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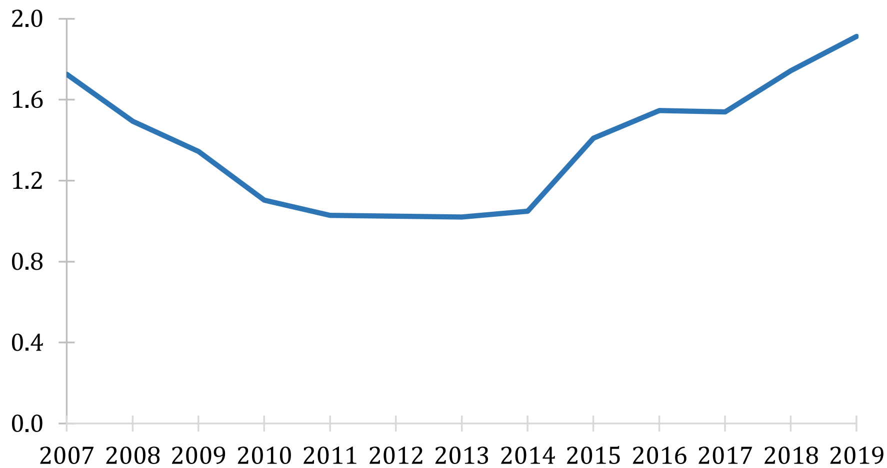
1. Introduction

Absorbing remittances when their volume is large in relation to economic activity is a significant challenge to an economy, as they are considered a potential source of Dutch disease (Acosta et al., 2009, Amuedo, 2004, and Guha, 2013). Large flows of remittances would lead to an appreciation of the real exchange rate, resulting in a loss of competitiveness in the export sector. Furthermore, recent literature has found a "fear of appreciation," as depreciated exchange rates appear to increase growth through higher savings and capital accumulation, and, to a lesser extent, through trade accounts (Levy-Yeyati et al. 2012).

In Latin America and the Caribbean (LAC), remittances as a percentage of GDP have returned to the level prevailing before the Great Recession (see Figure 1). Net remittance inflows (both in terms of total and as a percentage of GDP) have reached historic peaks in several countries of the region, as shown in Figure 2. Net remittances have become very high with respect to the size of their economies in some countries, accounting for between 14 and 22 percent of GDP in the countries of the Northern Triangle of Central America (Guatemala, El Salvador, Honduras). Moreover, the recent COVID-19 crisis is taking them to reach the highest history levels in several countries (see Figures 2 and 3).

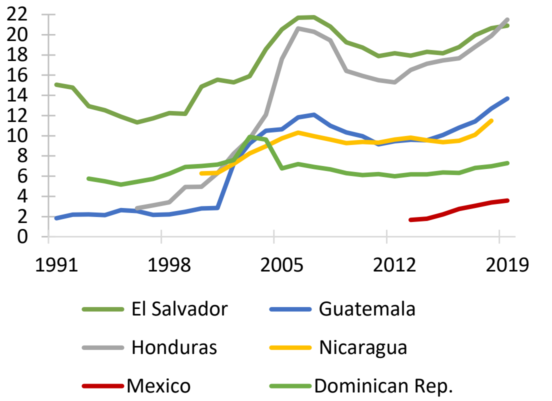
Figure 1. Remittances as a percentage of GDP in Latin America and the Caribbean



Source: World Development Indicators, The World Bank.

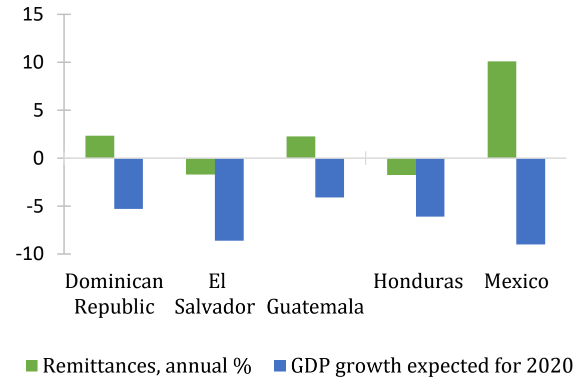
Despite the severe contraction expected in 2020, the stream of remittances to LAC has continued supported first by the state aid provided in the U.S. and then by its reopening of the economy. The Coronavirus Aid, Relief, and Economic Security Act (CARES) provided an unemployment benefit of US$ 600 per week in addition to the state unemployment programs, which resulted in legal migrants receiving an income above their previous salaries (Eggers and Laloum, 2020). For example, El Salvador and Honduras experienced only mild reductions in remittances, while Guatemala, Mexico, and the Dominican Republic had increments. As the GDP is expected to contract severely in these countries (Figure 3), remittances as a percentage of GDP are expected to increase further in 2020.

Figure 2. Net remittances as a percentage of GDP: selected countries



Source: Central America Monetary Board and the Bank of Mexico.

Figure 3. Net remittances accumulated Jan-Aug 2020 (annual variation) and GDP growth expected for 2020

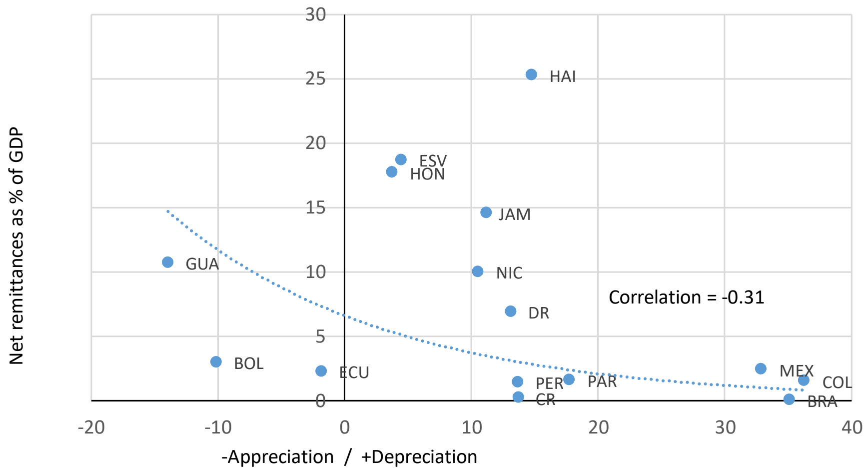


Source: Central America Monetary Board and United Nations (2020).

