifically, as discussed above, while we argue that unlike the nominal exchange rate, the level of real currency misalignment is not as influenced by current economic developments, the assumption of endogeneity of an over-/undervaluation of the domestic currency might still be considered very strong. Thus, we first simply lag the measure of real currency misalignment by one year. Next, we express the real currency misalignment as a backward-looking three-year average. Subsequently, we 'exogenize' our measure of real currency misalignment by regressing it on our output gap measure and year time effects, and we use the residuals from this regression as an alternative, 'exogenized' measure of real currency misalignment.[23] We report the findings of this robustness check in Figures A5 and A6 in the Appendix. This robustness check also corroborates our baseline findings, as an undervalued domestic currency seems to increase the speed of economic recovery only for low levels of financial development.

In the next robustness check, we address potential problems with our main response variable, as the estimates of the output gap are prone to some uncertainties. To do so, we first replace the output gap, as our main proxy for real output developments, with the logarithm of real GDP. The results of this robustness check, which are reported in Figures A7 and A8 in the Appendix broadly support our baseline findings, as an undervalued domestic currency does seem to lead to a faster return of real GDP to its preshock values for countries with lower financial development – although, in this case, the effect of an undervalued currency does not seem to be statistically significant. We treat these findings with some caution, as the return of real GDP to its precrisis level is not necessarily equivalent to the output gap turning positive (as the economy might still be below its potential; according to our definition of an economic recovery, the economic recovery period ends only after the economy returns to its potential level). As a result, and in line with the findings of Chen and Gornicka (2020), we also use another approach

[23]We argue that this approach enables us to 'exogenize' our main measure of currency misalignment by adjusting currency misalignment for the economic cycle. Specifically, deviations of the actual real exchange rate from its equilibrium value (i.e., currency misalignments) might be influenced by the stage of the economic cycle.

to obtain output gap estimates. In particular, while filtering methods, primarily the HP filter, are most often used to obtain output gap estimates, Chen and Gornicka (2020) find that the two-variable structural vector (SVAR) of Blanchard and Quah (1989) outperforms these alternative filtering techniques[24] As a result, we estimate a small open economy SVAR as in Chen and Gornicka (2020) for each country in our sample so that we can obtain alternative output gap estimates. This approach is based on estimating supply shocks with identification restrictions based on which potential output is reconstructed. Next, we re-estimate our baseline IPVAR models with the alternative output gap estimates as our main response variables. To save space, we do not report the results of this robustness check here, but the results are in line with our baseline findings. The findings of this robustness check do corroborate our baseline results.

In the final robustness check, we address the restrictive assumption that it is only the response of real output to external shock that is conditional on the vector of exogenous variables – and in line with Towbin and Weber (2013), we let responses of all the variables to vary with the level of exogenous variables. We report our findings in Figure A9 and Figure A10 in the Appendix. The findings of this robustness check fully corroborate our baseline findings.

7 Conclusions

Relying on a sample of 341 economic recoveries from output gap recessions, we explore the effect of weaker/undervalued domestic currency on the length of economic recovery. The estimates obtained by zero-truncated negative binomial regression approach indicate that in general, real currency undervaluation rather than nominal exchange rate depreciation might cut the length of economic recovery and thus, increase the speed of economic recovery. However, this effect is rather small in size: An increase in the level of domestic currency undervaluation by 1 p.p. is associated with the decrease in the length of economic recovery by merely 1.5 %. This finding seems to underscore that nominal depreciation, which could be triggered by policymakers with the aim of increasing the speed of economic recovery, might have positive macroeconomic consequences only if it

[24]In particular, a drawback of these 'a-theoretical' filtering techniques is that they assume that the average deviation of actual real output from potential output equals zero – although in our case, this drawback could be limited by the relatively large number of observations across time. Furthermore, Coibion et al. (2018) find that the potential output estimates obtained by the filtering techniques respond in a procyclical manner to transitory shocks. On the other hand, the use of SVARs to estimate output gaps also entails some disadvantages: i) SVARs are based on the restrictive assumption that supply shocks have a permanent impact on potential output, and ii) the number of shocks that can be included in SVAR models is limited.

leads to real undervaluation of the domestic currency (and is not counterbalanced by higher inflation). Furthermore, we also study the non-linearities in the macroeconomic effects of nominal exchange rate movements/real currency misalignments. We find that smaller nominal depreciations of up to 12 % might slightly reduce the length of economic recovery, while larger depreciations increase the length of economic recovery. Our findings for the non-linear effect of undervalued domestic currency on the length of economic recovery are broadly similar to the findings for nominal depreciation.

Next, we also a panel dataset to further explore the role of the exchange rate in influencing the economic recovery. In particular, using a panel of 66 advanced and emerging economies over the years 1989-2019, we examine the role of the exchange rate and financial development in influencing the speed of economic recoveries from external shocks. Using the interacted panel VAR model of Towbin and Weber (2013), we find that while an undervalued exchange rate seems to increase the speed of economic recovery, the increase in the speed of an economic recovery associated with an undervalued exchange rate seems to be relatively modest in size. This finding is in line with the results of our preliminary motivational empirical analysis, which indicated that while undervalued domestic currency does have a positive effect on economic growth, this effect is weaker during the periods of economic recovery, as well as with our findings from the cross-sectional regressions. Next, in line with the emerging literature on the role of the financial sector in influencing the macroeconomic consequences of the exchange rate, we assess the influence of financial development on the effect of real currency over/undervaluation on real output.

