Real Exchange Rates and Economic Growth: Industrialized Countries vs. non-Industrialized Countries

Tipo de cambio real y crecimiento económico: países industrializados vs. países no industrializados

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Abstract:

The main objective of this article is to quantify the elasticity of the economic growth rate respect to changes in real exchange rate (RER) by six economies; three are industrialized, that have strong and autonomous monetary systems (United States, Canada and New Zealand), other three are non-industrialized, so they have monetary dependence of the United States (Brazil, Chile and Mexico). Econometric estimations have made using panel data model using data from 1982 to 2017. Results indicate that despite a positive elasticity, to maintain devalued RER does not stimulate economic growth significantly.

Keywords:

Economic growth, Inflation targets, Panel data, Real exchange rate

Resumen:

El objetivo principal de este documento es cuantificar la elasticidad de la tasa de crecimiento del producto ante los movimientos del tipo de cambio real (TCR) de seis economías; tres industrializadas con sistemas monetarios sólidos y autónomos (Estados Unidos, Canadá y Nueva Zelanda), y tres no industrializadas con una fuerte dependencia monetaria respecto a Estados Unidos (Brasil, Chile y México). Las estimaciones econométricas se realizan mediante metodologías de datos de panel, para el periodo 1982-2017. Los resultados sugieren que, pese a la obtención de elasticidad positiva, mantener un TCR devaluado, no estimula el crecimiento económico en forma significativa.

Palabras Clave:

Tipo de cambio real, Crecimiento económico, Metas de inflación, Datos de panel

Introduction

Since the beginning of the 80s, economic growth in most of the world has been poor, mainly in non-industrialized economies, the economic environment worsened by the *subprime* crisis; Governments and central banks, in their concern for the recovery of the economies, have given a major role to the exchange rate and monetary policy; Since the collapse of Bretton Woods and the change of the fixed exchange rate regime, the adoption of regimes based on flexible exchange rates has taken place. High volatility has been observed, a situation that inevitably affects real variables of economies. Given this scenario, two ideologies have emerged in economic science: the first postulates that a competitive RER is an instrument that can stimulate economic growth and the second one asserts that a competitive RER promotes economic contraction.

This document quantifies economic growth elasticity respect to RER dynamics for six countries: Brazil, Chile, Canada, Mexico, New Zealand and United States, during the period 1982-2016. The six economies have adopted explicitly or implicitly (United States) the framework of inflation targets, using central banks interventions to control currency exchange rates; Due to the necessity to understand the dynamics between economic growth and RER in countries that have different levels of development, three industrialized nations and three non-industrialized countries were selected for this study, thus exploring the presence of some pattern of behavior that differs between those two groups.

About inflation targeting in the monetary policy framework, interest rate in the short-term is the principal instrument of monetary policy, that tradition was postulated by the results of Wicksel (1898) and those results are the fund of the monetary rules of the managing of Interest rate on Taylor Rule (1993); theoretically, under this context, the currency exchange rate fluctuates freely; empirical evidence shows us that in practice the central banks do not adhere to a policy of free floating change, otherwise, they do interventions that reduce the volatility of exchange rates and, in turn, the impact of this on the real economy. [1,2]

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For the achievement of the objective, after this introduction, findings of the empirical literature are collected, a further section examines the statistical data of six economies, on third section is presented an econometric analysis divided in two apparatuses: the first presents the methodological approaching and specification of models that was estimated, and the second part has results estimations; finally conclusions.

Empirical contributions

There is a discussion in economic literature about the role of RER in economic growth, the main objective about that is to find the relationship between the depreciations / appreciations of the RER and the economic growth / decreasing behavior; The debate was started in Latin America, using the idea that the low economic growth is due to the fact that the monetary authorities do not maintain competitive exchange rates, so that discussion has transcended to developed countries, therefore, on this document includes industrialized economies and not industrialized.

The answer to the question posed by the debate are empirical, on this part of the document the findings of both positions are synthesized. The idea that the competitive RER is an instrument to boost economic growth is supported by the works of: Krugman (1987), Goldberg and Klein (1997), Aguirre and Calderón (2005), Frenkel (2005) (2008), Galaindo and Ros (2006), Bresser (2007), Frenkel and Rapetti (2007, 2011), Rodrik (2008), Ros (2010), Loria (2016).

For Krugman (1987) a foreign exchange policy based on a RER depreciated incentive the boom of new productive sectors, which accumulate experience and knowledge, improving their relative productivity in comparison to the rest of the world, which allows the reduction of costs and specialization, favoring the economic and development growth.

Goldberg and Klein (1997), after analyzing a set of countries in Southeast, Latin America, United States and Japan, affirm the existence of a positive relationship between a competitive RER and economic growth, those via increased direct foreign investment; they point out that the depreciations of the RER, in relative terms, decrease the cost of inputs, mainly labor, so if these are compared to external production costs, internal costs will be lower, this leads to an increase domestical demand for labor by foreign investors, increasing their wealth in relation to domestic.

After evaluating the effects of the misalignments in the RER and the volatility of them in relation to economic growth Aguirre and Calderón (2005) using a sample of 60 countries, conclude that the misalignments reduce growth but not in a linear way, ie that the appreciated exchange rates will have negative effects on growth, the contained depreciations are beneficial for the economy and the large real depreciations are harmful.