High levels of remittances generate noticeable positive effects[1] but, notably also potential negative ones: remittances could be at the origin of a Dutch disease phenomenon (the country's exchange rate appreciates because of revenues increase due to remittance inflows). In this context, to evaluate policies aimed at mitigating the potential drawbacks of remittances while maintaining their benefits, it is essential to reassess the possible existence of Dutch disease in the region and discuss which countries are more exposed to additional increases in these inflows. To do so, we begin by identifying graphically if the change in price competitiveness in terms of the real exchange rate is in any way related to the volume of remittances with respect to the size of the economy. Figure 4 shows large variations in the change in price competitiveness over the last five years, with some countries experiencing depreciation of between 30% and 40% (note that these are the largest economies in the region: Brazil, Mexico, and Colombia), others having milder depreciation of between 5% and 15%, and a few experiencing appreciations (2013–2018[2]). In sum, the loss of price competitiveness of some economies with respect to others in the region is striking and will deepen because of the COVID-19 as the exchange rates will absorb the external shocks. Figure 4 shows a negative relationship between the change in the real exchange rate and the volume of remittances with respect to the size of the economy (net remittances as a percentage of GDP).

[1] See Ait Benhamou and Cassin (2021) on the impact of remittances on consumption and education of beneficiaries.
[2] The sample ends in 2018 due to the availability of data on net remittances.

Figure 4. Variation in the real exchange rate and average net remittances as a % of GDP in the last 5 years.



Source: Own calculations based on World Development Indicators (WDI) data from the World Bank.

The large volume of remittances also presents a challenge for local currency markets. Consequently, several central banks in the region have taken an active role in the foreign exchange market. For example, Guatemala's central bank has intervened in the exchange market by buying 2,453 million dollars worth of U.S. dollars in 2017; 1,206 million dollars' worth in 2018, and 1,329 million dollars' worth in 2019. Meanwhile, the central bank of Honduras intervenes daily to maintain the exchange rate band's exchange rate. Their interventions (whether direct or through rules) seek to mitigate short-term exchange rate movements.

In the next section, we use panel data modeling to estimate the real exchange rate determinants and calculate the effect of net remittance flows in the LAC region. We opt to use heterogeneous panel models because we are also interested in estimating the individual effects in each of the countries analyzed. Our setup allows us to identify which countries' remittances negatively impact (i.e., appreciation) on the real exchange rate. The panel data models used in this paper assume that cross-sectional units (countries) are not independent of one another; hence, a type of cross-sectional dependence exists that needs to be considered when modeling. This dependence may be due to the trade and financial integration among the countries of the region that is the result of certain trade agreements, such as the Southern Common Market (MERCOSUR) or the Dominican Republic-Central America Free Trade Agreement (CAFTA), the presence of international financial institutions, and liberalized financial markets. With this in mind, we assume that an unobservable factor structure is driving the cross-sectional dependence between LAC countries.

Pesaran (2006) proposes a methodology to estimate these types of panel models, called the Common Correlated Effects Mean Group (CCEMG). He uses the cross-sectional averages of the observables as good proxies for the unobserved factors to augment the model. Pesaran's original model assumes that all the variables involved in the model are integrated processes of order zero, I (0), i.e., that the variables are stationary. However, we show that the economic variables used in our models exhibit long-range dependence of non-integer order, oscillating around [0.4,0.8], i.e., that *our* economic variables are in the non-stationary bound. We then follow the methodology proposed by Ergemen and Velasco (2017), who extend Pesaran's model to allow for long-range dependence processes. See Rodríguez-Caballero (2021) for more possibilities of interconnections between the cross-sectional units.

Our results show that net remittances in several countries of the region have a negative effect on the real exchange rate. The countries where this effect is most substantial—as shown by the elasticity of the real exchange rate to remittances—and which have the highest volume of net remittances with respect to the economy (and one expected to continue growing) are more exposed to Dutch disease.

These results represent a call to policymakers. Firstly, they need to identify the problem, i.e., the existence of Dutch disease resulting from remittance flows in the context of historical peaks in remittances and a rise in competing countries' price competitiveness due to exchange rate depreciation (for example, in periods of global risk aversion such as the one resulting from the COVID-19). And secondly, they need to review policy alternatives to mitigate this situation, such as exchange rate and foreign exchange reserves policies, remittance payment systems, and competitiveness policies.

We recognize the complexity of the task. The literature on "fear of floating" (Calvo and Reinhart, 2002) and "fear of appreciation" describes the costs of substantial exchange rate movements. For example, when the level of imports is high with respect to the economy as a whole, a depreciation could result in high inflation and economic contraction; when there is liability dollarization, this poses a risk to financial stability. Meanwhile, inflation volatility could undermine the credibility of monetary policymakers in their efforts to target inflation. Strong appreciations result in a loss of international competitiveness and lower growth while keeping inflation low.

In sum, in this context, putting this issue on the table for discussion is crucial for some countries' future economic development.[3]

The document is divided into three sections. Section 2 presents the modeling strategy and the empirical results. Section 3 concludes.

2. Econometric strategy and empirical results

We aim to model the real exchange rate, our underlying hypothesis being that it is negatively affected by remittances. We use a panel data strategy to estimate the relationship among an expanded set of Latin American economies. The interrelationship between Latin American economies can be fundamental to understanding the dynamics of the region.

Panel data models have been widely used in recent years in empirical studies. They have been employed to analyze complex phenomena due to the ease with which they allow the heterogeneity presented among cross-sectional units to be controlled for and even exploited. Such models allow us to identify various effects that are simply not detectable in pure cross-sectional or time-series econometric models.

When analyzing economic phenomena, it becomes apparent that cross-sectional units may be exposed to the influence of statistical structures that end up creating interdependence among them; this is known as cross-sectional dependence. Such dependence has given rise to a vast literature because we may generate nonsense inferences if we neglect or treat this structure wrongly. The type of econometric models that have been used to analyze these data structures are known as "large data panels with cross-sectional dependence."[4]

This study assumes that a common factor structure drives the cross-sectional dependence among the countries analyzed. The approach we follow does not require us to identify the origins of that dependence, but simply bear it in mind in the estimation procedure. Furthermore, we consider that the assumption of homogeneity between the regressors and the dependent variable is inappropriate in our study because of the heterogeneity among countries.