We find evidence that higher financial development limits the adverse effect of an overvalued domestic currency on the speed of economic recovery. It seems that in economies that are more financially developed, economic agents are able to obtain external sources of funding more easily, limiting the negative consequences of the loss of international competitiveness due to an overvalued domestic currency. On the other hand, higher financial development does not seem to increase the speed of economic recovery for countries with undervalued exchange rates. Presumably, higher costs of cross-border lending that are associated with undervalued exchange rates, limit the positive effects of higher financial development when the domestic currency is undervalued.

In terms of policy conclusions, we argue that while our findings indicate that an undervalued exchange rate might stimulate the speed of economic recovery, this effect seems to be rather limited. Therefore, while policymakers might be able to slightly increase the speed of economic recovery by keeping the domestic currency undervalued or by implementing a policy of managed depreciation, they might attain similar results by increasing the level of financial development above the level implied by the country's GDP per capita (even with an overvalued domestic currency). Considering that higher financial development might be associated with numerous positive effects for the domestic economy while managed depreciation might have detrimental consequences for domestic inflation and welfare or for foreign economies, we argue that our findings indicate that it could be preferable for policymakers to concentrate on improving financial development rather than on having an undervalued domestic currency to increase the speed of an economic recovery.

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Appendix

Table A1: List of Countries

Australia	Hungary	Peru
Austria	Iceland	Philippines
Bahrain	India	Poland
Belgium	Indonesia	Portugal
Bolivia	Ireland	Qatar
Brazil	Israel	Romania
Canada	Italy	Russia
Chile	Japan	Saudi Arabia
China	Korea	Singapore
Colombia	Latvia	Slovak Republic
Croatia	Lithuania	Slovenia
Cyprus	Luxembourg	South Africa
Czech Republic	Malaysia	Spain
Denmark	Malta	Sweden
Dominican Republic	Mexico	Switzerland
Estonia	Moldova	Taiwan
Finland	Morocco	Thailand
France	Netherlands	Turkey
Georgia	New Zealand	Ukraine
Germany	North Macedonia	United Kingdom
Greece	Norway	United States
Hong Kong	Paraguay	Uruguay
		Venezuela

Table A2: Summary Statistics (Cross-Sectional Dataset)

Variable	Unit	Obs.	Mean	St. Dev.	Min	Max
Length of economic recovery	Quarter	341	3.85	3.22	1	18
Exchange rate (ER)	%	341	-2.04	12.93	-72.27	61.16
Real currency misalignment (CM)	%	339	-1.98	12.69	-40.81	30.09
Recession magnitude	%	341	-3.54	3.71	-25.03	-0.51
Recession length	Quarter	341	3.37	2.79	1	22
GDP (PPP) per capita	USD	341	26,742	17,435	3,878	94,729
GDP (PPP)	mil. USD	341	847,004	1,753,235	5,789	17,156,050
Government debt	%	341	47.74	31.91	1.26	198.02
Investments	%	341	21.85	5.41	7.70	39.64
Annual inflation	%	341	5.75	13.06	-3.75	116.82
Financial development	Index	326	0.49	0.22	0.07	0.99
Financial development adj.	Index	326	-0.00	0.14	-0.33	0.35

Table A3: Correlation Matrix (Cross-Sectional Dataset)

	Length	ER	CM	Rec. magn.	Rec. length	GDP (PPP) p.c.	GDP (PPP)	Gov. debt	Invest.	Infl.	Fin. dev. adj.
Length	1.00										
ER	-0.11	1.00									
CM	0.07	0.16	1.00								
Rec. magn.	0.02	0.31	0.00	1.00							
Rec. length	0.26	0.04	0.09	0.08	1.00						
GDP (PPP) p.c.	0.10	0.15	0.21	0.39	0.17	1.00					
GDP (PPP)	0.18	-0.14	-0.12	0.14	0.11	0.18	1.00				
Gov. debt	0.02	0.04	0.06	0.16	0.00	0.07	0.18	1.00			
Invest.	-0.17	0.10	-0.12	0.11	0.00	0.07	0.08	-0.13	1.00		
Infl.	-0.03	-0.53	-0.25	-0.49	-0.10	-0.31	0.07	-0.03	0.09	1.00	
Fin. dev. adj.	0.17	-0.02	-0.13	0.21	0.08	0.25	0.54	0.22	0.13	-0.10	1.00

Table A4: Data Description (Cross-Sectional Dataset)

