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Reconciling contrasting views on the growth effect of currency undervaluations*

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Abstract

This paper provides an in-depth analysis of the link between exchange rate misalignments and economic growth for a large sample of 170 countries over the 1973-2019 period. We rely on new cross-country data on multilateral currency misalignments and cross-quantile regressions to demonstrate that the seemingly divergent views of the Washington Consensus and the export-led growth theory on the role of currency undervaluations in promoting economic growth can be reconciled. Although any significant departures from the equilibrium exchange rate levels are found undesirable, we show that undervaluations are more likely to stimulate economic growth in developing countries. However, this positive impact is observed only up to certain thresholds of development level and currency undervaluation. Consequently, strategies in the poorest countries that systematically undervalue currencies in real terms to foster growth should be carefully tailored, as they raise the risk for these economies of switching from a positive to a less favorable growth regime, depending on both their specific wealth level and the extent of their currency undervaluation.

JEL Classification: F31; O47; C32.

Keywords: Cross-quantile regressions; economic growth; multilateral currency misalignments; undervaluations.

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1 Introduction

In the aftermath of the crises of the 1980s and 1990s, discussions about economic stabilization and growth strategies in developing countries were shaped by systemic debates and concerns. Proponents of the Washington Consensus advocated —among the set of ten economic policy prescriptions— for market-determined exchange rates, arguing that they prevent significant macroeconomic imbalances and the resultant misallocation of resources.[1] They viewed currency overvaluations as a primary risk, although they acknowledged that undervaluations might also be harmful. Specifically, the Washington Consensus suggests that significant undervaluations may conflict with macroeconomic goals in the medium term, hindering economic growth in developing nations. This can occur as large undervaluations generate unnecessary inflationary pressures and restrict the resources available for domestic investment (Berg and Miao, 2010). Several studies have confirmed that sustained undervaluations may lead to economic distortions,[2] thereby diminishing their direct positive effects on growth (e.g., Grekou, 2015; Chen, 2017; Morvillier, 2020). Part of this literature has also highlighted the existence of nonlinearities, i.e., threshold effects in the relationship between currency misalignments —i.e., deviations of the exchange rates from their equilibrium values— and economic growth,[3] supporting the Washington Consensus argument that significant undervaluations result in lower economic growth than moderate ones.

Against this view, the export-led growth theory —notably supported by Rodrik's (2008) seminal paper— states that undervaluations tend to promote economic growth through exports' expansion, which is accompanied —domestically— by capital accumulation. This theory builds on the grounds that modern tradable activities are inherently more productive or operate under increasing returns to scale. Given this characteristic, reallocating current and future resources to these activities, or structural change, can significantly accelerate GDP per capita growth. This dynamic is particularly relevant in developing countries as, according to Rodrik (2008), undervaluation provides a mechanism that facilitates their economic catch-up to the income levels of wealthier economies by fostering the expansion of the tradable sector, especially the industrial one (Gala, 2008; Razmi et al., 2012; Libman et al., 2019). Other operating transmission channels through which undervaluations positively impact growth in developing countries have been investigated in the literature. These include the productivity growth channel (Mbaye, 2013;

[1] See, e.g., Berg and Miao (2010), Schröder (2013), and Giordano (2023).

[2] For recent surveys on the link between real exchange rates and economic growth, see Rapetti (2020) and Demir and Razmi (2022).

[3] See Razins and Collins (1997), Aguirre and Calderon (2005), Béreau et al. (2012), Couharde and Sallenave (2013), Grekou (2015), and Tipoy et al. (2018).

Njindan Iyke, 2018), the export-led channel through enhanced price competitiveness (Di Nino et al., 2011), and the upgrading in the specialization pattern (Cimoni et al., 2013).

Although several papers corroborate the beneficial effect of undervaluations on growth and Rodrik's (2008) findings (see, e.g., Cavallo et al., 1990; Dollar, 1992; Gala, 2008; MacDonald and Vieira, 2010; Di Nino et al., 2011; Nouira et al., 2011; Béreau et al., 2012; Elbadawi et al., 2012; Rapetti et al., 2012; Missio et al., 2015), the debate over their policy relevancy in developing countries continues. Specifically, undervaluations turn out to be significantly less effective than many studies suggest. Ribeiro et al. (2020) show that undervaluations can indirectly affect growth negatively through their impact on income distribution despite the potential positive direct effects on technological innovation and growth. This observation underscores the tangible costs associated with undervaluation policies in developing countries, emphasizing the necessity for additional supportive measures. Accordingly, some authors claim that an overreliance on currency undervaluation as a growth strategy, without the support of complementary fiscal and structural policies, is unlikely to yield sustained economic development (Nouira and Sekkat, 2012; Guzman et al., 2018). Schröder (2013) argues that most studies supporting Rodrik's view are flawed because they rely on inappropriate homogeneity assumptions on cross-country long-run real exchange rate behavior and/or growth regression misspecification. When these problems are redressed, adjusted-PPP (Purchasing Power Parity) misalignments do not matter for developing countries' growth performance. Goncalves and Rodrigues (2017) reach the same conclusion and consider the association between exchange rate misalignments and economic growth as a myth. Finally, Cumperayot and Kouwenberg (2021) provide evidence challenging the effectiveness of weakening domestic currencies as a means to boost long-term economic growth, compared to policies aimed at reducing government expenditure and enhancing domestic savings.

How can these differing findings be reconciled? In this paper, we argue that reconciliation is indeed possible. Our main contribution is to point out that the answer to the question of whether undervaluations promote economic growth depends on how deviations from equilibrium exchange rates are calculated and how exactly they affect economic performance. In other words, both data and methodological issues are involved in explaining the current imbroglio resulting from discrepancies observed in the literature. Considering undervaluations in a multilateral —i.e., multi-country— setting, we show that the assertion that undervaluation fosters growth appears robust in a canonical regression, supporting the asymmetrical impact of currency misalignments. However, if we are interested in how varying degrees of misalignments influence growth, then the answer turns out to support the Washington Consensus view. Using our multilateral data

set, we find that the relationship between growth and undervaluation varies across the distribution of GDP per capita and currency misalignments. Although growth is maximized when exchange rates are at their equilibrium value, economic growth in the lower-income quantiles is associated with undervaluations, particularly modest ones. In contrast, undervaluations have a harmful impact on middle-income countries. Acknowledging these threshold effects allows for reconciling the export-led growth theory and the Washington Consensus thesis and deriving less controversial policy recommendations. By contrast, using traditional bilateral currency misalignments fails to detect large differences in the misalignment-growth relationship across countries.

We, therefore, enhance the literature in two distinct ways. Firstly, the measures of currency misalignments used in many of the existing studies are of doubtful accuracy. We re-examine the misalignment–growth relationship using what we consider to be more precise and extensive measures. Specifically, we employ multilateral measures of currency misalignments instead of the traditional bilateral indicators, which are often cited to support a positive correlation between undervaluations and economic growth. Secondly, we are able to incorporate nonlinear interactions into the analysis of the misalignment-growth relationship, in contrast to previous studies that have either exclusively relied on analyzing the nonlinear impact of misalignments or have examined the conditional relationship across different quantiles of GDP per capita. Specifically, the estimation of cross-quantile regressions allows us to investigate how the effects of misalignments vary not only across the distribution of countries' development levels but also within their own distribution. In addition to circumventing the arbitrariness of defining a strict cutoff between developed and developing countries, this two-dimensional approach enables us to identify more complex relationships between currency misalignments and growth that standard nonlinear regression models might overlook. Such methodology is particularly relevant in our context as it allows us to account for asymmetries and nonlinearities linked to both *(i)* the direction of misalignments —i.e., overvaluations vs. undervaluations— and their extent, and *(ii)* the countries' development level, providing us with a complete picture of the growth-misalignments nexus.

The remainder of the paper is organized as follows. Section 2 briefly details the measures of real exchange rates and currency misalignments used in this paper and highlights the discrepancies between bilateral and multilateral measures. Section 3 explores the relationship between misalignments and growth within the traditional analytical framework. Section 4 presents our methodological approach and discusses the results. Section 5 concludes.

2 Real exchange rates and misalignments

The empirical literature on exchange rate misalignments and economic growth has traditionally favored two types of real exchange rate (RER) measures: price level-based measures derived from the International Comparison Program (ICP) and RER indices. To evaluate RER deviations from their equilibrium values, i.e., currency misalignments, we consider deviations of relative price levels from PPP corrected for the Balassa–Samuelson effect.[4]

2.1 Relative price levels

Compared to RER indices, the advantage of using international price comparisons lies in their ability to *(i)* preserve the cross-sectional dimension of the data, enabling more accurate cross-country comparisons, and *(ii)* provide a broader coverage both temporally and geographically.[5] Accordingly, we fall into the category of empirical studies relying on price level-based measures.

Bilateral real exchange rates (RER_{it}^{Bil}) are computed by dividing the PPP exchange rate (PPP_{it}) by the nominal exchange rate (ER_{it}), both expressed in units of the currency of country i per unit of the US dollar in year t:

$$RER_{it}^{Bil} = PPP_{it}/ER_{it} \tag{1}$$

A RER value lower than unity means that the currency's value against the US dollar is lower (or more depreciated) than what PPP suggests. To calculate those RER series, we use data on exchange rates and PPP conversion factors from the Penn World Table (PWT) version 10.0 for a sample of 170 countries over the 1973-2019 period.

As specified by Equation (1), measuring RER involves bilateral comparisons, typically with the United States (US), since price levels are provided relative to the US. However, this bilateral framework for assessing the RER is questionable as it overlooks the complexities of multilateral trade relations and how they influence the RER. Indeed, by construction, the bilateral framework leaves out the influence exerted by movements in the bilateral RER of third countries. This omission results in an incomplete picture of a country's competitiveness and may produce a biased estimate of its RER misalignment.

