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Endogenous growth and economic capacity: Theory and empirical evidence for the NAFTA countries

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The present paper takes issue with the problem of making endogenous the natural growth rate of output, which Harrod (1939) defined as the sum of the growth rates of population (employment) and of labour productivity, and assumed it as exogenously given.

Already León-Ledesma and Thirlwall (1998) set out to ascertain that the natural rate of growth is endogenous to the actual growth rate of output. They argue that there exists a range of full employment economic growth rates for which the growth rate of demand determines the growth rate of supply. Thus, given the economy's (normal or expansive) growth regime, the growth rates of labour supply and of labour productivity will be normal or expansive through the incorporation of new workers into the labour market and Verdoorn's Law mechanism, in such a way that the supply of the 'labour' input and labour productivity respond positively to the expansion rate of demand.

Harrod (1939) had maintained that capital accumulation played a role in the determination of the (*exogenous*) natural growth rate of output. In the present writers' opinion, capital accumulation and, particularly, the growth rate of economic capacity[1] do play a role in

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[1] Following Shaikh and Moudud (2004), we define economic capacity as the desired level of output from a given plant and equipment; this definition is different from full

the determination of the *endogenous* natural rate of economic growth. Furthermore, we distinguish two kinds of endogeneity: first, the normal natural rate of growth is endogenous to the growth rate of economic capacity; and, second, given this gravitation milestone there are other natural rates of growth, which correspond to different growth regimes, namely, depressive and expansive ones. Accordingly, we develop a new way of estimating the expansive, normal and depressive natural rates of growth taking into account capital accumulation and the rate of economic capacity utilisation.[2]

The rest of the paper is organised as follows: the next section contains a brief review of the relevant literature, followed by an exposition of our own model, in which the normal natural rate of growth is endogenous to capital accumulation and, specifically, to the growth rate of economic capacity, whilst the depressive and expansive natural rates of growth are endogenous to the utilisation coefficient of economic capacity. The third section presents an empirical estimation of the depressive, normal and expansive natural rates of growth, using data from Canada, Mexico and the United States of America – the North American Free Trade Agreement (NAFTA) countries – for the period 1971-2014 (1974-2014 for the case of Mexico). The fourth part wraps up stating the chief theoretical and empirical contribution of the paper, namely, that along with effective demand, both the growth rates of economic capacity and capital accumulation have a positive role in the determination of the endogeneity of the natural growth rate of the economy.

1. A brief survey of the literature

León-Ledesma and Thirlwall (1998) have offered a theory of economic dynamics which, essentially, states that the natural growth

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employment output. Sometimes economic capacity has been labelled as "potential output" by neoclassical economists. For the sake of argument, we chose to stick to our conception of economic capacity.

[2] The rate of economic capacity utilisation is the actual output to economic capacity ratio.

rate of output is endogenous not just because it is inextricably entwined with aggregate demand, but, what is of utmost importance, the latter determines aggregate supply over a range of full employment growth rates.[3] This means that demand-side constraints tend to become operative before supply-side restrictions do. They define the natural growth rate as the growth rate of economic activity that keeps the rate of unemployment constant, which amounts to Harrod's definition provided the structure of the population does not change. León-Ledesma and Thirlwall lay down a model for their conception of the endogeneity of the natural growth rate of output that bears a strong family resemblance to Okun's Law (Okun, 1962):[4]

$$g_t = \lambda_0 + \lambda_1 u_t \qquad \lambda_1 < 0 \qquad (1)$$

where g is the growth rate of output, u is the percentage variation of the unemployment rate and λ_0 is the natural rate of growth in normal times. Their empirical estimation is based on the next equation:

$$g_t = \beta_0 + \beta_1 DU_t + \beta_2 u_t \qquad \beta_2 < 0 \qquad (2)$$

where DU is a dummy variable equal to 1 if $g > \lambda_0$ and 0 otherwise; $\beta_0 + \beta_1$ stands for the natural growth rate in expansive periods. The elasticity of the expansive growth rate with respect to the normal growth rate varies both across countries and time periods. According to León-Ledesma and Thirlwall, such elasticity tends to be lower for developed countries vis-à-vis developing economies, as the latter usually exhibit a greater excess supply of labour which, by and large, will become employed during expansive stages of productive activity.

León-Ledesma and Thirlwall's hypothesis has ushered in a number of empirical tests for different countries (see León-Ledesma

[3] The relevant role of aggregate demand has been acknowledged, in the aftermath of the recent financial crisis, even by some leading orthodox economists: "[i]t is hard to ignore facts. One major macro fact is that shifts in the aggregate demand for goods affect output substantially more than we would expect in a perfectly competitive economy. More optimistic consumers buy more goods, and the increase in demand leads to more output and more employment" (Blanchard, 2008, p. 5).

[4] The original equation specified by Okun (1962) is $u = \theta_0 + \theta_1 g$, with $\theta_1 < 0$. However, León-Ledesma and Thirlwall (1998) reversed the equation due to the potential possibility of the estimation of θ_0 and θ_1 being downward biased.

and Thirlwall, 2000, 2002; Perrotini-Hernández and Tlatelpa, 2003; León-Ledesma, 2006; Ciriaci, 2007; Lanzafame, 2009; Libânio, 2009; Vogel, 2009; Lanzafame, 2010; Dray and Thirlwall, 2011; Oreiro et al., 2012; Molerés-Regalado and Perrotini-Hernández, 2013; and Lanzafame, 2014). A large shared vision of methodology and substantial convergence of results supporting the endogeneity of the economy's natural growth rate have emerged out of the various statistical tests of the incumbent model. Yet, none of the above-mentioned analyses have dealt neither with the relationship between the different growth regimes (depressive, normal and expansive natural growth rates) and the growth rate of the economic capacity, nor with that between those growth regimes and the utilisation coefficient of economic capacity. The main purpose and contribution of the present paper, as will be shown later, is to cope with this *lacuna* providing such hitherto missing link analysis, as it were, by means of a formal model and an empirical assessment for the NAFTA economies.

While no discussion of the said *lacuna* is to be found in the relevant literature, Boggio and Seravalli (2002) and Boggio (2012) put forth a critical appraisal of León-Ledesma and Thirlwall's hypothesis. The gist of their criticism can be summarised as follows: if the natural growth rate is defined as the growth rate of output that keeps constant the rate of unemployment, then only a unique value can be obtained for the former even if the component elements of the natural growth rate are assumed to be increasing functions of the current growth rate. Let us suppose the following functional relationship of the growth rates of the labour force (n) and labour productivity (b):

$$n = n(g) \quad \text{with} \quad n(0) = n_0 > 0 \quad \text{and} \quad 0 < n' < 1 \qquad (3)$$

$$b = b(g) \quad \text{with} \quad b(0) = b_0 > 0 \quad \text{and} \quad 0 < b' < 1 \qquad (4)$$

where n' and b' are the first derivatives with respect to g. Given equations (3) and (4), the subsequent functional relationship obtains:

$$n + b = \varphi(g) \quad \text{with} \quad \varphi(0) = n_0 + b_0 > 0 \quad \text{and} \quad 0 < \varphi' < 1 \qquad (5)$$

where φ' is the first derivative with respect to g.