Variable	Description	Source
Length of economic recovery	Duration of the period of economic recovery, measured as the number of quarters starting from the quarter after through until the output gap turns positive	self-calculated based on IMF data
Exchange rate (ER)	Nominal effective exchange rate (NEER) at through, broad index, indirect quotation, annual % change	IMF, BIS
ER Appreciation	Value of exchange rate if exchange rate appreciated, 0 otherwise	self-calculated
ER Depreciation	Value of exchange rate if exchange rate depreciated, 0 otherwise	self-calculated
Real currency misalignment (CM)	Deviation of actual REER and equilibrium REER at through. Positive values represent overvaluation, while negative values represent undervaluation. % of equilibrium REER	CEPII
CM overvaluation	Value of real currency misalignment if real currency misalignment is positive, 0 otherwise	self-calculated
CM undervaluation	Value of real currency misalignment if real currency misalignment is negative, 0 otherwise	self-calculated
Recession magnitude	Output gap at through, % of potential output	self-calculated
Recession length	Duration of output gap recession measured as the number of quarters starting when output gap turns negative until through	self-calculated
GDP (PPP) per capita	Gross domestic product per capita at through, constant prices, international dollars	IMF
GDP (PPP)	Gross domestic product at through, current prices, international dollars	IMF
Government debt	Central government debt at through, % of GDP	IMF
Investments	Gross capital formation at through, nominal, % of GDP	IMF, World Bank
Annual inflation	Annual % change in Consumer Price Index (CPI) at through	IMF, Thomson Reuters
Financial development	Composite index of financial development at through	IMF
Financial development (adjusted)	Deviation of actual composite index of financial development and fitted value of a regression of financial development on logarithm of GDP (PPP) per capita at through	self-calculated

Table A5: Data Description (Panel Dataset)

Variable	Description	Source
Foreign real rate	3-month U.S. Treasury Bill yield adjusted for annual U.S. inflation rate	IMF
Global risk shock	Intra-day change of gold price between two auctions that occurred during narratively selected global risk shock events, quarterly average	Piffer and Podstawski (2018), Bobasu et al. (2021)
Investments	Gross capital formation, nominal, % of GDP	IMF, World Bank
Real GDP	Gross domestic product, constant prices, indexed to 100 for first observation for each country	IMF, Thomson Reuters
Real GDP growth	Gross domestic product, constant prices, annual % change	IMF, Thomson Reuters
Output gap	HP-filtered cyclical component of Real GDP, % of potential GDP	self-calculated
Annual inflation	Annual % change in Consumer Price Index (CPI)	IMF, Thomson Reuters
Real currency misalignment (CM)	Deviation of actual REER and equilibrium REER. Positive values represent overvaluation, while negative values represent undervaluation. % of equilibrium REER	CEPII
Real overvaluation	Value of real currency misalignment if real currency misalignment is positive, 0 otherwise	self-calculated
Real undervaluation	Value of real currency misalignment if real currency misalignment is negative, 0 otherwise	self-calculated
Financial development	Composite index of financial development	IMF
Financial development (adjusted)	Deviation of actual composite index of financial development and fitted value of a regression of financial development on logarithm of GDP (PPP) per capita	self-calculated

Table A6: Estimates of the non-linear effect of exchange rate on economic growth

	(1)	(2)	(3)	(4)
		Real GDP Growth (%)		
Currency misalignment	-0.028***			
	(0.006)			
Undervaluation		0.025**	0.020*	0.031***
		(0.010)	(0.010)	(0.011)
Overvaluation		-0.095***	-0.092***	-0.093***
		(0.012)	(0.012)	(0.013)
Undervaluation x Output gap			0.010***	
			(0.003)	
Overvaluation x Output gap			0.005	
			(0.004)	
Undervaluation x Economic recovery				-0.038*
				(0.021)
Overvaluation x Economic recovery				0.025
				(0.024)
GDP (PPP) per capita (ln)	-2.438***	-2.466***	-2.703***	-2.289***
	(0.577)	(0.574)	(0.577)	(0.569)
Output Gap (%)	0.318***	0.320***	0.331***	0.372***
	(0.022)	(0.022)	(0.032)	(0.022)
Economic recovery (0/1)				1.274***
				(0.216)
R-squared	0.219	0.225	0.228	0.245
Observations	4,702	4,702	4,702	4,702
Countries	48	48	48	48

Notes: All the explanatory variables are lagged by one quarter. Country and time fixed effects are included in all regressions. Standard errors are in parentheses. * indicates significance at 10 % level, ** at 5 % level and *** at 1 % level.

Table A7: Estimates of the effect of exchange rate on the strength of economic recovery