[4]See, e.g., Gala (2008), Rodrik (2008), and Berg and Miao (2010).

[5]Indeed, constructing real exchange rate indices requires data on price indices typically proxied by the consumer price indices. However, the availability of these data is limited notably in the least advanced economies. Furthermore, using such indices restricts the comparisons to the temporal dimension, living out the cross sectional one. This limitation also applies to the downstream approaches used to derive currency misalignments.

Therefore, we depart from the existing literature by considering an additional RER level measure, which is computed vis-à-vis a large basket of trade partners. In contrast to bilateral RER, these RER, due to their multilateral nature, are mutually dependent on each other, ensuring consistency in the between dimension when conducting panel data econometrics.

We obtain multilateral RER level series from the CEPII-MULTIPRIL database, which offers multilateral measures of price levels across a wide range of countries spanning from 1973 to 2019 (Couharde et al., 2021). The multilateral RER ($RER_{i,t}^{Multi}$) is computed as the geometric weighted average of bilateral relative prices against trading partners:

$$RER_{it}^{Multi} = \prod_{j=1}^{N} \left(\frac{RER_{it}^{Bil}}{RER_{jt}^{Bil}} \right)^{w_{ij,t}} \tag{2}$$

where $\frac{RER_{it}^{Bil}}{RER_{jt}^{Bil}}$ is the price level of country i relative to the trading partner j in period t, N denotes the number of trading partners, and $w_{ij,t}$ is the trade-based weight associated to the partner j.[6] Thus defined, $RER_{i,t}^{Multi}$ corresponds to the level of the real effective exchange rate of country i against its N trading partners and is also comparable across countries and over time. Like the bilateral RER, an increase in the multilateral RER denotes a real appreciation. RER values lower than one suggest that prices in country i are on average lower compared to its trading partners.

Figure 1 displays the distribution of the bilateral and multilateral RER —in logarithm— computed using data from the PWT 10.0. Two different samples are considered to ensure comprehensive coverage and robustness in our analysis. The "paired observations" sample includes all the available data points for each country and year where there is information for both bilateral and multilateral dimensions. Essentially, this sample ensures that every comparison made between bilateral and multilateral series is matched and directly feasible. The "common observations" sample is more restrictive. It contains only those country-year observations that are present in both bilateral and multilateral dimensions and that appear consistently across all versions of the PWT from version 6.1 to 10.0. Using data points appearing in all vintages, the sample is likely more stable and consistent, but smaller.

For both samples, the distributions of the variables maintain a consistent shape. However, notable differences in distributions between the bilateral and multilateral RER

[6] These weights are normalized so that they sum to one, i.e., $\sum_{j=1}^{N} w_{ij,t} = 1$. We retain the time-varying weights system against 186 trade partners (see Couharde et al., 2021).

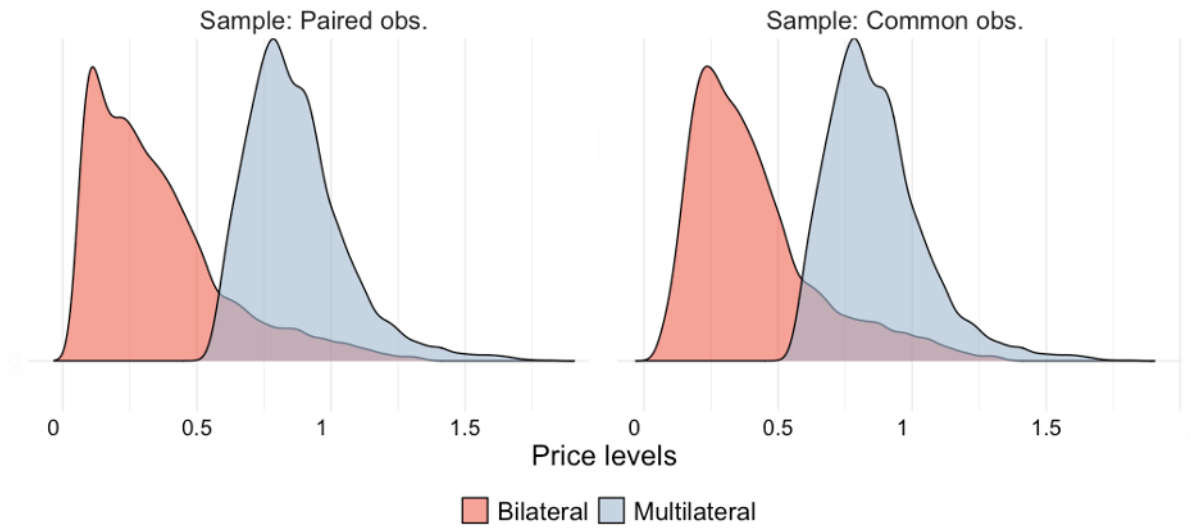

Figure 1 — Distributions of bilateral and multilateral real exchange rates in levels

Notes: Figure 1 displays the distribution of bilateral (orange color) and multilateral (blue color) real exchange rates computed using data from the Penn World Table (PWT) 10.0. The area under each curve represents the probability distribution of the respective dataset.

measures may raise significant concerns in calculating currency misalignments. Specifically, the right-skewed distribution of bilateral RER, characterized by a tail towards higher values, indicates a higher likelihood of extreme exchange rate values. Consequently, mean values might not adequately represent the "typical" RER, advocating for using econometric models equipped to address asymmetry. Conversely, the symmetrical distribution of multilateral RER around a mean of 0.7-0.8 reflects a relatively balanced set of exchange rate values, suggesting that economies might experience fewer extreme misalignments in a multilateral context. Finally, the persistence of these patterns throughout different data releases indicates that it is not an artifact of a particular data version, but rather indicative of a stable economic phenomenon (see Figure A.2 in Appendix A).[7] Overall, Figure 1 clearly questions the relevance of using a bilateral RER measure for a multilateral exercise such as growth analysis. In other words, it matters little to know that most countries have lower price levels than the US, but assessing price levels relative to trade partners is of foremost interest. In this respect, RER^{Multi} gives a more balanced picture, thus presenting the bilateral measure as a potentially misleading indicator, especially when dealing with economic growth issues.

[7]For the sake of completeness, we also rely on data extracted from the World Bank, World Development Indicators (WDI) database. As shown in Figure A.2 in Appendix A, similar findings are obtained.

2.2 Deriving currency misalignments

In line with Rodrik (2008), we compute currency misalignments by adjusting the RER measures (both bilateral and multilateral) for the Balassa-Samuelson effect (Balassa, 1964; Samuelson, 1964) as specified by Equation (3):

$$lnRER_{it}^{k} = \alpha + f_t + \beta_1 BS_{it}^{k} + \varepsilon_{it} \tag{3}$$

where k refers to the nature, bilateral or multilateral, of the RER measure. BS_{it}^{k} is a consistent Balassa-Samuelson proxy, f_t stands for year fixed effects, and ε_{it} is the idiosyncratic error term.[8]

Results are presented in Table 1. The coefficient of interest is β_1, which measures the Balassa-Samuelson effect. If countries with higher productivity in the tradable goods sector (reflected in higher GDP per capita) tend to have higher price levels, we would expect this coefficient to be positive and statistically significant.

As it turns out, the coefficient is always statistically significant across both RER measures and has a consistent positive sign.

After running this regression, the RER misalignment can be calculated using the difference between the observed and predicted RER. Figure 2 illustrates the resulting currency misalignments derived from both bilateral and multilateral settings.

[8]The Balassa-Samuelson proxy corresponds to the country i relative GDP per capita. In the bilateral framework, it is computed as the ratio between the country i GDP per capita and that of the US, both in PPP terms. In the multilateral dimension, the denominator is a weighted average of the trading partners' GDP per capita in PPP terms.

Table 1 — Deriving currency misalignments

Dimension	Bilateral (relative to the US)		Multilateral (relative to the trading partners)	
Sample	Paired obs.	Common sample	Paired obs.	Common sample
	(1.1)	(1.2)	(1.3)	(1.4)
Relative GDP per capita	0.240***	0.304***	0.098***	0.129***
	(0.004)	(0.011)	(0.002)	(0.005)
Constant	-3.937***	-3.611***	0.054***	-0.042**
	(0.049)	(0.105)	(0.008)	(0.018)
Observations	7,288	1,240	7,288	1,240
N. of countries	170	146	170	146
R-squared	0.523	0.408	0.337	0.359

Notes: Estimations based on price levels from the Penn World Table 10.0. Robust standard errors in parentheses. Year fixed effects included in the regressions. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