Aguirre y Calderón (2005) tras evaluar los efectos de los desalineamientos en el TCR y la volatilidad de los mismos en relación al crecimiento económico, para una muestra de 60 países, concluyen que los desalineamientos reducen el crecimiento pero no de forma lineal, so the appreciated exchange rates will have negative effects on growth, the contained depreciations are beneficial for the economy and the strong real depreciations are too harmful. 3

Frenkel (2005) emphasizes the competitive RER role as the axis of macroeconomic policy in Latin America countries, based on the idea that an appreciated RER unleashes distortions, contrary to a depreciated RER that promotes a growth strategy based on in the export and promotion of foreign investment; considers that in a competitive and stable RER macroeconomic regime, the exchange rate component encourages inflation and high growth rates of gross domestic product (GDP) and employment; Inflationary stress is remedied by controlling aggregate demand through economic policy, mainly through fiscal policy, reducing the economical vulnerability to external negative shocks through the accumulation of international reserves Frenkel (2008). 4,5

Rodrik (2008), through using different measures of the RER and different estimation techniques and occupying a sample of 188 countries for the period 1950-2004, shows that an undervalued currency stimulates economic growth, having as a channel the tradable sector, especially the industry; concluding that the above is true mainly in developed countries. Galindo and Ros (2006) analyzing Mexico's experience when it was adopting inflation goals as a monetary policy framework, conclude that in Mexico, during the period between 1981 and 2003 undervaluation of the RER generated a greater dynamism in the monetary policy. Product, so that a strong weight, has a negative effect on the pace of economic growth. 6,7

After analyze the policies that was implemented by Argentina in the 90s and those after the collapse period of the convertibility regime, Frenkel and Rapetti (2007) propose an alternative regime to the inflation targets, where the axis RER is a stable and competitive as a target intermediate macroeconomic policy, which according to the authors promotes employment and economic growth.

Ros (2010), when investigating the macroeconomic determinants of poor investment performance and growth in the Mexican economy since the 1980s, concludes that the RER has played a fundamental role in the evolution of private investment, distinguishing between effects of real depreciation in situations of high and low inflation; in conditions of high inflation, depreciation has a negative effect on private investment, in a scenario of low inflation, real depreciation stimulates investment through its positive effects on the profitability of the sectors producing tradable goods, boosting economic growth. 8,9

In excessive capital mobility context, for example Latin America, Frenkel and Rapetti (2011) state that the excessive appreciation of exchange rates represents a danger to the profitability of manufacturing sectors, which brings a contraction of employment and the weakening of region development, for that reason they propose the coordination of the exchange, monetary, fiscal and wage policies, where the exchange policy is based on a managed float regime and adopts as objective a stable trend of the RER at a competitive level. 10

Using a panel data technique, and two country samples for the period 1978-2007, Missio, Jayme, Britto and Oreiro

(2015), estimate the effect of the RER on the economic growth rate, investigate the existence of a relationship non-linear among the variables, as well as the possibility of different patterns across groups of countries; indicate that maintaining a competitive level for the RER has positive effects in developing countries with medium incomes, such as Latin America, under a non-linear effect, that is to say, moderate levels of undervaluation of the exchange rate could generate positive effects and growth increases at first, to then act in the opposite direction. 11

For Loria (2016), between 1950-2014 in Mexico the continuous real exchange rate appreciations have reduced the capacity of economic growth, so that an appreciated RER is a drag on the economy that affects the macroeconomic equilibrium; In the same way for Guzman, Ocampo and Stiglitz (2016) a competitive RER is a necessary condition to increase the diversification of the tradable sector, but it requires complementary actions, such as increased taxation for certain sectors that allow financing traditional industrial policies that increase the elasticity of the aggregate offer with respect to the RER; The ideal is to have a portfolio of economic policy instruments, since in the face of the instability of the financial markets, governmental interventions become necessary. 12,13

The investigations perpetrated so far, far from closing the debate, have expanded it with different results; Among the authors whose works contribute to the empirical demonstration of the assertion that a competitive RER causes economic stagnation, stand out: Krugman and Taylor (1978) that based on a Keynesian and a monetarist model, illustrate the contractionary effects of the devaluation of the currency, highlighting that such effects are caused by redistributive mechanisms of income between agents with an unequal marginal propensity to save. 14

More recently, López and Perrotini (2006) in their reflection on the growth strategy for the Latin American economies, they conclude against conventional economy, that improving competitiveness by means of a devaluation of the national currency is not always efficient and it is not the best alternative, since it generates inflationary pressures, a drop in domestic demand that can be greater than possible increase in net external demand, in the case of Latin America. 15

Regarding the impact of the volatility of the exchange rate on economic growth, Guérin and Lahreche-Révil (2002) consider that it cannot be generalized for all economies, this depends on the level of openness of a country and its commercial integration degree, that is to say, it depends on the percentage of the cost of the produced goods that is denominated in foreign currency, therefore the structural characteristics of the industrial organization determine the degree of impact of the exchange rate shocks; In a country with greater industrial specialization, the impact will be less. 16

On the other hand, Berman and Berthou (2009) analyzed the reaction of the exports before the depreciation of the currency, considering the role of the imperfections of the financial markets; To do this, they used a sample of 27 developed and developing countries during the 1990-2005 period, they find that the impact of a depreciation on exports will be less positive or even negative depending on the debt of companies in foreign currency and their external capital requirements; therefore, in presence of financial imperfections, there is a non-linear relationship between the depreciation of the RER and the reaction of exports. 17

For Argentina and Brazil, Vernengo (2010) analyzes and compares the macroeconomic policy of the period after the 2001 crisis, concludes that a competitive and stable RER is just an instrument and cannot be expected to cause growth, price stability and better income distribution; and although in the case of Argentina, a competitive RER and a flexible monetary policy were necessary instruments to maintain the growth trajectory of the economy, the fiscal policy was a central element on this. 18

Bastourre, Casanova and Espora (2011) after a vast literary review, affirm the existence of a close link between RER and economic growth in emerging economies, especially Asian and to a lesser extent Latin American, detecting in all cases certain conditions for the relationship to operate in the expected direction, such as: sustaining the RER at competitive levels, avoiding the persistent exchange rate appreciation and limiting the volatility of the RER. 19

