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Endogenous growth, capital accumulation and Thirlwall's dynamics: the case of Latin America

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The article draws together the analyses of the interaction between economic capacity (ec), the endogeneity of the natural growth rate (g_n) and the growth rate consistent with balance-of-payments equilibrium (g_{tb}) that constrains economic activity. We identify two possible scenarios: the self-correcting scenario where g_{tb} is more elastic than the normal natural rate of growth (g_{nn}) vis-à-vis ec, and the self-aggravating scenario where g_{nn} is more elastic than g_{tb} with respect to ec. We empirically assess our central tenet (ec is a determinant of the relations between g_{tb}, g_w and g_{nn}) for the cases of Argentina, Brazil, Chile and Mexico, and found that, in all countries, the relationships between ec and g_{nn} and between ec and g_{tb} are positive, except in the case of Argentina where the relation between g_{tb} and ec was negative in the sub-period 1975–1990.

Keywords: *growth, capital accumulation, balance of payments, Latin America*

JEL codes: *E22, N16, 041*

> *'There is nothing natural about the natural rate of growth … the natural rate of growth is endogenous, not exogenous, and responds to the actual rate of growth.'*
>
> Kevin S. Nell and A.P. Thirlwall (2017, p. 215)

1 INTRODUCTION

Harrod (1936; 1939; 1948) carried Keynes's (1936 [1964]) static short-run analysis of the principle of effective demand over the long period by considering the effect of investment on income (the multiplier) and productive capacity (the acceleration principle). He established the foundations of dynamic analysis while introducing three fundamental concepts: the actual growth rate (g) given by the ratio of the savings rate (s) to the actual capital accumulation (c) or incremental capital–output ratio ($\Delta K/\Delta Y$); the warranted growth rate (g_w) defined as the growth rate that leaves 'all parties satisfied' as induced investment equals planned investment when firms 'have produced neither more nor less than the right amount' (Harrod 1939, p. 16); and the natural growth rate,

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which represents a full-employment equilibrium growth path determined by the full-employment of the labour force plus the growth rate of technological progress.

Harrod recognized that the existence of a full-employment equilibrium growth path is a mere coincidence, since there is no built-in mechanism whereby g and g_w would necessarily tend to converge, nor is there any automatic tendency for g_w to coincide with g_n.

Harrod's instability principle can be summarized as follows: suppose investment increases faster (slower) than g_w; the income effect of investment will be greater (less) than the effect on the economic capacity. This will in all probability quicken (slow down) the growth rate of investment, which will widen the rising (descending) deviation of g vis-à-vis g_w and expand the disequilibrium. If g rises above (falls below) g_w, g will tend to increase (decrease) without limits and will aggravate the initial inflationary (depressive) disequilibrium. Furthermore, if the natural growth rate exceeds (falls short of) the warranted rate there will be a tendency for g to exceed (fall short of) g_w, and thus for the economy to experience chronic inflation (depression). Therefore, according to Harrod's instability principle, it appears that once g deviates from g_w, an ever-worsening stagnation or an ever-rising inflation will prevail, unless an anti-cyclical economic policy prevents the system from collapsing or exploding.

Harrod (1939) solved the first instability problem through endogenous changes of both the propensity to save and g_w coupled with the upper limit set on g by g_n. He solved the second instability problem through a reduction of the growth rate of population (when $g_n > g_w$) or through a decreasing savings propensity (when $g_n < g_w$).

Seminal as his contribution was, Harrod (1939) did not analyse the influence of the balance of payments in his extension of Keynes's (1936 [1964]) short period analysis of effective demand problems. In his seminal article 'The balance of payments constraint as an explanation of the international growth rate differences', Thirlwall (1979) bridged the gap by extending Harrod's dynamic analysis for an open-economy setting. In Thirlwall's model the growth rate consistent with balance-of-payments equilibrium (g_{tb}) depends on the growth rate of exports (x) and the income elasticity of the demand for imports (Ψ). Elaborating on his g_{tb} model, Thirlwall (2001) reconsidered Harrod's instability principle to show six scenarios with different disequilibrium positions which are summarized in two self-aggravating scenarios and one self-correcting scenario.

Following Thirlwall (1979), Vázquez-Muñoz (2018) has put forth a model where, given the gross capital elasticity of the demand for imports (Ψ_I) and Ψ, g_{tb} is a function of both x and the growth rate of economic capacity (ec). Similarly, Perrotini and Vázquez-Muñoz (2017) ponder depressive, normal and expansive growth regimes to argue that g_n is endogenous to both effective demand (*à la* León-Ledesma and Thirlwall 1998; 2000) and the growth rate of economic capacity (*à la* Lewis 1954). Perrotini and Vázquez-Muñoz (2017) also maintain that in the normal growth regime case g_n is equal to g_w.

The purpose of this paper is to reappraise Harrod's instability problems from a Thirlwallian perspective, so to speak, where all the involved growth rates, g_{nn}, g_w and g_{tb}, are functions of ec. We found two scenarios. In the first scenario, the disequilibrium between g_{tb} and g_{nn} is self-aggravating; in the second, the disequilibrium is self-correcting. However, in both of them the economic policy aimed at altering capital accumulation (k) –the main determinant of ec – can either aggravate or improve the unstable case, or else make the stable case slower or faster. It is also found that when g_{nn} is higher than g_{tb}, either in the self-correcting or in the self-aggravating cases, the economy may face external financial fragility, inducing a restrictive economic policy and hindering the self-correcting or the self-aggravating processes.

The rest of the paper is organized as follows: Section 2 describes our theoretical models where *ec* is a determinant of g_{tb}, g_{nn}, and g_w. Section 3 briefly discusses Thirlwall's assessment of Harrod's instability problem. Section 4 presents the empirical analysis for the main Latin American economies, namely Argentina, Brazil, Chile and Mexico.[1] Section 5 contains our final remarks.

2 ECONOMIC CAPACITY, BALANCE-OF-PAYMENTS EQUILIBRIUM, THE NATURAL AND THE WARRANTED GROWTH RATES

Capital accumulation affects a country's demand for imports positively (some capital goods must be imported) and negatively (capital accumulation adds to economic capacity,[2] making room for an import substitution effect) (Vázquez-Muñoz 2018). The same is true of exports: their direct effect improves the trade balance, while their indirect effect may tend to increase imports as a result of the increased income generated by export revenues.