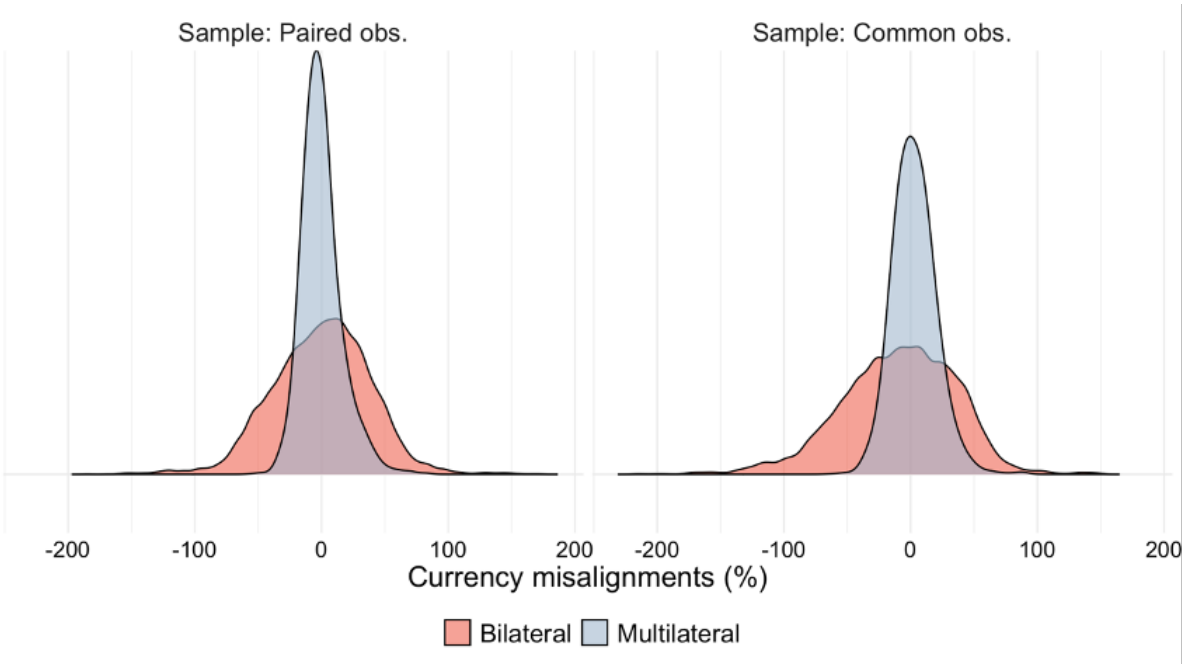

Figure 2 — Comparative distributions of currency misalignments across RER measures

Note: Figure 2 displays the distribution of currency misalignments measured in bilateral (orange color) and multilateral (blue color) terms. Negative (resp. positive) values correspond to undervaluations (resp. overvaluations). The area under each curve represents the probability distribution of the respective dataset.

Although both measures exhibit distributions centered around zero, their shapes markedly differ. Specifically, the distribution of the bilateral measure is significantly broader than that of the multilateral measure, with nearly half of the observations in the latter category representing extreme values. Consequently, this figure demonstrates that selecting a measurement framework can profoundly influence the evaluation of currency misalignments. Moreover, there is a consistent pattern in the distributions of misalign-

ments across the different versions of PWT and between PWT and WDI, suggesting that the methodology used to calculate these misalignments provides stable results across various data sources and over time (see Figure A.3 in Appendix A).

To deliver deeper insights, Figure 3 provides a bivariate map to illustrate better the discrepancies between the bilateral and multilateral estimates of currency misalignments, averaged over the 2015-2019 period.

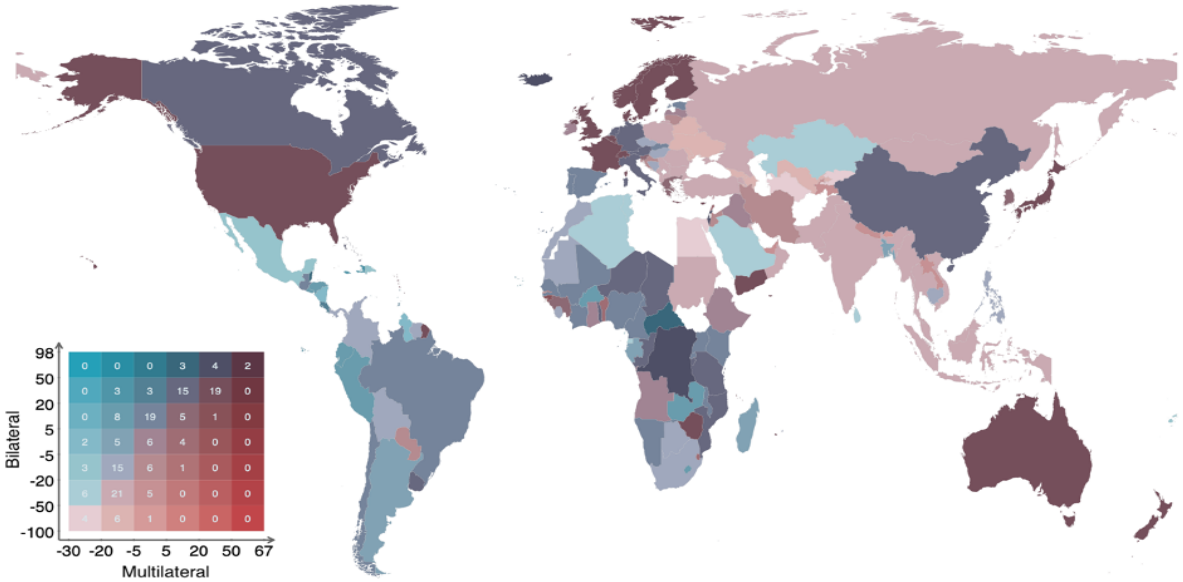

Figure 3 — Exchange rate misalignments (percentage, average 2015-2019)

Notes: This bivariate map shows, for each country, the average of its bilateral misalignment and the average of its multilateral misalignment with color-coded legend. Darker hues represent more pronounced differences between the bilateral and the multilateral frameworks. Conversely, lighter shades suggest a smaller difference between the two measures. Positive (resp. negative) values indicate overvaluations (resp. undervaluations).

Among the 170 countries with available estimates of currency misalignments over the 2015-2019 period, two-thirds exhibit disparities exceeding 10% in the magnitude of bilateral and multilateral misalignment estimates (e.g., China, France, India, Mexico, Norway). Slightly more than a quarter of the countries demonstrate disparities greater than 20% in their estimates (e.g., Canada, Egypt, Russia, Turkey). Notably, 15% of the countries not only show differences exceeding 10 percentage points in their misalignment values but also display divergences in directionality. For instance, in the bilateral framework, Brazil and Singapore have misalignment estimates of 18% and -4%, respectively, whereas in the multilateral framework, they amount to -1% and 7%. Moreover, the divergences between the two measures do not show any geographical or economic patterns. Overall, the divergences between the two approaches are sizable. Our multilateral metric thus provides a distinct perspective on the measurement of exchange rate misalignments, which will likely have crucial implications on the misalignments-growth analysis.

3 Do undervaluations promote economic growth?

We estimate the effect of misalignments on economic growth using the empirical framework of Rodrik (2008):

$$Growth_{it} = \alpha + \mu_i + f_t + \beta y_{i,t-1} + \gamma Mis_{it}^k + \Theta X_{it} + \varepsilon_{it} \tag{4}$$

where $Growth_{it}$ is the growth rate of real GDP per capita of country i at time t, $y_{i,t-1}$ stands for the lagged real GDP per capita (in logarithm), and Mis_{it}^k is the real exchange rate misalignment. As before, k indicates the considered dimension, i.e., bilateral or multilateral. X_{it} is the vector of control variables considered in Rodrik (2008) —i.e., institutional quality, government spending, terms of trade, inflation, savings, and human capital.[9]

To investigate whether the growth effect of misalignments is asymmetric, Equation (4) can be modified by distinguishing episodes of overvaluation and undervaluation:

$$Growth_{it} = \alpha + \mu_i + f_t + \beta y_{i,t-1} + \gamma_1 Under_{it}^k + \gamma_2 Over_{it}^k + \Theta X_{it} + \varepsilon_{it} \tag{5}$$

where $Under_{it}^k$ and $Over_{it}^k$ respectively represent exchange rate undervaluations and overvaluations.

We estimate Equations (4) and (5) with annual data using panel fixed effects and system-GMM estimators. The corresponding results are presented in Tables 2 and 3.

Both bilateral and multilateral measures exhibit negative coefficients, indicating that currency misalignments are, on average, associated with reduced economic growth. Accounting for the type of misalignments is, however, crucial. Indeed, currency undervaluations correspond with enhanced growth, while overvaluations are connected to decreased growth, supporting an asymmetrical effect of currency misalignments on economic growth. Furthermore, these findings remain consistent when employing system-GMM estimators; the misalignment coefficients being larger with the system GMM-model compared to the fixed effects model. Therefore, Tables 2 and 3 corroborate that the growth-promoting effect of undervaluations is robust across various dimensions, including the addition of more controls and addressing the endogeneity of currency misalignments. Our analysis further provides evidence that this result is also robust to the choice of the misalignment measure.

[9] See Table A.1 for the definitions and sources of the control variables.