In a study focused on developing economies, Mantey (2013) affirms that the establishment of a competitive and stable RER, through the way of nominal exchange rate, with the purpose of promoting growth based on exports, it is inadvisable because of the following: the high dollarization of liabilities that characterize these economies, the effect that the devaluation produces in the balance sheets and its consequent penalty in international credit ratings, the declining influence of the RER and the relative unit labor costs in the competitiveness due to the technological advance and the disadvantages of origin of the exporting companies in front of the transnational companies. 20

Fiorito (2015), through the methodology of time series and taking as sample the following countries: Brazil, South Korea, India, Mexico, Taiwan, Tanzania, Uganda, Argentina, Germany and Venezuela; verifies that changes in exchange rates have limited effects on the increase of the quantities produced and marketed; conversely, movements in the exchange rate have an impact on the distribution of income when forming domestic prices; since a devaluation of the RER the fall of purchasing capacity of people who have their income in domestic currency. 21

In a study on the adoption of inflation targeting in Latin America, Pérez (2014) highlights that in addition to a significant and positive correlation between exchange rate appreciation and commodity prices, there is also a positive correlation between the performance of the stock market values and price indices of raw materials; generating evidence that confirms the importance of the RER as an instrument of macroeconomic policy and vehicle for the transmission of shocks, which in practice generates fear of floating in the makers of monetary policy. 22

The empirical literature review that relates the RER to economic growth, allows to assert that a competitive RER is not always favorable to the economy, it depends

fundamentally on the structural characteristics of the economy and the economic policy guidelines established.

Evolution of the RER and economic growth

This section describes the behavior of the RER and economic growth of each country, characterized by abrupt changes and long periods of stability in some cases, elements that offer a context of favorable analysis for the determination of the effects of the RER on economic growth. The currency exchange history of the countries under study reveals numerous experiments with exchange rate policies, most of them aimed at controlling inflation; the primacy of inflation control in macroeconomic policy is confirmed after adopting the inflation targeting model, downplaying economic growth, employment and other real variables; however, monetary and exchange policies have real effects, one of them affecting fluctuations in economic activity.
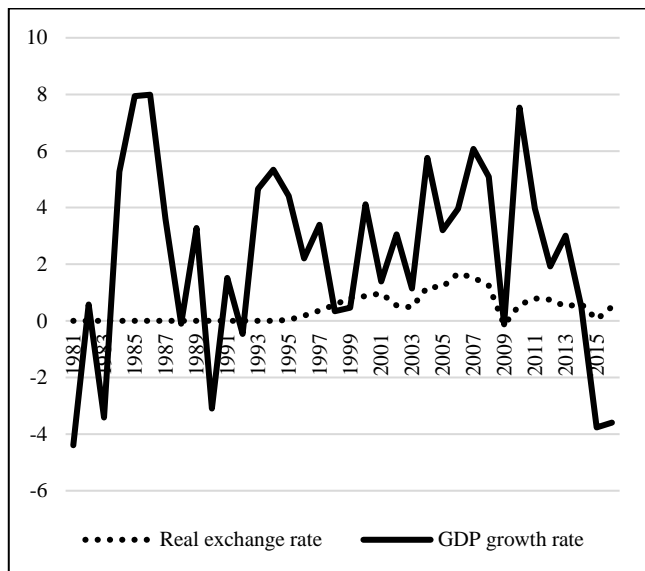
Graph 1. Real exchange rate (RER) and GDP growth in brazil.
Source: Own preparation with data from the World Bank, (2018).

Starting in the non-industrialized countries, in Brazil the RER (respect to dollar) is stable until 1995, while economic growth shows sharp drops due to the debt crisis of the 1980s, which, like Mexico, was a lost decade; In response, Brazil reoriented its macroeconomic policy, in 1986 the heterodox stabilization program was launched, substantially devalued its currency and introduced a new one and maintained a fixed exchange rate regime until January 1999, which it abandoned after adopting a free floating regime. The RER shows a growing trend, which in 2009 and 2015 is interrupted by the outbreak of the subprime financial crisis, which does not originate in the RER the characteristic appreciation of most countries around the world; In general terms, the RER and the economic growth in Brazil shows no really apparent relationship on that sample (see graph 1).
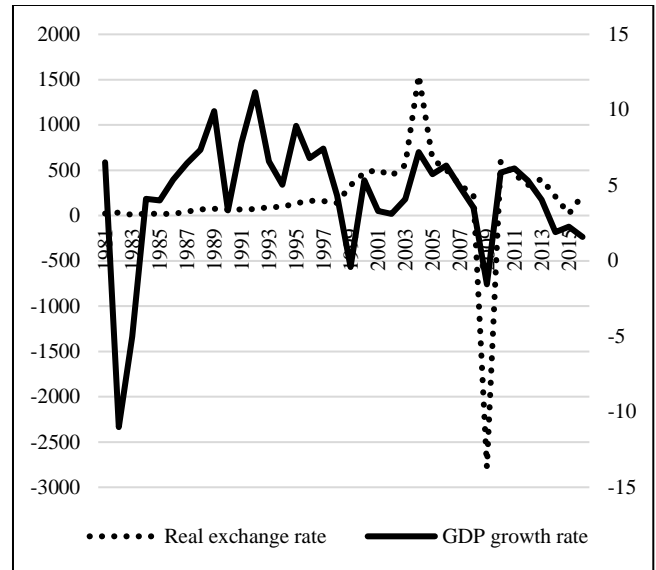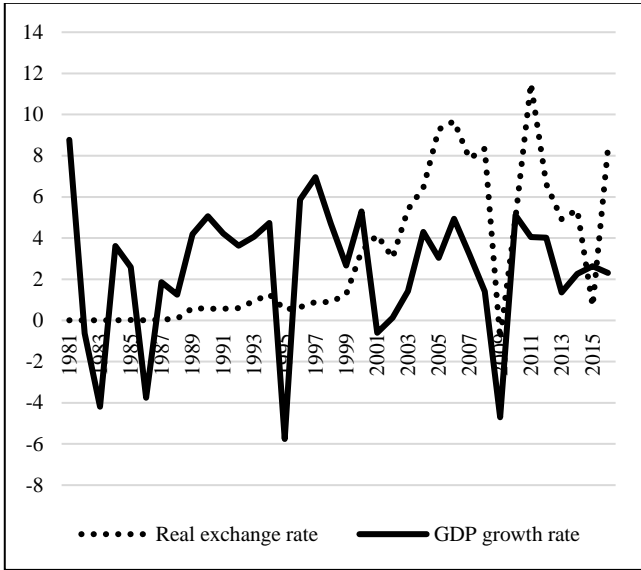

