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Current equilibrium exchange rate: methodology and estimations for Latin American countries[1]

Taxa de câmbio de equilíbrio: metodologia e estimativas para países da América Latina

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RESUMO: Este artigo propõe uma metodologia para a estimação da taxa de câmbio de equilíbrio em conta-corrente – a taxa de câmbio que garante o equilíbrio intertemporal da conta-corrente de um país. Além disso, a metodologia é testada através de técnicas econométricas apropriadas (Modelos VECM) para Argentina, Brasil, Chile e Colômbia, usando dados trimestrais de cerca de 2000 (de acordo com a disponibilidade de dados para cada país) até 2020. O modelo inclui tanto variáveis como termos de troca, comércio de bens e serviços como porcentagem do PIB e PIB per capita, bem como variáveis de política de curto prazo, como diferencial de taxas de juros e EMBI plus. Além de propor

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uma metodologia inovadora para estimar a taxa de câmbio de equilíbrio em conta--corrente, o artigo traz *insights* importantes em termos de apreciação (depreciação) crônica e cíclica da taxa de câmbio nos países da AL. Além disso, mostra alta correlação entre os desalinhamentos negativos (positivos) da taxa de câmbio e os déficits em conta-corrente (superávits) nos países analisados.
PALAVRAS-CHAVE: Taxa de câmbio de equilíbrio; conta-corrente; novo desenvolvimentismo; Modelo VEC.

ABSTRACT: This paper proposes a methodology for the estimation of the current account equilibrium exchange rate – the exchange rate that guarantees the intertemporal current account equilibrium for a country. Moreover, the methodology is tested throughout appropriate econometric technics (VECM Models) for Argentina, Brazil, Chile, and Colombia, using quarterly data from around 2000 (according to data availability for each country) to 2020. The model includes both long-term structural variables such as terms of trade, goods and service trade as percentage of GDP and GDP per capita as well short term policy variables such as interest rate differential and EMBI plus. Apart from proposing an innovative methodology for estimating the current account equilibrium exchange rate, the paper brings important insights in terms of chronicle and cyclical appreciation (depreciation) of the exchange rate in LA countries. In addition, it shows high correlation between the exchange rate negative (positive) misalignments and the current account deficits (surpluses) in the countries analyzed.
KEYWORDS: Equilibrium exchange rate; current account; new developmentalism; VEC Model.
JEL Classification: F30; F31; F4.

1. INTRODUCTION

A great majority of conventional economists adopt and recommend the adoption of the so-called external debt exchange rate equilibrium methodology to estimate the equilibrium and the misalignments of the exchange rate in developing countries. This equilibrium is associated with a deficit in current account and it is constrained by a lower increase in the external debt than the observed growth rate of GDP – which therefore maintains the external debt to GDP ratio stable or declining. Thus, ceteris paribus, the methodology proposes an exchange rate that would prevent the developing countries from a balance of payment crisis and allow them to adopt a strategy of growth cum external debt. The fundamental equilibrium exchange rate of Williamson (1994) corresponds to the external debt exchange rate equilibrium.

This approach, whose target is the stability in the external debt to GDP ratio, seems similar to the analysis of the intertemporal fiscal balance, which is constrained by the evolution of the public debt to GDP ratio. However, differently from pursuing a stable ratio between public debt and GDP in the long run, when a country allows for a growing external debt (even while holding a steady ratio between external debt and GDP), it is necessary to improve their revenues in foreign currency, remarkably in developing countries, since their domestic currency is, usually, not accepted to pay external liabilities; and, the history of Latin America has shown us, the increasing external debt implies in domestic adjustment and lower growth rates.

Additionally, the increasing external debt also reveals the acceptance of current account deficits, which may be tied to a strategy of "growth" with foreign savings – the government and the economic elites understand that the domestic savings are insufficient for financing the development and that the country needs to import most of the high-technological content goods; therefore, a current account deficit would be a "natural" characteristic of the development process and, mistakenly, policy makers decide that attracting external savings are necessary (Bresser-Pereira 2020b), which results in a large capital inflow and, consequently, in a currency appreciation.

The implementation of this strategy often requires rising interest rates to attract short term capitals, which reinforces the currency overvaluation and, consequently, also makes the imported goods cheaper, suddenly reducing inflation, bringing political support for this policy, but reinforces and amplifies the current account deficits, making it necessary to attract even larger amounts of external savings; the extension of this strategy provokes the exchange rate appreciation for vast periods, generating deindustrialization, as deep as the country suffers a Dutch disease process, and, finally, it results in lower growth rates of the economy. Surely it is a populist strategy.

Consequently, we understand that the approach of the external debt exchange rate equilibrium is not suitable for countries that aim to catch up. In order to grow without foreign constraints, it is necessary to maintain the current account equilibrium, which is an assumption to estimate an equilibrium exchange rate.

Nevertheless, both Keynesian and neoclassical economics treat the exchange rate as endogenous, and even if the first assumes that the exchange rate is more volatile in the short term than the second, both assume that the only problems are short-term 'exchange misalignments'. Inverselly, the New Developmentalism (ND) Theory asserts that the exchange rate can remain cyclically and cronically appreciated in the long run if the country faces an unneutralized Dutch disease and/or it chooses a growth with foreign savings strategy. As long as the imbalance in the current account is maintained, the country continues to practice high interest rates to generate net capital inflows and the currency remains overvalued.

Inasmuch the exchange rate is a crucial macroeconomic variable for economic development (Bresser-Pereira, Oreiro, and Marconi 2014; Bresser-Pereira 2012), cronicle and cyclical appreciation of the exchange rate should be avoided and the exchange rate should be maintained at a level in which companies operating with the state-of- the-art technology are competitive both in the external and domestic markets.

There is sound empirical litherature that have concluded that maintaining the exchange rate at a competitive level induces economic growth (Gala 2008; Rodrik 2008; Missio et al. 2015) and structural change (Araujo and Lima 2007; Missio, Araujo, and Jayme 2017). The ND theory claims the existence of two equilibrium exchange rates apart from the market (observed) exchange rate (Bresser-Pereira et al. 2014). The first – current account equilibrium exchange rate – is the one that guarantees that the country's current account is balanced intertemporally. The second – the industrial equilibrium exchange rate – is the one that makes competitive those companies producing internationally tradable non-commodities goods and services (Bresser-Pereira 2008; Marconi et al. 2021) and it is distinct from the current account equilibrium when an economy suffers the effects of Dutch disease, usually caused by comparative advantages in natural resources (Bresser-Pereira et al. 2014). When there is an unneutralized Dutch disease process in an economy, the exchange rate needed to maintain manufacturing competitiveness will be higher than the exchange rate needed to maintain current account balance. In other words, the equilibrium exchange rate would be the industrial level when there is Dutch disease, and it would be the one that guarantees the current account balance when the neutralized Dutch disease process is neutralized and/or it is absent.[7]

The main contribution of this paper is to build an econometric methodology for estimating the current account equilibrium exchange rate and to present empirical estimations for Argentina, Brazil, Chile, and Colombia. It is a clear alternative for the Williansons Fundamental Equilibrium Exchange Rate and it is extremely relevant to understand the economic behaviour of several Latin American countries in the past decades as well as to serve as a benchmark for exchange rate policies.[8]

Apart from this brief introduction, section 2 discuss the theory and methodology behind the current account equilibrium exchange rate, section 3 elaborates the econometric model for its estimation and presents the econometric results and section 4 presents the conclusions of the article.