From equation (5), the following equality obtains:

$$g_1 = n_1 + b_1 = \varphi(g_1) \qquad (6)$$

Since $g - b$ yields the growth rate of the demand for labour and n is the growth rate of the labour supply, g_1, as defined by equation [6], is the natural growth rate. Now, suppose g takes on a value lower than g_1, say g_2; from [5] we gather that g_2 should correspond to a given value $n_2 + b_2$; yet $n_2 + b_2$ is higher than g_2, therefore:

$$g_2 < n_2 + b_2 = \varphi(g_2)$$

consequently, $g_2 - b_2$ is lower than n_2 and the rate of unemployment is increasing. Alternatively, suppose g is higher than g_1, say it is equal to g_3; from [5] it can be said that g_3 should correspond to $n_3 + b_3$; yet $n_3 + b_3$ is lower than g_3, therefore:

$$g_3 > n_3 + b_3 = f(g_3)$$

consequently, $g_3 - n_3$ is higher than n_3 and the rate of unemployment is decreasing. So the question arises as to how is it possible for León-Ledesma and Thirlwall (2000) to come up with more than one natural growth rate of output? According to Boggio and Seravalli (2002):

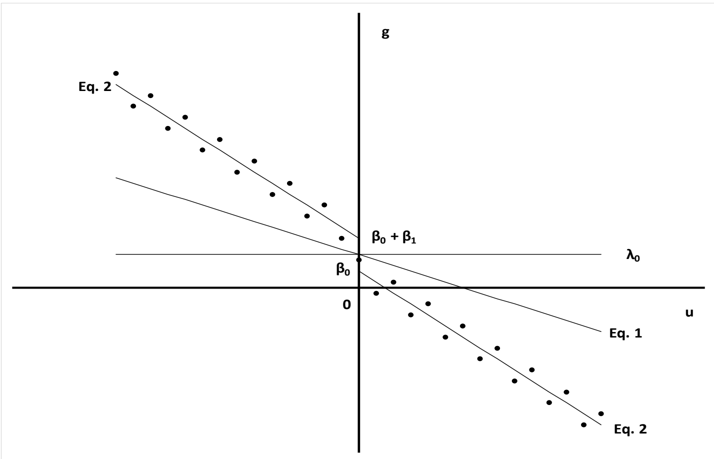
> "this possibility however raises serious difficulties: if f is continuous, it is necessary to explain why the effect of g on $(n + [b])$ is less than one to one [...] for certain intervals of g and larger than one to one [...] for certain other intervals." (Boggio and Seravalli, 2002, p. 223).

Moreover, Boggio (2012) contends that the estimations of equation (2) tend to be biased,[5] and if the bias is nearly as big as the OLS measure of β_1, León-Ledesma and Thirlwall's argument falls apart. Ledesma and Thirlwall's rebuttal (León-Ledesma and Thirlwall, 2002, p. 229) stresses that Boggio and Seravalli miss the point when arguing that the endogeneity of the natural rate of growth can be represented by continuous functions of the growth rates of the labour

[5] "[...] suppose an exogenous shock hits the economy, so that the error term is increased by μ_t. If as a consequence the division between the years with $g_t > [\beta_0]$ and the years with $[\beta_0] > g_t$ changes, as it is well possible, $[DU]$ will also change, hence it is not independent from the error term" (Boggio, 2012, p. 11).

force and of labour productivity with respect to the growth rate of output. Instead – they reply – they actually had assumed two growth regimes (see figure 1), a 'high' and a 'low' growth regime, and the natural rate of growth varies because of increasing labour force and productivity growth. As for their statistical procedure, León-Ledesma and Thirlwall (2002) contend that Boggio and Seravalli's critique is invalid in most cases, albeit it could be partially right in the few instances in which the estimated error of equation (2) is high.

Figure 1 – *Relationship between growth and unemployment changes in León-Ledesma and Thirlwall's model (equations 1 and 2)*



3. Capital accumulation, economic capacity utilisation and growth regimes

The above-surveyed literature neglects the roles of both capital accumulation and the growth rate of productive capacity. We maintain that effective demand problems, different growth regimes and capital accumulation can all be part of a model of the natural rate of growth (cf. Harrod, 1939).

In what follows, we assume an insufficient stock of capital – a term we borrow from the classical development economists[6] – and analyse the role of capital accumulation as a determinant of the natural rate of growth. Since the latter is defined as the growth rate of output that keeps constant the rate of unemployment, nil capital accumulation will imply a normal natural rate of growth equal to zero. We further categorize three scenarios depending on the rate of economic capacity utilisation, namely, expansive, normal and depressive.[7] Accordingly, the proper warranted growth rate is defined as the growth rate of output corresponding to normal economic capacity utilisation, whereas the natural rate of growth under normal conditions will be equal to the proper warranted rate of economic growth.

Our reasoning can be formalised as follows: the economy's productive capacity is given by the following equation (7):

$$CE_t = min(\sigma K_t, bL_t) \qquad (7)$$

where CE, K and L denote the economic capacity, the capital stock and employment, respectively; and σ and b are the average productivities of capital and labour, respectively.[8] The rate of economic capacity utilisation is represented by ψ:

$$\psi_t = \frac{Y_t}{CE_t} \qquad (8)$$

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[6] Lewis (1954), Nurkse (1953) and Prebisch (1970) speak of an insufficient supply of capital when its available quantity falls short of the amount needed to fully employ the existing labour force in the modern capitalist sector. Whilst such situation is idiosyncratic of developing countries, the theoretical structure of classical development economics lends itself to unravel some economic problems of developed countries (Ros, 2013).

[7] Our analysis is in agreement with the Kaleckian and neo-Kaleckian tradition in that the economy can achieve an equilibrium position with unused capacity where such equilibrium degree of capacity utilisation is determined endogenously (see Dutt, 1984, 1997; Hein et al., 2011; and Patriarca and Sardoni, 2014).

[8] There is no need to assume a complementary relationship between labour and capital, since a constant real wage due to an insufficient stock of capital suffices to derive a constant capital-labour ratio in the capitalist sector (see Ros, 2004).

where Y is the output level. Assuming that the economy faces an insufficient stock of capital and a normal degree of utilisation, the normal natural growth rate of output (nn) can be defined as:

$$nn_t = ce_t = \widehat{\sigma_t} + \widehat{K_t} \tag{9}$$

where ce is the growth rate of the economic capacity, $\hat{\sigma}$ is the growth rate of the productivity of capital, and $\hat{K}$ is the growth rate of the stock of capital. Moreover, given equation (7) the function of the demand for labour obtains as:

$$L_t^D = \frac{Y_t}{CE_t} \cdot \frac{CE_t}{b} = \frac{\psi_t \sigma K_t}{b} \tag{10}$$

Its growth rate is as follows:

$$\widehat{L_t^D} = \widehat{\psi_t} + \widehat{\sigma_t} + \widehat{K_t} - \widehat{b_t} = \widehat{\psi_t} + ce_t - \widehat{b_t} \tag{11}$$

where $\hat{\psi}$ is the growth rate of ψ and $\hat{b}$ is the growth rate of labour productivity. Equation (10) says that, for a given value of CE, the demand for labour is a function of ψ.