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[3] We thank the Associate Editor, Gueorgui Kolev, and an anonymous reviewer for their helpful comments that contributed to enrich the analysis.

[4] See Chudik and Pesaran (2015) for an excellent review of the literature.

Consider the following fractionally integrated heterogeneous panel data model with interactive fixed effects for $i = 1, \dots, N$ and $t = 1, \dots, T$,

$$y_{it} = \alpha_i + \beta_i' \boldsymbol{x_{it}} + \lambda_i' F_t + \Delta_{t+1}^{-d_{io}} \epsilon_{it}, \qquad (1)$$

$$\boldsymbol{x}_{it} = \mu_i + \Gamma_i' F_t + \Delta_{t+1}^{-\delta_{io}} \boldsymbol{\nu}_{it}. \qquad (2)$$

where the α_i and μ_i are covariate-specific fixed effects, x_{it} is a $k \times 1$ vector of individual observed regressors, F_t defines the r-dimensional vector of common factors, which are fractionally integrated processes of order ϑ_i, denoted as $F_t \sim I(\vartheta_i)$, and Γ_i is the $r \times 1$ vector of the associated factor loadings. Nuisance long-memory parameters (ϑ_i , δ_i, ϵ_i) are the object of interest, along with constant parameters (β_i). Note that the actual integration orders are unknown.
The estimation procedure is executed by taking first differences in equations (1-2) to remove the fixed effects, and then, the model is estimated cf. Ergemen and Velasco (2015). Further technical details of the econometric procedure are available in appendix B.
Finally, to capture the existence of Dutch disease in the Latin American region as a whole, we also estimate the Common Correlated Effect Mean Group (CCEMG) estimator proposed by Pesaran (2006), which is defined as follows:

$$\hat{\beta}_{CCEMG}(d^*) = \frac{1}{N} \sum_{i=1}^{N} \hat{\beta}_i(d^*). \qquad (3)$$

Our data set includes annual data from the following North, Central, and South American countries: Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, and Peru. All these countries are employed to estimate the panel data model introduced in the previous section.
The sample size spans the period 1980–2018 due to the availability of data.[5] The variables are bilateral real exchange rate against the US dollar, remittances (net remittances in models), external debt, international reserves, interest rates, and GDP per capita relative to the U.S.[6] (as a proxy of productivity). We use net remittances (rather than merely inflows) as the net flow provides a clearer picture of the country's exposure to these types of inflows. GDP per capita is treated as a proportion of the GDP per capita of the U.S. The basic setup of the econometric specification follows the theoretical model developed by Farhi and Gabaix (2015), and empirically verified by Marmolejo and Ventosa-Santaulària (2019) for the case of Mexico. This model provides a closed-form solution of the real exchange rate in terms of relative productivity and interest rates. To these variables, we add remittances given their importance in some countries in the region, and other variables that have proven relevant to capture short-term movements of the exchange rate (Driver and Westaway, 2004). Remittances are considered a stable source of external inflows, even despite COVID-19 (World Bank, 2021), and as such, should impact the exchange rate. However, the fluctuations of the exchange rate might also affect remittances (bidirectional causality), but the evidence is still inconclusive (see Kunkoro, 2020), among other reasons because the significance of the effect is influenced by the exchange rate system (Calvo and Reinhart, 2002). Notwithstanding, with a flexible exchange rate, some works have found it to be relevant, and this result seems to appear more often in studies using

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5 Source: World Bank. https://data.worldbank.org/indicator

6 The US data are used to build the bilateral real exchange rate series (the NER with respect to the US dollar) and the productivity proxy (GDP per capita of a Latin American country relative to US GDP per capita). Around 76% of total remittances sent to LAC come from the US (see table 1 in Martin et al., 2019), and therefore, bilateral measures of the real exchange rate and productivity with the US are used. Nonetheless, it is noteworthy that replacing RERs with Real Effective Exchange Rates does not alter the results. See Table 1 and Table C.1 in Appendix C. We also considered using the Total Factor Productivity (TFP) from the Penn World Table, however, this variable was not available for all the countries in the sample, in concrete for Haiti, El Salvador, and Nicaragua. Including these countries is important for our analysis as they are among those with the highest ratios of remittances to GDP.

quarterly and monthly data (see for example Lin, 2011, Pant and Budha, 2016, and Vargas-Silva, 2021), suggesting the exchange rate affects remittances more naturally within short periods, an effect that is lost with annual data, like those used here.

For example, using quarterly data for Indonesia, Kuncoro (2020) finds that a home currency depreciation induces the growth of remittances, but that its appreciation does not reduce them. The author also finds that the exchange rate in Indonesia is highly dependent on remittances, stating that "Given the huge flows of remittance, the impact of remittances on the supply of foreign exchange should be a major concern for monetary authority." As our analysis is on a potential Dutch disease, we focus on the effect of remittances on the real exchange rate.

In the panel analysis, we use deflated net remittances, deflated external debt, and deflated international reserves as a proportion of the GDP of the respective country[7]. We do this to homogenize the variables due to specific differences in their magnitudes across countries. The respective standard descriptive statistics can be found in Table A.1 of Appendix A.

We obtain overwhelming evidence of the nonstationarity (≥ 0.5) of all these variables by estimating the fractional memory parameter (the memory parameters are shown in Table A.2).[8]

To study the dynamics of the real exchange rate (RER), we begin the panel data analysis by estimating simplified panel data models with only one regressor, GDP per capita relative to US GDP per capita, as a proxy for productivity.

We estimate three different models to analyze our estimates' performance, taking the differences before doing so. First, we use the mean group (M.G.) and demeaned mean groups (DMG) estimators of Pesaran and Smith (1995) (ignoring the fact that countries may be cross-correlated). We obtain the CCEMG estimates, taking into account a possible cross-sectional dependence in the panel. The basic aim is to determine whether overlooking or considering that cross-sectional dependences between Latin American countries may be driven by an unobserved factor structure that affects the sign and magnitude of the parameters. Furthermore, in all models, we include constants, while in the CCEMG variants, we also include deterministic trends.