	(1)	(2)	(3)	(4)	(5)	(6)
	Strength of economic recovery (ln)					
ER (%)	0.005					
	(0.004)					
ER Apprecition (%)		0.001	0.003			
		(0.004)	(0.004)			
ER Depreciation (%)		-0.009	-0.009			
		(0.008)	(0.008)			
CM				-0.010**		
				(0.004)		
CM Overvaluation					-0.003	-0.009
					(0.007)	(0.007)
CM Undervaluation					0.015***	0.015**
					(0.006)	(0.006)
Fin. Development adj. x ER Appreciation			0.044			
			(0.027)			
Fin. Development adj. x ER Depreciation			0.025			
			(0.027)			
Fin. Development adj. x CM Overvaluation						-0.042
						(0.041)
Fin. Development adj. x CM Undervaluation						0.045
						(0.037)
Recession magnitude (% of potential GDP)	-0.133***	-0.132***	-0.132***	-0.143***	-0.143***	-0.140***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Recession length	-0.020**	-0.020**	-0.020**	-0.018*	-0.017*	-0.015
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
GDP (PPP) per capita (ln)	-0.185***	-0.194***	-0.188***	-0.139**	-0.135**	-0.107
	(0.066)	(0.064)	(0.068)	(0.067)	(0.066)	(0.066)
GDP (PPP) (ln)	-0.057**	-0.056**	-0.054**	-0.071***	-0.074***	-0.057**
	(0.025)	(0.025)	(0.027)	(0.023)	(0.024)	(0.024)
Government debt (% of GDP)	-0.003*	-0.003*	-0.003*	-0.003*	-0.003*	-0.002*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Investments (% of GDP)	0.020***	0.019**	0.020**	0.018***	0.018***	0.020***
	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)	(0.007)
Annual inflation (%)	0.000	0.003	0.002	-0.005	-0.005	-0.006
	(0.006)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)
Fin. Development adj.			-0.577			-0.678*
			(0.420)			(0.403)
Constant	2.682***	2.777***	2.672***	2.432***	2.385***	1.967**
	(0.795)	(0.759)	(0.872)	(0.791)	(0.779)	(0.781)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	340	340	325	338	338	323
Countries	60	60	58	60	60	58

Notes: *ER* stands for the nominal exchange rate, *CM* stands for the real currency misalignment, *(ln)* stands for natural logarithm. All the explanatory variables take the values at through (i.e., quarter before the start of economic recovery). Standard errors that are clustered at country-level are reported in parentheses. * indicates significance at 10 % level, ** at 5 % level and *** at 1 % level.

Table A8: Estimates of the effect of exchange rate on the length of economic recovery – Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)
	Length of economic recovery					
CM Overvaluation	-0.004	-0.011	-0.007	-0.010*	-0.013*	-0.017**
	(0.006)	(0.007)	(0.005)	(0.006)	(0.007)	(0.008)
CM Undervaluation	-0.011	-0.013*	-0.006	-0.006	-0.017**	-0.018**
	(0.008)	(0.008)	(0.006)	(0.007)	(0.008)	(0.007)
Fin. Development adj. x CM Overvaluation		-0.134***		-0.084**		-0.110**
		(0.045)		(0.036)		(0.045)
Fin. Development adj. x CM Undervaluation		-0.043		-0.036		-0.023
		(0.066)		(0.048)		(0.062)
Recession magnitude (% of potential GDP)	-0.010	-0.013	-0.003	-0.004	-0.005	-0.004
	(0.016)	(0.017)	(0.015)	(0.015)	(0.017)	(0.018)
Recession length	0.027**	0.024*	0.001	0.003	0.009	0.013
	(0.013)	(0.014)	(0.013)	(0.013)	(0.017)	(0.017)
GDP (PPP) per capita (ln)	-0.079	-0.114*	-0.030	-0.052	-0.167**	-0.179***
	(0.063)	(0.061)	(0.055)	(0.052)	(0.067)	(0.064)
GDP (PPP) (ln)	0.078***	0.060*	0.045*	0.038	0.050**	0.038
	(0.024)	(0.032)	(0.024)	(0.031)	(0.025)	(0.037)
Government debt (% of GDP)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Investments (% of GDP)	-0.011	-0.010	-0.008	-0.008	-0.005	-0.005
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.008)
Annual inflation (%)	0.007	0.007	0.004	0.004	0.011***	0.013***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.002)	(0.004)
Fin. Development adj.		1.065**		0.688**		0.858**
		(0.454)		(0.341)		(0.417)
Constant	1.683**	2.307***	1.936***	2.217***	2.990***	3.262***
	(0.776)	(0.860)	(0.664)	(0.721)	(0.806)	(0.951)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	238	228	182	177	202	196
Countries	58	56	56	54	56	54

Notes: *CM* stands for the real currency misalignment, *(ln)* stands for natural logarithm. All the explanatory variables take the values at through (i.e., quarter before the start of economic recovery). Specifications (1)-(2) include only economic recoveries that lasted more than 1 quarter. Specifications (3)-(4) include only economic recoveries that lasted more than 2 quarters. Specifications (5)-(6) include only economic recoveries that lasted more than 1 quarter and which followed recessions that lasted more than 1 quarter. Standard errors that are clustered at country-level are reported in parentheses. * indicates significance at 10 % level, ** at 5 % level and *** at 1 % level.

Figure A1: Financial Development and Economic Development

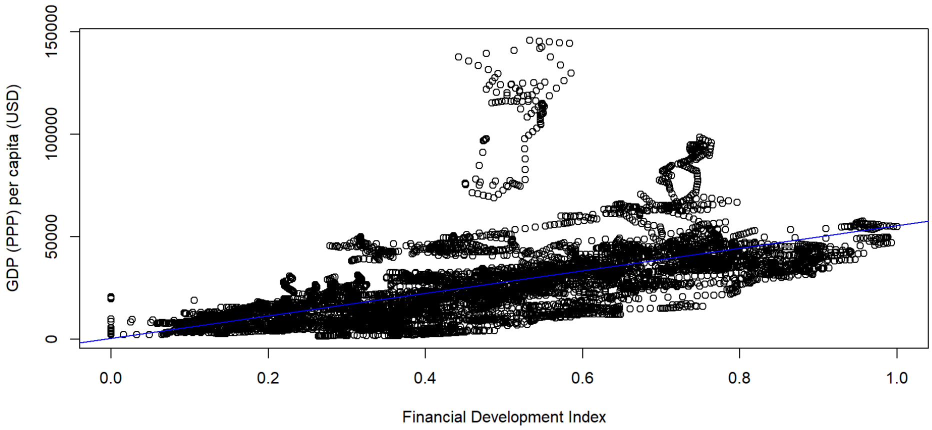


Figure A2: Total Marginal Effect of Exchange Rate on the Length of Economic Recovery at Different Magnitudes of Depreciation