It appears that these dual consequences of capital accumulation and exports should be made explicit in a model in which the adjustment process hinges upon quantity changes rather than price or real exchange-rate fluctuations. Our demand-for-imports equation is meant to capture such dual effects:

$$lnM_t = \alpha_0 + \Psi_{KB} lnKB_t + \alpha_2(lnID_t - lnEC_t) + \alpha_3(lnX_t - lnEC_t), \tag{1}$$

where *ln*, *M*, *KB*, *ID*, *X*, *EC*, α_0, Ψ_{KB}, α_2 and α_3 stand for the natural logarithm operator, the imports level, the gross capital stock, the level of domestic demand for domestic goods, the exports level, the level of economic capacity, a constant, the gross capital elasticity of the demand for imports, the income elasticity of the demand for imports weighted by the share of total imports financed by domestically generated income and the income elasticity of the demand for imports weighted by the share of total imports financed by the increased income generated by exports, respectively, and the subscript *t* is a time index. Therefore, $\alpha_2 + \alpha_3$ are the overall income elasticity of the demand for imports (Ψ). *EC* is that part of output that covaries with the net capital stock over the long run, given as:

$$lnEC_t = \beta_0 + \beta_1 lnK_t + \beta_2 t, \tag{2}$$

where *K* is the net capital stock measured in domestic output, β_0 is a constant, β_1 is the long-run net capital stock elasticity of the economic capacity and β_2 is the growth rate of the exogenous productivity of net capital.

Now, assuming that the real exchange rate is constant ($q = 1$), the value of the trade balance (*F*) is equal to:

$$F_t = M_t - X_t. \tag{3}$$

As shown by Thirlwall and Hussain (1982; see also McCombie and Thirlwall 1997; Moreno-Brid 1998/1999; Barbosa-Filho 2001), the dynamic condition to maintain a

1. The rationale for our choice of countries is as follows: Argentina, Brazil and Mexico, according to the World Development Indicators, are the largest Latin American economies in terms of GDP, whilst Chile holds the largest GDP per capita in the region.
2. Economic capacity is defined as the desired level of output, given the economy's net capital stock (Shaikh and Moudud 2004).

constant position of the trade balance as a percentage of the level of output (Y), can be decomposed as follows:

$$\phi x_t + (1-\phi)g_t = m_t \qquad \text{if } \phi < 1 \tag{4}$$ [3]

or

$$\phi x_t - (1-\phi)g_t = m_t \qquad \text{if } \phi > 1, \tag{4'}$$

where x, g and m stand for the growth rates of exports, output and imports, respectively, and ϕ is the ratio X to M. Since we are explicitly considering the specific effect of ID and X on the demand for imports, disaggregating g into the growth rates of ID (id) and x, we can rewrite equations (4) and (4′) and obtain:

$$\phi x_t + \{[1-\phi][\lambda id_t + (1-\lambda)x_t]\} = m_t \qquad \text{if } \phi < 1 \tag{5}$$

or

$$\phi x_t - \{[1-\phi][\lambda id_t + (1-\lambda)x_t]\} = m_t \qquad \text{if } \phi > 1. \tag{5'}$$

Taking time derivatives of equation (1), substituting the result in equations (5) and (5′) and solving for id obtains the growth rate of the internal demand for domestic output consistent with a constant position of the trade balance as a percentage of the level of output:

$$id_{tbt} = \frac{[\phi + (1-\phi)(1-\lambda) - \alpha_3]x_t - \Psi_{KB}kb_t + \Psi ec_t}{\alpha_2 - (1-\phi)\lambda} \qquad \text{if } \phi < 1 \tag{6}$$

or

$$id_{tbt} = \frac{[\phi - (1-\phi)(1-\lambda) - \alpha_3]x_t - \Psi_{KB}kb_t + \Psi ec_t}{\alpha_2 + (1-\phi)\lambda} \qquad \text{if } \phi > 1, \tag{6'}$$

where kb is the growth rate of gross capital stock and ec is the growth rate of economic capacity. Using equations (6) and (6′), we obtain the growth rate of output consistent with a constant position of the trade balance as a percentage of the output level:

$$g_{tbt} = \lambda id_{tbt} + (1-\lambda)x_t. \tag{7}$$

Hence g_{tb} is obtained as a function of ec and x, given Ψ_{KB} and Ψ.

Now, following Perrotini and Vázquez-Muñoz (2017), we argue that the natural growth rate is endogenous both to effective demand (*à la* León-Ledesma and Thirlwall 1998; 2000) and to economic capacity (*à la* Lewis 1954). This reasoning is consistent with León-Ledesma and Thirlwall (1998; 2000), who, using Okun's law, estimated the next equation to get the normal natural growth rate (g_{nn}):

$$g_t = \theta_0 + \theta_1 u_t + v_{gt} \qquad (\theta_0 > 0, \theta_1 < 0), \tag{8}$$

where u is the percentage variations of the unemployment rate, θ_1 is the elasticity of output vis-à-vis the rate of unemployment and v_{gt} is an error term.[4] According to León-Ledesma and Thirlwall (1998 and 2000), θ_0 is equal to g_{nn}; to obtain the

3. The ratio F/Y will be constant if the growth rates of F and Y (f and g) are equal.
4. See Boggio and Seravalli (2002) for a critic of the endogeneity of the natural growth rate and the rejoinder by León-Ledesma and Thirlwall (2002).

expansive natural growth rate, León-Ledesma and Thirlwall (1998; 2000) used a dummy variable for the upward shift of the intercept of equation (8) when the economy expands.[5] Here we are concerned with a twofold endogeneity of g_n, that is, with respect to effective demand and ec, which may be written as:

$$g_t = \theta_2 ec_t \sigma_t + \theta_3 u_t + v_{2gt} \qquad (\theta_2 > 0, \theta_3 < 0), \tag{9}$$

where σ is the utilization ratio of EC (Y/EC) and θ_2 measures the positive or negative shifts of the intercept of equation (9) in the $u - g$ quadrant owing to increases or decreases of σ and/or ec (see Figure 1). We define g_{nn} as the growth rate that keeps the unemployment rate constant and σ is equal to its average value.