Table 1: Panel estimation with one variable

Variable	Dependent variable: log(RER)			
	MG	DMG	CCEMG	CCEMG+T
log(GDP per capita relative to the US)	-0.614*** (0.071)	-0.704*** (0.054)	-0.667*** (0.069)	-0.672*** (0.064)
Trend				0.002
Constant	-0.005	-0.000	0.000	-0.004
Observations	513	513	513	513

Notes: (1) *p<0.1; **p<0.05; ***p<0.01;

As shown in Table 1, in all models our productivity measure significantly affects the real exchange rate. This result is to be expected. All the countries in our sample have suffered a productivity loss with respect to the U.S., which is a driving force that eventually depreciates the local currency in

7 We also considered monthly interest rates with respect to the monthly interest rate of the US. However, the lack of information made the degree of unbalancedness increases highly. We discarded the interest rate to preserve enough information to estimate the model.

8 We use the Extended Local Whittle (ELW) method proposed by Abadir et al. (2007) that consistently estimates the memory parameter even beyond the unit root. After detrending the data, we then estimate the memory with a bandwidth of $m = T^{0.7}$ corresponding to m = 12. Given the level of our memory parameters, we choose $d^* = 1$.

dollar terms. In short, it is the opposite of a Balassa-Samuelson effect. As long as these economies continue to lag behind the U.S. in terms of productivity gains, their exchange rate should eventually depreciate (see Marmolejo and Ventosa-Santaulària, 2019). Note that the deterministic trend in the CCEMG model is not statistically significant. This, again, is rather intuitive. In the PPP literature, a deterministic trend is usually included to consider the Balassa-Samuelson effect. As mentioned previously, the latter occurs because of a difference in productivities among the commercial and non-commercial sectors of a country and among those of its trading partners. By including GDP per capita, the deterministic trend becomes irrelevant. Note that ignoring cross-sectional dependence provokes a small negative bias that is controlled for by the CCEMG estimators.

In addition to GDP per capita relative to the U.S., the following set of models incorporate the remaining economic variables: remittances, reserves, and external debt (relative to the corresponding GDP). The results are shown in Table 2.

Table 2: Panel estimation with all the variables

Dependent variable: log (RER)					
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
log(GDP per capita relative to the US)	-.667***	-0.666***	-0.672***	-0.778***	-0.793***
	(0.032)	(0.037)	(0.032)	(0.042)	(0.035)
Remittances/GDP		-0.756**	-1.600***	-0.512*	-1.214***
		(0.341)	(0.323)	(0.283)	(0.249)
log(Reserves/GDP)			0.035***		0.040***
			(0.012)		(0.011)
log(Debt/GDP)				-0.076***	-0.087***
				(0.024)	(0.022)
Constant	0.000	-0.001	-0.001	0.001	-0.002
Observations	513	513	513	513	513

Notes: (1) *p<0.1; **p<0.05; ***p<0.01; All first-differenced models are estimated using Common Correlated Effects Mean Groups estimators.

Model 1 is the simplified model described earlier that we include as a benchmark, while Model 2 includes remittances. Note that their effect is negative and significant. This implies that an increase in remittances will tend to appreciate the exchange rate, as hypothesized in this work. Model 3 includes reserves. Model 4 adds external debt, and Model 5 adds both reserves and debt.[9]

Overall, International Reserves and External Debt have the expected effect on the real exchange rate: an increase in reserves implies buying dollars and selling the local currency, which should depreciate the value of the latter. An increase in external debt also implies receiving foreign currency and thus a depreciation of the local currency. Table A.3 of the appendix shows the signs of the coefficients by country. The sign of GDP per capita relative to the U.S. is negative for all countries, whereas the sign

[9] Model 5 allows for heterogeneous (i.e., country-specific) results, which are shown in Appendix A. Note that some countries present significant biases, which may be controlled for by including more specific variables in a country-specific analysis. We are currently analyzing some particular cases using the ARDL methodology, though the analysis is beyond the scope of this paper.

of the coefficients of reserves and debt are mixed across countries. This is to be expected, given that the macroeconomic conditions of each country would affect these signs. The sign may vary, for example, depending on the market perception of the sustainability of debt: in a country where the market perception is that the level of debt is high and its sustainability at risk, an increase in debt will probably generate a depreciation (and an increase in reserves an appreciation), whereas, in a country where the level of debt is low or perceived as manageable, we would expect the opposite effect. However, this level of detail is beyond the main focus of this paper. In sum, the panel data model(s) provides evidence that Latin American exchange rates are related to productivity (relative to the U.S.), remittances, reserves, and debt. The signs are correct, and the parameters significant.

It is important to note how the bias evident in some coefficients is corrected after controlling for a specific effect. For instance, the impact of GDP per capita relative to the U.S. is higher when we control for debt. This suggests that ignoring debt in the specification may provoke a positive bias. Furthermore, a strong positive bias in remittances is found when reserves are not considered in a specification with remittances and debt (see Model 4). Model 5 corrects for this positive bias in remittances after incorporating reserves.

For the fifth model, we use the conditional-sum-of-squares (CSS) approach of Hualde and Robinson (2011) to estimate the fractional memory parameters of the residuals for each country to identify a possible cointegrating relationship. For all countries, the residual memories are much lower than those estimated by ELW for the RER (see Figure 5). This suggests a strong long-run relationship (fractional cointegration) between the RER and the variables in the model.

Figure 5. Comparison of the fractional memory parameter estimates of the RER using the ELW method and the residuals of Model (5) using CSS.