Graph 2. Real exchange rate and GDP growht in chile
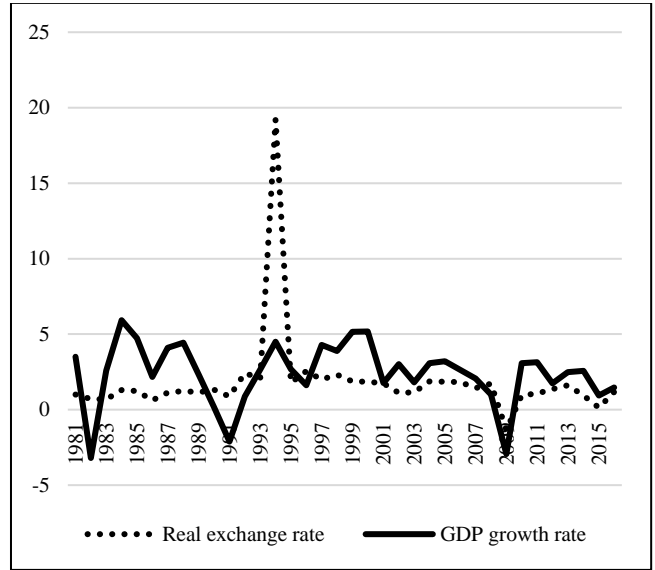*Source: Own preparation with data from the World Bank, (2018).*

Chile´s policy Exchange changed in the second half of the 70's after suffering severe economic and political crises, and a persistently highly inflation, was oriented towards the stabilization of prices; subsequently, the balance of payments crisis at the beginning of the 1980s, implied the use of exchange rate regimes conducive to preserving a stable RER and avoiding sharp devaluations and extremely high inflation. a system of mobile bands was implemented in 1984, abandoned in 1999 with the adoption of the inflation targeting model and a flexible exchange rate; fact that coincides with the loss of stability in the RER (see graph 2), likewise, it is from this moment that the dynamics of the RER and economic growth has synchronized.

In Mexico, the fixed parity of 12.50 mexican pesos per dollar was maintained until September 1976, when a serious balance of payments crisis forced a devaluation for the first time in more than twenty years; in the crisis of the 80's, the increase in inflation and the fall in the price of oil, caused a devaluation in February 1982, which involved, by August of the same year, the adoption of a dual exchange rate system: a preferential one and another general; from December 1982 to August 1985, a regime of exchange control was established. Between August 1985 and November 1991, it was operated with a regulated flotation system, replaced in 1991 by a flotation band, which after the 1994 crisis changed for a flexible exchange rate.

The stability of the RER was lost when Mexico establishes a floating system of the exchange rate; After adopting the inflation targeting model, the RER and the economic growth show a harmonized behavior, both fall drastically due to the subprime financial crisis, economic stagnation was accompanied by a significant appreciation of the RER (see graph 3).
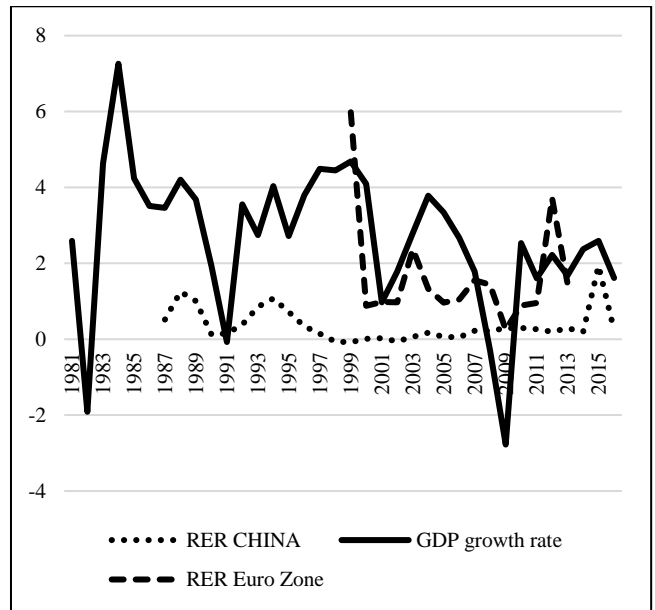
Graph 3. Real exchange rate and GDP growth in Mexico

Source: own preparation with data from the World Bank, (2018).