2. THE CURRENT ACCOUNT EQUILIBRIUM EXCHANGE RATE: METHODOLOGY

The most usually adopted methodologies for estimating the equilibrium exchange rate are the Purchase Power Parity (PPP) and the Fundamental Approach (Hinkle and Montiel 1999). Under PPP, one would first identify a period of reference (of internal and external balance) and then use the exchange rate observed in that period as a proxy for the equilibrium. Then the PPP series are built considering the differences among the purchasing power of a basket of goods in different countries.

[7] Regarding the Duch disease process and the impacts on exchange rate and growth rates, see (Bresser-Pereira 2020a, 2008, 2021).

[8] The concept and methodology to estimate the industrial equilibrium exchange rate was previously defined in Marconi (2012) and its improvement and estimation can be found at https://eaesp.fgv.br/centros/centro-estudos-novo-desenvolvimentismo/projetos/taxa-cambio-equilibrio-industrial.

Implicitly, the equilibrium rate is constant regarding other fundamental variables of the economy, and it it would only be legitimate if the fundamentals do not change between reference and comparison periods (Hinkle and Montiel 1999).

If fundamental variables of the economy influence the equilibrium exchange rate, the preferred methodology for estimating the equilibrium exchange rate is the Fundamental Approach. Its methodology was developed by authors such as Edwards (1989) and Baffes, O'Connel et al. (1999), involving, in general, three main stages.

In the first stage, the long-term relationship to be estimated is investigated, reconciling the existing theory and the characteristics of the economy. In a second stage, this relationship is represented by a model whose long-term parameters are estimated, using appropriate techniques for the characteristics of the time series used. In the third stage, the estimated parameters are used to calculate the "equilibrium" exchange rate, that is, the exchange rate aligned with economic fundamentals.

Our proposed estimation of the current account equilibrium exchange rate will consist in adapting the three steps of the Fundamental Approach by allowing short-term policy variables to influence permanently the exchange rate equilibrium (according to the New Developmentalist Theory, which considers extended periods of observed high interest rates, for example), and also by adding a final step that consists of using the estimated coefficients to calculate the long-term current account equilibrium exchange rate, which is the one that allows for a zero balance in the current account.

Even though it follows the econometric strategy of Baffes, O'Connell et al. (1999) and Edwards (1989b), our proposal is diverse from the Fundamental Approach of Williamson (1994) because it considers that both long-term structural forces as well as shor-term policy variables determines the current account equilibrium exchange rate. Most importantly, whreas the Fundamental Equilibrium Exchange Rate defines an equilibrium bounded to curb any prospectively excessive current account imbalances back to a limit of ±3 percent (Cline 2008), ND theory explicitly argues against the possibility of observing a sustainable growth associated with persistent foreign indebtedness. Hence, this article proposes a new equilibrium exchange rate consistent with the current account balance, which we denominate current account equilibrium exchange rate. Empirically, this equilibrium level is calculated assuming the current account equal to zero in the equation adopted in the econometric tests after the estimation of their respective parameters.

As described briefly in the theoretical part, the current account equilibrium is conditioned on a vector of fundamental economic variables – that consist in both short-term policy variables and long term structural variables. Our task is to construct a series of this unobserved variable – the current account equilibrium exchange rate – using data on the real exchange rate and its main determinants discussed by the economic literature. The first step is to assume a linear relationship by taking a simple transformation (in this case, natural logarithm) of the variables[9]. Our model then is represented in equation 1 below:

$$lnereer_t = \alpha + \beta`X_t \qquad (1)$$

Where ereer is the equilibrium real exchange rate and X a vector of the fundamental variables.

Given that our sample is composed of a single equation of non-stationarity variables (I(1)), both ordinary least squared (OLS) regression as well VEC are fitted for our purpose (Baffes, O'Connell, and Elbadawi 1999; Nassif, Feijó, and Araujo 2011). However, given autocorrelation and endogeneity bias in OLS regression and since the non-stationary series have one cointegration relashionship, it is more appropriated to choose for the VEC estimation. Equation (1) then is reformulated to include the error correction term and becomes:

$$\Delta lnereer = \alpha ecm + \beta`\Delta X_{t-1} \qquad (2)$$

The first term on the right-hand side is the error correction term and *Xt* is the vector of fundamental variables. For the Latin American countries analyzed, the 'fundamental' long term structural variables considered in the estimations are a) the natural logarithim (ln) of the terms of trade (lntot);[10] b) the ln of the net trade of goods and services as a percentage of GDP (lngst_gdp); c) ln of GDP per capita (lngdp_pc); while the 'fundamental' short-term policy variables are; d) country risk premium captured by the ln of EMBI+ (lnembi) and the e) ln of the of the interest rate differential (lnidif). The short and long term variables were selected according to the main determinants of exchange rate discussed in the literature (Edwards 1989b).

To take into account structural transformations of the economy, current account balance, productivity and terms of trade were selected. Regarding the first, we included this explanatory variable because, according to our theoretical model, policy makers may choose a strategy of growth with foreign savings that implies in current account deficits and a currency appreciation. This causality (current account deficits provoking currency appreciation) seems counterintuitive, because most of economists used to affirm that the causality is in the opposite direction (i.e., a currency appreciation causing a current account deficit); in this article, we argue that the option for accepting current account deficits implies in a currency appreciation, for the reasons previously explained. We consider, as a proxy to current account balance, the trade balance of goods and services, because we are directly interested in estimating an exchange rate that balances (ceteris paribus) the trade

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[9] Following Nassif, Feijó, et al. (2011, p.10), monotonic transformation is executed in variables with negative values by adding a positive number (in our case +1) in order to apply the logarithm transformation.

[10] Please see the source and acronym of the variables in Appendix 1 and the graphic representation in Appendix 2.

account; as a result, this equilibrium exchange rate will also influence the balance of income and transfers accounts (whose behavior is linked to prior decisions about debt and investments).