Now, let us suppose that the supply of labour is elastic vis-à-vis the demand for labour, pretty much along the lines of both León-Ledesma and Thirlwall (who actually assumed an endogenous behaviour of the supply of labour with respect to the growth regimes)[9] and Lewis (1954), who made the supply of labour (industrial employment) endogenous to capital accumulation. Our reasoning allows us to rewrite equation (1) as:

$$g_t = \omega_0 + \omega_1 \psi_t^a + \omega_2 u_t \tag{12}$$

where ψ^a is equal to $\hat{\psi}$ multiplied by ψ.[10] From this we can get the different estimated values of the natural rate of growth:

[9] It is also worth noting that León-Ledesma and Thirlwall's hypothesis hinges upon the endogenous response of the growth rate of labour productivity to the effective growth rate of output, i.e. Verdoorn's Law.

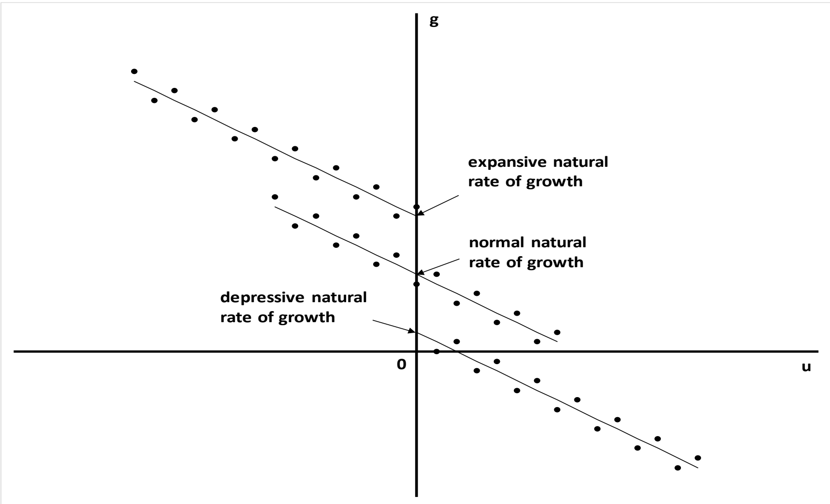
[10] We use $\hat{\psi}$ multiplied by ψ, because ψ alone could give an 'erroneous' state of the economy. For example, if at some point in time ψ is equal to its average value, the economy could be in a normal regime if $\hat{\psi}$ itself has been constant. Yet, if $\hat{\psi}$ has been decreasing or increasing, the economy could be in either a depressive or an expansive regime as well.

$$\begin{aligned} &\textit{expansive}: && en = \omega_0 + \omega_1 mx\psi^a \\ &\textit{normal}: && nn = \omega_0 + \omega_1 a\psi^a \\ &\textit{depressive}: && dn = \omega_0 + \omega_1 mn\psi^a \end{aligned} \quad (13)$$

where $mx\psi^a$, $a\psi^a$ and $mn\psi^a$ stand for the maximum, average and minimum values of ψ^a, respectively.

Our modified proposition for the endogenous natural rate of growth is shown in figure 2, which looks quite similar to figure 1. Yet, in figure 2 the corresponding values of the expansive, normal, and depressive natural rates of growth are a function of a given value of ψ^a.

Figure 2 – *Relationship between growth and unemployment changes, given the average utilisation of economic capacity (equation 13)*



Moreover, $[(dn/nn) - 1] \cdot 100$, henceforth *elasdep*, and $[(en/nn) - 1] \cdot 100$, henceforth *elasexp*, indicate the elasticity of the natural rate of growth in the depressive and expansive scenarios, respectively, which of course will not only depend on the growth rate of the economic capacity, but also on ψ^a.

4. Empirical analysis

Our aim in this part of the paper is to estimate the economic capacity and the depressive, normal and expansive natural economic growth rates of Canada, Mexico and the United States during the period 1971-2014 (1974-2014 for the case of Mexico). We aim at demonstrating that such growth regimes are related to both the growth rate of each country's economic capacity and their own rate of economic capacity utilisation.

4.1. Estimating the economic capacity of the NAFTA countries

In computing the economic capacity of Canada, Mexico and the United States, we follow Berlemann and Wesselhöft (2012) in building the capital stock series as the following relationship:

$$I_t = \alpha_{I0} + \alpha_{I1} t + \varepsilon_{It} \tag{14}$$

where I is the natural log of the Gross Capital Formation series (investment), t is a time trend variable, the α_{Ii} terms are the parameters to be estimated, and ε_I is an error term, and the subscript t indicates time. The results of the OLS estimation of the previous equation are shown in table 1, in which we report a number of further dummy variables that capture structural changes in Mexico's and the United States' dynamics of investment.

Table 1 – *OLS estimation of the investment series: equation (14)*

	Canada	**Mexico**	**United States**
	1970-2015	1960-2015	1970-2015
Constant	24.97*	26.55*	27.04*
	(693.86)	(545.65)	(858.24)
t	0.03*	0.08*	0.04*
	(33.54)	(20.42)	(37.51)
D82-15		0.34*	
		(3.58)	
$t \cdot$ D8215		–0.05*	
		(–10.20)	
D09-15			–0.29*
			(–7.83)
R^2	0.96	0.96	0.98

* : statistically significant at 1% level.

Notes: t-statistics between parentheses. D82-15 and D09-15 stand for dummy variables with value equal to 1 in the periods 1982-2015, and 2009- 2015, respectively, and 0 otherwise.
Source: elaboration on data from the *World Development Indicators* database of the World Bank.

In accord with equation (14), we estimate the initial I as:

$$I_{-1} = \alpha_{I0} - \alpha_{I1}$$

and the initial K as:

$$K_{-2} = \frac{I_{-1}}{\delta_{-1} + \alpha_{I1}}$$

where K is the natural log of the series of the stock of capital, and δ the rate of capital depreciation. We assume that the trend annual growth rate of investment is equal to the trend annual growth rate of the stock of capital. Table 2 summarises the initial values of the natural logs of both I and K for the NAFTA economies.

Table 2 – *Initial values of the natural logs of investment and the stock of capital*

Canada		Mexico		United States	
I_{1969}	K_{1968}	I_{1959}	K_{1958}	I_{1969}	K_{1968}
25.28	27.82	26.47	28.59	27.38	29.81