Table 2 — Currency misalignments and economic growth (Fixed effects)

	Bilateral				Multilateral			
	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)
Initial income	-0.073***	-0.096***	-0.073***	-0.096***	-0.074***	-0.099***	-0.075***	-0.099***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.006)	(0.004)	(0.006)
Currency misalignments	-0.053***	-0.062***			-0.133***	-0.130***		
	(0.004)	(0.006)			(0.009)	(0.013)		
Undervaluations			0.044***	0.036***			0.197***	0.105***
			(0.007)	(0.010)			(0.020)	(0.024)
Overvaluations			-0.061***	-0.086***			-0.102***	-0.144***
			(0.006)	(0.009)			(0.013)	(0.017)
Institutional quality		0.007***		0.007***		0.007***		0.007***
		(0.002)		(0.002)		(0.002)		(0.002)
Government spending		-0.136***		-0.150***		-0.174***		-0.174***
		(0.045)		(0.045)		(0.045)		(0.045)
Terms of trade		0.032***		0.032***		0.030***		0.030***
		(0.005)		(0.005)		(0.005)		(0.005)
Inflation		-0.038***		-0.038***		-0.039***		-0.039***
		(0.005)		(0.005)		(0.005)		(0.005)
Savings		0.123***		0.129***		0.128***		0.131***
		(0.020)		(0.020)		(0.020)		(0.020)
Human capital		0.063**		0.064**		0.058**		0.059**
		(0.025)		(0.025)		(0.025)		(0.025)
Constant	0.671***	0.677***	0.671***	0.692***	0.676***	0.724***	0.681***	0.725***
	(0.032)	(0.052)	(0.032)	(0.052)	(0.032)	(0.053)	(0.032)	(0.053)
Observations	7,251	3,271	7,251	3,271	7,251	3,271	7,251	3,271
N. of countries	170	130	170	130	170	130	170	130
R-squared	0.167	0.317	0.167	0.319	0.172	0.317	0.174	0.317

Notes: Robust standards errors are reported in parentheses. Time and country fixed effects are included in all estimations. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3 — Currency misalignments and economic growth (System-GMM)

	Bilateral				Multilateral			
	(3.1)	(3.2)	(3.3)	(3.4)	(2.5)	(3.6)	(3.7)	(3.8)
Lagged growth	0.145***	0.132***	-0.038	-0.070	0.077**	0.105***	-0.007	-0.066
	(0.035)	(0.034)	(0.068)	(0.064)	(0.033)	(0.033)	(0.070)	(0.065)
Initial income	-0.063***	-0.056***	-0.114***	-0.139***	-0.032**	-0.034**	-0.172***	-0.163***
	(0.017)	(0.017)	(0.030)	(0.036)	(0.015)	(0.016)	(0.032)	(0.033)
Currency misalignments	-0.145***		-0.152***		-0.469***		-0.209***	
	(0.020)		(0.028)		(0.060)		(0.074)	
Undervaluations		0.047**		0.079		0.129*		-0.047
		(0.023)		(0.062)		(0.073)		(0.167)
Overvaluations		-0.231***		-0.170***		-0.500***		-0.202**
		(0.031)		(0.041)		(0.080)		(0.085)
Institutional quality			0.035***	0.028**			0.024*	0.019
			(0.013)	(0.013)			(0.014)	(0.013)
Government spending			-0.166	-0.260			-0.084	-0.142
			(0.275)	(0.276)			(0.335)	(0.360)
Terms of trade			0.113***	0.118***			0.100***	0.105***
			(0.034)	(0.034)			(0.032)	(0.033)
Inflation			-0.075***	-0.069***			-0.056***	-0.046*
			(0.027)	(0.026)			(0.018)	(0.026)
Savings			0.229	0.219			0.283*	0.381**
			(0.141)	(0.152)			(0.153)	(0.187)
Human capital			0.278**	0.407**			0.549***	0.532***
			(0.127)	(0.161)			(0.126)	(0.154)
Constant	0.637***	0.567***	0.257	0.378	0.290**	0.395***	0.587**	0.505*
	(0.158)	(0.160)	(0.276)	(0.291)	(0.137)	(0.147)	(0.271)	(0.302)
Observations	7,214	7,214	3,267	3,267	7,214	7,214	3,267	3,267
N. of countries	170	170	130	130	170	170	130	130
Hansen	0.954	1	1	1	0.957	1	1	1

Notes: Robust standards errors are reported in parentheses. Time and country fixed effects are included in all estimations. As in Rodrik (2008), we include the lagged growth in the GMM regressions. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

All in all, within the standard framework, both bilateral and multilateral misalignment measures provide similar findings, confirming an asymmetrical relationship between currency misalignments and economic growth. However, the traditional setting adopted above has paved the way for many unresolved debates and, consequently, has failed to provide a solid basis for policy recommendations. The reasons are two-fold. Firstly, various studies replicate this framework with differing methodologies for deriving currency misalignments, leading to debates centered more on the considered estimation method[10] than on misalignments' consistency within a standard cross-country growth model. Yet, currency misalignments typically assessed —either within a bilateral setting or on a country-by-country basis— are often not nested in a coherent way for studying their effects in panel data growth models. Secondly, relying on linear growth models offers a limited view of the relationship between misalignments and economic growth. Evidence suggests that nonlinear dynamics significantly influence this relationship, given that countries at different development stages exhibit specific growth patterns, indicating that the effects of currency misalignments may vary along countries' development trajectories. However, models that explicitly address these nonlinearities typically focus only on one aspect of nonlinearity.[11] We therefore bring these two sources of nonlinearities together and consider nonlinearities that are conditioned by both the extent of misalignments and the country's level of development. In what follows, we examine how explicit attention to misalignments that are mutually interdependent and combined nonlinearities can be integrated into a regression evaluation of the growth-misalignment nexus and how it affects the policy conclusions one might draw concerning undervaluation and growth, especially in developing countries.

4 Reconciling the findings: a cross-quantile approach

We combine two sources of nonlinearities by examining how both the distribution of GDP per capita and currency misalignments influence the relationship between misalignments and economic growth. As mentioned before, such combined nonlinearities are likely overlooked in traditional nonlinear regression models.

To do this, we introduce a cross-quantile regression (CQR) approach, which basically

[10] In this sense, part of the disagreement between studies refuting and those supporting Rodrick's view may be interpreted as a disagreement about whether misalignments should be estimated on an individual country basis (Schröder, 2013), or derived with and without country fixed effects (Demir and Razmi, 2022).

[11] Quantile regressions enable the estimation of currency misalignment effects across different points in the GDP per capita distribution (Missio et al., 2015). Meanwhile, transition regression models delineate the nonlinear impacts of currency misalignments on economic growth (Béreau et al., 2012; Couharde and Sallenave, 2013; Tipoy et al., 2018).

consists in identifying the effect (magnitude and sign) that an exogenous variable (say X_1) at its $Q_{X1^{th}}$ quantile has on a dependent variable, conditional upon another variable (say X_2) at its $Q_{X2^{th}}$ quantile. Put in our context, we aim to investigate the conditional effects of the misalignments' quantiles on economic growth, conditional upon the different quantiles of the level of economic development, proxied by the real GDP per capita —in PPP terms. The idea here is to capture multiple nonlinearities so that the effect of currency misalignments on growth is allowed to vary across the misalignments and the real GDP per capita distributions.[12] This involves extending the baseline framework by a term that multiplies the misalignment variable by a vector of dummy variables corresponding to a country's membership in each respective quantile of misalignments and real GDP per capita:

$$Growth_{it} = \alpha + \mu_i + f_t + \beta y_{i,t-1} + \gamma Mis_{it}^k + \sum_{j=1}^{Q}\sum_{j'=1}^{Q} \delta_{jj'} Mis_{it}^k \times I_{jj'} + \Theta X_{it} + \varepsilon_{it} \quad (6)$$

where $I_{j,j'}$ stands for the dummy variable associated with group jj', i.e., quantiles j and j' for the currency misalignments and the real GDP per capita, respectively. X_{it} is the vector of additional control variables considered in Equations (4) and (5).[13] μ_i and f_t respectively stand for the country and time fixed effects, and ε_{it} is the error term.

Our main focus is on the estimated values of $\delta_{jj'}$ relative to $\widehat{\gamma}$, the average effect associated with currency misalignments. Indeed, since each $\widehat{\delta}_{jj'}$ indicates the marginal effect of currency misalignments in group jj', the "total" growth effect, for each group, is given by the sum of the coefficients, i.e., $\widehat{\gamma} + \widehat{\delta}_{jj'}$.[14] We set $Q = 5$, i.e., we split the distributions of currency misalignments and GDP per capita into five ranked quintiles (see Figure A.4 in Appendix A), which gives us a 5×5 matrix and thus a total of 25 cross-subgroups.[15]

Figures 4 and 5 provide contour plots synthesizing our results from regression (6), without (baseline model) and with (augmented model) control variables, respectively,

[12] It should be noted that our approach has the key advantage of allowing for greater homogeneity —in the growth response— compared to the other approaches used in the existing literature.

[13] In addition to the initial set of controls, we also control for crises, differentiating currency crises from other crises.

[14] Provided that the coefficients $\widehat{\delta}_{jj'}$ are statistically significant.

[15] We set $Q = 5$ for several reasons. First, considering five groups allows us to capture quite precisely the asymmetries and nonlinearities and ensure robust inferences with sufficient degrees of freedom. Second, while increasing the number of groups entails smaller observations in each group —and so less accuracy—, considering a smaller number of groups comes at the cost of a clear image of the growth effects of currency misalignments. For instance, for currency misalignments, considering 3 groups leads to lumping together currencies at their equilibrium values —broadly speaking— with relatively important undervaluations and overvaluations. Also note that, for collinearity issues, we remove the 13^{th} subgroup, i.e., the intersection of groups 3 for both the misalignments and income level.

based on our two misalignments measures —bilateral and multilateral.[16] By displaying the specific growth response ($\widehat{\gamma}+\widehat{\delta}_{jj'}$) for each currency misalignment-income group, these contour plots provide a visual and insightful summary of the relationship between economic growth and currency misalignments by showing the different effects and illustrating how they are modulated along the distributions of both conditioning variables (i.e., misalignments and income levels).

The difference between the two panels in Figure 4 is striking; the bilateral price level-based measure falls short in capturing the complexities of the relationship between currency misalignments and economic growth. Indeed, no specific region can be detected in the sense that no distinctive effect can be associated with any area. In other words, whatever the magnitude and the sign of misalignments as well as the level of economic development, bilateral misalignments have no significant differentiated impact on economic growth. In contrast, Panel B (multilateral price level-based misalignments) is almost filled to capacity. As shown, nonlinearities and asymmetries are at play, underlining that the growth impact of misalignments depends on both their direction and magnitude, as well as on the countries' development level. Several regions delimiting the effects of currency misalignments are visible, indicating that there is no "one size fits all".