The expected sign of the relationship between real exchange rate and current account balance, according to our theory, may be negative in the short run but positive in the long run. Although a current account deficit would result in a currency devaluation in the short term, the option for maintaining these deficits may result in the attaction of large capital inflows and in a valuation of the domestic currency (or an exchange rate appreciation).

As for productivity, the aim is to capture the well-known Balassa-Samuelson Effect. It refers to a 'tendency of a country that shows higher changes in productivity of tradable goods compared with non-tradable ones relative to the world economy to have higher price levels, that is to say, a real exchange rate appreciation' (Nassif, Feijó, et al., 2011, p.6). However, the sign can be ambiguous since empirical evidence has shown that Balassa-Samuelson Effect does not work in developing countries (Wang, Xue, and Du 2016). Countries' GDP per capita is used as a proxy for productivity.

Terms of Trade (ToT) are also an important variable associated with the exchange rate long-term behavior. The literature points out two divergent outcomes of fluctuations in the ToT. The first is the income effect, and the second is the substitution effect. The former is associated with the increase in income measured in imported goods (which become cheaper) that generates a spending effect – increasing demand for all goods – and thus, appreciating the real exchange rate. Conversely, the substitution effect is in the opposite direction; the relative price of imported goods decreases, the demand for them increases, engendering a depreciation in the exchange rate.

Apart from the long-term structural variables, the exchange rate financial determinants such as the interest rate differential and risk premium are considered as the short term policy variables. The first is measured by the difference between countries' basic interest rates and the one adopted by the FED. An increase in the differential would increase foreign investors' return, ceteris paribus, and thus, attracting foreign capital and appreciating the currency. The variable EMBI+ captures the risk premium. An increase in the risk premium would make foreign investors less likely to invest in the corresponding country, ceteris paribus, depreciating its currency.

3. THE CURRENT ACCOUNT EQUILIBRIUM EXCHANGE RATE: ESTIMATIONS

To econometrically estimate model (2) the following steps were conducted: a) unit root test for all dependent and independent variables; b) analysis of their cointegration relationship; c) estimation of the parameters throughout the VEC model; d) residual analysis to avoid autocorrelation and heteroscedasticity problems; and, e) decomposition of transitory and permanent components.

In the first step, Augmented Dick Fuller (ADF) and Phillip Perron (PP) unit root tests were performed in both dependent and independent variables. In our sample, all the variables are stationary of order I(1) (See Appendix 3).

In the second step, the Johansen cointegration test is applied to estimate the long-term relationship of the variables. The test considers all the variables in the estimation process as endogenous and tries to simultaneously determine the equilibrium relationship among them[11]. It derives, throughout the Maximum Likelihood estimation for the VAR, a set of cointegration vectors. The number of cointegration vectors is determined by trace and eigenvalue tests. The models for the Latin American countries included in this study suggested one cointegration equation at a 5% level (See Appendix 4).[12]

Having established that the variables are I(1) and present a cointegration relationship, the econometric model becomes:

$$\Delta lnreer_t = \alpha_1 + \beta_1 ecm_{t-1} + \sum_{i=1}^{k} \Delta (\beta_2 lnToT_{t-1} + \beta_3 lngst_{t-1} + \beta_4 lnIdif_{t-1} + \beta_5 lnEMBI_{t-1} + \beta_6 lnGDPpc_{-1}) + \varepsilon_t \quad (3)$$

Where ecm refers to the error correction term, k refers to the lag order of the long-run relationship of the variables and ε_t is the residual vector of the equation.

The results of the VEC model for the four Latin American countries included in this study (Argentina, Brazil, Chile, and Colombia) for the period around 2000 (see note on Appendix 1) to 2020 are presented in Table 1 below. As expected, an increase in terms of trade and the interest rate differential is associated with currency appreciation. On the contrary, an increase in net trade of goods and services as % of GDP, EMBI+, and GDP per capita is associated with currency depreciation. The signals were equivalent for all LA countries.

[11] The lag interval used in the cointegration and VEC estimations followed the Var lag order selection criteria (ex. AIC, SIC, FPE, etc.). However, in the presence of autocorrelation and heteroscedasticity in the errors, different lag interval was allowed.

[12] It is not uncommon for the results of these two tests to diverge, indicating different numbers of cointegration vectors, which can be a consequence of small samples. Thus, when these tests diverge, Enders (1995) suggests using the Eigenvalue Value test. When applying the VEC models, changes in the variable lags were allowed to improve the model. That strategy can modify the number of cointegration vectors. This phenomenon was observed in the case of Chile. As our main variable of interest is the equilibrium exchange rate, we choose to analyze only its cointegration vector rather than trying to identify and estimate the other cointegration vectors.

Table 1: Vector Error Correction estimates for Selected Latin American countries

Variables	(1)	(2)	(3)	(4)
	Argentina	Brazil	Chile	Colombia
Ln of Terms of Trade	-4.21	-0.66	-1.06	-2.03
	[2.648]	[2.581]	[8.326]	[3.992]
Ln of Trade of Goods and Services Net as % of GDP	10.67	7.53	1.03	6.65
	[-2.708]	[-5.451]	[-8.462]	[-1.930]
Ln of Interest Rate Differential	0.22	-0.21	-0.03	-0.61
	[3.826]	[3.642]	[1.968]	[5.995]
Ln of EMBI+	0.4	0.24	0.12	0.79
	[-3.400]	[-2.497]	[-3.640]	[-4.654]
Ln of GDP per capita	1.66	0.19	1.70	1.15
	[-2.711]	[-1.879]	[-8.348]	[-4.819]
C	-6.16	5.59	-15.86	3.15
Included observations:	64	80	78	70
LM test	26.51	36.62	38.39	39.69
Prob	0.87	0.43	0.36	0.3
White test (Chi-sq)	824.64	1089.02	1282.2	1076.25
Prob	0.24	0.19	0.64	0.28

Notes: t-statistics in [ ]. Lags 1 to 3, 1 to 5, 1 to 4, 1 to 4, were allowed as a lag interval on the VEC model of Argentina, Brazil, Chile, and Colombia, respectively. For Argentina 4, 2, 3, 2, 1 lags was used for terms of trade, trade of goods and services net as % of GDP, interest rate differential, EMBI+, GDP per capita, respectively. For Brazil 1, 3, 2, 3, 3 lags were used for terms of trade, trade of goods and services net as % of GDP, interest rate differential, EMBI+, GDP per capita, respectively. For Chile 2, 1, 3, 1, 2 lags were used for terms of trade, trade of goods and services net as % of GDP, interest rate differential, EMBI+, GDP per capita, respectively. For Colombia 1, 3, 2, 1, 4 lags were used for terms of trade, trade of goods and services net as % of GDP, interest rate differential, EMBI+, GDP per capita, respectively. In some cases, as the case of Chile, the Jarque-Bera normality test suggests rejecting the hypothesis that errors follow a normal distribution. However, this problem can be minimized by following the Central Limit Theorem, according to which as the sample size of a given variable increases, the sample mean distribution will tend toward normal (Durrett 2019).