Now we can obtain g_n as $\theta_2 ec_t \sigma_t$, from which the normal natural growth rate is defined (g_{nn}) as:

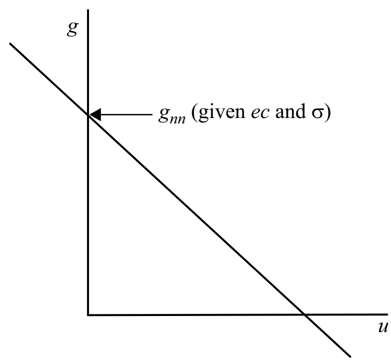
$$g_{nn} = \theta_2 ec_t \sigma_{ave},$$

where σ_{ave} is the average value of σ.

Harrod (1939) defined the warranted growth rate (g_w) as the g for which induced investment is equal to planned investment. Therefore, it is fair to say that g_w is equal to g_{nn} as it implies a particular g for which σ is equal to its normal value; in other words, it entails a g equal to ec, so there are no incentives to modify planned investment. Further, it can be argued that g_w, g_{nn}[6] and g_{tb} are functions of ec:

$$\begin{aligned} g_w &= g_{nn} = f(ec) && (f' > 0) \\ g_{tb} &= h(ec) && (h' > 0), \end{aligned}$$

where f and h denote functions and $'$ stands for the first derivative.



Source: Authors' elaboration.

Figure 1 Determination of the natural growth rate

5. Empirical estimations of the endogeneity of the natural growth rate are found in León-Ledesma and Thirlwall (1998; 2000), Perrotini and Tlatelpa (2003), León-Ledesma (2006), Ciriaci (2007), Oreiro et al. (2007), Lanzafame (2009; 2010; 2014), Libânio (2009), Vogel (2009), Dray and Thirlwall (2011) and Perrotini and Molerés (2012).
6. Harrod's definition of the natural growth rate considered the stock of capital: '[t]his is the maximum rate of growth allowed by the increase of population, *accumulation of capital*, technological improvement and the work/leisure preference schedule, supposing that there is always full employment in some sense' (Harrod 1939, p. 30, emphasis added).

3 THE RELATIONSHIP BETWEEN g_w, g_{nn} AND g_{tb}

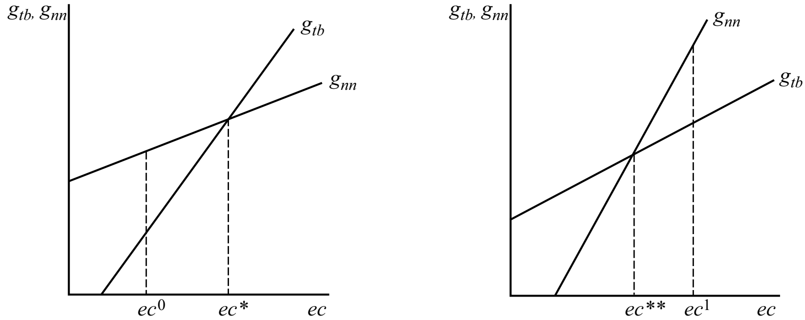
According to Thirlwall (2001), given the existence of g_w, g_n and g_{tb}, there exist six possible dynamic disequilibrium scenarios which, in turn, can be summarized into two self- aggravating scenarios and one self-correcting scenario. Thirlwall (2001, p. 87) concludes that

> [f]or most countries, it must be true, however, that as long as some countries run payments surpluses through choice, or are literally supply constrained (such as some oil producing countries), the ultimate constraint on growth must be its balance of payments equilibrium growth rate, not the Harrodian natural rate of growth.

In keeping with this view, given that *ec* determines g_{nn} (g_w) and g_{tb}, we argue that countries are constrained by g_{tb} according to two different possible scenarios shown in Figure 2.

In scenario (a), g_{tb} is more elastic than g_{nn} to *ec*, in the second g_{nn} is more elastic than g_{tb} to *ec*. Scenario (a) is self-correcting whilst scenario (b) is self-aggravating. If the economy falls in the scenario (a) and *ec* is higher (lower) than ec^*, the full employment position is reached while running an increasing trade balance surplus (deficit) and capital outflows (capital inflows). Therefore, the initial disequilibrium gets reduced. On the other hand, if the economy falls in the scenario (b) and *ec* is higher (lower) than ec^{**}, the economy runs an increasing trade balance deficit (surplus) and capital inflows (capital outflows). Therefore, the initial disequilibrium gets aggravated.

However, it is worth mentioning that, in both cases, the self-correcting and the self-aggravating scenarios, the processes could be interrupted if, in scenario (a), *ec* happens to be lower than ec^0 or if, in scenario (b), *ec* is higher than ec^1. In both cases the interruption is brought about by an increase in the economy's external financial fragility, which is a positive function of the discrepancy between g_{nn} and g_{tb}. Should such a situation occur, it could be necessary to implement restrictive economic policies to rein in economic expansion, although in the self-correcting scenario the result of this course of action can be a vicious circle of even greater external financial fragility, the adoption of further restrictive economic policies, an inducement of a larger gap between g_{nn} and g_{tb}, and so on and so forth. Now we turn to an empirical assessment of the preceding theoretical discussion for the cases of Argentina, Brazil, Chile and Mexico.



Scenario (a): g_{tb} is more elastic than g_{nn} to *ec* Scenario (b): g_{nn} is more elastic than g_{tb} to *ec*

Source: Authors' elaboration.

Figure 2 The relation between g_{nn} (g_w), g_{tb} and ec

4 EMPIRICAL EVIDENCE

We estimate the demand for imports (equation (1))[7] for each of the countries of our sample study using the Bound Test Approach (Pesaran et al. 2001) and information from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean and the Penn World Table version 9.0. All the series are measured in constant local currency; the internal demand for domestic goods was taken as the difference between GDP and exports, the gross capital stock is the sum of the net capital stock (K) in period $t - 1$[8] plus the gross investment (gross fixed capital formation) in period t, and EC was obtained estimating equation (2).[9] Table 1 reports the unit root test for the lnM, $lnKB$, $lnID - lnEC$ and $lnX - lnEC$ series.