The lower region of the plot —which delineates the growth effects of currency misalignments for lower-income countries— exhibits the strongest variability, suggesting the presence of clear and important asymmetries and nonlinearities. Indeed, for these less developed countries, growth appears to be maximized when currencies are close to their equilibrium (center of the x-axis) or slightly undervalued. Deviating from these specific levels of misalignment comes at the cost of lower economic growth. Considering these threshold effects, the differences in the growth impact of undervaluations for this group of countries are as follows. The maximum —estimated— growth effect fades from 0.78 in the case of misalignments ranging between -5% and +2% (group $Q3$) to 0.53 for misalignments ranging between -13% and -5% (group $Q2$) and drops to 0.25 for undervaluations exceeding 13% (group $Q1$). More dramatically, overvaluations are found to be detrimental to growth; the growth effect vanishes for moderate/intermediate overvaluations (group $Q4$, up to +11%) and turns negative for higher overvaluations.[17] Less developed economies are thus particularly vulnerable to currency overvaluations. Moving one level higher along the income distribution ($Q2$, y-axis), the same conclusions hold, although with diminished growth gains from undervaluations and a slightly higher tolerance to overvaluations.

[16] Figure A.1 in Appendix A depicts the sample of countries for the baseline and the augmented models. The estimation results are displayed in Table B.1 in Appendix B.

[17] Figure A.4 in Appendix A displays boxplots of currency misalignments for each group.

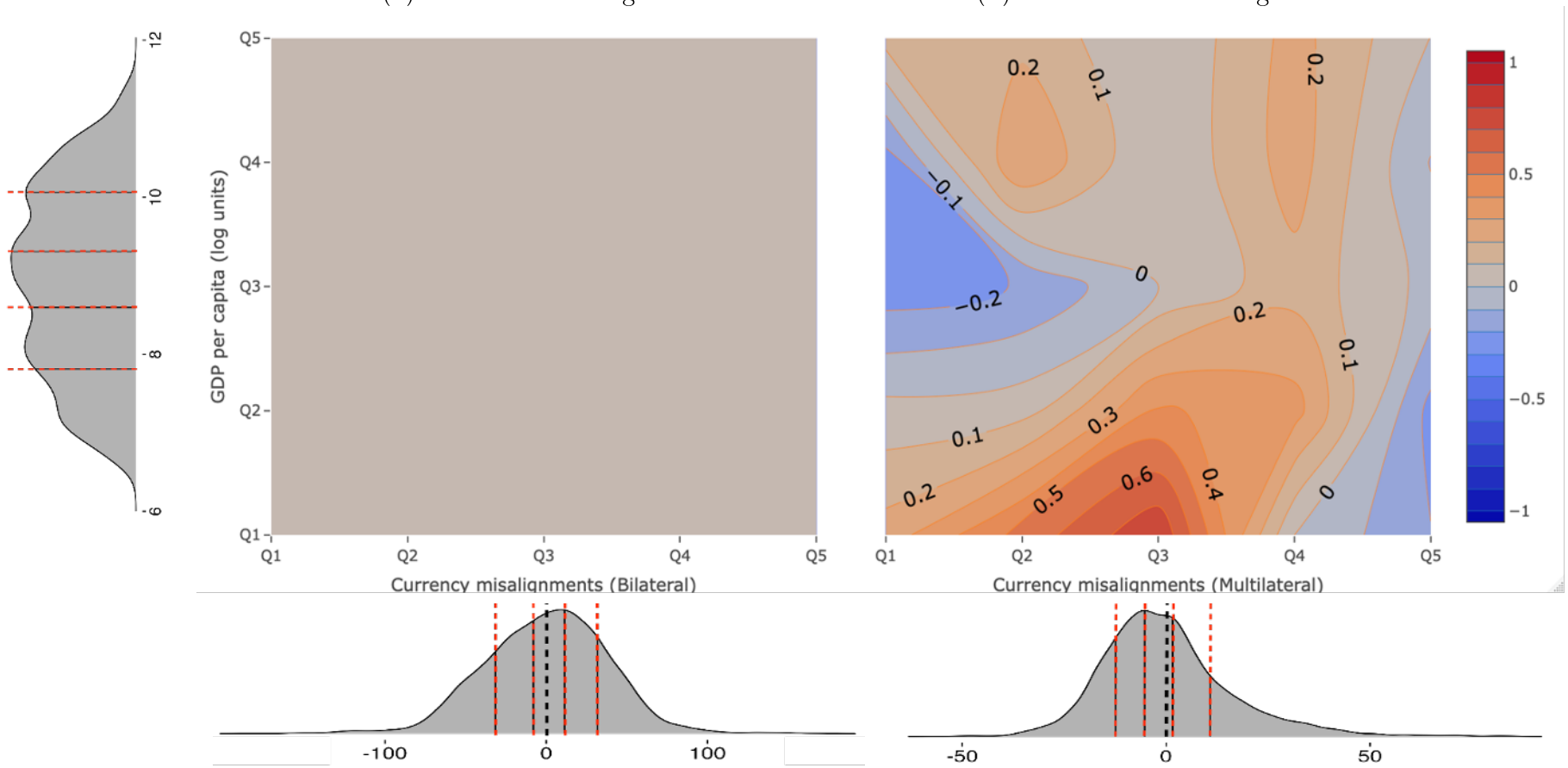

Figure 4 — Two-dimensional distribution of the relative growth effects of exchange rate misalignments (baseline model)

Notes: The figures present contour plots depicting the growth effects of exchange rate misalignments (bootstrap estimates, 1000 replications), measured as deviations from the "central" effect (i.e., measured at "$Q3$" in both the GDP per capita and currency misalignment distributions). The degree of deviation is indicated by the shades of color —provided that the p-value of the null (i.e., "zero-distance") is lower than 1%. Exchange rate misalignments are shown on the x-axis, arranged in ascending order from undervaluations (negative values, left side) to overvaluations. For each misalignment measure (i.e., bilateral, multilateral), the bottom chart illustrates the distribution of misalignments. The y-axis refers to the log GDP per capita (in PPP terms) in ascending order, with "$Q5$" indicating the highest quintile (illustrated by the left-rotated distribution). In the distribution charts, red dashed lines delimit the quintiles. Table B.1 in Appendix B details the estimation results underpinning the contour plots.

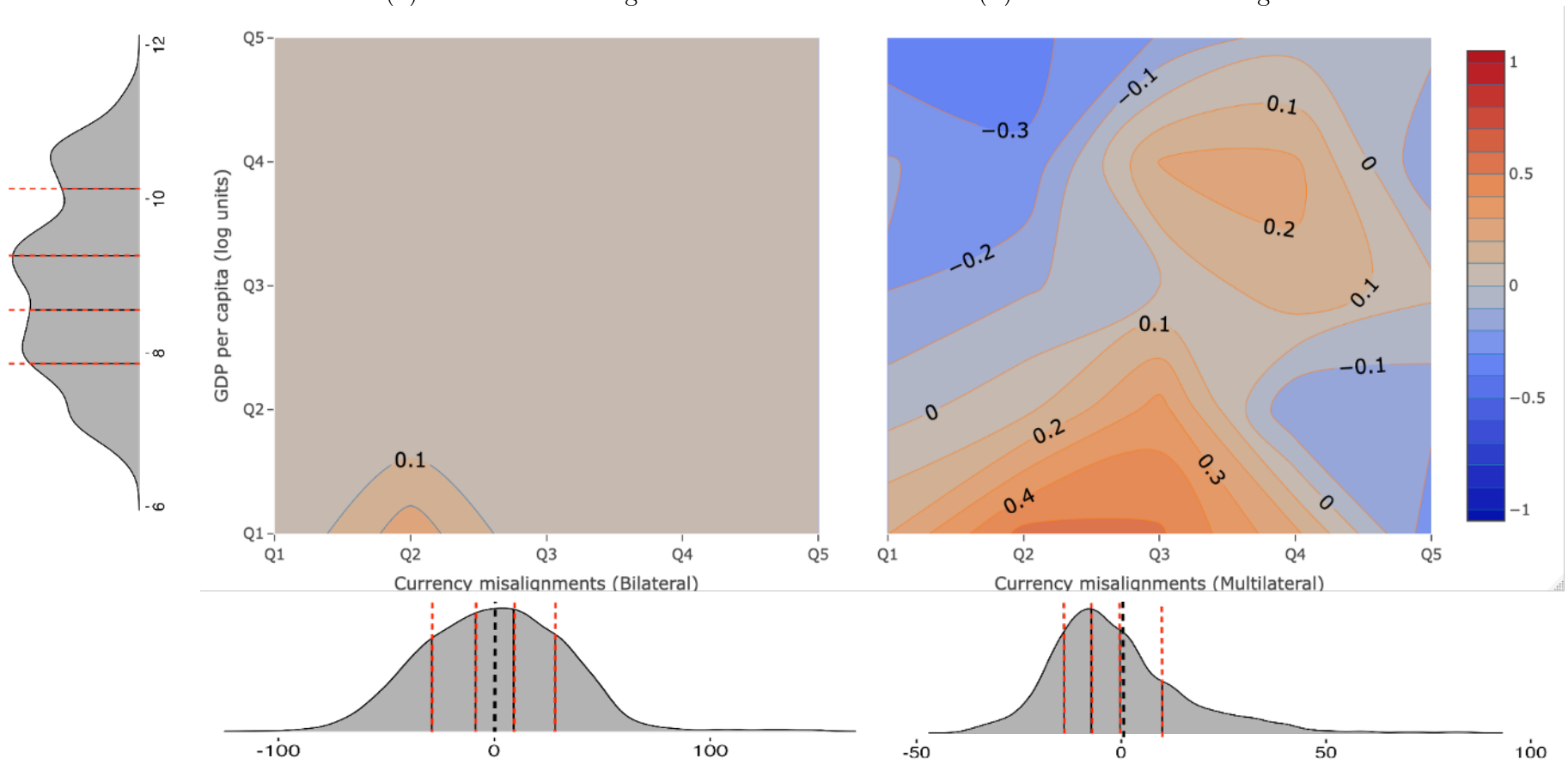

Figure 5 — Two-dimensional distribution of the relative growth effects of exchange rate misalignments (augmented model)

Notes: The figures present contour plots depicting the growth effects of exchange rate misalignments (bootstrap estimates, 1000 replications), measured as deviations from the "central" effect (i.e., measured at "$Q3$" in both the GDP per capita and currency misalignment distributions). The degree of deviation is indicated by the shades of color —provided that the p-value of the null (i.e., "zero-distance") is lower than 1%. Exchange rate misalignments are shown on the x-axis, arranged in ascending order from undervaluations (negative values, left side) to overvaluations. For each misalignment measure (i.e., bilateral, multilateral), the bottom chart illustrates the distribution of misalignments. The y-axis refers to the log GDP per capita (in PPP terms) in ascending order, with "$Q5$" indicating the highest quintile (illustrated by the left-rotated distribution). In the distribution charts, red dashed lines delimit the quintiles. Table B.1 in Appendix B details the estimation results underpinning the contour plots.