Table 1 also shows the residual diagnoses of the models. To investigate autocorrelation in the residuals, the Residual Serial Correlation LM test was implemented. In all models, the null hypothesis of no serial correlation could not be rejected. Additionally, the White test for Heteroscedasticity indicated that the null hypothesis of homoscedasticity in the residuals could not be rejected. Hence, the models are robust to autocorrelation and heteroscedasticity problems.

Having estimated robust models, the parameters are used to calculate the equilibrium exchange rate:

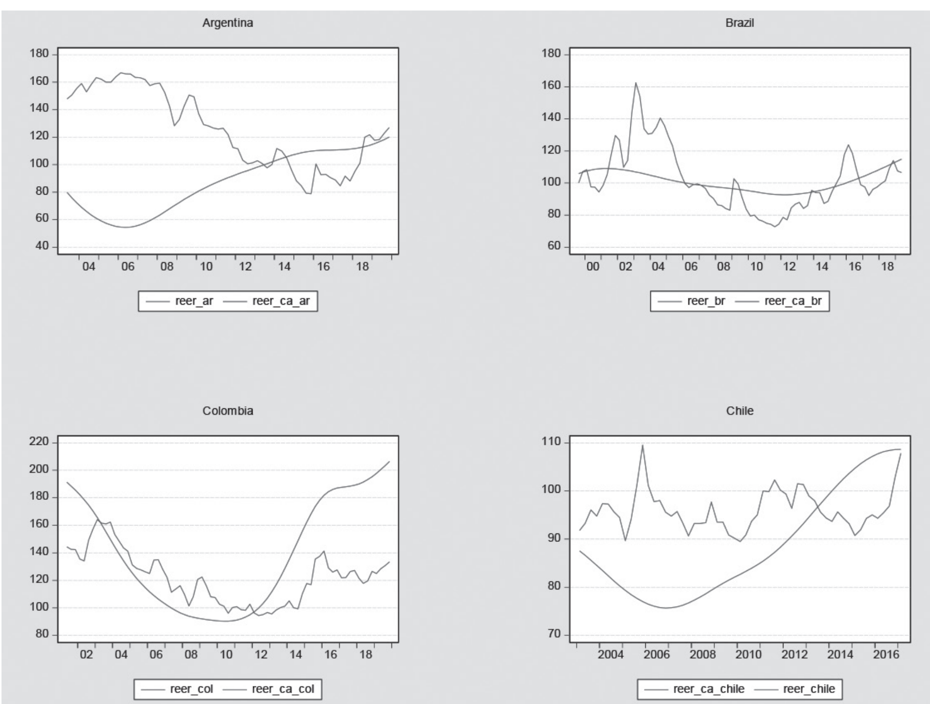
$$lnreer_t = \alpha_1 + \beta_1 lnToT_{t-1} + \beta_2 lngst_{t-1} + \beta_3 lnIdif_{t-1} + \beta_4 lnEMBI_{t-1} + \beta_5 lnGDPpc_{-1} \quad (4)$$

As argued before, the current account equilibrium exchange rate is the one in which the current account is in equilibrium (neither surplus nor deficits), and thus the term *Ingst* is zero. The new equation becomes:

$$lnreer\_ca_t = \alpha_1 + \beta_1 lnToT_{t-1} + \beta_3 lnIdif_{t-1} + \beta_4 lnEMBI_{t-1} + \beta_5 lnGDPpc_{-1} \quad (5)$$

Equation 5 allows the formulation of an index of the lnreer_ca based on the respective economy's short term policy variables and long term structural variables, restricted to a current account equilibrium. However, the variables used in the model are likely to incorporate both transitory and permanent components. Hence, a strategy to estimate the long-term lnreer_ca can be based on an econometric decomposition of transitory and permanent components. Only the latter would be considered in the long-run equilibrium since it reflects the long-term trend of the series. Following Edwards (1989) and Nassif, Feijó et al. (2011), the Hodrick-Prescott (HP) filter technique is implemented to estimate the long-term trend of the series and thus, capture the permanent components of the explanatory variables of the model. Therefore, the final sample of the REER_CA is obtained by multiplying the permanent component of the explanatory variables by the vector of estimated parameters of the regression model (3).

Figure 1: Real Effective Exchange Rate and Current Account Equilibrium Exchange Rate for selected Latin American Country's



The series of current account equilibrium exchange rate (REER_CA) and observed real effective exchange rates (REER) can be seen in Figure 1 above. REER_CA larger than REER means that the observed real exchange rate is depreciated in relation to the current account equilibrium level. The opposite situation (REER_CA lower than REER) means an appreciation. The figure shows that until the second quarter of 2012, it's the observed real effective exchange rate was more depreciated than its current account equilibrium level in Argentina. After that, the real effective exchange rate surpassed the current account equilibrium. For Brazil, it is possible to observe that REER > REER_CA until 2005 and then REER became more appreciated than the REER_CA for ten years, with sporadic exceptions. After 2014, REER gravitated around the REER_CA. Chile is the case in which REER is depreciated in relation to its current account equilibrium for most of the period analyzed. Finally, for Colombia, the first quarter of 2012 represented a shift from depreciated REER to appreciated REER in relation to its current account equilibrium level.

Figure 2: Exchange Rate Misalignment (MIS = REER-REER_CA)
and Net Trade of Goods and Services as a percentage of GDP