Source: elaboration on data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

For the subsequent period, the K series is built in accordance with the following equation:

$$K_t = (1 - \delta_{t-1})K_{t-1} + I_t \quad (15)$$

Following Shaikh (2016) we adjust both Y (the natural log of GDP) and K with the GDP price index (P_Y), in order to eliminate any spurious relative price term from the cointegration relationship between output and the stock of capital. Then, we use the so adjusted K to get the following expression:

$$KS_t = K_t \frac{P_{It}}{P_{Yt}} \quad (16)$$

where KS is the adjusted stock of capital and P_I is the investment price index. In the final step, we use Y and KS and, following Shaikh (2016), we estimate the CE of the NAFTA countries with a cointegration relationship approach, linking output (Y) and capital stock (KS), as expressed by equation (17):[11]

$$Y = \alpha_0 + \alpha_1 KS + \alpha_2 t + \varepsilon_t \quad (17)$$

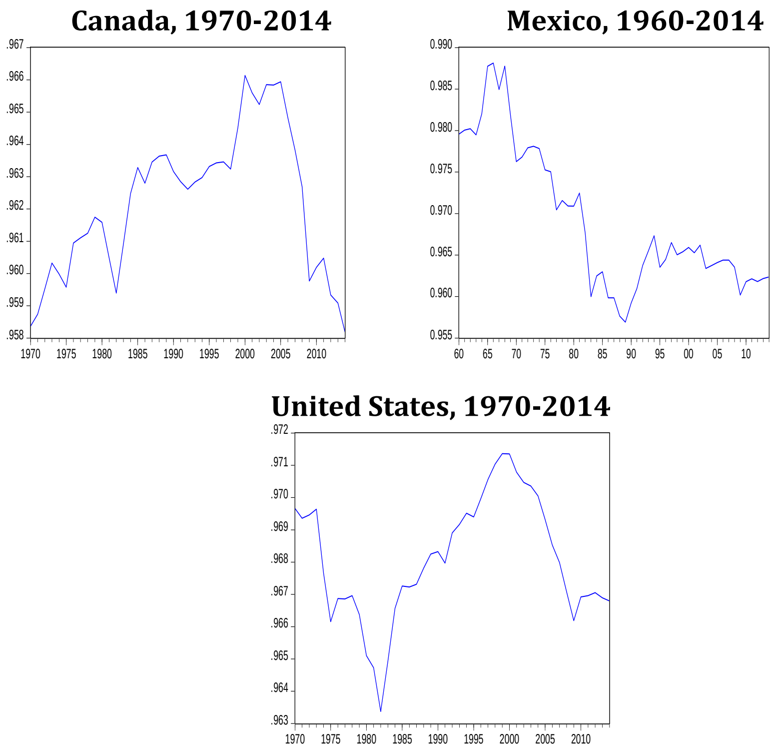
where both Y and KS are measured in constant local currency units.

We identified some structural breaks in the ratio Y/KS (see figure 3) in all three countries. In Canada, there appears to be a change in the trend behaviour of Y/KS from 2005 to 2014; in Mexico, two changes in the trend behaviour of Y/KS can be verified, the first one from 1965 to

[11] "[...] economic capacity is that aspect of output which is cointegrated with the capital stock over the long run, subject to a trend in the capital-capacity ratio due to technical change" (Shaikh, 2016, p. 825).

1968, and the second from 1983 to 1991; and for the United States, three changes in the trend behaviour of *Y/KS* are illustrated: the first from 1974 to 1982, the second from 1983 to 1999 and the third from 2000 to 2009. Hence, we incorporated some dummy and composed dummy[12] variables in the cointegration methodology to capture the structural breaks of the *Y/KS* behaviour. We use the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests to determine the integration order of the *Y* and *KS* series; the corresponding results are shown in table 3.

Figure 3 – *Ratio Y to KS*



Source: elaboration on data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

[12] A composed dummy variable is a dummy variable multiplied by a variable series.

Table 3 – *Unit root tests for the Y and KS series*

		Period	ADF test	Lags used	Phillips-Perron test	Bandwidth
Canada	Y_t	1970-2014	−2.61	1	−2.39	2
	d(Y_t)	1970-2014	−4.86*	0	−4.76*	4
	KS_t	1970-2014	−0.26	0	−0.51	1
	d(KS_t)	1970-2014	−4.99*	0	−4.91*	3
Mexico	Y_t	1960-2014	−2.77	0	−2.85	1
	d(Y_t)	1960-2014	−4.86*	0	−6.25*	5
	KS_t	1960-2014	−4.41**	0	−4.40**	3
United States	Y_t	1970-2014	−1.60	1	−1.03	3
	d(Y_t)	1970-2014	−4.84*	0	−4.64*	6
	KS_t	1970-2014	−3.58**	1	−2.47	3
	d(KS_t)	1970-2014	−3.24**	1	−2.51	4

* : statistically significant at 1% level; ** : statistically significant at 5% level.

Notes: The number of lags included is based on the Schwarz Information Criterion; the optimal bandwidth is based on the Newey-West Criterion. *d*(*Z*) stands for the first time difference of variable *Z*.
Source: elaboration on data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

As shown in table 3, *Y* is integrated of order 1 for all three countries; *KS* is so integrated for Canada and the United States, though for the case of Mexico *KS* is integrated of order 0. As dummy and composed variables were incorporated into the estimation, we used the Pesaran et al. (2001) autoregressive distributed lag (ADL) bound testing approach to test a long-run relationship between output and the stock of capital. 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 (the results of the ADL models and of the long-run relationship between output and the stock of capital are presented in the appendix, tables A1.1 through A1.3).

4.2. Endogenous natural rate and growth regimes

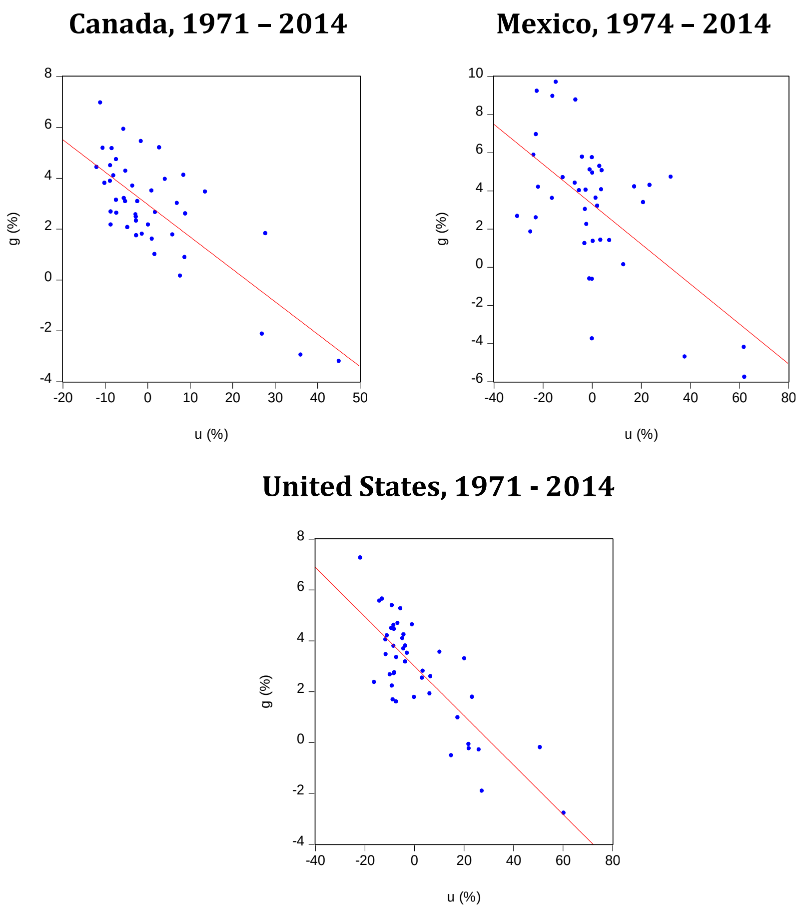
As shown in figure 4, the annual percentage variations of the unemployment rate (*u*) and of the annual growth rate of output (*g*) appear to be negatively correlated with one another throughout the period 1971-2014. More specifically, in the case of Canada, when the value of *u* lies between –5% and 5%, 14 observations of *g* fall within a long range of 1% to 4%,[13] while when *u* lies between –15% and –5%, 17 observations of *g* are within a long range of 2% to 7%. In the case of Mexico, when *u* lies between –10% and 10%, 21 observations of *g* fall within a long range of –4% to 6%,[14] while when *u* lies between –30% and –10%, 10 observations of *g* are within a long range of 0% to 10%. In the United States, when *u* lies between –5% and 5%, 10 observations of *g* fall within a long range of 1% to 5%, and when *u* lies between –15% and –5%, 19 observations of *g* are within a long range of 1% to 6%. The fact that in all three countries a long range of *g* happens to go along either with a more or less constant *u* or a decreasing *u* alike, signals the apparent existence of different growth regimes in such economies.