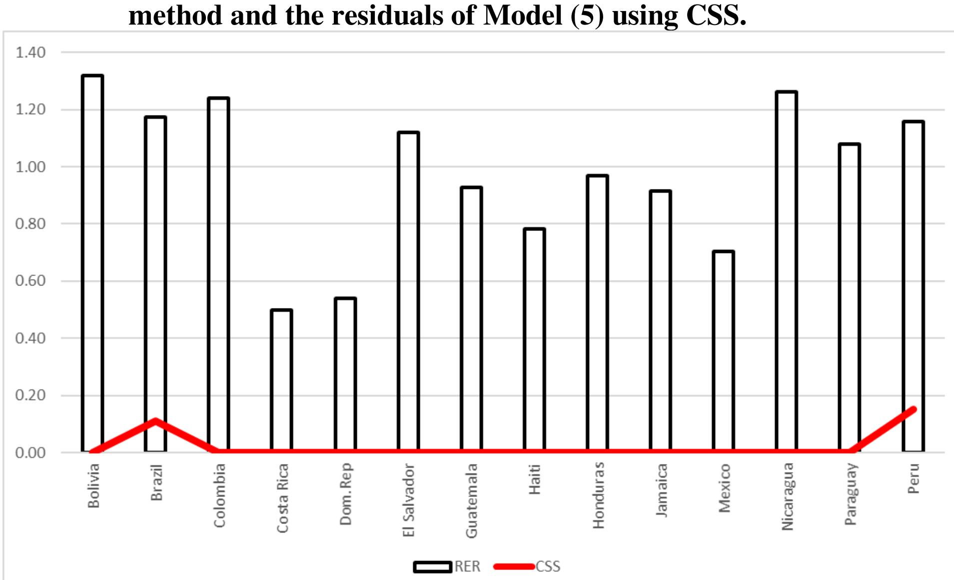
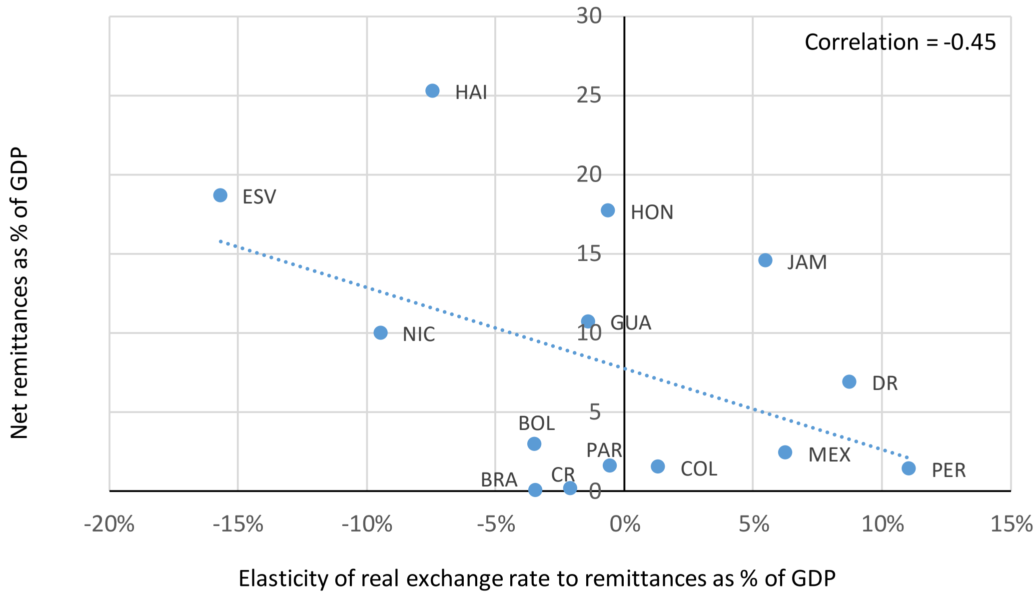


Figure 6 shows the elasticity of the real exchange rate to remittances by country obtained in the model and average net remittances as a percentage of GDP in the last five years. The countries where the net inflows of remittances are estimated to have appreciated the real exchange rate (given by the negative elasticity) are El Salvador, Nicaragua, Haiti, Bolivia, Brazil, Costa Rica, Guatemala, Honduras, and Paraguay. This result, along with the amount of remittances as a percentage of GDP, can indicate the potential extent of Dutch disease in a country. It is particularly relevant that countries with the lowest levels of GDP per capita in the region, such as Haiti, Nicaragua, and El Salvador, are among the most affected. In addition to the high levels of remittances (between 10% and 25% of GDP), the strong effect in these countries might be influenced by low institutional capacity or structural characteristics of the economies that prevent the implementation of policies to offset such negative effect. Haiti and Nicaragua have been facing social and economic crises for several years now, and El Salvador is dollarized, eliminating its capacity for monetary interventions. The cases of Guatemala and Honduras also stand out given their high share of remittances as a percentage of GDP (around 10% and 20% of GDP, respectively).

Figure 6. The elasticity of the RER to remittances by country and average net remittances as a % of GDP in the last five years



The elasticity of the real exchange rate to remittance inflows may be influenced not only by the value of remittances with respect to the size of a given economy but also by its exchange rate policy (see Mahraddika, 2020 on the relation between exchange rate regimes and the misalignment of the real exchange rate, and Rodriguez, 2016 on the political and economic determinants of exchange rate regimes in Latin America), financial liberalization, trade balance, the volume of other foreign inflows, and so on. We do not provide a detailed explanation of these determinants. This would require a detailed and profound analysis on a country-by-country basis. Our main objective is to stress the issue of Dutch disease in a particularly challenging environment for low-income countries in LAC (one characterized by remittances as a percentage of GDP at peak levels, strong real depreciations among several competitors in the region, an urgent need to find new sources of growth, and the COVID-19 crisis that exacerbates all these elements). It pretends to spark a discussion on an issue that could potentially affect the development of various countries in years to come, and encouraging policymakers to explore policies to mitigate this.

Several countries have established Sovereign Wealth Funds to mitigate the Dutch disease resulting from state-controlled exports of natural resources. However, in the case of remittances, these are privately-owned inflows, and as such, the experience of China could be useful (Yanzhen, Willett, and Li, 2019, The Economist, 2020). To prevent a strong appreciation of its currency, The People's Bank of China printed the Yuans required to buy the foreign inflows from China's trade surplus. To prevent the additional money supply from causing inflation, it then sterilized the inflows by substantially increasing reserve-requirement ratios for banks. This and other policies should be explored in detail in light of the results presented here.

3. Concluding remarks

We set out to study the dynamics of the real exchange rate in Latin American countries. To be precise, we paid particular attention, on a country-by-country basis, to the impact of remittances on the real exchange rate and found this to be significant and negative. An increase in remittances appreciates the exchange rate.

It is worth noting that various countries in Central America receive substantial amounts of remittances from abroad. In several, these inflows tend to appreciate the local currency, a phenomenon that, according to the literature, has a potentially negative effect on growth and the competitiveness of their export sectors. We also find evidence that a loss of productivity (relative to the U.S.) depreciates the exchange rate.

In terms of future research, we suggest that an exploration of the determinants of the real exchange rate elasticity to remittances on a country-by-country basis would be useful, as this would help identify potential policies to reduce the threat of Dutch disease.