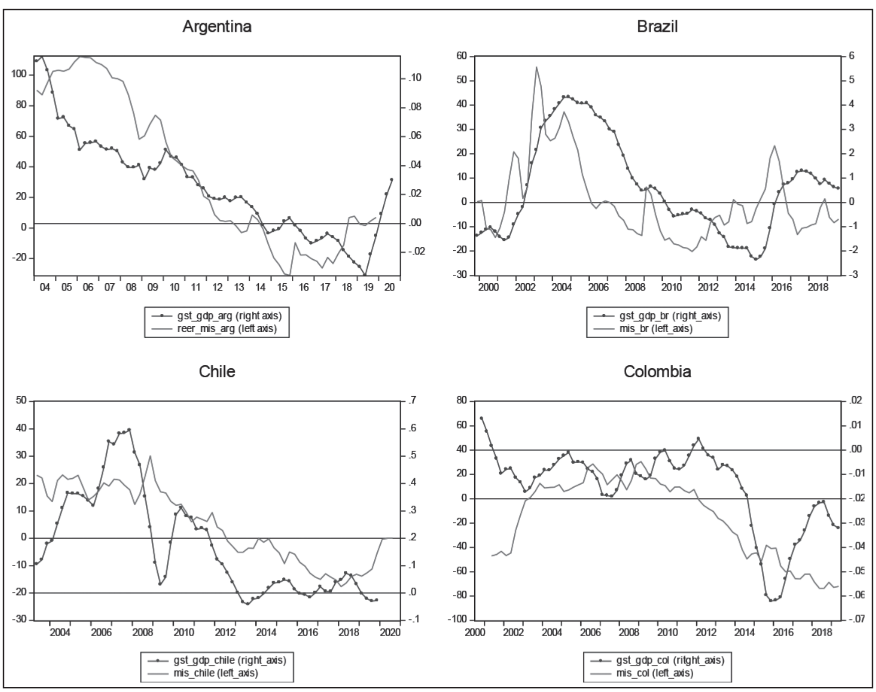


Figure 2 illustrates the exchange rate misalignment (REER-REER_CA) and the net trade of goods and services as a percentage of GDP. It seems that there is a positive correlation between exchange rate misalignments and the current account balance. If the New Developmentalist Theory is correct, there is a process in which both variables reinforce each other; and an extended period of appreciation is correlated with a growing trade deficit in Latin American countries.

4. CONCLUSION

The paper brings important contribution to the literature of *Equilibrium Exchange Rate* by introducing an original methodology and present empirical estimations for LA countries of the so-called current account equilibrium exchange rate introduced by the ND theory. A single equation VEC model is built to capture both long term structural variables and short-term policy variables considered determinants for the exchange rate. The approach proposed considers the current account balance as a relevant variable to determine the level of the exchange rate and our methodology allows to capture the relationship between the "equilibrium" real exchange rate and the changes in the current account balance, verifying how the latter influences the real exchange rates and the equilibrium exchange rate. Actually, a constraint for the current account balance (CA=0) is imposed in the model and, thus, explicitly rules out the 'external debt sustainable limit' of the Willianson Fundamental equilibrium.

The econometric estimations are robust in relation to autocorretation and heterocedasticity and the variables signals behaved as expected and are similar for all LA countries. An increase in terms of trade and the interest rate differential is associated with currency appreciations. On the contrary, an increase in net trade of goods and services as % of GDP, EMBI+, and GDP per capita is associated with currency depreciations.

The series built by the model parameters shows cyclical and cronicle appreciation for Argentina, Brazil, and Colombia and a cronicle depreciation of Chilean observed exchange rate compared to the current account equilibrium. Moreover, a positive (negative) misalignment of the exchange rate compared to the current account equilibrium is positively correlated with the current account surpluses (deficits). The estimations clearly demonstrates that countries face cronicle and cyclical misalignments and thus, a policy to management the exchange rate must be a crucial economic policy to be implemented in the countries included in this study. The search for an exchange rate level that is associated with a current account equilibrium seems relevant to avoid large trade deficits, high external debts and lower growth rates in Latin America.

Regarding suggestions for future research agenda, it seems important to incorporate country level especificities and variables to better capture them in the models. As an introductory framework, the present research faced the trade-off between proposing a general model comparable for several LA countries and considering the existent especificities of each country in the models, and, thus, capturing countries particularities but harming possible comparisons.

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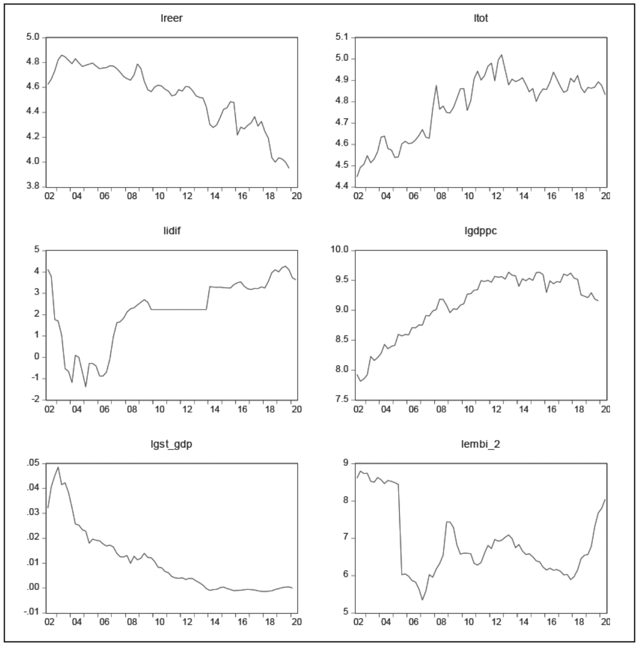
Appendix 1: Variables, Acronyms, and Sources

Variable	Acronym	Source
Real Effective Exchange Rate	reer	For Argentina, FRED. For Brazil, Brazilian Central Bank. For Chile, Central Bank of Chile. For Colombia, Banco de la Republica.
Terms of Trade	tot	For Argentina, INDEC. For Brazil, Brazilian Central Bank. For Chile, Central Bank of Chile. For Colombia, Banco de la Republica.
Policy Rate Differential	idif	Bank of International Settlements (BIS)
GDP per capita	GDPpc	GDP data was obtained from different sources: For Argentina, IFS-IMF, for Brazil, Brazilian Central Bank, for Chile, Central Bank of Chile. For Colombia, we had to merge the two databases from DANE of the National Accounts. There is one series from 2000 to 2017 and another series from 2005 to 2020. They updated their methodology in 2005. However, the variations on both series were equivalent. Therefore, we applied the variations of the former in the latter. The series were in millions of current pesos. Nominal Exchange Rate from FRED was used to obtain the current GDP in US dollars. Population data was obtained in World Development Indicators from World Bank.
Goods and Services Trade, net (as % of GDP)	gst_gdp	For all countries, data from IFS-IMF. More specifically – Balance of Payments, Current Account, Goods and Services, Net [BPM6], US Dollar. For GDP: See note on GDPpc. Both series were accumulated 12m. before constructing the ratio.
embi +	embi	LCA consulting