We estimate equation (12) on data of three different time spans, namely, the whole period of analysis, the pre-NAFTA period (1971-1993) and the NAFTA phase (1994-2014). Then, using equation (13), we calculate the depressive, normal and expansive natural rates of growth (henceforth *dn*, *nn* and *en*, respectively). The results of the OLS estimation are shown in table 4, and those of the natural rates of growth for each country and time periods are reported in table 5. As can be readily seen from table 4, the residuals of the estimations are normally distributed, not autocorrelated and homoscedastic. In most cases, we used dummy variables to capture irregular values or structural changes of the dependent variable; the estimated parameters have the correct sign in all cases and are statistically significant at least at 5% level. A perusal of table 5 confirms that *nn* and *ce* are positively correlated in the three countries under

[13] We dropped two extreme values of *g*, corresponding to a range of 5% to 6%.
[14] We dropped an extreme value of *g*, corresponding to a range of 8% to 10%.

consideration (see figure 5). In all cases *ce* reached its highest value during the pre-NAFTA sub-period, and its lowest value during the NAFTA phase. The same is true of *nn*.

Figure 4 – *Annual rate of change of the unemployment rate and annual growth rate of output*



Source: elaboration on data from the *World Development Indicators* of the World Bank, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

Table 4 – *OLS estimation of g, equation* (12)

	Canada			Mexico			USA		
	1971-2014	**1971-1993**	**1994-2014**	**1974-2014**	**1974-1993**	**1994-2014**	**1971-2014**	**1971-1993**	**1994-2014**
ψ^a	0.22*	0.29**	0.22	0.32*	0.19**	0.52*	0.39*	0.47*	0.18**
	(2.74)	(2.56)		(4.98)	(2.90)	(6.83)	(5.19)	(5.03)	(2.15)
u	−0.12*	−0.12*	−0.12*	−0.07*	−0.07**	−0.05**	−0.09*	−0.10*	−0.08*
	(−8.31)	(−6.72)	(−5.76)	(−3.90)	(−2.65)	(−2.38)	(−10.63)	(−7.44)	(−10.14)
Constant	2.62*	2.90*	2.40*	3.01*	4.28*	2.51*	3.06*	3.20*	3.21*
	(15.91)	(10.66)	(11.83)	(9.19)	(8.39)	(6.83)	(25.98)	(23.97)	(20.57)
D71-76	2.23*	1.93*							
	(4.95)	(3.68)							
D77-81				4.04*	2.92*				
				(4.90)	(3.69)				
D82-88				−2.26**	−3.86*				
				(−2.69)	(−4.48)				
D71							2.40*	2.56*	
							(3.34)	(3.98)	
D75							2.98*	3.75*	
							(3.74)	(4.66)	
D11-14							−2.05*		−2.05*
							(−5.36)		(−6.69)
D05-10									−0.98*
									(−3.57)
R^2	0.78	0.82	0.64	0.79	0.90	0.78	0.90	0.95	0.94
Jarque-Bera	2.56	1.43	1.52	0.02	0.07	0.49	0.11	1.06	0.22
LM test (F-stat)	2.21	0.47	0.56	0.0002	0.008	0.89	0.50	0.34	0.03
White test (F-stat)	1.27	1.46	1.24	0.85	0.81	1.22	0.52	0.31	1.39

* : statistically significant at 1% level; ** : statistically significant at 5% level.

Notes: t-statistics in parentheses. The LM tests include one lag of the residual variable. The White tests include cross terms. For Canada in the 1994-2014 period, the estimated parameter corresponding to ψ^a was not significant, though it was not statistically different to the value found for the 1971–2014 period. So we regressed g – 0.22ψ^a with respect to a constant and u. For Mexico in the first and second period, 1983 and 1992 were omitted as in those years a structural break of the economic capacity coincided with maximum and minimum values of ψ^a, which distorted the growth regime indicated by the value of ψ^a. For the United States in the first and second period, 1974 and 1983 were omitted as in those years a structural break of the economic capacity coincided with maximum and minimum values of ψ^a, which distorted the growth regime indicated by the value of ψ^a. D stands for a dummy variable with value equal to 1 in the relevant year or period, and 0 otherwise. The unit root test for the time series used and the estimation of ψ^a are found in the appendix.