Data availability

The data that support the findings of this study are available from different sources: Source: a) World Bank. https://data.worldbank.org/indicator, b) Penn World Table, and c) Haver DLX. The data are public, but they are available from the corresponding author upon reasonable request.

References

1. Abadir, K.M., W. Distaso, and L. Giraitis (2007) "Nonstationarity-extended local Whittle estimation" *Journal of Econometrics* 141(2),1353–84.
2. Acosta, P., E. Lartey, and F. Mandelman (2009) "Remittances and the Dutch disease" *Journal of International Economics* 79, 102-16.
3. Ait Benhamou, Z. and L. Cassin (2021) "The impact of remittances on savings, capital and economic growth in small emerging countries" *Economic Modelling* 94, 789-803.
4. Amuedo, C. and S. Pozo (2004) "Workers' Remittances and the Real Exchange Rate: A Paradox of Gifts" *World Development Journal* 32 (8), 1407-17.
5. Bailey, N., G. Kapetanios, and M.H. Pesaran (2016) "Exponent of cross-sectional dependence: Estimation and inference" *Journal of Applied Econometrics* 31(6), 929-60.
6. Calvo, G. and C. Reinhart (2002) "Fear of Floating" *Quarterly Journal of Economics* 107(2), 379-408.
7. Chami, R., E. Ernst, C. Fullenkamp, and A. Oeking (2018) "Is There a Remittance Trap?" *Finance & Development* 55 (3), IMF: Washington, D.C.
8. Chudik, A., and H. Pesaran (2015) "Large Panel Data Models with Cross-Sectional Dependence" in The Oxford Handbook of Panel Data by Badi H. Balgati, Oxford University Press: Oxford.
9. Chudik, A., M.H. Pesaran, and E. Tosetti (2011) "Weak and strong cross-section dependence and estimation of large panels" *The Econometrics Journal* 14(1), 45–90.
10. Driver, R. and P. Westaway (2004) "Concepts of Equilibrium Exchange Rates" *Quarterly Bulletin* 248, Bank of England: London. Retrieved from https://www.bankofengland.co.uk//media/boe/files/workingpaper/2004/conceptsofequilibriumexchangerates.pdf (Accessed 26 September 2018).
11. Eggers, C. and M. Laloum (2020) "Cómo se explica la resiliencia en las remesas de Centroamérica". *Vox Latin American and Caribbean Economic Association*. http://vox.lacea.org/?q=blog/resiliencia_remesas_centroamerica
12. Farhi, E. and X. Gabaix (2015) "Rare disasters and exchange rates" *Quarterly Journal of Economics* 131 (1), 1–52.
13. Ergemen, Y.E., and C. Velasco (2017) "Estimation of fractionally integrated panels with fixed effects and cross-section dependence" *Journal of Econometrics* 196(2), 248-58.
14. Guha, P. (2013) "Macroeconomic effects of international remittances: The case of developing economies" *Economic Modelling* 33, 292-305.
15. Hualde, J., and P.M. Robinson (2011) "Gaussian pseudo-maximum likelihood estimation of fractional time series models" *Annals of Statistics* 39(6), 3152-81.

16. Kuncoro, H. (2020) "The role of exchange rate in remittance inflows Evidence from Indonesia", *Economics Bulletin* 40: 1508-21.
17. Levy-Yeyati, E., F. Sturzenegger, and P. Gluzmann (2012) “Fear of appreciation” *Journal of Development Economics* 101, 233-47.
18. Lin, H.H. (2011) "Determinants of Remittances: Evidence from Tonga", *IMF Working Paper* WP/11/18.
19. Mahraddika, W. (2020) “Real exchange rate misalignment in developing countries: The role of exchange rate flexibility and capital account openness” *International Economics* 163, 1-24.
20. Marmolejo, A. L. and D. Ventosa-Santaulària (2019) “Why does the peso-dollar exchange rate show a depreciation trend? The role of productivity differentials” *Economic Modelling* 80, 158-70.
21. Martin, X., Sobol, D., Magnoni, B. and E. Burgess (2019) “Remittances from the US to Latin America and the Caribbean. Following the Money Journey”. Inter-American Development Bank: Washington, D.C.
22. Pant, B. and B.B. Budha, (2016) “Remittances and Exchange Rate Linkages: Experiences of Nepal”, NRB Working Paper 33.
23. Pesaran, M.H. (2006) “Estimation and inference in large heterogeneous panels with a multifactor error structure” *Econometrica* 74(4), 967-1012.
24. Pesaran, M.H., and R. Smith (1995) “Estimating long-run relationships from dynamic heterogeneous panels” *Journal of Econometrics* 68(1), 79-113.
25. Rodriguez, C. (2016) “Economic and political determinants of exchange rate regimes: The case of Latin America” *International Economics* 147, 1-26.
26. Rodríguez-Caballero, C. V. (2021) “Energy consumption and GDP: a panel data analysis with multi-level cross-sectional dependence” *Econometrics and Statistics*, forthcoming.
27. The Economist (2020) “Conforming to norms - China's monetary stimulus is unusually restrained”. The Economist: London. August 22, 2020.
28. United Nations (2020) “Enfrentar los efectos cada vez mayores del COVID-19 para una reactivación con igualdad: nuevas proyecciones”. Cepal - United Nations: New York.
29. Vargas-Silva, C. (2021) “The Tale of Three Amigos: Remittances, Exchange Rates and Money Demand in Mexico” *Review of Development Economics*, forthcoming.
30. World Bank (2021) “Resilience COVID-19 Crisis Through a Migration Lens” *Migration and Development Brief 34,* World Bank Group - Global Knowledge Partnership on Migration and Development: Washington, D.C.
31. Yanzhen W., T.D. Willett and X. Li (2019) “International Capital Flows and the Independence of China's Monetary Policy” *The Chinese Economy* 52(4), 300-17.