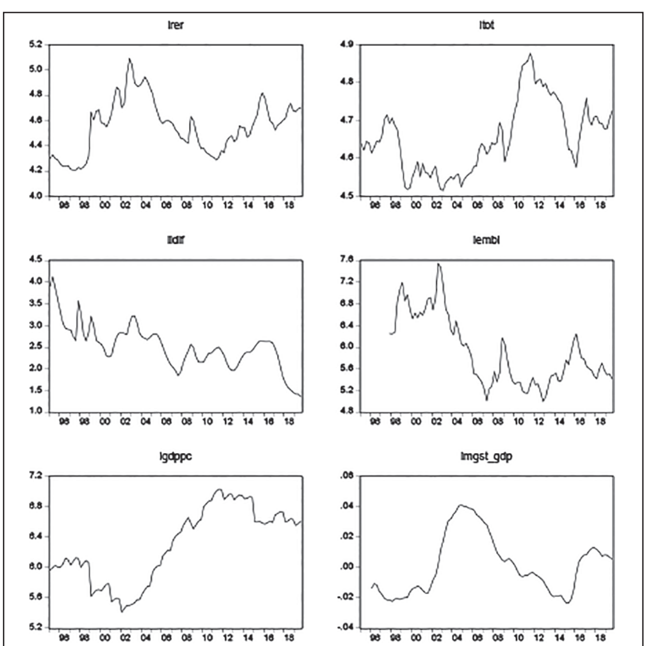
Note: All data are set to be quarterly data. In the case of monthly series, the transformation done was taking the average of the period (unless otherwise specified). For Argentina, the final model is estimated using data from the first quarter of 2004 to the fourth quarter of 2019. For Brazil, from the last quarter of 1999 to the third quarter of 2019. For Chile, from the third quarter of 2000 to the fourth quarter of 2019. For Colombia, from the third quarter of 2003 to the fourth quarter of 2019.

Appendix 2: Graphic representation of the variables

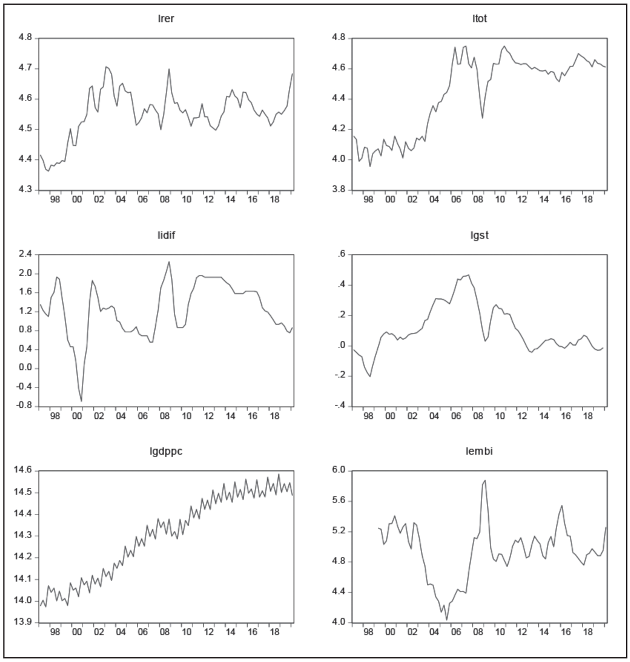
Argentina



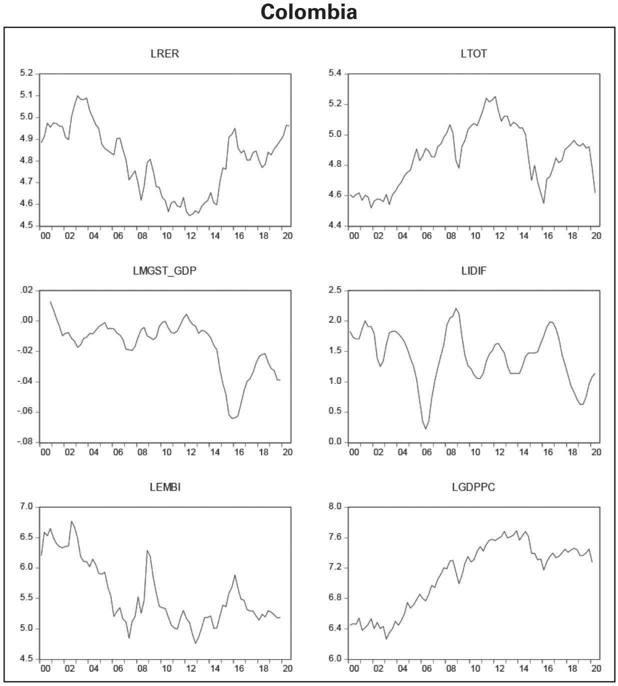
Brazil



Chile



Colombia



Appendix 3: ADF and PP Unit Root Tests

Argentina

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

		LREER	LIDIF	LGST_GDP	LGDPPC	LEMBI	LTOT
	At Level						
With Constant	t-Statistic	0.5657	-1.4352	-2.8242	-2.6454	-1.9114	-2.1370
	Prob.	***0.9878***	***0.5604***	***0.0600***	***0.0893***	***0.3254***	***0.2312***
		n0	n0	*	*	n0	n0
With Constant & Trend	t-Statistic	-3.1361	-4.5234	-1.0974	0.9566	-1.2355	-1.3802
	Prob.	***0.1062***	***0.0028***	***0.9220***	***0.9998***	***0.8952***	***0.8584***
		n0	***	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	-1.4152	-0.9325	-3.6652	-0.3817	-0.4414	1.2750
	Prob.	***0.1450***	***0.3094***	***0.0004***	***0.5427***	***0.5200***	***0.9475***
		n0	n0	***	n0	n0	n0
	At First Difference						
		d(LREER)	d(LIDIF)	d(LGST_GDP)	d(LGDPPC)	d(LEMBI)	d(LTOT)
With Constant	t-Statistic	-6.9494	-6.8064	-7.8475	-0.9381	-7.3366	-8.5976
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.7695***	***0.0000***	***0.0000***
		***	***	***	n0	***	***
With Constant & Trend	t-Statistic	-7.1617	-6.9094	-8.2533	-3.6440	-7.6288	-8.8479
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0342***	***0.0000***	***0.0000***
		***	***	***	**	***	***
Without Constant & Trend	t-Statistic	-6.7905	-6.8558	-7.3616	-1.4362	-7.3837	-8.4462
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.1394***	***0.0000***	***0.0000***
		***	***	***	n0	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

		LREER	LGDPPC	LEMBI	LGST_GDP	LIDIF	LTOT
	At Level						
		LREER	LGDPPC	LEMBI	LGST_GDP	LIDIF	LTOT
With Constant	t-Statistic	1.0997	-4.1672	-2.0924	-1.4530	-1.7574	-2.3760
	Prob.	***0.9972***	***0.0015***	***0.2483***	***0.5515***	***0.3985***	***0.1521***
		n0	***	n0	n0	n0	n0
With Constant & Trend	t-Statistic	-3.1711	0.4615	-1.4290	-1.4377	-4.4435	-2.0377
	Prob.	***0.0987***	***0.9990***	***0.8440***	***0.8412***	***0.0035***	***0.5709***
		*	n0	n0	n0	***	n0
Without Constant & Trend	t-Statistic	-1.5019	1.2988	-0.4427	-2.0981	-1.0526	1.2433
	Prob.	***0.1238***	***0.9497***	***0.5195***	***0.0353***	***0.2615***	***0.9444***
		n0	n0	n0	**	n0	n0
	At First Difference						
		d(LREER)	d(LGDPPC)	d(LEMBI)	d(LGST_GDP)	d(LIDIF)	d(LTOT)
With Constant	t-Statistic	-6.9818	-9.9237	-7.3488	-7.8803	-6.8064	-8.8631
	Prob.	***0.0000***	***0.0001***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.7217	-18.4102	-7.6276	-8.2533	-6.9094	-20.4704
	Prob.	***0.0000***	***0.0001***	***0.0000***	***0.0000***	***0.0000***	***0.0001***
		***	***	***	***	***	***
Without Constant & Trend	t-Statistic	-6.6511	-9.6205	-7.3956	-7.3719	-6.8558	-8.3454
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant .

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

Brazil

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level						
		LRER	LTOT	LMGST_GDP	LIDIF	LGDPPC	LEMBI
With Constant	t-Statistic	-2.2061	-1.8892	-2.1760	-3.1359	-0.8508	-1.7620
	Prob.	***0.2055***	***0.3361***	***0.2164***	***0.0272***	***0.7997***	***0.3969***
		n0	n0	n0	**	n0	n0
With Constant & Trend	t-Statistic	-2.2054	-2.3085	-2.1715	-4.2196	-1.2565	-2.6612
	Prob.	***0.4810***	***0.4252***	***0.4994***	***0.0061***	***0.8924***	***0.2552***
		n0	n0	n0	***	n0	n0
Without Constant & Trend	t-Statistic	0.3122	0.2891	-2.1783	-1.7249	0.7124	-0.6001
	Prob.	***0.7740***	***0.7676***	***0.0290***	***0.0801***	***0.8674***	***0.4546***
		n0	n0	**	*	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LMGST_GDP)	d(LIDIF)	d(LGDPPC)	d(LEMBI)
With Constant	t-Statistic	-7.7385	-7.4412	-3.3457	-4.8260	-9.2172	-6.8994
	Prob.	***0.0000***	***0.0000***	***0.0156***	***0.0001***	***0.0000***	***0.0000***
		***	***	**	***	***	***
With Constant & Trend	t-Statistic	-7.6996	-7.4056	-3.3249	-4.7959	-9.1680	-6.8590
	Prob.	***0.0000***	***0.0000***	***0.0686***	***0.0010***	***0.0000***	***0.0000***
		***	***	*	***	***	***
Without Constant & Trend	t-Statistic	-7.7613	-7.4703	-3.3713	-4.7095	-9.2161	-6.9182
	Prob.	***0.0000***	***0.0000***	***0.0009***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

	At Level						
		LRER	LTOT	LMGST_GDP	LIDIF	LGDPPC	LEMBI
With Constant	t-Statistic	-1.9845	-1.7605	-1.6057	-2.1984	-0.8762	-1.5246
	Prob.	***0.2932***	***0.3980***	***0.4757***	***0.2083***	***0.7920***	***0.5166***
		n0	n0	n0	n0	n0	n0
With Constant & Trend	t-Statistic	-1.9657	-2.2043	-1.5721	-3.0265	-1.3024	-2.3322
	Prob.	***0.6123***	***0.4816***	***0.7967***	***0.1304***	***0.8815***	***0.4122***
		n0	n0	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	0.4833	0.2304	-1.5828	-1.7772	0.7106	-0.5868
	Prob.	***0.8177***	***0.7511***	***0.1064***	***0.0718***	***0.8671***	***0.4604***
		n0	n0	n0	*	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LMGST_GDP)	d(LIDIF)	d(LGDPPC)	d(LEMBI)
With Constant	t-Statistic	-7.5270	-7.4158	-3.5952	-7.3347	-9.1973	-7.2298
	Prob.	***0.0000***	***0.0000***	***0.0076***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.4780	-7.3795	-3.5769	-7.3151	-9.1453	-7.1772
	Prob.	***0.0000***	***0.0000***	***0.0373***	***0.0000***	***0.0000***	***0.0000***
		***	***	**	***	***	***
Without Constant & Trend	t-Statistic	-7.5601	-7.4451	-3.6172	-7.2792	-9.1967	-7.2669
	Prob.	***0.0000***	***0.0000***	***0.0004***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

Chile

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level						
		LRER	LTOT	LIDIF	LGST_GDP	LGDPPC	LEMBI
With Constant	t-Statistic	-2.7348	-1.3337	-4.1056	-2.6261	-0.9596	-2.8920
	Prob.	***0.0721***	***0.6110***	***0.0015***	***0.0915***	***0.7644***	***0.0506***
		*	n0	***	*	n0	*
With Constant & Trend	t-Statistic	-2.9071	-1.9356	-4.2655	-2.6585	-1.7012	-2.9502
	Prob.	***0.1652***	***0.6279***	***0.0054***	***0.2563***	***0.7426***	***0.1527***
		n0	n0	***	n0	n0	n0
Without Constant & Trend	t-Statistic	0.7712	0.7004	-1.5464	-2.0314	2.7115	-0.1207
	Prob.	***0.8784***	***0.8650***	***0.1141***	***0.0410***	***0.9983***	***0.6391***
		n0	n0	n0	**	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LIDIF)	d(LGST_GDP)	d(LGDPPC)	d(LEMBI)
With Constant	t-Statistic	-7.9195	-3.3961	-5.2003	-4.4002	-3.0772	-6.5456
	Prob.	***0.0000***	***0.0137***	***0.0000***	***0.0006***	***0.0320***	***0.0000***
		***	**	***	***	**	***
With Constant & Trend	t-Statistic	-7.8910	-4.2085	-5.1745	-4.4334	-3.1372	-6.5411
	Prob.	***0.0000***	***0.0066***	***0.0003***	***0.0032***	***0.1043***	***0.0000***
		***	***	***	***	n0	***
Without Constant & Trend	t-Statistic	-7.8634	-3.3143	-5.2308	-4.4248	-2.6391	-6.5894
	Prob.	***0.0000***	***0.0012***	***0.0000***	***0.0000***	***0.0088***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