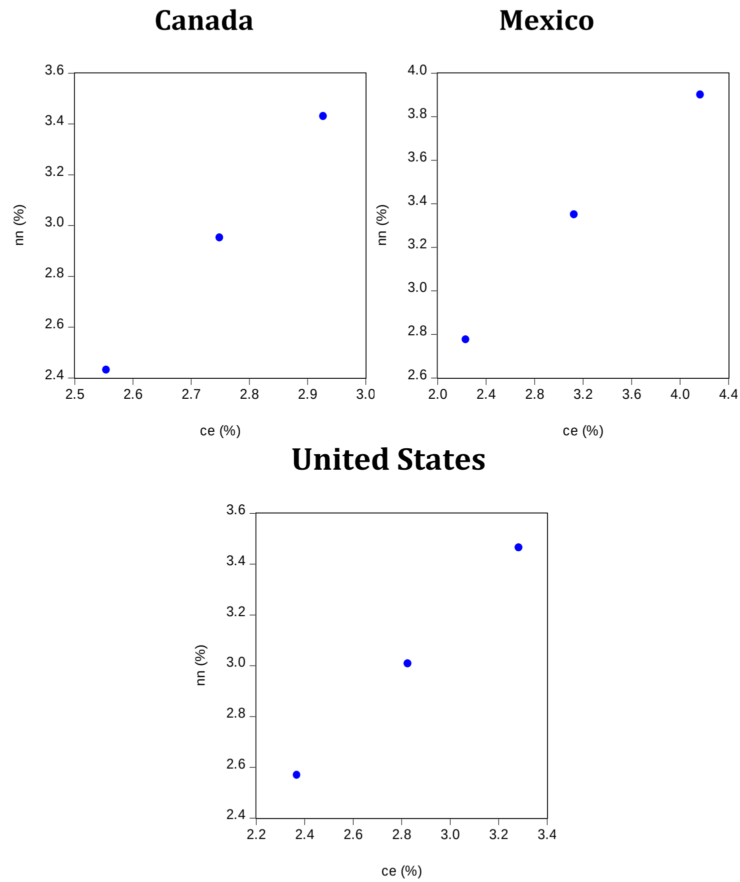
Table 5 – *Natural rates of growth*

	Canada			Mexico			USA		
	1971-2014	**1971-1993**	**1994-2014**	**1974-2014**	**1974-1993**	**1994-2014**	**1971-2014**	**1971-1993**	**1994-2014**
$mn\psi^a$	−4.74	−4.23	−4.74	−10.11	−10.11	−9.22	−3.87	−3.87	−1.82
$a\psi^a$	0.12	0.10	0.15	0.53	0.55	0.51	0.05	−0.07	0.16
$mx\psi^a$	4.94	4.68	4.94	8.03	8.03	6.97	4.60	4.25	2.73
dn	1.87	2.18	1.34	−0.07	1.90	−2.24	1.47	1.69	2.21
nn	2.95	3.43	2.43	3.35	3.90	2.78	3.01	3.46	2.57
en	4.03	4.75	3.50	5.76	5.31	6.11	4.79	5.48	3.03
elasdep	−36.68	−36.36	−44.74	−102.00	−51.37	−180.83	−51.07	−51.28	−13.80
elasexp	36.36	38.41	43.95	71.88	36.04	120.06	59.40	58.21	17.97
ce	2.75	2.93	2.55	3.13	4.17	2.23	2.83	3.28	2.37

Notes: the estimation of *ce* is found in the appendix. For Mexico in the first and second period, 1983 and 1992 were omitted as in those years a structural break of the economic capacity coincided with maximum and minimum values of ψ^a, which distorted the growth regime indicated by the value of ψ^a. For the USA in the first and second period, 1974 and 1983 were omitted as in those years a structural break of the economic capacity coincided with maximum and minimum values of ψ^a, which distorted the growth regime indicated by the value of ψ^a.

Source: elaboration on data from the *World Development Indicators* of the World Bank, the *World Penn Table 9.0* database, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

Figure 5 – *Annual growth rate of economic capacity and normal natural rate of growth for the subperiods under analysis*



Source: elaboration on data from the *World Development Indicators* of the World Bank, the *World Penn Table 9.0* database, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

We also found that the three NAFTA countries' natural rate of growth is endogenous to the growth regimes. Mexico exhibited the highest elasticity of the natural rate of growth in the expansive and depressive regimes throughout the whole period of analysis, while Canada displayed the lowest one. During the pre-NAFTA sub-period, Mexico and the United States showed the highest elasticity of the natural rate of growth in the depressive regime and the United States the highest elasticity in the expansive regime, whilst Canada displayed the lowest elasticity with respect to both the depressive and the expansive regimes. Throughout the NAFTA sub-period Mexico showed the highest elasticity with respect to both regimes, depressive and expansive, whereas the United States displayed the lowest elasticity. The decrease of the normal natural rate of growth in all three countries during the NAFTA period coincides with an increase in the elasticity with respect to both regimes in Canada and Mexico, where, as a result of the lower growth regime, such phenomena overlapped with the worsening of the working class's economic conditions.

It is worth mentioning that, throughout all periods and sub-periods alike, Mexico's elasticity with respect to the depressive regime was higher than the elasticity with respect to the expansive regime, implying that Mexican workers are more likely to lose their jobs in a depressive cyclical phase than to enter the labour market and get a job over an expansive stage. These phenomena appear to mirror a more precarious condition of Mexico's labour market as opposed to the corresponding prevailing conditions in its NAFTA trade partners.

The increase in Canada's elasticities with respect to both the expansive and depressive regimes could also be a result of the reversal – from an increasing to a decreasing – of the trend of the rate of labour force participation between 1971-1989 (when there was an increasing tendency) and 2003-2014 (when the tendency was decreasing: Bernard and Usalcas, 2014). While Canada does not face high immigration flows in absolute terms, measured by world standards, it has exhibited a high proportion of immigrants relative to the Canadian population over the last years (OECD, 2015).

In contrast, in the United States the diminution of the elasticities with respect to both the expansive and depressive regimes has overlapped with a dwindling labour force participation rate, and with tougher immigration law enforcement efforts that reduced the immigration flows from Mexico and other developing countries over the past two decades: by 2012 the annual migration rate in the USA had dropped from 25 Mexican migrants per thousand to 7 migrants per thousand (Villarreal, 2014).

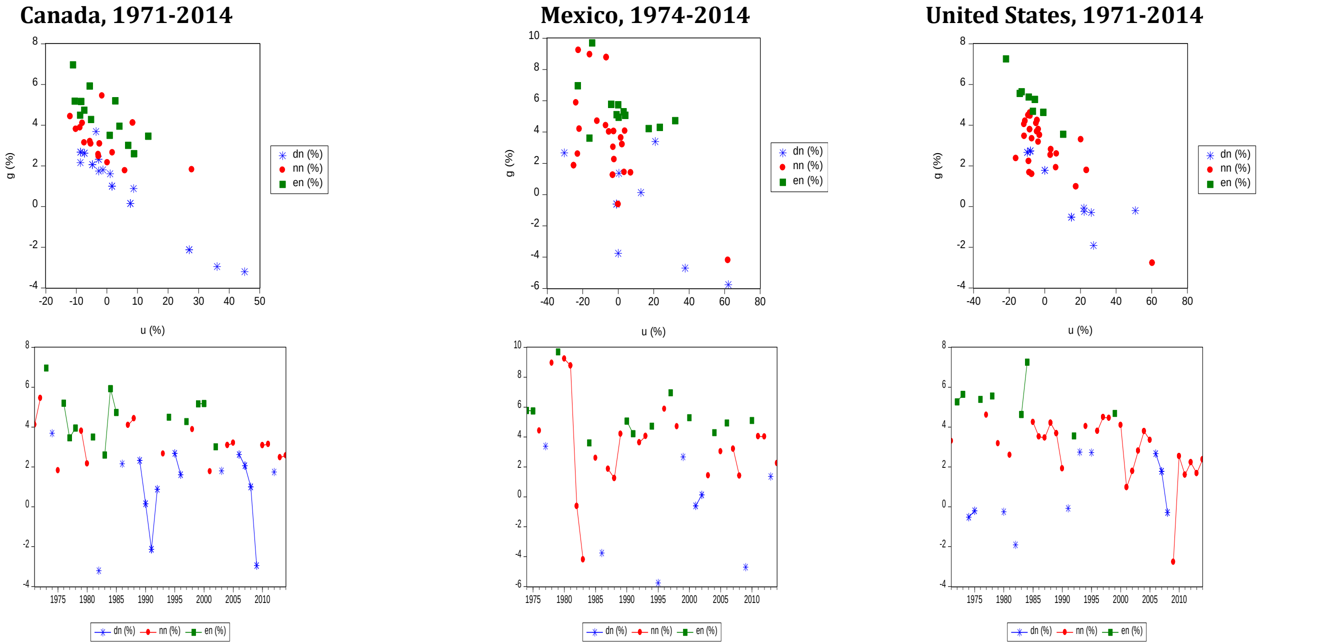
Finally, taking advantage of the estimations from table 1, we represent in the figures 6 and 7 the relationships between the annual percentage variations of the unemployment rate and the growth rate of output for the depressive, normal and expansive growth regimes. The graphs display output growth rate values compliant with the growth regime occurred each year.[15] As can be readily seen, there is a good fit with respect to each year's growth regime identified for the three countries under analysis, regardless of whether we use the estimated parameters for the whole period or, instead, those for the pre-NAFTA and NAFTA phases.