For the middle-income group ($Q3$ on the y-axis), the positive growth effect of undervaluations falls away. Instead, greater undervaluations correlate with increasingly adverse impacts. Still, while high overvaluations also seem to hamper growth, middle-income countries benefit from being at the equilibrium as well as from moderate to intermediate overvaluations. The dynamics become even more pronounced among upper-middle-income countries, where high undervaluations and overvaluations both negatively affect economic growth. Although the growth impact of moderate undervaluations is minimal —and positive— it becomes markedly significant for mild to intermediate overvaluations. The comfort zone for higher-income economies is even more important. Indeed, when extreme currency misalignments —associated with negative impacts— are excluded, these countries seem to accommodate both moderate/intermediate undervaluations and overvaluations —with no specific effect for currencies around the equilibrium.

These estimated effects are the most conservative, with a significance level set at 1 percent. Allowing for more flexibility —specifically, considering results significant at the 5 percent level[18]— alters the previous takeaways for the southeastern and northwestern regions of the plot. In both cases, the negative effects of currency misalignments on growth are exacerbated, as evidenced by the more extensive blue areas. For low-income countries ($Q1$ and $Q2$ on the y-axis), the main finding of maximized growth around the equilibrium is further supported by more pronounced adverse effects of currency overvaluations. Symmetrically, the negative effects associated with —intermediate to high— undervaluations noted for middle-income countries ($Q3$ on the y-axis), now extend to high-income countries ($Q4$ and $Q5$ on the y-axis). Again, those results relate specifically to multilateral RER-based currency misalignments; the left "radar" —i.e., the bilateral framework— is still not detecting any signal.

Despite the drastic fall in the number of observations, results from the augmented model —illustrated in Figure 5— support our previous findings. In particular, when considering multilateral misalignments (Panel B), the results appear to offer a valuable synthesis of the corresponding charts based on the baseline model. A notable finding is that Panel A now reveals a distinct pattern: intermediate undervaluations are associated with a positive growth effect for the lower-income countries, while no specific effects are observed for other combinations of currency misalignments and income levels.[19]

Overall, if we synthesize the findings from the baseline and augmented models, we

[18] See the right chart of Figure B.1 in Appendix B.

[19] Again, the results are similar at the 5 percent level (see Figure B.1 in Appendix B). More specifically, in the left chart, the picture is identical. In the right chart, however, owing to the lower number of observations, the image is "fuzzier" but still supports our general results.

find evidence in favor of the different —dominant— viewpoints in the literature, i.e., the export-led growth theory and the Washington Consensus, once we turn to multilateral misalignments. Specifically, for less developed countries, we show that undervaluations spur growth —although to a lesser extent than when misalignments are null. Moving upper the income distribution does not reverse this conclusion, though it introduces some nuances for the misalignment-growth nexus in more advanced economies. Our findings indicate that the most positive growth responses in more developed countries occur in the context of mild currency misalignments, with a weaker sensitivity to moderate overvaluations. Thus, our results suggest that to gain a comprehensive understanding of the relationship between exchange rate misalignments and economic growth, it is preferable to adopt a framework that not only captures combined nonlinearities but also incorporates multilateral price level-based misalignments. This approach is likely to yield less controversial policy recommendations, particularly in developing countries where policy debates have been most intense.

5 Conclusion

Although more than fifteen years have passed since Rodrik published his influential essay supporting the role of currency undervaluations in fostering economic growth in developing countries, the issue remains contentious. Numerous studies support the export-led growth theory, but evidence also shows that undervaluations may have mixed effects on economic growth, adversely affecting other economic outcomes (inflation, debt, income distribution, composition of exports, ...), which aligns with the Washington Consensus view.

As shown in this paper, the two perspectives are not mutually exclusive. Thanks to our novel measure of real exchange rates and multidimensional nonlinear approach, our analysis demonstrates asymmetries and nonlinearities in the growth effects of multilateral misalignments in connection with the distribution of currency misalignments and the countries' development level. We find that large undervaluations generally hurt growth in middle-income countries and tend to come at the cost of economic slowdown in low-income economies. Conversely, large overvaluations are less harmful to higher-income countries' growth compared to their lower-income counterparts. Additionally, our results indicate that moderate misalignments, whether undervaluations or overvaluations, are more likely to affect economic growth positively.

A key finding is that these patterns captured by a multilateral assessment of currency misalignments are lost when focusing solely on (bilateral) misalignments vis-à-vis the US

dollar. The effect of currency misalignments on economic growth is therefore obscured or misrepresented in a bilateral framework, illustrating the relevance and the necessity of a more careful evaluation of misalignments before driving policy recommendations.

Overall, our findings suggest that, in response to the policy question of whether to promote or discourage currency undervaluation in developing countries, such strategies should be carefully tailored by accounting for both their level of development and the extent to which their currency deviates from its equilibrium value.

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Appendices

A. Data

Table A.1 — Variables | Definitions & Sources

Variables	Sources
Crises	
Currency crisis: dummy variable (1 equals crisis; 0 otherwise) Other crisis: dummy variable (1 in case of systemic banking and/or sovereign debt crisis; 0 otherwise)	Laeven & Valencia (2018)
Human capital: Human capital index, based on years of schooling and returns to education	Penn World Tables
Inflation: consumer price annual growth rate	WDI[a]
Institutional quality First component of a principal component analysis on *Civil Liberties, Corruption*, and *Democracy* indices. (All indices are from the *Quality of Government* basic dataset, version Jan20)	
Price levels: price level of GDP (ratios of purchasing power parities to market exchange rates)	Penn World Tables
Real GDP per capita (in PPP terms)	Penn World Tables
Savings: Gross domestic savings (% of GDP)	WDI[a]
Terms of trade: net barter terms of trade index	WDI[a]
Trade weights: Time-varying weights (5-year windows, non-overlapping)	EQCHANGE (CEPII)

[a] WDI: World Development Indicators (World Bank)

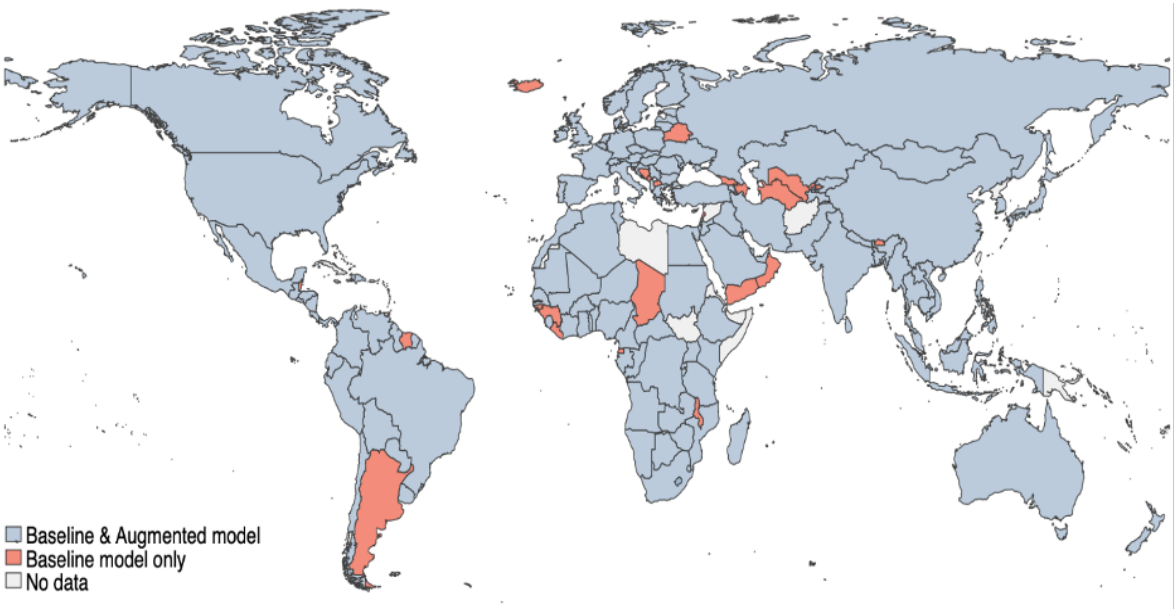

Figure A.1 — Sample of countries

Notes: The map depicts the sample of countries for the baseline and the augmented models. Countries shaded in blue indicate those included in both the baseline and augmented models. Countries shaded in orange represent those included only in the baseline model. Areas in white denote countries for which data are unavailable.