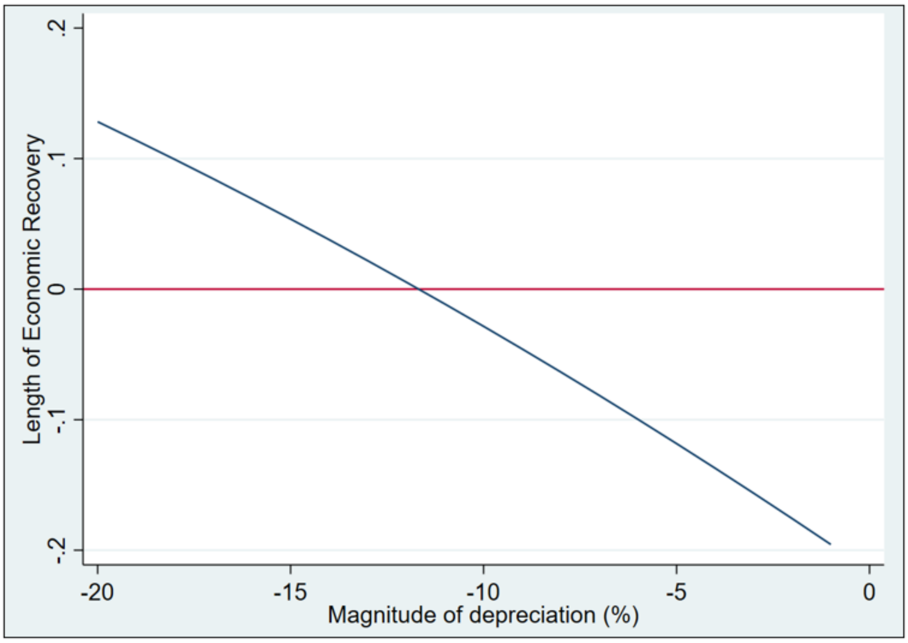
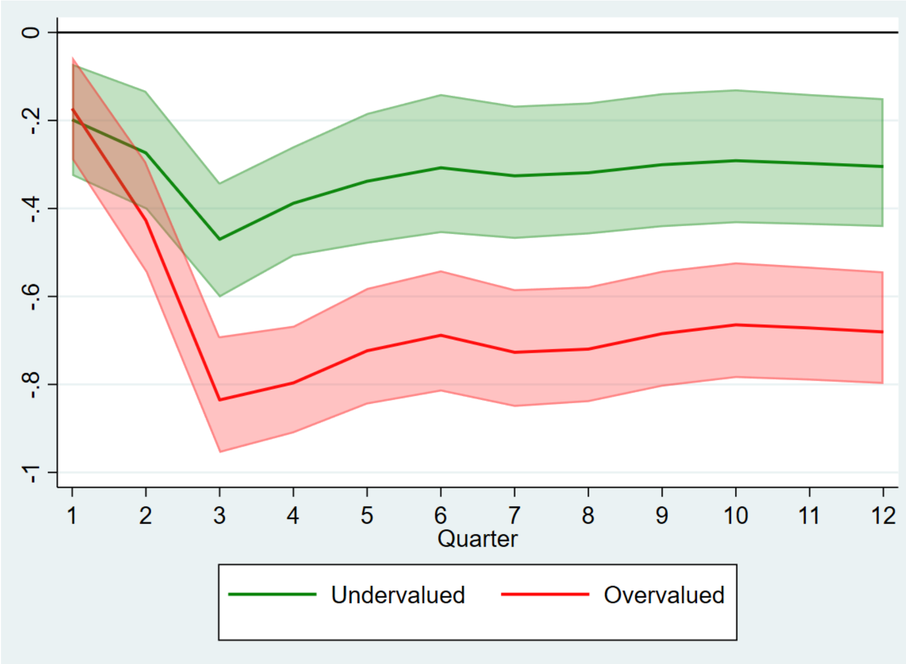
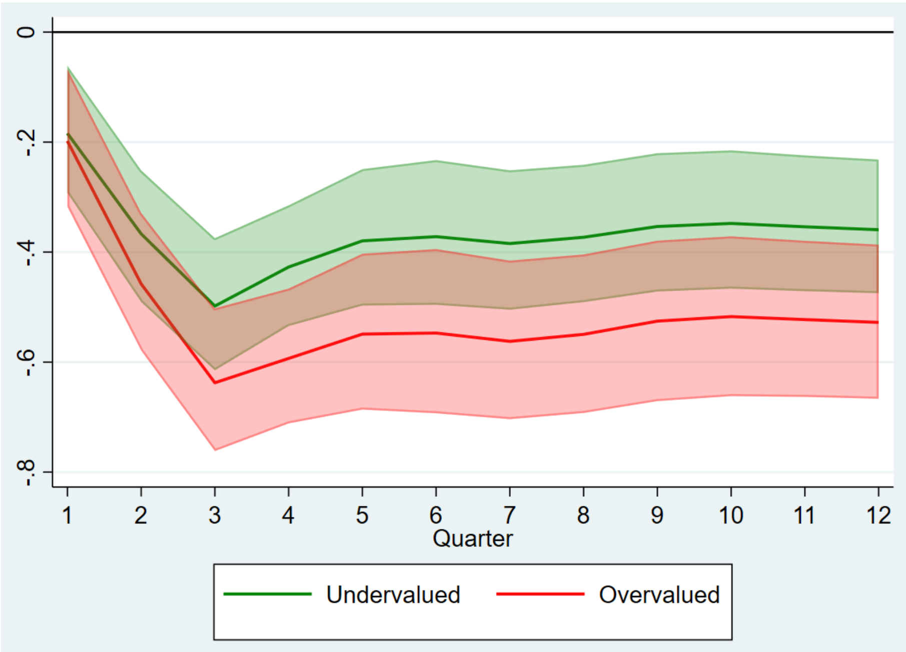