As can be seen in Table 1, all series are integrated of order one, except $lnKB$ for the cases of Chile and Mexico, and $lnID - lnEC$ for the case of Chile, which are stationary. So, we can use the Bound Test Approach cointegration methodology to estimate equation (1) for each country scrutinized.[10] Table 2 reports the results of our estimations.

According to our results shown in Table 1, Argentina's estimated gross capital stock and income elasticities of the demand for imports have increased from 1991 – the year of its trade liberalization – onwards. Brazil's estimated gross capital stock elasticity of the demand for imports also increased after the inception of trade liberalization in 1991, while its income elasticity of the demand for imports was not affected. By contrast, Chile's gross capital stock and income elasticities of the demand for imports (1.01 and 1.68, respectively, for the entire period) did not change as a result of the trade liberalization that started in 1976. Finally, Mexico's gross capital stock and income elasticities of the demand for imports have also increased since 1986, the year trade liberalization started.

Now let us estimate the natural growth rate (equation (9)) with ordinary least squares (OLS) for the four Latin American countries researched. The data sources used are the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean, the Penn World Table version 9.0 and Termómetro de la Economía Mexicana database of Mexico Máxico; and the chosen variables are g = the growth rate of GDP, σ = the GDP to EC ratio and u = the annual percentage variations of the rate of unemployment. Table 3 reports the unit root tests for the g, ec, σ and u series.

As can be seen in Table 3, all series are stationary. Table 4 contains the OLS estimation results for equation (9).

7. Following Thirlwall (1979), we do not include the effect of the percentage variations of the real exchange rate on the growth rate of the demand for imports. Although it is true that some authors (Rodrik 2008) have argued that the real exchange level may be relevant for the determination of the long-run growth rate through its effect on the profitability of the tradable industries and/or exports, this phenomenon is however beyond the scope of the present paper. Moreover, a competitive exchange rate is not free from adverse consequences, so it is no panacea for economic stagnation.
8. See the description of the determination of K in Appendix 1.
9. See the description of the estimation of EC in Appendix 1.
10. This approach is applicable regardless of whether the underlying regressors are purely I(0), purely I(1), mutually cointegrated or any combination of these characteristics. This is, indubitably, a considerable advantage given the low power of the unit root test and the relatively small size of our data for each country.

Table 1 Unit root test for lnM, lnKB, lnID – lnEC, lnX – lnEC series: 1950–2017

Variable	ADF	PP	ADFBPT	Variable	ADF	PP	ADFBPT
Argentina	–	–	–	*Argentina*	–	–	–
lnM	−3.69**	−3.11	–	*d(lnM)*	−7.03*	−7.02*	–
lnKB	−1.70	−1.47	–	*d(lnKB)*	−3.04**	−3.17**	–
lnID – lnEC	−2.08	−2.08	–	*d(lnID – lnEC)*	−7.40*	−7.38*	–
lnX – lnEC	−0.69	−0.48	–	*d(lnX – lnEC)*	−8.54*	−8.62*	–
Brazil	–	–	–	*Brazil*	–	–	–
lnM	−2.85	−2.68	–	*d(lnM)*	−8.10*	−8.14*	–
lnKB	−0.85	−0.34	–	*d(lnKB)*	−1.53	−1.49	−4.52**[a] (1978)
lnID – lnEC	−3.06**	−3.02**	–	*d(lnID – lnEC)*	–	–	–
lnX – lnEC	0.17	0.27	–	*d(lnX – lnEC)*	−9.04*	−9.11*	–
Chile	–	–	–	*Chile*	–	–	–
lnM	−2.11	−2.25	–	*d(lnM)*	−7.43*	−7.43*	–
lnKB	−1.64	−0.02	−5.70**[b] (1981)	*d(lnKB)*	–	–	–
lnID – lnEC	−1.38	−1.53	−6.73*[b] (1981)	*d(lnID – lnEC)*	–	–	–
lnX – lnEC	−0.45	−0.49	–	*d(lnX – lnEC)*	−7.92*	−7.93*	–
Mexico	–	–	–	*Mexico*	–	–	–
lnM	−3.68**	−2.94	–	*d(lnM)*	−6.68*	−7.29*	–
lnKB	−1.34	−0.42	−4.58**[b] (1981)	*d(lnKB)*	–	–	–
lnID – lnEC	−0.61	−0.57	–	*d(lnID – lnEC)*	−6.96*	−6.95*	–
lnX – lnEC	0.75	0.75	–	*d(lnX – lnEC)*	−7.60*	−7.60*	–

Notes: * and ** are statistically significant at the 1 per cent and 5 per cent levels. *d(·)* stands for the first difference operator. ADFBPT is the Augmented Dickey Fuller unit root test considering one break point, break year between parentheses.

a. Test was done assuming an additive outlier break type.

b. Tests were done assuming an innovative outlier break type.

All tests were done using the EViews software version 10.0. Level tests for *lnM* and *lnKB* assume the existence of intercept and trend, whilst level tests for *lnID – lnEC* and *lnX – lnEC* were done assuming the existence of intercept; all first differences tests were done assuming the existence of intercept. The number of lags used for the ADF and ADFBPT tests were chosen according to the Schwarz information criterion, whereas the number of Bandwidth used for the PP test were chosen according to the Newey–West criterion.

Sources: Authors' elaboration using data from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean and the World Penn Table version 9.0.