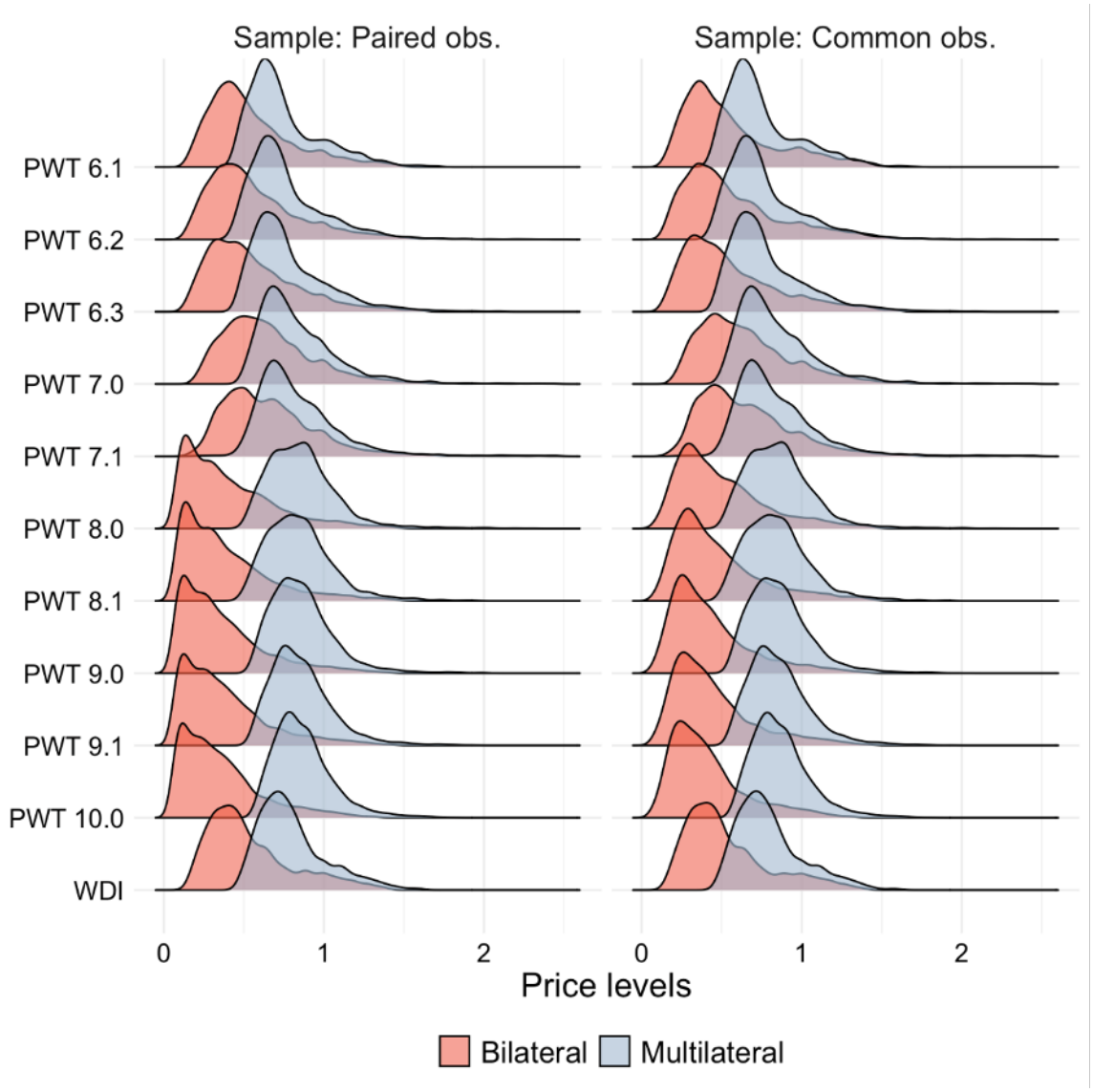

Figure A.2 — Distributions of bilateral and multilateral real exchange rates in levels

Notes: Figure A.2 displays the distribution of bilateral (orange color) and multilateral (blue color) real exchange rates computed using data from different versions of the Penn World Table (PWT) and the World Bank, World Development Indicators (WDI) database. The area under each curve represents the probability distribution of the respective dataset. For the PWT 7.0 and 7.1, the distributions have been truncated for the sake of presentation. In both cases, the excluded outliers correspond to 0.5% of the observations.

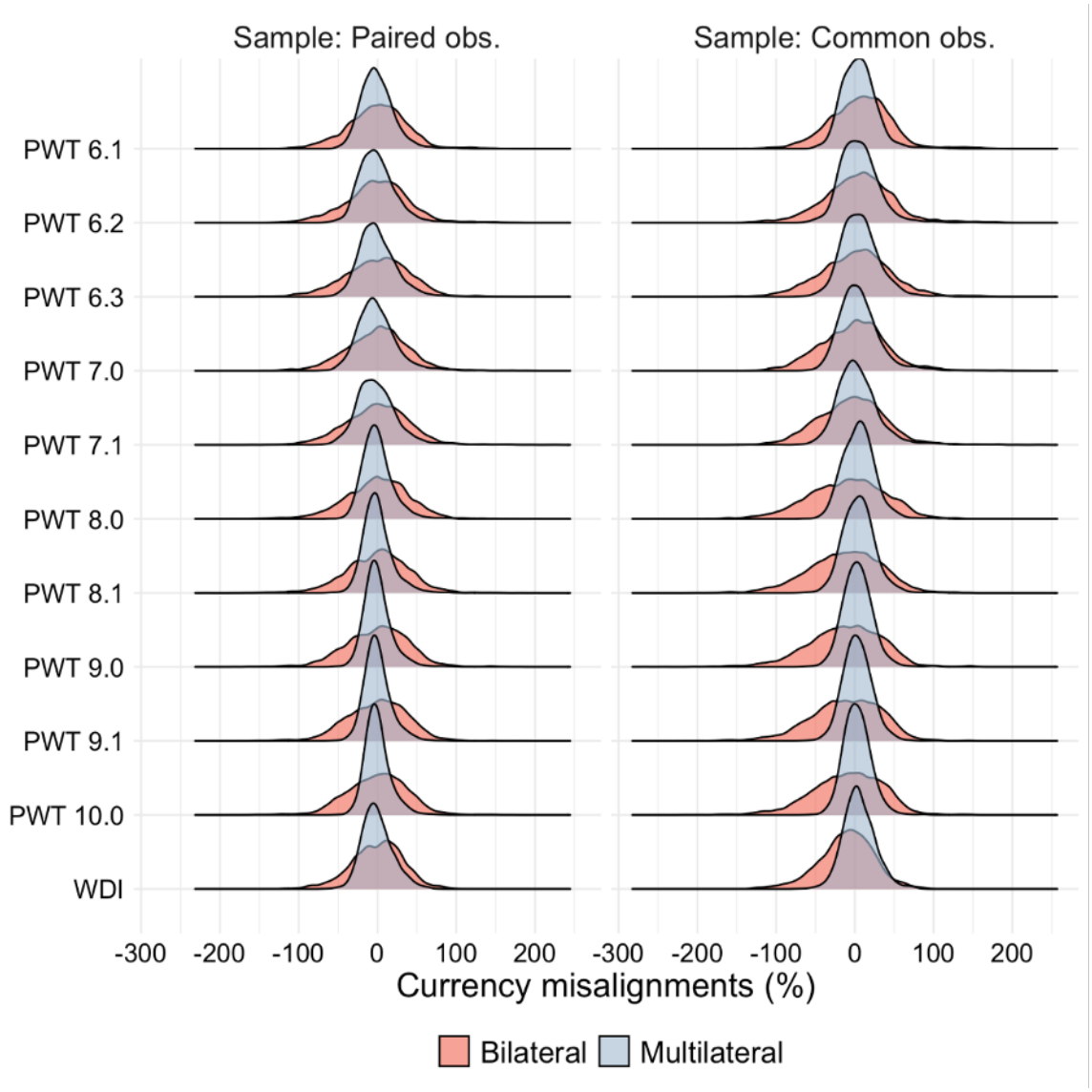

Figure A.3 — Comparative distributions of currency misalignments across RER measures

Note: Figure A.3 displays the distribution of currency misalignments measured in bilateral (orange color) and multilateral (blue color) terms, computed using data from different versions of the Penn World Table (PWT) and the World Bank, World Development Indicators (WDI) database. Negative (resp. positive) values correspond to undervaluations (resp. overvaluations). The area under each curve represents the probability distribution of the respective dataset.

Figure A.4 — Currency misalignments across models and by quintiles

Notes: The box plots present currency misalignments derived from the baseline and augmented models across varying levels of GDP per capita quintiles (Q_{GDP}) and currency misalignment quintiles (Q_{Mis}) computed from bilateral and multilateral measures. Each row corresponds to a specific GDP per capita quintile, descending from the highest undervaluations ($Q5$) to the highest overvaluations ($Q1$), and each column corresponds to a specific currency misalignment quintile, ascending from the low-income ($Q1$) to the high-income ($Q5$) countries.