5. Conclusions

A number of empirical studies have reached the conclusion that the natural rate of economic growth, defined as the sum of the growth rates of both employment and labour productivity, is endogenous to demand. Effective demand is crucial for the determination of the natural rate of growth, indeed. For example, a continuous sub-utilisation of the economic capacity due to insufficient demand will impart negative effects on the incentives to invest, thus depressing the natural rate of growth.

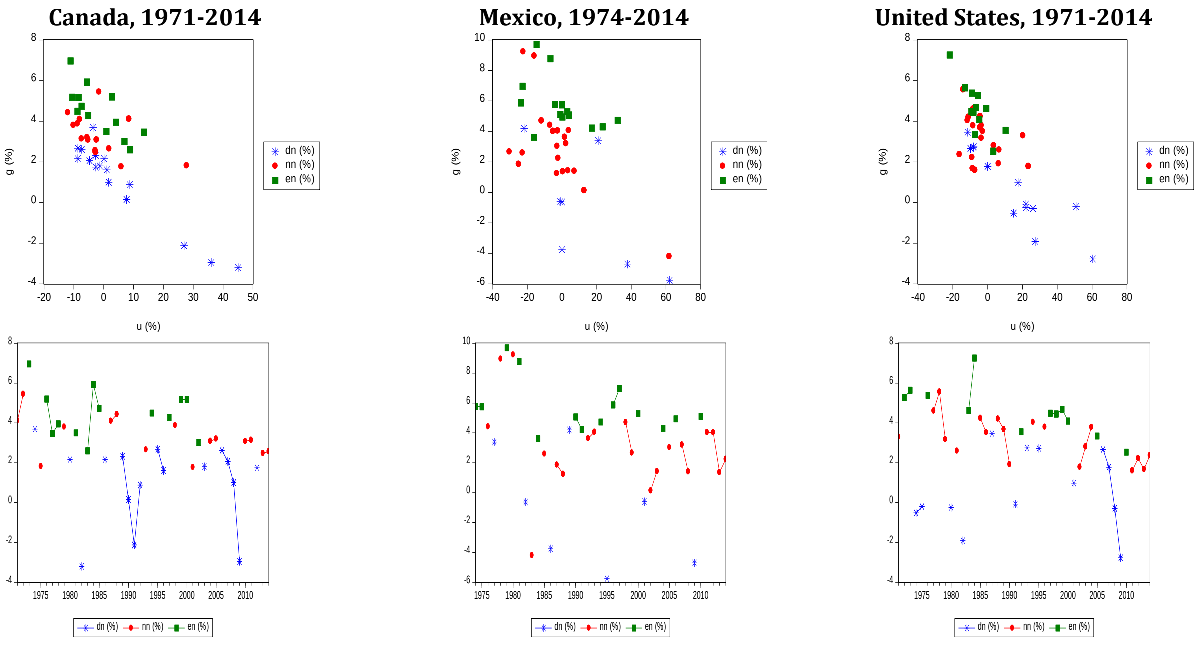
[15] The estimated equations shown in table 1 were used this way: first we fixed values of ψ^a for mnψ^a, aψ^a and mxψ^a; then, with the u series, we built three relationships between u and g, for the depressive, normal and expansive regimes; finally, we got the errors of each case with respect to the actual values of g and took the lowest error to indicate the growth regime corresponding to each year.

Figure 6 – *Relationship between u and g (top panel) and g (bottom panel) corresponding to each growth regime, using the estimated parameters for the whole period*



Note: solid lines represent years when the growth regime did not change.
Source: elaboration on data from the *World Development Indicators* of the World Bank, the *World Penn Table 9.0* database, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

Figure 7 – *Relationship between u and g (top panel) and g (bottom panel) corresponding to each growth regime, using the estimated parameters for the pre-NAFTA and NAFTA subperiods*



Note: solid lines represent years when the growth regime did not change.
Source: elaboration on data from the *World Development Indicators* of the World Bank, the *World Penn Table 9.0* database, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

Appendix. Long-run relationship between output and the stock of capital

Table A1.1 – *Autoregressive distributed lag models, dependent variable:* Y_t

	Canada	**Mexico**	**USA**
	1970-2014	1960-2014	1970-2014
Y_{t-1}	0.93*	0.78*	0.35**
	(8.26)	(8.08)	(2.64)
Y_{t-2}	–0.33*	–0.19***	–0.18***
	(–3.05)	(–1.82)	(–1.88)
Y_{t-3}		–0.20**	
		(–2.05)	
Y_{t-4}		0.19***	
		(2.01)	
$D05\text{-}14_t$	9.32*		
	(3.58)		
$D65\text{-}68_t$		–0.01	
		(–0.66)	
$D65\text{-}68_{t-1}$		0.04***	
		(1.72)	
$D65\text{-}68_{t-2}$		0.05**	
		(2.39)	
$D65\text{-}68_{t-3}$		–0.03**	
		(–2.10)	
$D83\text{-}91_t$		–0.07**	
		(–2.67)	
$D83\text{-}91_{t-1}$		–0.02	
		(–0.83)	
$D83\text{-}91_{t-2}$		–0.02*	
		(–3.09)	
$D8391_{t-3}$		–0.06*	
		(–7.58)	
$D83\text{-}91_{t-4}$		0.04*	
		(3.63)	
$D74\text{-}82_t$			–36.45*
			(–5.55)
$D74\text{-}82_{t-1}$			40.39*
			(6.77)

(*continued*)

(*continues*)

	Canada	**Mexico**	**USA**
	1970-2014	1960-2014	1970-2014
$D83\text{-}99_t$			25.75*
			(4.58)
$D83\text{-}99_{t-1}$			–37.79*
			(–6.29)
$D00\text{-}09_t$			9.25*
			(6.22)
KS_t	0.26***	–0.03	1.78*
	(1.85)	(–0.44)	(12.00)
KS_{t-1}	0.21	0.33*	1.35*
	(1.59)	(4.36)	(–5.60)
KS_{t-2}			0.34**
			(2.53)
KS_t * $D05\text{-}14_t$	–0.32*		
	(–3.58)		
KS_t * $D74\text{-}82_t$			1.20*
			(5.54)
KS_{t-1} * $D74\text{-}82_{t-1}$			–1.33*
			(–6.77)
KS_t * $D83\text{-}99_t$			–0.83*
			(–4.57)
KS_{t-1} * $D83\text{-}99_{t-1}$			1.22*
			(6.29)
KS_t * $D00\text{-}09_t$			–0.30*
			(–6.23)
KS_{t-1} * $D00\text{-}09_{t-1}$			0.001*
			(2.92)
$D82_t$	–0.08		
	(–6.37)		
$D91_t$	–0.03**		–0.03*
	(–2.62)		(–4.09)
$D09_t$	–0.05*	–0.06*	
	(–3.72)	(–10.15)	
$D95_t$		–0.14*	
		(–11.14)	
$D75_t$			–0.02
			(–1.43)

(*continued*)

(*continues*)

	Canada	Mexico	USA
	1970-2014	1960-2014	1970-2014
$D76_t$			0.04*
			(3.41)
Constant	–2.31*	3.45*	1.26*
	(–3.07)	(3.28)	(5.97)
t		–0.001	
		(–0.71)	
R^2	0.9992	0.9992	0.9999
Jarque-Bera test	0.23	0.69	1.83
LM test (*F*-statistics)	0.05	0.92	0.36
White test (*F*-statistics)	1.02	1.90***	0.40

* : statistically significant at 1% level. ** : statistically significant at 5% level. *** : statistically significant at 10% level.