Table 2 Estimation of the import demand function

Dependent variable: *lnM*				
Long-run relationship				
Country Period	Argentina[a] 1950–2017	Brazil 1950–2017	Chile 1950–2017	Mexico 1950–2017
Constant	1.96* (0.43)	30.00* (0.54)	–	−6.01* (0.90)
lnKB	0.60* (0.03)	–	1.01* (0.11)	1.20* (0.05)
lnID – lnEC	1.46* (0.19)	3.18* (0.78)	0.74* (0.27)	2.56* (0.53)
lnX – lnEC	–	1.38* (0.16)	0.94* (0.23)	–
D9117	−8.00* (1.63)	–	–	–
D7180	–	0.89* (0.15)	–	–
lnKB·D9117	0.78* (0.10)	0.01*** (0.01)	–	–
lnKB·D8617	–	–	–	0.18* (0.02)
(lnX – lnEC)·D9117	0.82* (0.12)	–	–	–
(lnX – lnEC)·D8617	–	–	–	1.33* (0.11)
Model type	Restricted constant, no trend	Restricted constant, no trend	No constant, no trend	Restricted constant, no trend
ARDL model	(1, 0, 0, 0, 0)	(4, 4, 4, 2, 0)	(2, 2, 4, 2)	(4, 0, 0, 0)
F-bounds test	–	–	–	–
F-statistic	40.73*	3.72**	8.54*	14.66*
t-bounds test	–	–	–	–
t-statistic	–	–	−4.72*	–
Adjustment coefficient				
v_{Mt-1}	−0.83* (0.05)	−0.29* (0.06)	−0.39* (0.06)	−0.56* (0.06)
t-bounds test	–	–	–	–
t-statistic	–	–	−6.02*	–
Jarque-Bera test	1.67	0.39	0.80	4.35
LM test (*F*-statistic, 1 lag)	1.54	0.01	0.14	2.21
White test (*F*-statistic)[b]	1.88***	0.52	1.48	1.02

Notes: *, ** and *** are statistically significant at the 1 per cent, 5 per cent and 10 per cent level (standard errors in parentheses).

a. Standard errors adjusted by the Newey–West procedure.

b. White tests do not include cross terms.

All estimations were done using the EViews software version 10.0. We use some dummy and composed dummy variables to capture structural breaks; *DXXYY* stands for a dummy variable with value equal to 1 from *19XX(20XX)* to *19YY(20YY)* and 0 otherwise. ARDL model indicates the number of lags of the dependent and independent variables. A complete report of the estimation, including the fixed regressors used in each case, is available on request from the authors.

Sources: Authors' elaboration using data from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean and the Penn World Table version 9.0.

Table 3 Unit root test for g, ec·σ and u series

Variable	ADF	PP	ADFBPT
Argentina (1971–2017)			
g	−5.72*	−5.69*	–
ec·σ	−2.89***[a]	−2.92***[a]	–
u	−7.02*	−7.02*	–
Brazil (1973–2017)			
g	−4.56*	−4.48*	–
ec·σ	−1.97	−1.06	−4.96*[c] (1988)
u	−5.95*	−5.92*	–
Chile (1976–2017)			
g	−5.74*	−5.72*	–
ec·σ	−3.02**	−2.77***[b]	–
u	−7.60*	−7.63**	–
Mexico (1974–2017)			
g	−5.36*	−5.34*	–
ec·σ	−3.20**	−3.31**	–
u	−5.65*	−5.58*	–

Notes: *, ** and *** are statistically significant at the 1 per cent, 5 per cent and 10 per cent level.
a. 2009 is omitted.
b. 2013 is omitted. For the omitted years, see the notes for Table 4.
c. Test was done assuming an innovative outlier break type.
All tests were done using the EViews software version 10.0. ADFBPT is the Augmented Dickey Fuller unit root test considering one break point; break year between parentheses. All tests were done assuming the existence of intercept, except all the tests for the *u* series, which assumed neither intercept nor trend. The number of lags used for the ADF and ADFBPT tests were chosen in accordance with the Schwarz information criterion, whilst the number of Bandwidth used for the PP test were chosen according to the Newey–West criterion.
Sources: Authors' elaboration using data from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean, the World Penn Table version 9.0 and Termómetro de la Economía Mexicana database of Mexico Máxico.

With the results shown in Table 4, we obtain g_{nn} as $\theta_2 ec\sigma_{ave}$ for the countries under inspection. Also, the modified growth rate consistent with a constant position of the trade balance as a percentage of GDP (g_{tbm}) is obtained as:

$$g_{tbm} = \frac{-\alpha_1 kb + \psi ec + [\lambda\phi + (1-\phi)(1-\lambda) - \alpha_3]\bar{x}}{\alpha_2 - (1-\phi)\lambda} + (1-\lambda)\bar{x}, \tag{10}$$

where $\bar{x}$ is the simple average of x.[11] Figure 3 (see pp. 456–457) shows the relations between g_{nn} and ec and between g_{tb} and ec.

As shown in Figure 3, we obtained positive relations between g_{tb} and ec and between g_{nn} and ec for the four countries and sub-periods scrutinized, except for the

11. We preferred to use $\bar{x}$ in lieu of x because we are presenting the empirical relation between g_{tb} and ec. When x is used, this relation is shifted up or down according to the exhibited value of x, whereas when using $\bar{x}$ the relation is stable for the period under examination.

Table 4 Estimation of the output growth rate

Dependent variable: g				
Country Period	Argentina 1971–2017	Brazil 1973–2017	Chile 1976–2017	Mexico 1974–2017
$ec{\cdot}\sigma$	0.64*	1.27*	1.76*	0.99*
	(0.20)	(0.15)	(0.14)	(0.11)
u	−0.04**	−0.06*	−0.07*	−0.09*
	(0.02)	(−3.28)	(0.02)	(−0.02)
D91	9.91*	–	–	–
	(3.40)	–	–	–
D92	10.71*	–	–	–
	(3.39)	–	–	–
D8190	–	−3.68*	–	–
	–	(1.18)	–	–
D82	–	–	−14.98*	–
	–	–	(3.11)	–
D83	–	–	−10.34*	–
	–	–	(2.62)	–
D9906	–	–	−4.26*	–
	–	–	(1.12)	–
$u{\cdot}D9617$	−0.37*	–	–	–
	(−0.07)	–	–	–
R^2	0.63	0.39	0.69	0.53
Jarque–Bera test	0.64	0.36	0.21	0.08
LM test (F-statistic, 1 lag)	0.26	1.08	2.37	1.04
White test (F-statistic)[a]	1.60	1.64	0.88	0.98

Notes: * and ** are statistically significant at the 1 per cent and 5 per cent level (standard errors in parentheses).
a. White tests include cross terms.
All estimations were done using the EViews software version 10.0. Our estimations are very similar to those reported in this table when the year 2009 is omitted for the case of Argentina and the year 2013 for the case of Chile. We use some dummy and composed dummy variables to capture structural breaks; *DXX* stands for a dummy variable with value equal to 1 in *19XX* and 0 otherwise; *DXXYY* stands for a dummy variable with value equal to 1 from *19XX(20XX)* to *19YY(20YY)* and 0 otherwise.
Sources: Authors' elaboration using data from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean, the Penn World Table version 9.0 and Termómetro de la Economía Mexicana database of Mexico Máxico.