		LRER	LTOT	LIDIF	LGST_GDP	LGDPPC	LEMBI
	At Level						
With Constant	t-Statistic	-2.1198	-1.2932	-2.8554	-1.7637	-1.5511	-2.4454
	Prob.	***0.2375***	***0.6300***	***0.0547***	***0.3962***	***0.5034***	***0.1327***
		n0	n0	*	n0	n0	n0
With Constant & Trend	t-Statistic	-2.3326	-2.0180	-2.9308	-1.7751	-7.3016	-2.4856
	Prob.	***0.4122***	***0.5836***	***0.1579***	***0.7088***	***0.0000***	***0.3344***
		n0	n0	n0	n0	***	n0
Without Constant & Trend	t-Statistic	0.8852	0.7660	-1.2848	-1.4217	3.0091	-0.1550
	Prob.	***0.8980***	***0.8775***	***0.1822***	***0.1437***	***0.9993***	***0.6272***
		n0	n0	n0	n0	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LIDIF)	d(LGST_GDP)	d(LGDPPC)	d(LEMBI)
With Constant	t-Statistic	-8.1326	-9.0627	-5.2939	-4.2817	-39.9175	-6.1752
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0009***	***0.0001***	***0.0000***
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-8.0822	-9.0452	-5.2681	-4.2785	-49.0627	-6.1508
	Prob.	***0.0000***	***0.0000***	***0.0002***	***0.0053***	***0.0001***	***0.0000***
		***	***	***	***	***	***
Without Constant & Trend	t-Statistic	-8.0486	-8.9871	-5.3234	-4.3089	-25.6580	-6.2300
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

Colombia

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level						
		LRER	LTOT	LMGST_GDP	LIDIF	LEMBI	LGDPPC
With Constant	t-Statistic	-1.2145	-1.4692	-2.1716	-4.8008	-1.6997	-1.6668
	Prob.	***0.6649***	***0.5441***	***0.2183***	***0.0002***	***0.4275***	***0.4438***
		n0	n0	n0	***	n0	n0
With Constant & Trend	t-Statistic	-0.8974	-0.8606	-2.9006	-5.0441	-2.1705	-0.5778
	Prob.	***0.9509***	***0.9549***	***0.1683***	***0.0005***	***0.4989***	***0.9774***
		n0	n0	n0	***	n0	n0
Without Constant & Trend	t-Statistic	0.1497	-0.0427	-0.0168	-1.0927	-0.7749	1.0141
	Prob.	***0.7269***	***0.6656***	***0.6736***	***0.2467***	***0.3774***	***0.9170***
		n0	n0	n0	n0	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LMGST_GDP)	d(LIDIF)	d(LEMBI)	d(LGDPPC)
With Constant	t-Statistic	-7.2977	-6.9931	-4.3737	-4.7226	-7.8888	-3.5682
	Prob.	***0.0000***	***0.0000***	***0.0008***	***0.0002***	***0.0000***	***0.0087***
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.3481	-7.1553	-4.3415	-4.6914	-7.8751	-3.8900
	Prob.	***0.0000***	***0.0000***	***0.0050***	***0.0015***	***0.0000***	***0.0172***
		***	***	***	***	***	**
Without Constant & Trend	t-Statistic	-7.3433	-7.0424	-4.3282	-4.7448	-7.8712	-3.3851
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0010***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

	At Level						
		LRER	LTOT	LMGST_GDP	LIDIF	LEMBI	LGDPPC
With Constant	t-Statistic	-1.2145	-1.6041	-1.9299	-2.7631	-1.7254	-1.4673
	Prob.	***0.6649***	***0.4759***	***0.3171***	***0.0682***	***0.4147***	***0.5451***
		n0	n0	n0	*	n0	n0
With Constant & Trend	t-Statistic	-0.8974	-1.0526	-2.3318	-2.8448	-2.3847	-0.9331
	Prob.	***0.9509***	***0.9300***	***0.4118***	***0.1861***	***0.3846***	***0.9465***
		n0	n0	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	0.1292	-0.0490	-0.8612	-1.0933	-0.7920	1.0312
	Prob.	***0.7206***	***0.6635***	***0.3397***	***0.2466***	***0.3699***	***0.9195***
		n0	n0	n0	n0	n0	n0
	At First Difference						
		d(LRER)	d(LTOT)	d(LMGST_GDP)	d(LIDIF)	d(LEMBI)	d(LGDPPC)
With Constant	t-Statistic	-7.2247	-6.9931	-4.2690	-3.8018	-7.9049	-9.1187
	Prob.	***0.0000***	***0.0000***	***0.0010***	***0.0043***	***0.0000***	***0.0000***
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.2453	-7.1741	-4.2302	-3.7820	-7.9912	-9.2600
	Prob.	***0.0000***	***0.0000***	***0.0066***	***0.0226***	***0.0000***	***0.0000***
		***	***	***	**	***	***
Without Constant & Trend	t-Statistic	-7.2726	-7.0424	-4.2556	-3.8227	-7.8532	-9.0548
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0002***	***0.0000***	***0.0000***
		***	***	***	***	***	***

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant.

b: Lag Length based on SIC.

c: Probability based on MacKinnon (1996) one-sided p-values.

Appendix 4: Johansen (Maximum Eigenvalue) Cointegration Test:

Argentina

Trend assumption: Linear deterministic trend
Series: LREER LTOT LIDIF LGDPPC LGST_GDP LEMBI_2
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.706095	82.04144	40.07757	0.0000
At most 1	0.388017	32.90039	33.87687	0.0650
At most 2	0.293230	23.25237	27.58434	0.1630
At most 3	0.189362	14.06557	21.13162	0.3597
At most 4	0.165099	12.08965	14.26460	0.1073
At most 5	0.024738	1.678321	3.841466	0.1951

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Brazil

Trend assumption: No deterministic trend (restricted constant)
Series: LRER LTOT LIDIF LEMBI LGDPPC LMGST_GDP
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.407713	42.94868	40.95680	0.0295
At most 1	0.328075	32.60393	34.80587	0.0895
At most 2	0.245480	23.09726	28.58808	0.2147
At most 3	0.181302	16.40324	22.29962	0.2706
At most 4	0.134053	11.80243	15.89210	0.1977
At most 5	0.027047	2.248441	9.164546	0.7279

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Chile

Trend assumption: No deterministic trend (restricted constant)
Series: LRER LTOT LIDIF LGST_GDP LGDPPC LEMBI
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.443167	45.66821	40.95680	0.0137
At most 1	0.318342	29.89167	34.80587	0.1719
At most 2	0.258931	23.37363	28.58808	0.2012
At most 3	0.201393	17.54111	22.29962	0.2025
At most 4	0.165642	14.12523	15.89210	0.0928
At most 5 *	0.122260	10.17157	9.164546	0.0321

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Colombia

Trend assumption: Linear deterministic trend
Series: LRER LTOT LMGST_GDP LIDIF LEMBI LGDPPC
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.604469	66.78196	40.07757	0.0000
At most 1	0.289395	24.59796	33.87687	0.4127
At most 2	0.267289	22.39231	27.58434	0.2009
At most 3	0.223684	18.23006	21.13162	0.1215
At most 4	0.098927	7.500177	14.26460	0.4318
At most 5	0.045800	3.375495	3.841466	0.0662

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values