Canada, in 1950, broke with the Bretton Woods system, under the idea that a fixed exchange rate involved focusing monetary policy on the stability of the exchange rate, neglecting the stabilization of domestic prices; since then, Canada maintains a regime of free floating of the exchange rate. During the study period the RER remains stable, except for the year 1994, when it increases drastically, due to the fact that inflation was extremely low (0.18%); On the other hand, economic growth does not seem to be related to the behavior of the RER, at least not before the adoption of the inflation targeting model (see graph 4), the outbreak of the subprime financial crisis has a strong impact on both variables, the fall in economic growth is accompanied by a remarkable real appreciation. In the monetary order, after the Bretton Woods agreements, the currency of the United States became the center of the system, however, with the adoption of the euro as the official currency of the Eurozone states, this currency currently competes with the dollar for world monetary hegemony; graph 5 compares the behavior of GDP growth with the US RER respect to China (period 1987-2016) and in relation to the euro area (period 1999-2013); China is chosen as the main origin of imports and the third destination of exports, the US RER to China is stable throughout the study period, except for a significant increase in 2015, explained by the collapse of prices of oil and the recession of the US economy; jointly and apparently, there is no relationship of the RER with the economic growth.

Graph 4. Real exchange rate and GDP growth in Canada

Source: Own preparation with data from the World bank, (2018).

Graph 5. Real exchange rate and GDP growth in the United States

Source: Own elaboration with data from the World Bank (2018), and FRED (2018).

The US RER to the euro, denotes greater instability and a closer relationship and equated with the economic growth, therefore the dollar is more vulnerable against the euro than against the yuan; in the crises of 2001 and 2008, there was a real appreciation of the dollar, decreasing its purchasing power against the euro, (see graph 5).

New Zealand, in the post-Bretton Woods stage, has experienced some exchange rate regimes; between 1973 and 1984 the authorities set an exchange rate, maintaining

some control over capital flows; later in the 1985-1991 period, a flotation band system was adopted, abandoned in 1992 with the setting of inflation targets and a flexible exchange rate. Throughout the study period, the RER has fluctuated considerably, coinciding with the growth performance of the product (see graph 6).
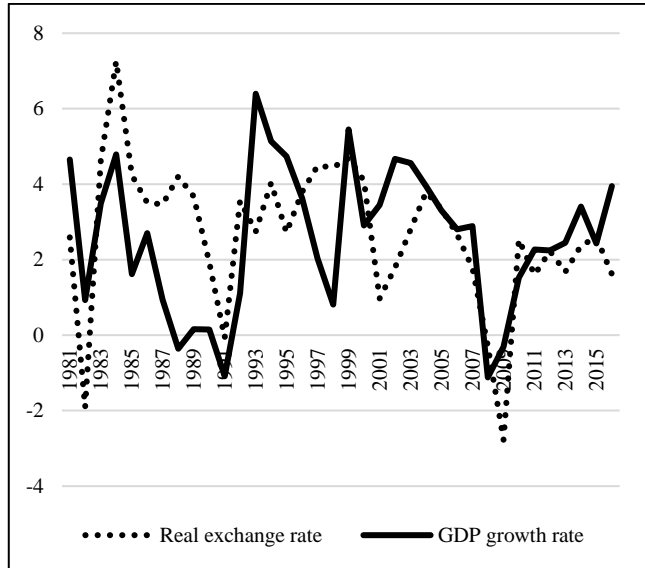

Graph 6. Real exchange rate and GDP growth in New Zealand
Source: Own elaboration with data from the World Bank (2018) and FRED (2018).

In the study period of New Zealand presents three historical real assessments, all contextualized by economic stagnation, the first in 1982, the second in 1991 a year prior to the adoption of the inflation targeting regime, and the most recent and pronounced in 2009, the three cases accompany economic stagnation.

Specification of the methodology and econometric models

The previous section offers a first approach to the data, evidencing the absence of a clearly defined behavior pattern among the study countries; In the analysis period, Brazil does not show a parallel behavior between the RER and the growth of the product; On the other hand, in Chile, Mexico and Canada the synchronicity in both variables arises from the adoption of the inflation target model; in New Zealand the RER and growth are linked throughout the study cycle, while in the United States there seems to be no relationship between the RER and the dynamics of the economy.

Considering the particularities of the statistical information, for its econometric scrutiny, the panel data methodology is used, which combines data of temporal and structural dimension, with the purpose of capturing the unobservable heterogeneity between economic agents and time, when determining the specific individual effects that unequally disrupt each of the study agents and the temporal effects that affect them equally, but do not vary over time, Mayorga and Muñoz (2000).

For the analysis, annual series of the following variables are used: the rate of growth of the RER as an independent variable and as a dependent variable the rate of economic growth GDP; the data sources are BM and FRED; The regression models of panel data, raise different hypotheses about the behavior of the residues, depending on how their behavior is assumed (fixed parameter or random variable), a Fixed Effects (FE) or a Random Effects (RE) model will be obtained; The Hausman test provides elements to discern the best estimation.

The FE model involves less assumptions about the behavior of the waste, considers the existence of a different constant term for each individual, and assumes that the explanatory variables affect the cross-section units equally, differentiating themselves from each other by the intercept they measure own characteristics of each of them; the RE model considers that the individual effects are not independent of each other and are distributed randomly around a given value for each country.

The existence of unit root for panel data is detected using the Levin-Lin-Chu test, under the basic assumption that the series are independent of each other and are distributed in a normal distribution, assumes the existence of homogeneous autoregressive coefficients; discarded the existence of unit roots, to determine if in the countries of study, the behavior of the real exchange rate has influenced economic growth during the period 1981-2016, in this section eight models are proposed and estimated under the panel data methodology, each with its own assumptions regarding the intersection, the coefficients of the slopes and the error term:

1.- Specification by grouped data (Pooled), it is estimated under the assumption of the absence of differences between groups or cross-section units, so there will be only one intercept and the error is considered as a specific error of the group:

$$GDP_{it} = \beta_1 + \beta_2 RER_{it} + \varepsilon_{it} \quad (1)$$

Where:
RER   Real Exchange Rate
GDP   GDP growth rate

2.- Specification using coefficients of constant slopes and variable intersection respect to individuals; this model is a regression model of Ordinary Least Squares (OLS) using dichotomous variables, it includes 1 dichotomous variable that isolates developing countries with derisory monetary autonomy (Brazil, Chile and Mexico), from developed countries that has greater than the others degree of monetary sovereignty (Canada, the United States and New Zealand):

$$GDP_{it} = \beta_1 RER + \beta_2 DD_{it} + \varepsilon_{it} \quad (2)$$

Where:
DD   1   Developing country
           0   Developed country

3.- Specification using constant slopes coefficients and variable intersection respect to individuals; a dichotomous variable is included that divides the period of study into

two samples, considering the explicit adoption of the inflation targeting model:

$$GDP_{it} = \beta_1 RER + \beta_2 DIT_{it} + \varepsilon_{it} \quad (3)$$

Where:
DITI   1   Inflation targeting
       0   Non Inflation targeting

4.- Specification using constant slopes and variable intersection respect to individuals, by means of an OLS regression model with dichotomous variables that consider the individual character of the cross-sectional units; a dichotomous variable is used for each country of study:

$$GDP_{it} = \beta_1 RER_{it} + \beta_2 DC1_{it}$$
$$+ \beta_3 DC2_{it} + \beta_4 DC3_{it} + \beta_5 DC4_{it} \quad (4)$$
$$+ \beta_6 DC5_{it} + \beta_7 DC6_{it} + \varepsilon$$

Where:
DC1	1	Country = Brazil
	0	Country ≠ Brazil
DC2	1	Country = Chile
	0	Country ≠ Chile
DC3	1	Country = Mexico
	0	Country ≠ Mexico
DC4	1	Country = Canada
	0	Country ≠ Canada
DC5	1	Country = U.S
	0	Country ≠ U.S
DC6	1	Country = New Zealand
	0	Country ≠ New Zealand

5.- Specification using coefficients of constant slopes and variable intersection with time, 36 dichotomous variables are added to symbolize each year of study:

$$GDP_{it} = \beta_1 RER_{it} + \beta_2 D1981_{it}$$
$$+ \beta_3 D1982_{it} + \beta_4 D1983_{it} + \beta_5 D1984_{it} \quad (5)$$
$$+ ... + \beta_{37} D2016_{it} + \varepsilon$$

Where:
D1981	1	Year = 1981
	0	Year ≠ 1981
D1982	1	Year = 1982
	0	Year ≠ 1982
…		
D2016	1	Year = 2016
		Year ≠ 2016

6.- Specification using intersection and coefficients of the constant slopes respect to time and space, the term error enunciates the discrepancies in time and in each country, without specifying the specific nature of the cross-sectional units; The estimation has made using the Ordinary Least Squares (OLS) methodology:

$$GDP_{it} = \alpha_1 + \beta_1 RER_{it} + \varepsilon_{it} \quad (6)$$

7.-Specification by the FE method, which groups the total of the observations, but each country expresses each variable as a deviation from its average value.

$$GDP_{it} = \alpha_1 + \beta_1 RER_{it} + u_{it} \quad (7)$$

8.- Specification by the RE method that has consideration of the individual character of the units of transversal cut and coefficients of the constant slopes.

$$GDP_{it} = \alpha_1 + \beta_1 RER_{it} + u_i + e_{it} \quad (8)$$

Of the eight specifications proposed, three examine the existence of effects for the following groups: developed countries vs developing countries, time with inflation goals vs time without inflation targets, for each country; and one more, inspect the effects of time. To choose the estimate that best describes the behavior of the variables and to confirm the existence of group effects, the restricted F test is applied, where the unrestricted equation in all cases is the Pooled estimate and the restricted equations are those that analyze the different Group effects:

$$F = \frac{(R^2_{UR} - R^2_R)/m}{(1 - R^2_{UR})/(n-k)} \quad (9)$$

Where:
Ho: Restricted model R is more apropiated.
UR   Non-restricted regression.
R   Restricted regression.
m   Number of linear restrictions.
n   Number of observations in the unrestricted equation.
k   Number of observations in the restricted equation.

Subsequently, under the panel data methodology, three models were estimated: OLS, FE and RE; the F test confronts OLS with FE, while the Breusch and Pagan Lagrangian multiplier test compares OLS against RE; Finally, the Hausman test compares FE and RE; the model that is optimal should pass the autocorrelation tests; otherwise, a dynamic panel data model (DPM) is estimated, a methodology where the first assumption that is relaxed is the strict exogeneity of the model, therefore the lags in the time of the dependent variable are included as explanatory variables of the model.

Consecutively, the Sargan test detects the existence of some excess in the identification of the restrictions in an econometric model of DPM, that is to say validates the instrumental variables, the null hypothesis of the test states that the instrumental variables are not correlated with the set of waste and consequently its inclusion in the model will be adequate.

Results of the econometric estimation

Prior to the estimation of the econometric models specified in the previous section, the Levin-Lin-Chu test was carried out to rule out the existence of unit roots in the residuals (see table 1).

Levin-Lin-Chu unit-root test		
	Statistic	p-value
TCR		
Unadjusted t	-7.1286	0.0000
Adjusted t*	-6.9549	0.0000
PIB (-1)		
Unadjusted t	-10.2489	0.0000
Adjusted t*	-5.0754	0.0000

Table 1. Unit roots in panel data.
Source: Own elaboration using stata.

Restricted equation (R) Estimation 1 (Ordinary Least Squares)			
Variable	**Coefficient**	**Standard error**	**Probability**
C	5.536505	0.8949828	0.0000
RER	0.0059103	0.0019253	0.0022
R^2	0.0433		
Adjusted R^2	0.0387		
Observations	210		

Table 2. Pooled estimation
Source: Own elaboration using stata.