Appendix A

Table A.1: Descriptive statistics

		Bolivia	Brazil	Colombia	Costa Rica	Dom.Rep	El Salvador	Guatemala	Haiti	Honduras	Jamaica	Mexico	Nicaragua	Paraguay	Peru
Real Exchange Rate	Min	3.600	1.618	1585.839	369.170	36.226	0.981	6.218	38.071	15.549	70.434	10.233	20.914	2206.544	2.592
	Max	9.919	4.093	3389.910	754.713	67.129	6.702	14.720	111.645	32.273	148.367	19.887	24.073	8463.314	11.586
	Median	7.003	2.414	2499.963	637.347	40.916	1.095	9.168	64.624	19.464	99.609	12.880	22.232	4716.230	3.288
	Mean	6.850	2.569	2428.294	606.612	44.338	2.008	9.603	64.163	21.642	102.360	13.782	22.395	4863.732	4.248
	Std.Dev.	1.569	0.695	508.650	80.865	8.274	1.706	2.183	19.989	4.596	19.350	2.311	1.076	1510.160	2.260
	Skewness	0.203	0.688	0.005	-0.953	1.417	1.790	0.285	0.364	0.551	0.439	0.916	0.253	0.601	1.762
	Kurtosis	-0.175	-0.601	-1.065	0.611	1.174	1.865	-0.966	-0.581	-0.888	-0.196	0.361	-1.586	0.488	2.115
Remmitances / GDP	Min	-0.001	0.000	0.000	0.000	0.018	0.011	-0.001	0.007	0.000	0.013	0.005	-0.002	0.003	-0.003
	Max	0.074	0.004	0.032	0.013	0.109	0.216	0.124	0.293	0.217	0.152	0.028	0.115	0.025	0.020
	Median	0.009	0.001	0.011	0.002	0.062	0.127	0.024	0.102	0.051	0.090	0.013	0.062	0.014	0.011
	Mean	0.017	0.001	0.013	0.004	0.058	0.128	0.053	0.119	0.083	0.086	0.016	0.050	0.013	0.009
	Std.Dev.	0.020	0.001	0.008	0.003	0.021	0.063	0.047	0.095	0.077	0.045	0.007	0.044	0.005	0.008
	Skewness	1.098	0.696	0.346	1.052	0.030	-0.384	0.254	0.270	0.340	-0.160	0.354	-0.019	-0.337	-0.327
	Kurtosis	0.452	-0.471	-0.155	0.116	0.115	-1.235	-1.799	-1.504	-1.626	-1.499	-1.218	-1.837	-0.450	-1.355
Debt / GDP	Min	0.245	0.154	0.194	0.219	0.062	0.279	0.159	0.103	0.244	0.451	0.175	0.554	0.222	0.262
	Max	1.432	0.499	0.474	1.445	0.758	0.685	0.408	0.461	1.032	1.976	0.751	10.874	0.884	1.190
	Median	0.671	0.290	0.303	0.381	0.273	0.518	0.304	0.312	0.541	0.912	0.304	1.233	0.410	0.519
	Mean	0.639	0.295	0.320	0.548	0.328	0.504	0.287	0.307	0.565	0.915	0.344	2.195	0.442	0.525
	Std.Dev.	0.282	0.100	0.078	0.356	0.181	0.135	0.070	0.082	0.225	0.328	0.142	2.484	0.169	0.208
	Skewness	0.724	0.372	0.201	1.306	0.709	-0.324	-0.101	-0.365	0.254	1.039	1.250	2.333	0.715	1.096
	Kurtosis	0.921	-0.880	-1.146	0.310	0.058	-1.279	-1.124	0.097	-1.123	1.591	1.430	4.791	-0.164	1.399
Reserves / GDP	Min	0.017	0.014	0.036	0.030	0.007	0.021	0.013	0.001	0.004	0.017	0.005	0.005	0.076	0.031
	Max	0.437	0.202	0.163	0.154	0.095	0.163	0.157	0.290	0.242	0.256	0.161	0.205	0.193	0.323
	Median	0.109	0.065	0.099	0.113	0.044	0.113	0.086	0.051	0.136	0.119	0.059	0.094	0.126	0.170
	Mean	0.160	0.081	0.104	0.111	0.043	0.098	0.087	0.089	0.113	0.117	0.072	0.105	0.128	0.172
	Std.Dev.	0.146	0.055	0.027	0.027	0.026	0.041	0.043	0.099	0.081	0.068	0.043	0.059	0.031	0.092
	Skewness	0.893	0.784	-0.101	-0.789	0.200	-0.392	-0.128	1.036	-0.020	0.202	0.523	0.282	0.135	0.147
	Kurtosis	-0.765	-0.447	0.728	0.985	-1.249	-1.130	-1.455	-0.528	-1.718	-1.153	-0.799	-1.156	-0.719	-1.184
GDP PER CAPITA / GDP PER CAPITA USA	Min	0.023	0.074	0.053	0.072	0.037	0.037	0.035	0.008	0.029	0.049	0.091	0.010	0.034	0.034
	Max	0.074	0.266	0.156	0.201	0.122	0.066	0.086	0.020	0.086	0.103	0.272	0.053	0.123	0.127
	Median	0.033	0.142	0.083	0.107	0.082	0.056	0.052	0.014	0.039	0.092	0.178	0.031	0.063	0.068
	Mean	0.040	0.143	0.089	0.122	0.084	0.054	0.056	0.014	0.044	0.087	0.173	0.032	0.072	0.075
	Std.Dev.	0.014	0.048	0.028	0.043	0.026	0.009	0.013	0.003	0.016	0.014	0.038	0.011	0.025	0.026
	Skewness	0.744	0.774	0.974	0.758	-0.196	-0.436	0.586	0.067	1.207	-1.125	-0.066	0.157	0.426	0.639
	Kurtosis	-0.721	0.063	0.231	-0.839	-1.090	-0.988	-0.798	-0.784	0.153	0.669	0.432	0.173	-1.130	-0.720

Table A.2: Fractional estimated integration orders

	Estimated integration orders				
	RER	Remm/GDP	Debt/GDP	Reserves/GDP	GDPC/GDPC_USA
Bolivia	1.32	1.19	0.86	1.15	1.21
Brazil	1.18	0.96	1.00	0.62	1.01
Colombia	1.24	0.95	1.34	1.23	1.26
Costa Rica	0.50	1.07	1.10	0.80	1.17
Dom.Rep	0.54	0.73	1.13	0.53	0.98
El Salvador	1.12	1.28	1.49	0.68	1.19
Guatemala	0.93	1.24	1.03	0.76	1.24
Haiti	0.78	1.28	0.73	0.95	0.78
Honduras	0.97	1.01	1.27	1.19	1.46
Jamaica	0.91	0.74	0.96	0.55	0.74
Mexico	0.70	1.25	0.83	0.57	0.83
Nicaragua	1.26	1.26	0.86	0.52	0.81
Paraguay	1.08	0.67	1.01	0.58	1.21
Peru	1.16	1.25	1.33	1.27	1.09

Notes: This table reports the estimated fractional integration orders obtained using the Extended Local Whittle (ELW) estimation approach proposed by Abadir et al. (2007) with bandwidth choices of m = 12. Data are demeaned and linear or quadratic detrended. Standard errors of the estimates are 0.111 in all cases.