(negative) relation between g_{tb} and ec in Argentina during sub-period 1975–1990. More specifically, we identified the features shown below, country-wise.

4.1 Argentina

In this case, two relevant sub-periods were found. The first one can be decomposed into two segments, 1971–1974 and 1991–2017. During this time span, the elasticity of g_{tb} vis-à-vis ec was greater than that of g_{nn} with respect to ec, implying a self-correcting scenario. During most of this sub-period the Argentinian economy tends to work below the equilibrium position and closer to g_{nn} than to g_{tb}, which means that Argentina was accumulating capital inflows.

So, at the end of the first segment, and after the Argentinian oil crisis of 1973, the import substitution growth strategy was replaced by an economic liberalization program, which mainly covered domestic issues and the Argentinian government implemented contractive policies to reduce both private and public investments and then to rein in capital inflows. Over the second sub-period, 1975–1990, g_{nn} and g_{tb} were positively and negatively related to *ec,* respectively,[12] featuring a self-aggravating system hand-in-hand with a strong reduction of g.

Given the bad performance of the Argentinian economy, an Open Trade Liberalization program was implemented during President Menem's administration (in 1991), paving the way for the beginning of the second segment of the first sub-period (1991–2017). In this second segment, g increased, but the economy started to accumulate capital inflows. Consequently, in 2016 president Macri implemented restrictive policies to halt g; the effect of such policies on the relations between g_{nn} and ec and between g_{tb} and ec are yet to be seen.

4.2 Brazil

In Brazil, the elasticity of g_{tb} vis-à-vis ec happened to be higher than that of g_{nn} with respect to ec during the three identified scenarios, which means that all of them are self-correcting scenarios. During the first sub-period (1973–1980), which belongs to the state-led industrialization period, the annual average of g_{nn} (8.51 per cent) was somewhat higher than that of g_{tb} (7.59 per cent), whilst the annual average of g fell in between (8.05 per cent). However, the annual average of the trade balance position was negative, –2.49 percentage points of GDP, which contributed to the foreign debt crisis of 1982.

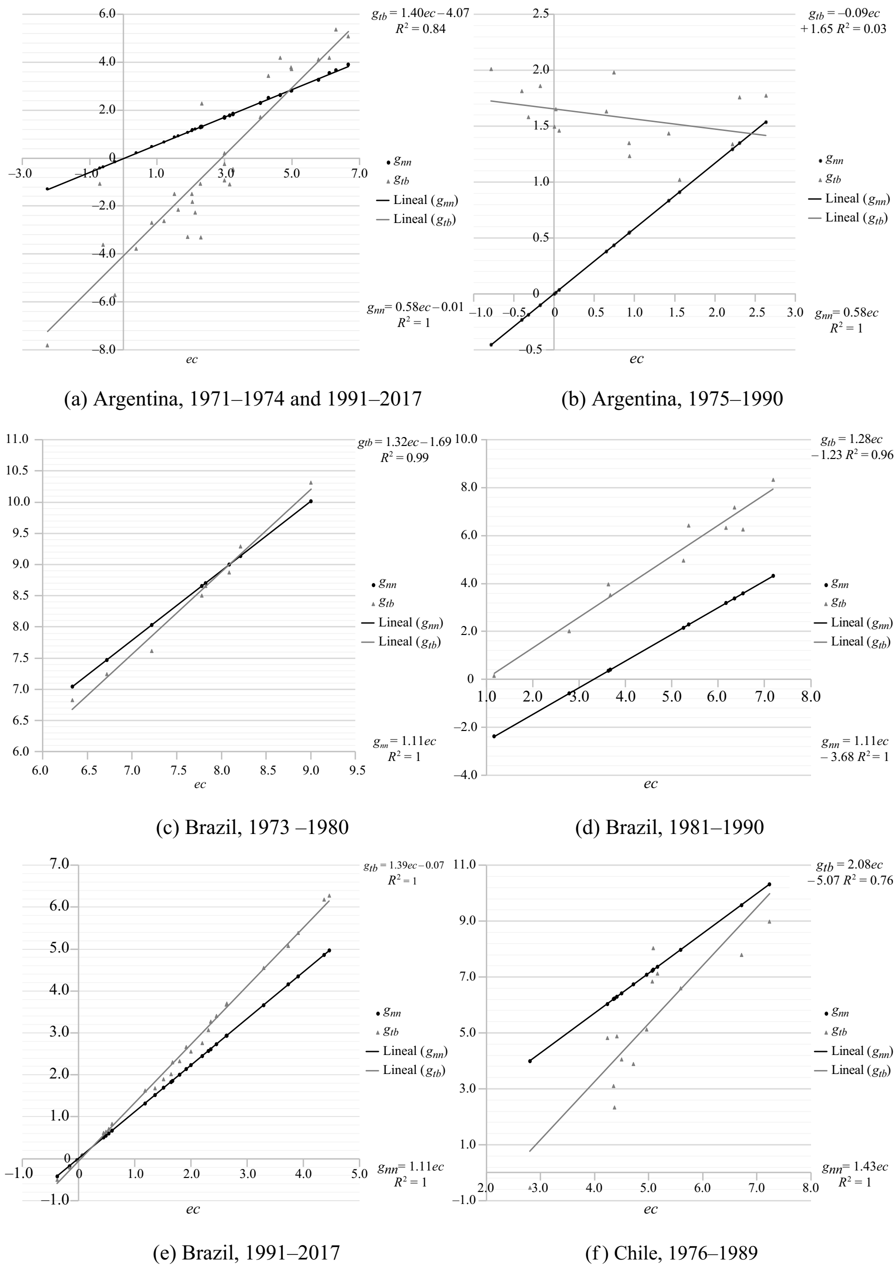
The $ec - g_{nn}$ relationship shifted down through 1981–1990 (the lost decade), most likely as an outcome of the restrictive economic policies experienced. Consequently, the annual average of both g_{nn} and g were pretty similar, 1.67 per cent and 1.66 per cent respectively, whereas the annual average of g_{tb} was much higher (5.65 per cent).