Unrestricted equation (UR) Estimation 2 (OLS- group effects)			
Variable	**Coefficient**	**Standard error**	**Prob**
TCR	0.00254	0.000939	0.0072
DD	2.90850	0.326722	0.0000
R^2	-0.3033		
Adjusted R^2	-0.3095		
Obs.	210		

Unrestricted equation (UR) Estimation 3 (OLS with group effects)			
Variable	**Coefficient**	**Standard error**	**Prob**
TCR	0.00296	0.000979	0.0028
DMI	2.52456	0.345777	0.0000
R^2	-0.43264		
Adjusted R^2	-0.43957		
Obs.	210		

TABLE 3. Ols estimates using group effects
Source: Own elaboration using stata.

Nine estimations were formalized, each time it explores the elements of the relationship between the RER and the economic growth for Brazil, Chile, Mexico, Canada, the United States and New Zealand; On Table 2 shows results pooled estimation considering an ordinate at the origin and the common slope for all the countries (specification 1), table 3 contains the results of the specifications 2 and 3, both representative ordinary least squares regression models using dichotomous variables, differentiated by the meaning of the dichotomous variable, in the first case, the dummy variable, refers to the countries, which are not available, and in the second, indicates the use and the absence of the inflation targeting model.

Results of table 4 correspond to the estimation of the fourth specification, it is an OLS model with group effects where the intersection varies with respect to each of the six study countries.

Unrestricted equation (UR) Estimation 4 (OLS group effects by country)			
Variable	**Coefficient**	**Standard error**	**Prob**
C	5.631075	0. 9040132	0.0000
DC1	0.00721	0.0021495	0.0000
DC2	0.0033613	0.0071522	0.039
DC3	0.002984	0.0085732	0.728
DC4	-0.0049833	0.0107743	0.040
DC5	-0.0013072	0.0118151	0.912
DC6	-0.0043971	0.0127946	0.731
R^2	0.0557		
Adjusted R^2	0.0278		
Obs.	210		

Table 4. Estimation by group effects by country
Source: Own elaboration using stata.

The fifth estimate is an OLS model using time effects (see table 5), where the same one is ordered at the origin, with slopes from each year of study. To establish the relevance of the 5 estimations made so far, the restricted F test is used, the Pooled estimate is compared with the four estimates by OLS with group and time effects, the results indicate that the only estimate that improves the first is that it considers the use of dummy variables that capture the events common to all countries during one period or another, (see table 6).

So far the estimated elasticities of economic growth with respect to the RER are extremely low, close to zero; the existence (at least through the econometric methodology of panel data) of a differentiated behavior pattern between industrialized and non-industrialized countries is ruled out, and the vicissitudes of the adoption of the inflation targeting model have been a determining factor in the relationship between the RER and economic growth.

There is not enough support to affirm that a devalued RER is an instrument to stimulate economic growth, because although the elasticity is positive and the episodes of economic stagnation coincide with the appreciation of the

RER, the graphic evidence is not sufficient to attribute causality, the most important falls in the economic growth rate, coincide with periods of crisis.

Var	Coefficient	Standard error	Prob
C	5.120873	0.9930193	0.0000
D1981	3.806863	1.144001	0.0011
D1982	-0.024811	0.1552607	0.873
D1983	0. 021437	0.1424994	0.179
D1984	-0.005581	0.0381225	0.884
D1985	-0.005699	0.0804434	0.044
D1986	0.0981097	0.122448	0.424
D1987	0.0402899	0.034061	0.238
D1988	0.0748202	0.0449025	0.097
D1989	0.0336644	0.0157198	0.034
D1990	0.0026753	0.0103408	0.796
D1991	0.0081292	0.0040666	0.047
D1992	-0.092182	0.0349903	0.009
D1993	0.0074039	0.0146811	0.615
D1994	0.0102384	0.0080381	0.204
D1995	0.0079263	0.00274	0.004
D1996	0.0110627	0.0320132	0.730
D1997	-0.011961	0.093913	0.899
D1998	-0.002123	0.0791134	0.979
D1999	0.0106372	0.0224961	0.637
D2000	0.066272	0.0564285	0.242
D2001	-0.012186	0.0522741	0.816
D2002	0.0045813	0.0419131	0.913
D2003	0.0525602	0.0447588	0.242
D2004	0.0752925	0.040989	0.068
D2005	-0.097029	0.1283779	0.451
D2006	0.1953774	0.2688715	0.468
D2007	-0.007241	0.0433865	0.868
D2008	-0.053408	0.275267	0.846
D2009	0.0111177	0.0094147	0.239
D2010	-0.036230	0.0131293	0.006
D2011	0.0567682	0.0896763	0.528
D2012	0.0005264	0.0545564	0.992
D2013	-0.028970	0.1468634	0.844
D2014	0.0899344	0.1338285	0.502
D2015	0.0090684	0.0140442	0.519
D2016	-0.006553	0.0059097	0.269
R²	0.3661		
Adjust R²	0.1725		

Table 5. Estimation using time effects
Source: Own elaboration using stata.

Estimation	R^2_{UR}	R^2_R	m	n	k
1 y 2	-0.30330	0.04330	1	210	2
1 y 3	-0.43268	0.04330	1	210	2
1 y 4	0.05570	0.04330	6	210	7
1 y 5	0.36618	0.04330	36	210	37

Estimation	F calculated	F tables	Observation
1 y 2	-55.31581	3.89	Ho is accepted
1 y 3	-69.10433	3.89	Ho is accepted
1 y 4	0.4442797	2.14	Ho is rejected
1 y 5	2.4479844	1.52	Ho is rejected

Table 6. Restricted f test
Source: own elaboration using stata.