Table A.3: Panel results of model 5. Heterogeneous estimates.

	Heterogenous parameters in Model 5				
	Intercept	log(GDPCvsUSA)	RemmGDP	log(ResGDP)	log(DebtGDP)
Bolivia	0.005	-0.913	-2.075	0.059	-0.185
Brazil	0.015	-0.864	-25.258	-0.104	-0.086
Colombia	0.031	-0.621	1.062	0.106	-0.216
Costa Rica	0.024	-0.931	-5.135	0.005	0.073
Guatemala	0.008	-1.173	-0.263	-0.018	-0.100
Haiti	-0.029	-0.623	-0.623	0.043	-0.035
Honduras	-0.015	-0.937	-0.073	0.090	-0.038
Jamaica	0.045	-0.542	0.641	-0.005	0.025
Mexico	0.032	-0.655	3.996	-0.028	0.115
Nicaragua	0.000	-0.335	-1.898	0.009	0.049
Paraguay	0.040	-0.844	-0.420	0.184	0.000
Peru	-0.032	-1.517	12.773	0.195	-0.655
Dom Rep	-0.001	-1.050	1.502	0.009	-0.409
Salvador	-0.149	-0.099	-1.225	0.014	0.245

Appendix B: Further econometric details

The growing popularity of macroeconomic panel data analysis has resulted in researchers (both theoretical and empirical) focusing on the study and treatment of panels with cross-sectional dependence. Chudik et al. (2011) define the concepts of weak and strong dependence based on the asymptotic behavior of the higher eigenvalue of the associated covariance matrix of the variables under study. A strong dependence can be generated by common factors, while a weak one can have its origin in spatial processes (see Bailey et al., 2016). Consider the model stated in eqs. (1) and (2). Since long-run persistence is transmitted to the model through different channels (either by the common factors or by the idiosyncratic shocks), the model guarantees a cointegrating relationship in the panel if $\max(\delta_i, \vartheta_i, d_i) > d_i \ \forall i$, i.e., if the common factors or covariates exhibit more persistence than the dependent variable. However, cointegration is not a prerequisite to obtaining consistent estimates of the parameters of interests (see Ergemen and Velasco (2017)).

In many empirical studies, it is also interesting to obtain estimations of the expected value of the heterogeneous parameters to draw a global inference. In this sense, Pesaran and Smith (1995) propose estimating such global effects by using the average of heterogeneous parameters, labeled "Group Average Estimators" or Mean Group Estimators (MGE). However, these estimates do not contemplate the existence of cross-sectional dependence, so MGE may also be inconsistent.

For clarity of the exposition, we present equations (1-2) again. The model is

$$y_{it} = \alpha_i + \beta_i' \boldsymbol{x_{it}} + \lambda_i' F_t + \Delta_{t+1}^{-d_{io}} \epsilon_{it},$$
$$\boldsymbol{x}_{it} = \mu_i + \Gamma_i' F_t + \Delta_{t+1}^{-\delta_{io}} \boldsymbol{\nu}_{it}.$$

In this model, the number of unobservable factors is assumed fixed and much smaller with respect to N, so that r << N. Furthermore, the idiosyncratic shocks are also fractionally integrated processes, specifically $\nu_{it} \sim I(\delta_i)$, and $\epsilon_i \sim I(d_i)$. Covariate-specific idiosyncratic shocks ν_{it}, the idiosyncratic terms ϵ_i, the unobservable common factors F_t, and the factor loadings λ_i, and Γ_i are all pairwise independent.

As explained before, we follow the estimation methodology proposed by Ergemen and Velasco (2017), who perform the estimation in first differences to remove fixed effects. Then, GLS estimation is executed after fractional differencing using d^*. The intuition is that the idiosyncratic error term is approximately $\Delta_{t+1}^{d^*-d_{io}}\epsilon_{it} \sim I(0)$, when $\delta_i^* \approx d_i$. Consequently, the model to be estimated is

$$\Delta_{t-1}^{d^{*-1}}\Delta y_{it} = \beta_i'\Delta_{t-1}^{d^*-1}\Delta \boldsymbol{x_{it}} + \lambda_i'\Delta_{t+1}^{d^*-1}\Delta F_t + \Delta_{t-1}^{d^*-1}\Delta\epsilon_{it}, \qquad (3)$$

where d^* should be large enough compared to the other fractional memory parameters involved in the model. For most economic applications, as in our case, taking $d^* \approx 1$ is enough to guarantee asymptotic normality of the parameter estimates.

Appendix C: Robustness check

We replaced the RER with Real Effective Exchange Rates (REER) in the estimated model. As can be seen in Table C.1., the difference of these estimates with those obtained using the RER is not sizeable in terms of magnitudes and signs. We kept the results using RER as the main results because: (i) the aforementioned reasons stated in footnote 6, and; (ii) the sample size is considerably reduced when using REER (only 8 countries remain in the sample: Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Mexico, Nicaragua and Paraguay). The data was obtained from the IMF (source: https://data.imf.org/).

Table C.1: Panel estimation with all the variables

Dependent variable: log (REER)					
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
log(GDP per capita relative to the US)	-.532***	-0.541***	-0.601***	-0.595***	-0.624***
	(0.040)	(0.034)	(0.041)	(0.049)	(0.058)
Remittances/GDP		-8.157***	-6.739***	-4.149***	-3.511***
		(1.660)	(1.307)	(0.715)	(0.691)
log(Reserves/GDP)			-0.024***		0.006
			(0.021)		(0.015)
log(Debt/GDP)				-0.014	-0.031
				(0.024)	(0.028)
Constant	2.496***	1.890***	1.874***	1.719***	1.582***
Observations	293	293	293	293	293

Notes: (1) *p<0.1; **p<0.05; ***p<0.01; All first-differenced models are estimated using Common Correlated Effects Mean Groups estimators.