Figure A3: Cumulative IRFs of Output Gap to Global Risk Shock Shock: Low Financial Development



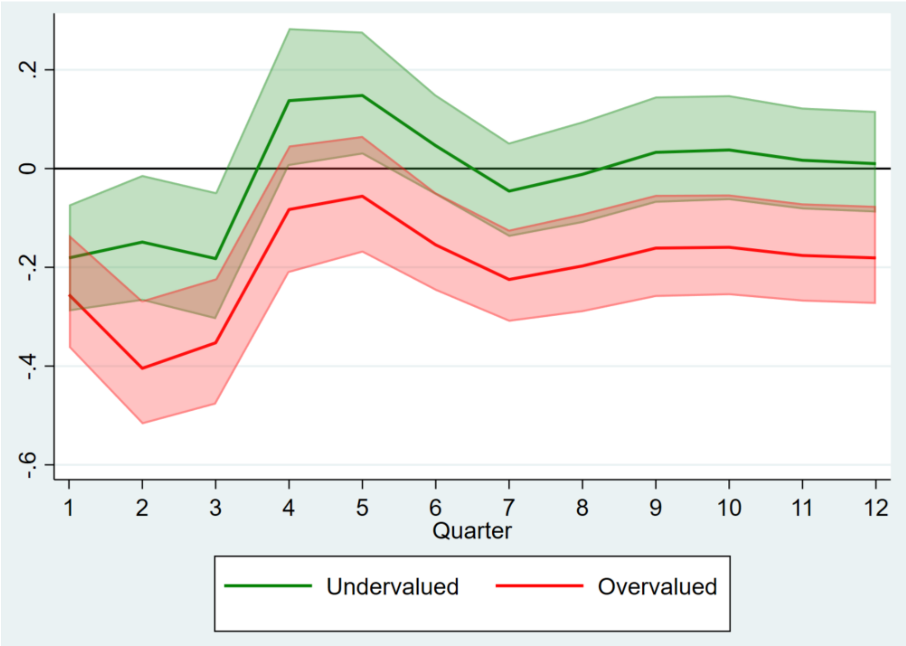
The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 25th percentile of financial development measure. 90 % confidence bands are reported.

Figure A4: Cumulative IRFs of Output Gap to Global Risk Shock: High Financial Development



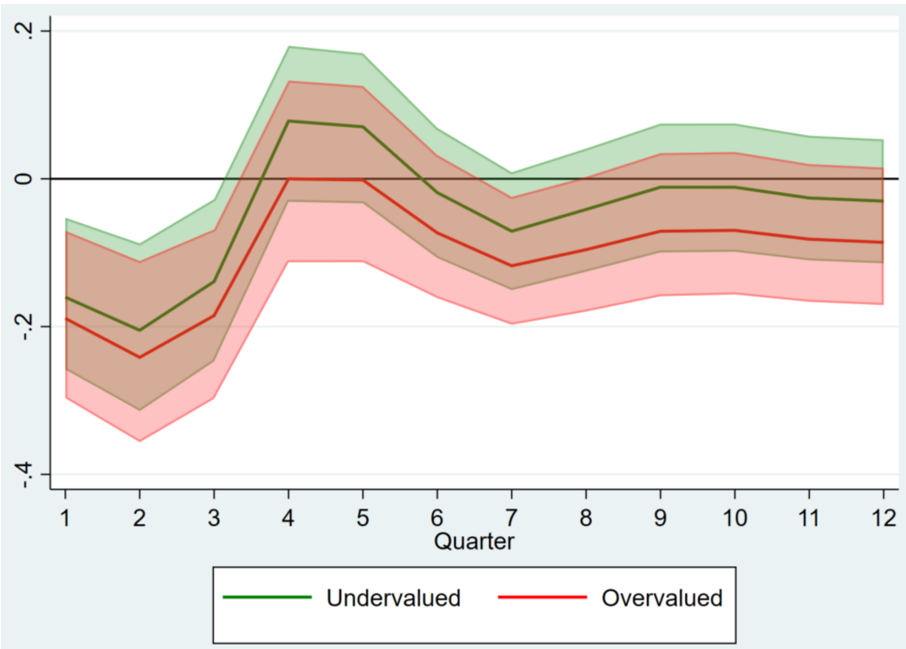
Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 75th percentile of financial development measure. 90 % confidence bands are reported.