B. Additional results

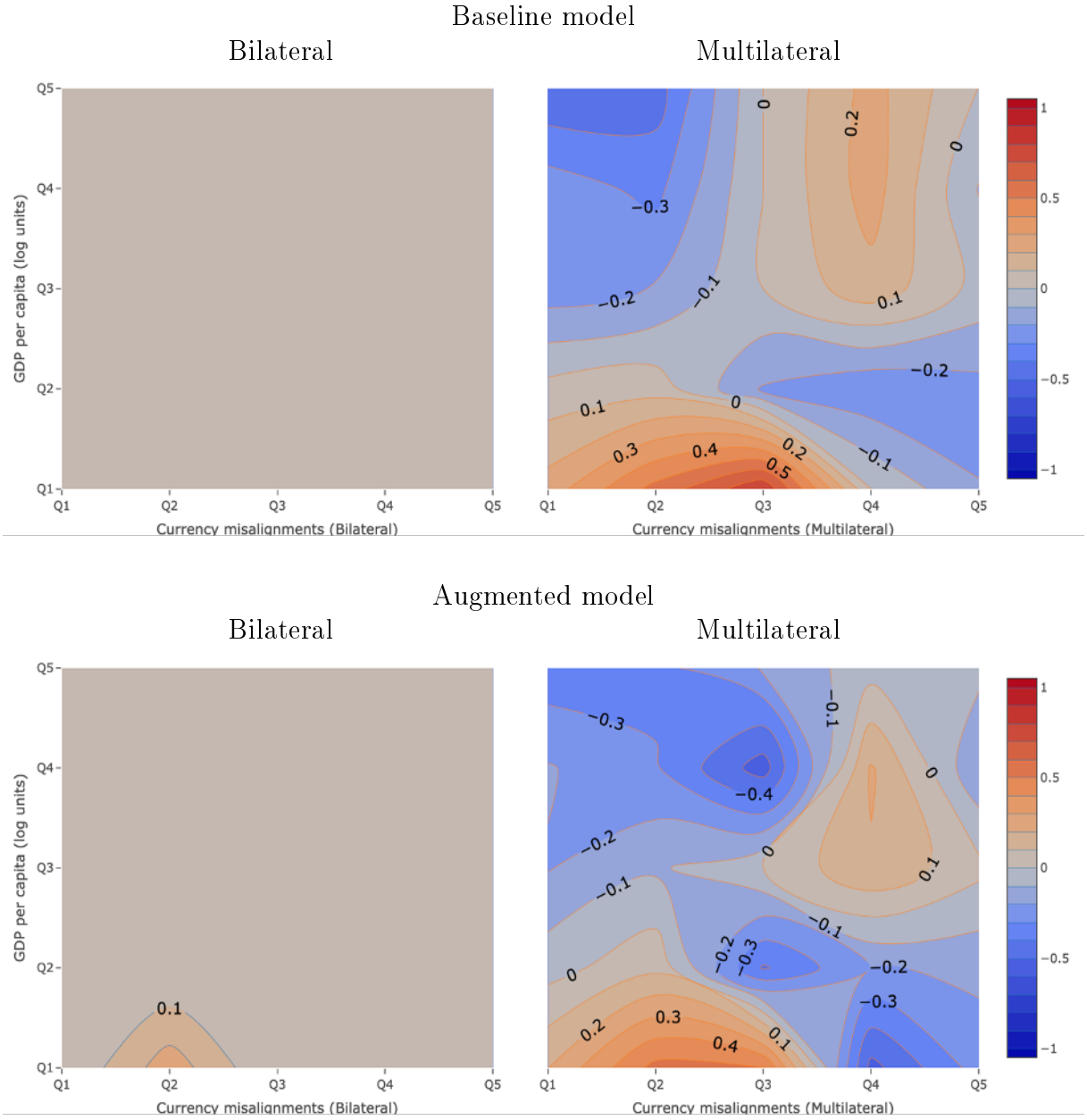

Figure B.1 — Two-dimensional distribution of the relative growth effects of exchange rate misalignments (baseline and augmented models, 5% significance level)

Notes: The figures present contour plots depicting the growth effects of exchange rate misalignments (bootstrap estimates, 1000 replications) measured in deviation from the "central" effect (i.e., measured at "$Q3$" in both the GDP per capita and currency misalignments distributions). The degree of deviation is indicated by the shades of color —provided that the p-value of the null (i.e., "zero-distance") is lower than 5%. Exchange rate misalignments are indicated on the x-axis in ascending order from undervaluations (negative values, left side) to overvaluations. For each measure (i.e., bilateral, multilateral), the bottom chart depicts the misalignments' distributions. The y-axis refers to the log GDP per capita (in PPP terms) in ascending order, with "$Q5$" indicating the highest quintile (illustrated by the left-rotated distribution). In the distribution charts, the red dashed lines delimit the quintiles. Table B.1 in Appendix B presents the estimation results underpinning the contour plots.

Table B.1 — Cross-quantile approach: bootstrap estimation results

	Baseline		Augmented model	
Model	Bilateral	Multilateral	Bilateral	Multilateral
	(B.1.1)	(B.1.2)	(B.1.3)	(B.1.4)
Initial income	-0.094***	-0.093***	-0.116***	-0.116***
	(0.006)	(0.006)	(0.009)	(0.009)
Currency misalignments	-0.063	-0.626***	-0.098	-0.754***
	(0.069)	(0.191)	(0.068)	(0.213)
$Mis \times I_{1,1}$	0.128*	0.872***	0.131*	0.951***
	(0.071)	(0.210)	(0.079)	(0.230)
$Mis \times I_{1,2}$	0.214***	1.160***	0.257***	1.286***
	(0.077)	(0.210)	(0.083)	(0.231)
$Mis \times I_{1,3}$	-0.132	1.412***	-0.153	1.268***
	(0.115)	(0.305)	(0.116)	(0.331)
$Mis \times I_{1,4}$	-0.153**	-0.026	-0.108	0.221
	(0.073)	(0.223)	(0.079)	(0.246)
$Mis \times I_{1,5}$	-0.031	0.430**	-0.034	0.497**
	(0.070)	(0.197)	(0.069)	(0.224)
$Mis \times I_{2,1}$	0.100	0.659***	0.112	0.714***
	(0.071)	(0.194)	(0.072)	(0.205)
$Mis \times I_{2,2}$	0.150*	0.682***	0.144**	0.828***
	(0.079)	(0.188)	(0.073)	(0.201)
$Mis \times I_{2,3}$	-0.198	0.414	-0.033	0.342
	(0.124)	(0.259)	(0.127)	(0.317)
$Mis \times I_{2,4}$	-0.078	0.341	0.019	0.556**
	(0.076)	(0.229)	(0.077)	(0.283)
$Mis \times I_{2,5}$	-0.027	0.392**	0.030	0.579**
	(0.071)	(0.197)	(0.069)	(0.230)
$Mis \times I_{3,1}$	0.013	0.371**	0.025	0.547***
	(0.071)	(0.187)	(0.071)	(0.201)
$Mis \times I_{3,2}$	-0.001	0.432**	0.051	0.637***
	(0.072)	(0.186)	(0.072)	(0.193)
$Mis \times I_{3,4}$	0.024	0.790***	0.110	0.942***
	(0.080)	(0.260)	(0.077)	(0.359)
$Mis \times I_{3,5}$	0.000	0.594***	0.017	0.781***
	(0.070)	(0.199)	(0.084)	(0.234)
$Mis \times I_{4,1}$	-0.023	0.382**	0.003	0.562***
	(0.071)	(0.186)	(0.068)	(0.206)
$Mis \times I_{4,2}$	-0.039	0.296	0.013	0.465**
	(0.074)	(0.185)	(0.072)	(0.200)

Notes: "$I_{j,j'}$" stands for the dummy variable associated with group jj', i.e., quantiles j and j' for the log GDP per capita and currency misalignments, respectively. Bootstrap standard errors are reported in parentheses (1000 replications). Group dummies as well as time and country fixed effects are included in all estimations. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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Table B.1 — *(Continued)*

	Baseline		Augmented model	
Model	Bilateral	Multilateral	Bilateral	Multilateral
	(B.1.1)	(B.1.2)	(B.1.3)	(B.1.4)
$Mis \times I_{4,3}$	0.173*	0.031	0.019	0.205
	(0.095)	(0.235)	(0.103)	(0.276)
$Mis \times I_{4,4}$	0.106	0.872***	0.106	0.967***
	(0.073)	(0.256)	(0.084)	(0.352)
$Mis \times I_{4,5}$	0.010	0.521***	-0.050	0.572**
	(0.073)	(0.200)	(0.096)	(0.283)
$Mis \times I_{5,1}$	-0.122*	0.136	-0.025	0.391*
	(0.071)	(0.191)	(0.074)	(0.211)
$Mis \times I_{5,2}$	-0.214**	0.176	-0.082	0.423*
	(0.084)	(0.202)	(0.080)	(0.235)
$Mis \times I_{5,3}$	0.146	-0.123	0.070	0.560**
	(0.093)	(0.285)	(0.100)	(0.263)
$Mis \times I_{5,4}$	0.086	0.863***	0.059	0.712***
	(0.071)	(0.206)	(0.077)	(0.236)
$Mis \times I_{5,5}$	0.066	0.624***	0.024	0.680***
	(0.070)	(0.193)	(0.073)	(0.217)
Institutional quality			0.008***	0.010***
			(0.003)	(0.003)
Government spending			-0.156**	-0.174***
			(0.065)	(0.066)
Terms of trade			0.032***	0.026***
			(0.006)	(0.006)
Inflation			-0.029***	-0.029***
			(0.010)	(0.010)
Savings			0.119***	0.137***
			(0.030)	(0.031)
Human capital			0.060**	0.042
			(0.028)	(0.029)
Crisis			-0.018***	-0.015***
			(0.004)	(0.004)
Currency crisis			-0.016**	-0.014**
			(0.007)	(0.007)
Constant	0.855***	0.845***	0.872***	0.904***
	(0.053)	(0.054)	(0.073)	(0.080)
Observations / Countries	7,251 / 170	7,251 / 170	3,271 / 130	3,271 / 130
R-squared	0.194	0.199	0.352	0.351

Notes: "$I_{j,j'}$" stands for the dummy variable associated with group jj', i.e., quantiles j and j' for the log GDP per capita and currency misalignments, respectively. Bootstrap standard errors are reported in parentheses (1000 replications). Group dummies as well as time and country fixed effects are included in all estimations. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.