Ordinary least squares Estimation 6			
Variable	Coefficient	Standard error	Prob
C	5.709683	0.4201856	0.000
RER	0.0040001	0.0025766	0.196
Fixed effect Estimation 7			
Variable	Coefficient	Standard error	Prob
C	5.519712	0.9060156	0.000
RER	0.0060956	.0020376	0.003
F test that all u_i=0: F(5, 203) = 0.14 Prob > F = 0.0020			
Random effects Estimation 8			
Variable	Coefficient	Standard error	Prob
C	5.536505	0.8949828	0.000
RER	0.0059103	0.0019253	0.002
Modified Bhargava et al. Durbin-Watson	= 1.2588838		

Table 7. Estimates by random effects
Source: Own elaboration using stata.

Table 7 groups the results of the panel data estimates by the three methods: OLS, FE and RE; results that are validated through the corresponding tests. The F test for FE (see table 7), and the Breusch and Pagan test (see table 8), for RE, point out that the estimates by FE and RE improve the OLS estimation; to choose between FE and RE, the Hausman Test is applied (see table 9) that indicates as best estimation, the one made through the RE methodology. The Durbin-Watson statistic of the RE estimation confirms the existence of positive autocorrelation, which justifies the estimation of a model using the DPD methodology (see table 10), validated by the acceptance of the null hypothesis of the Sargan test (see table 11).

Test: Var(u) = 0
chibar2(01) =   0.000
Prob > chibar2 =   1.0000
Ho is rejected

Table 8. Test Breusch and pagan Lagrangian multiplier
Source: Own elaboration using stata.

Test: Ho: difference in coefficients not systematic
chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
=   0.08
Prob>chi2 =   0.7813

Table 9. Test de Hausman
Source: Own elaboration using stata

Dynamic Panel Data Estimate 9			
Variable	**Coefficient**	**Standard error**	**Prob**
GDP(-1)	0.2833579	0.0627501	0.000
RER	0.0055404	0.0018416	0.003
C	4.180074	0.9137308	0.005

Table 10. Dynamic panel data estimation
Source: Own elaboration using stata.

H0: Overidentifying restrictions are valid	
chi2(182)	192.4221
Prob > chi2	0.2840

Tabla 11. Test de Sargan
Source: Own elaboration using stata.

All estimates show a positive elasticity of economic growth vis-à-vis the fluctuations of the RER, however it is minimal, very close to zero; of the nine specified regressions, the optimum is that estimated by DPD, where the elasticity parameter between the variation of the RER and the GDP is 0.0055404; it is an insignificant effect; In the analyzed relation, it is accurate the inclusion of dummy variables for each year of study, which capture the common events that affect the six countries during each year of the study period.

The graphical analysis showed an apparent and close relationship between the behavior of the RER and the growth rate of the product, in periods subsequent to the explicit adoption of the inflation targeting model; However, the estimations show that what is relevant is not the specific characteristics of each country, nor the regime on which monetary policy is based, neither is it if the country is developed or underdeveloped, what is relevant for this relationship are international events (the subprime financial crisis, a war, etc.) that affect all nations, framed in temporary effects.

The instability of real exchange rates denotes the absence of a purchasing power parity PPP of the United States with Brazil, Chile, Mexico and New Zealand; In Canada, the situation is different, the Canadian RER to the dollar is very stable during the study period; however, based on the estimates, it is deduced that for the real exchange rate to generate a positive effect on economic growth, a real depreciation is needed, which increases the real competitiveness of the national currency vis-à-vis the exterior.

The variation in the real exchange rate depends on the amount of the deviation in the nominal price and relative prices; a real depreciation of the currency will always have the effect of increasing the competitiveness of the national currency, added to the loss of its purchasing power; scenario that arises from the following contexts:

When there is an increase in the nominal exchange rate accompanied by an increase in relative prices.

When generating an increase in the nominal exchange rate, together with a decrease in relative prices; provided that the nominal depreciation of the exchange rate exceeds the fall in relative prices.

In the face of a decline in the nominal exchange rate, associated with a rise in relative prices; exclusively in the event that the nominal appreciation is less than the change in the level of relative prices.

As econometric valuations reveal, the contribution to product growth from a real depreciation of the currency is derisory, and may have more negative than positive effects, among them: inflationary pressures, contraction of real wages, scarce employment growth, movements in interest rates, and changes in capital flows, among others. It is dangerous for a country's competitiveness to be sustained by a depreciated real exchange rate, competitiveness is also a question of public policies, quality strategies, investment and development, industrial structures, etc.

Conclusions

This document quantifies the elasticity of economic growth vis-à-vis the fluctuations of the RER, explores the presence of some pattern of behavior that differentiates the industrialized from the non-industrialized countries; with the intention of providing empirical evidence to the postulate that asserts that a competitive RER is not an effective instrument to stimulate the economic growth of a country. Six countries were analyzed, half of them developed and the rest underdeveloped, a characteristic that is not significant under the econometric methodology of panel data. Neither are the adoption of inflation targets and the distinctive features of each country, however temporary contingencies, such as like the crises, if they are relevant to the relationship between economic growth and the RER.

In the graphical analysis it seems that an overvalued RER is a cause of economic stagnation, however such dynamics are observed in times of crisis, generally crises that go beyond national borders, consequently the fall in economic growth is not due to the appreciation of the

RER, if not to deeper causes, which coincides with the significance of temporal effects in the corresponding estimate.

Nine econometric models were estimated using the panel data methodology, each one traces different aspects of the analyzed relation, the results provide positive elasticities, but very close to zero, dogmatizing that a competitive RER is an instrument capable of stimulating economic growth, it is a delicate affirmation, it is possible that under certain circumstances it is a favorable strategy, but it must be accompanied as suggested by Vernengo (2010) and Guérin and Lahreche-Révil (2011) of adequate monetary and fiscal policies. 10,16

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