Figure A5: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: Low Financial Development – Exogenized Currency Misalignment



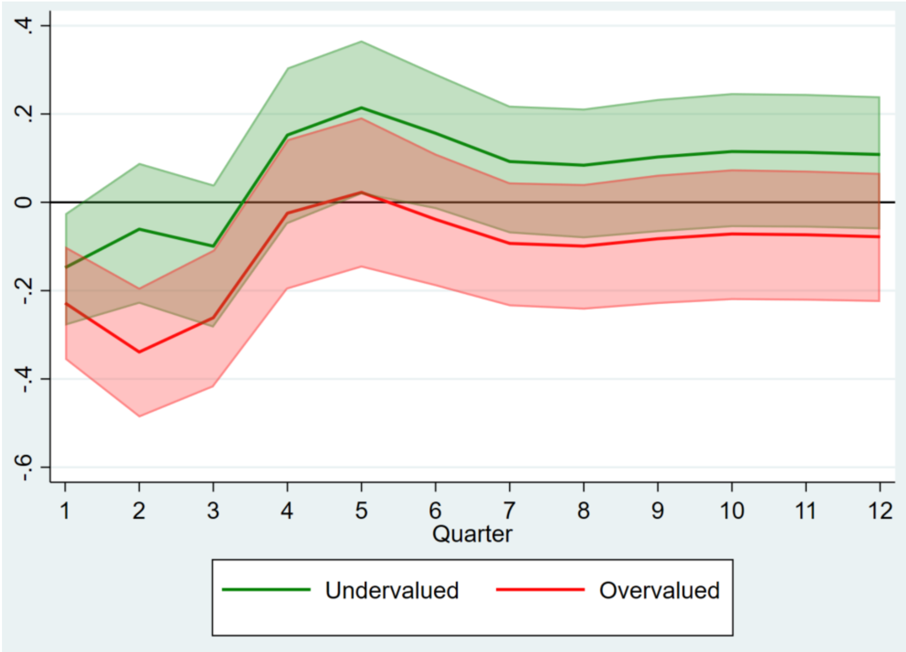
The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. The baseline measure of real currency misalignment was 'exogenized' by obtaining residuals from a regression of baseline currency misalignment measure on output gap and time fixed effects. Both IRFs were generated at 25th percentile of financial development measure. 90 % confidence bands are reported.

Figure A6: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: High Financial Development – Exogenized Currency Misalignment



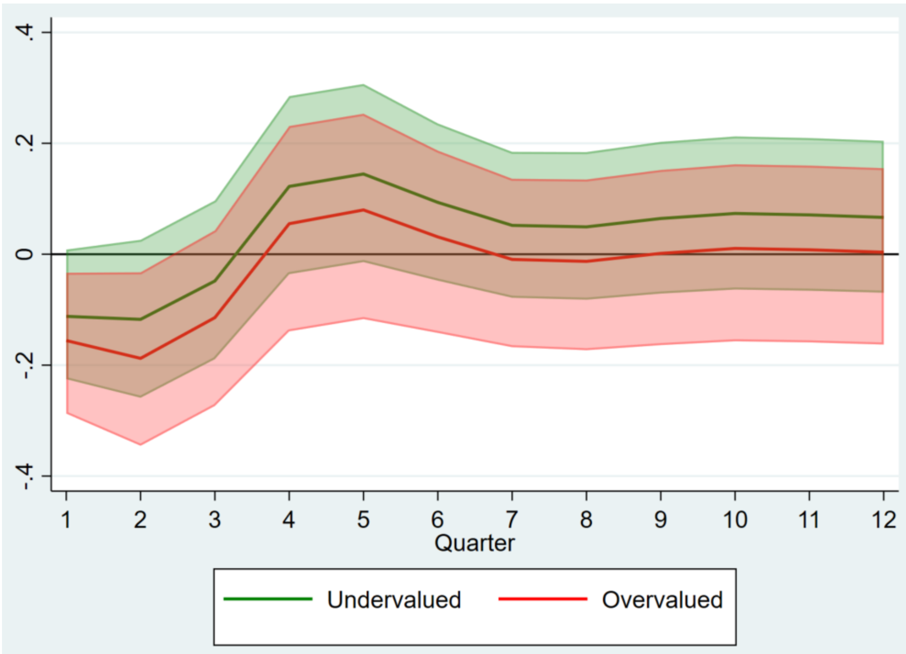
Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. The baseline measure of real currency misalignment was 'exogenized' by obtaining residuals from a regression of baseline currency misalignment measure on output gap and time fixed effects. Both IRFs were generated at 75th percentile of financial development measure. 90 % confidence bands are reported.