The $ec - g_{nn}$ relationship shifted up and that of $ec - g_{tb}$ shifted down from (1991) the inception of trade liberalization onwards. These movements implied an increase of the equilibrium value of ec. In turn, the annual average of both g_{tb} and g were about the same, 2.47 per cent and 2.48 per cent respectively, and somewhat higher than the annual average of g_{nn}, 2.02 per cent. It is worth noting that the equilibrium value of g_{nn} and g_{tb} was equal to 0.25 per cent, which implies a depressive economy in comparison with the values exhibited during the first sub-period.

4.3 Chile

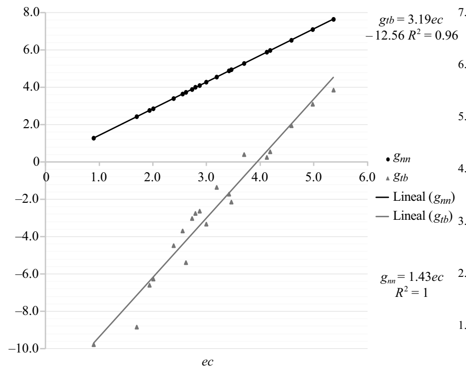
The first sub-period ran from 1976 to 1989, and was a self-correcting scenario. The annual averages of g_{nn} and g_{tb} were very similar, 7.05 per cent and 6.80 per cent, and the annual average of g was lower (4.67 per cent). Now, although the Chilean economy escaped fast from the external debt crisis of the early 1980s, our results suggest an aggressive restrictive economic policy was implemented in 1982 in order to reduce g and generate subsequent higher trade balance surpluses to meet international financial liabilities: during 1976–1981 the annual average of the trade balance position

12. The negative relationship between g_{tb} and ec could have been the result of a strong decline of the elasticity of economic capacity with respect to gross investment, which implied that import substitution allowed by *EC* was lower than the imports required to generate *EC* (Vázquez-Muñoz 2018).

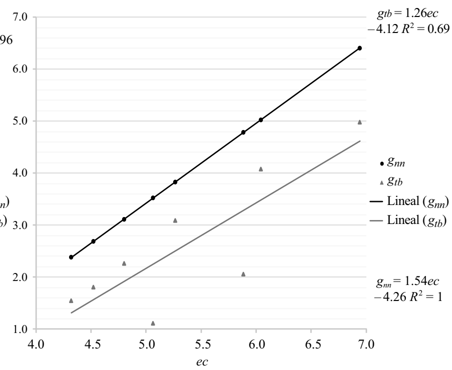


Notes: Lineal conveys the OLS estimated relations between g_{tb} and *ec* and between g_{nn} and *ec*.
Sources: Authors' elaboration using data from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean and the Penn World Table version 9.0.

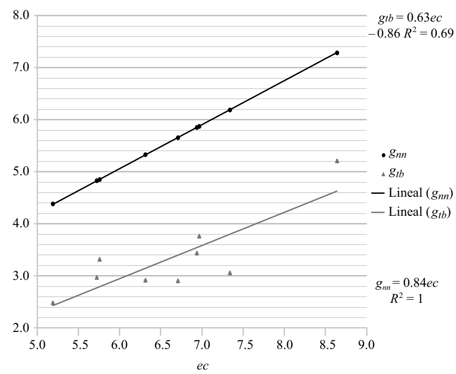
Figure 3 Relation between g_{nn} and ec and between g_{tb} and ec



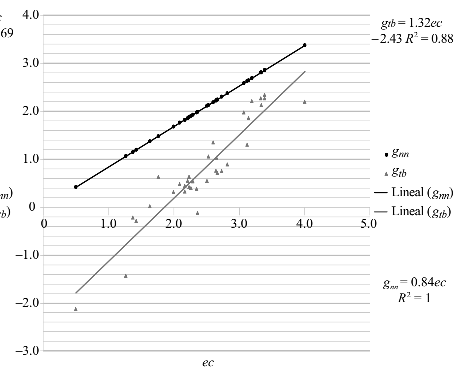
(g) Chile,1990–1998 and 2007–2017



(h) Chile, 1999–2006



(i) Mexico, 1974–1982



(j) Mexico, 1983–2017

Figure 3 (continued)

was equal to 4.40 percentage points, whilst from 1983 to 1989 it was equal to 10.40 percentage points.

As regards the sub-periods 1990–1998 (a time of deepening of economic liberalization reforms) and 2007–2017 (beginning with leftist governments), the $ec - g_{tb}$ relation shifted down and its slope increased, implying a fall in the equilibrium value of ec. However, the Chilean economy worked far below the equilibrium value of ec; the annual average of g_{nn} and g were pretty similar, 4.46 per cent and 4.98 per cent respectively, but much higher than the annual average of g_{tb}, −1.02 per cent, which represents a decreasing trade balance surplus (decreasing capital outflows).

Finally, throughout the sub-period 1999–2006 the $ec - g_{nn}$ relation shifted down and the $ec - g_{tb}$ relation shifted up, and its slope decreased, resulting in a self-aggravating scenario where the annual average of g_{nn}, g_{tb} and g were 3.97 per cent, 3.29 per cent and 3.67 per cent respectively. In this sub-period, the restrictive economic policy allowed the Chilean economy to experience an annual average of *dxmy* equal to 13.38 percentage points, representing an accumulation of capital outflows that helped the country to cope with external financial fragility. Nonetheless, such an economic policy stand induced a reduction of g.