Figure A7: Cumulative IRFs of Real GDP to Foreign Real Rate Shock: Low Financial Development



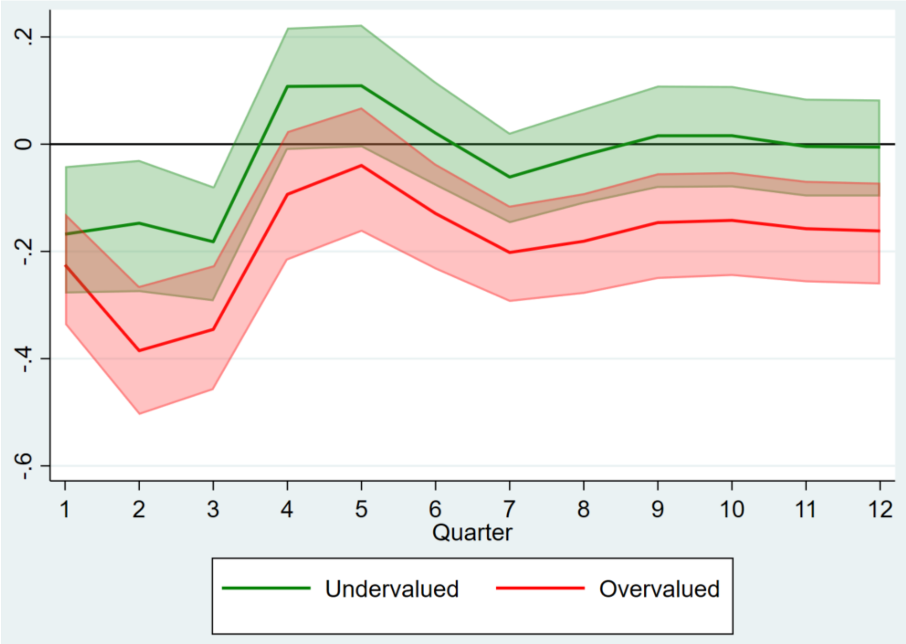
The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 25th percentile of financial development measure. Real GDP was expressed in logarithms. 90 % confidence bands are reported.

Figure A8: Cumulative IRFs of Real GDP to Foreign Real Rate Shock: High Financial Development



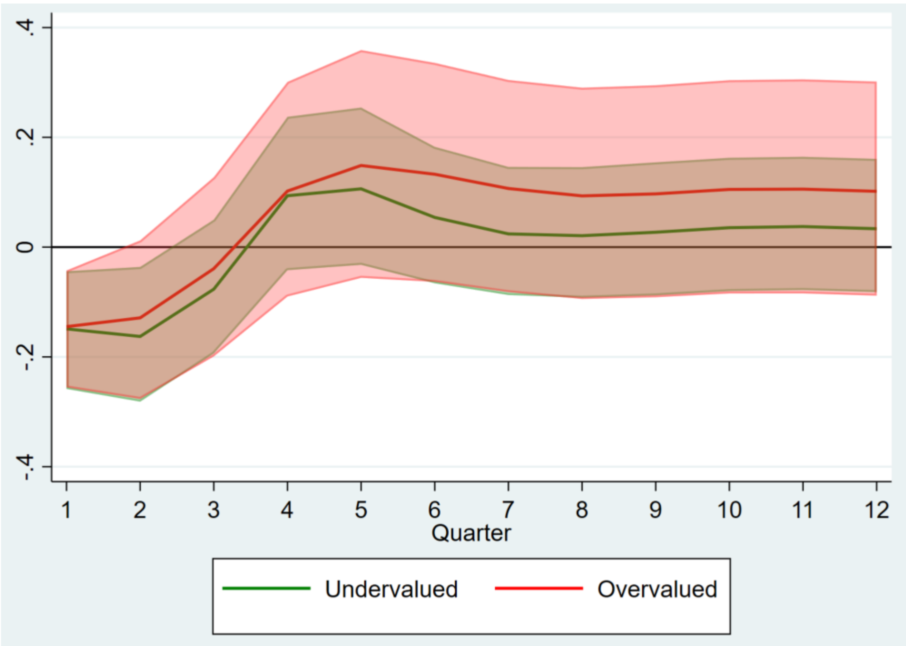
Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 75th percentile of financial development measure. Real GDP was expressed in logarithms. 90 % confidence bands are reported.

Figure A9: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: Low Financial Development – without Restrictions on Interaction Terms



The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 25th percentile of financial development measure. In this case, we let the vector of exogenous variables to influence the responses of all variables to external shocks – not only the output gap as in baseline regressions. 90 % confidence bands are reported.

Figure A10: Cumulative IRFs of Output Gap to Foreign Real Rate Shock: High Financial Development – without Restrictions on Interaction Terms



Notes: The IRFs were generated at 25th percentile (Undervalued) and 75th percentile (Overvalued) of real currency misalignment measure. Both IRFs were generated at 75th percentile of financial development measure. In this case, we let the vector of exogenous variables to influence the responses of all variables to external shocks – not only the output gap as in baseline regressions. 90 % confidence bands are reported.

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