4.4 Mexico

It can be argued that Mexico experienced a self-aggravating scenario from 1974 through 1982. Throughout this sub-period the annual average of g (5.92 per cent) was higher than those of g_{nn} and g_{tb} (5.58 per cent and 4.08 per cent respectively). The Mexican economy experienced a high growth regime and increasing trade balance deficits (increasing capital inflows). While those trade deficits may have enhanced ec, they also generated an external financial fragility which led to the 1982 external debt crisis.

During the sub-period 1983–2017, the Mexican government followed IMF-type macroeconomic adjustment economic policies and, beginning in 1986, implemented a radical process of economic liberalization. As a consequence, the $ec - g_{tb}$ relation shifted down and its slope increased, resulting in a self-correcting scenario. However, as in the first sub-period, the annual average of g (2.29 per cent) was somewhat higher than that of g_{nn} (2.06 per cent) in this sub-period. The latter, in turn, was higher than the average of g_{tb} (0.82 per cent). Therefore, the Mexican economy evolved towards a self-correcting scenario involving lower equilibrium values of ec, g_{nn} and g_{tb}.

5 FINAL REMARKS

The main thrust of this article is as follows. We have argued that Thirlwall's (1979) principle that g_{tb} is the critical constraint on growth and bridged a theoretical gap in dynamic theory, a *lacuna* left by Harrod's extension of Keynes's (1936 [1964]) static short-run analysis of effective demand to the long-run setting. We have also attempted to draw together, from Thirlwall's perspective, the analyses of the interaction between economic capacity, the endogeneity of the natural growth rate and the external constraint on output expansion.

Our research led us to identify two possible scenarios, showing the theoretical relations between g_{nn} and g_{tb}, namely the self-correcting scenario where g_{tb} is more elastic than g_{nn} vis-à-vis ec, and the self-aggravating scenario where g_{nn} is more elastic than g_{tb} with respect to ec, that is, ec affects g_{tb} negatively. Moreover, if the economy's external financial fragility increases rapidly, both the self-correcting and the self-aggravating processes could be interrupted by restrictive economic policies. This Thirlwallian-driven narrative, as it were, also led us to empirically assess our central tenet (ec is a determinant of the relations between g_{tb}, g_w and g_{nn}) for the cases of Argentina, Brazil, Chile and Mexico. We found that, in all countries, the relationships between ec and g_{nn} and between ec and g_{tb} are positive, except for the case of Argentina where the relation between g_{tb} and ec was negative in the sub-period 1975–1990.

The main policy implication of the previous analysis can be summarized as follows: our model shows that in the self-correcting scenario the gap between g_{tb} and g_{nn} tends to reduce, albeit some degree of financial fragility is present. If the government tries to tackle financial fragility implementing conventional restrictive economic policies, the position will worsen as such policies will widen the aforementioned gap, shrink the growth rate of output and increase the unemployment. On the contrary, in the self-aggravating scenario the $g_{tb} - g_{nn}$ gap tends to expand, and so does financial fragility. In this case a restrictive economic policy will reduce both financial fragility and the $g_{tb} - g_{nn}$ gap. As g_{nn} is endogenous, the unemployment rate will not increase as a result of lower output growth.

By and large, most governments of developing economies adopt recessionary policies when faced with slow growth *cum* financial fragility; this policy stand only worsens the economic outlook. A wiser alternative policy would be to enhance capital accumulation with the aim of both easing financial fragility and reducing the balance-of-payments constraint to economic growth, as Thirlwall argued long ago.

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APPENDIX 1

A1.1 Determination of the net capital stock

Following Berleman and Wesselhöft (2014), we built the net capital stock using the growth rate of the net capital stock ($\hat{K}$):

$$\hat{K} = \frac{I_t}{K_{t-1}} - \delta_t, \tag{A1}$$

where I_t is gross investment in period t, K_{t-1} is the net capital stock in period $t-1$, and δ_t is the depreciation rate of capital in period t. Then, solving equation (A1) for K_{t-1} *we obtain:*

$$K_{t-1} = \frac{I_t}{\hat{K} + \delta_t}. \tag{A2}$$

Now, we assume that $\hat{K}$ is equal to the trend growth rate of gross investment ($\hat{I}$). Therefore, we can rewrite equation (A2) as:

$$K_{t-1} = \frac{I_t}{\hat{I} + \delta_t}. \tag{A2$'$}$$

Then, we have $\hat{I}$ through the OLS estimation of the following equation:

$$ln(I_t) = \beta_3 + \beta_4 t + v_{It}, \tag{A3}$$

where β_i are the parameters to be estimated, t is a trend variable and v_{It} is an error term; β_4 is the estimated value of $\hat{I}$. Finally, we can build the net capital stock series using the gross investment series, the depreciation rate series and $\hat{I}$ as follows:

$$K_t = K_{t-1} + I_t - \delta K_{t-1}. \tag{A4}$$

To estimate equation (A3) for the countries scrutinized, we obtained information from the World Development Indicators database of the World Bank, the CEPALSTAT database of the Economic Commission for Latin America and the Caribbean and the World Penn Table version 9.0. We used Gross Fixed Capital Formation, measured in constant local currency, as the gross investment series. The estimations of equation (A3) were not included due to space constraints, however they are available from the authors upon request. Once we estimated the trend growth rate of gross investment, we had the net capital stock series for each country in our sample using equation (A4).[13]

13. We used the depreciation rate series reported in the World Penn Table version 9.0 for each researched country.

A1.2 Estimation of the economic capacity series

Following Shaikh and Moudud (2004) and Shaikh (2016), we obtained the economic capacity series for each country estimating equation (A5) with the Bound Test Approach:

$$lnY_t = \gamma_0 + \gamma_1 lnK_t + v_{Yt}, \qquad \text{(A5)}$$ [14]

where γ_i are the parameters to be estimated and v_{Yt} is an error term. GDP, measured in constant local currency, is the variable Y. The estimations of equation (A5) were not included due to space constraints; they are available from the authors upon request. Using the long-run relationship, we can estimate the economic capacity (EC) series for each scrutinized country.

14. Following Shaikh (2016), we adjusted K with the ratio Gross Fixed Capital Formation price index to the GDP price index in order to eliminate any spurious relative price term from the cointegration relationship between output (Y) and the net stock of capital (K).