Notes: t-statistics in parentheses. The LM tests include one lag of the residuals variable. The White tests do not include cross terms. For Mexico we use White heteroscedasticity-consistent standard errors and covariance for the estimation of the t-statistics. *D* stands for a dummy variable with value equal to 1 in the relevant year or period, and 0 otherwise.
Source: elaboration using data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

Table A1.2 – *ADL long-run forms and bounds tests, dependent variable:* d(Y_t)

	Canada	**Mexico**	**USA**
	1970-2014	1960-2014	1970-2014
Constant	–2.31*	3.45*	1.26*
	(–3.07)	(3.13)	(5.97)
t		–0.001	
		(–0.69)	
Y_{t-1}	–0.41*	–0.42*	–0.83*
	(–4.01)	(–4.17)	(–6.32)
D05-14$_t$ †	9.32*		
	(3.58)		
D65-68$_{t-1}$		0.04	
		(1.65)	
D83-91$_{t-1}$		-0.12*	
		(–5.31)	
D74-82$_{t-1}$			3.94**
			(2.72)
D83-99$_{t-1}$			–12.04*
			(6.14)
D00-09$_t$ †			9.25*
			(6.22)
KS_{t-1}	0.47*	0.30*	0.76*
	(3.85)	(4.11)	(6.22)
KS_t * D05-14$_t$ †	–0.32*		
	(–3.58)		
KS_{t-1} * D74-82$_{t-1}$			–0.13*
			(2.82)
KS_{t-1} * D83-99$_{t-1}$			0.39*
			(6.16)
KS_{t-1} * D00-09$_{t-1}$			–0.29*
			(–6.22)
d(Y_{t-1})	0.33*	0.20***	0.18***
	(3.05)	(1.86)	(1.88)
d(Y_{t-2})		0.01	
		(0.12)	

(*continued*)

(*continues*)

	Canada	**Mexico**	**USA**
	1970-2014	1960-2014	1970-2014
d(Y_{t-3})		−0.19***	
		(−1.79)	
d(D65-68$_t$)		−0.01	
		(−0.73)	
d(D65-68$_{t-1}$)		−0.02	
		(−1.01)	
d(D65-68$_{t-2}$)		0.03***	
		(1.98)	
d(D83-91$_t$)		−0.07*	
		(−3.70)	
d(D83-91$_{t-1}$)		0.04**	
		(2.39)	
d(D83-91$_{t-2}$)		0.02	
		(1.11)	
d(D83-91$_{t-3}$)		−0.04***	
		(−1.76)	
d(D74-82$_t$)			−36.45*
			(−5.55)
d(D83-99$_t$)			25.75*
			(4.58)
d(KS_t)	0.26***	−0.03	1.78*
	(1.85)	(−0.46)	(12.00)
d(KS_{t-1})			−0.34**
			(−2.53)
d(KS_t * D74-82$_t$)			1.20*
			(5.54)
d(KS_t * D83-99$_t$)			−0.83*
			(−4.57)
d(KS_t * D00-09$_t$)			−0.30*
			(−6.23)
D82$_t$	−0.08*		
	(−6.37)		
D91$_t$	−0.03**		−0.03*
	(−2.62)		(−4.09)
D09$_t$	−0.05*	−0.06*	
	(−3.72)	(−3.08)	
D95$_t$		−0.14*	
		(−4.57)	

(*continued*)

(*continues*)

	Canada	**Mexico**	**USA**
	1970-2014	1960-2014	1970-2014
$D75_t$			–0.02
			(–1.43)
$D76_t$			0.04*
			(3.41)
	F-Bounds Test		
F-statistics (k = 3)	5.85**	9.40*	18.88*
	t-Bounds Test		
t-statistics	–4.01**	–4.17**	–6.32*

* : statistically significant at 1% level; ** : statistically significant at 5% level; *** : statistically significant at 10% level.
† : variable interpreted as $Z_t = Z_{t-1} + d(Z_t)$.

Notes: t-statistics in parentheses. F-bounds tests for Canada and the USA, critical values based on samples equal to 40 and 45, for Mexico, critical values based on samples equal to 50 and 55. *D* stands for a dummy variable with value equal to 1 in the relevant year or period, and 0 otherwise. $d(Z)$ means the first time difference of variable *Z*.
Source: elaboration on data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

Table A1.3 – *Error correction forms, dependent variable: d*(Y_t)

	Canada	**Mexico**	**USA**
Constant	−2.31*	3.45*	1.26*
	(−4.99)	(6.58)	(14.12)
t		−0.001*	
		(−3.42)	
d(Y_{t-1})	0.33*	0.20**	0.18*
	(3.74)	(2.39)	(2.87)
d(Y_{t-2})		0.01	
		(0.14)	
d(Y_{t-3})		−0.19**	
		(−2.20)	
d(D65-68$_t$)		−0.01	
		(−0.94)	
d(D65-68$_{t-1}$)		−0.02	
		(−1.20)	
d(D65-68$_{t-2}$)		0.03**	
		(2.41)	
d(D83-91$_t$)		−0.07*	
		(−4.11)	
d(D83-91$_{t-1}$)		0.04**	
		(2.54)	
d(D83-91$_{t-2}$)		0.02	
		(1.18)	
d(D83-91$_{t-3}$)		−0.04***	
		(−1.86)	
d(D74-82$_t$)			−36.45*
			(−10.93)
d(D83-99$_t$)			25.75*
			(10.68)
d(KS_t)	0.26**	−0.03	1.78*
	(2.12)	(0.56)	(16.79)
d(KS_{t-1})			−0.34*
			(3.53)
d(KS_t * D74-82$_t$)			1.20*
			(10.91)
d(KS_t * D83-99$_t$)			−0.83*
			(10.66)
d(KS_t * D00-09$_t$)			−0.30*
			(−14.07)
D82$_t$	−0.08*		

(*continued*)

(*continues*)

	Canada	Mexico	USA
	(−6.71)		
$D91_t$	−0.03*		−0.03*
	(−2.78)		(−5.07)
$D09_t$	−0.05*	−0.06*	
	(−5.04)	(−3.24)	
$D95_t$		−0.14*	
		(−4.88)	
$D75_t$			−0.02*
			(−3.08)
$D76_t$			0.04*
			(7.39)
ε_{t-1}	−0.41*	−0.42*	−0.83*
	(−5.04)	(−6.41)	(−14.03)
	t-Bounds Test		
t-statistics	−5.04*	−6.41*	−14.03*

* : statistically significant at 1% level; ** : statistically significant at 5% level; *** : statistically significant at 10% level.

Notes: *t*-statistics in parentheses. *D* stands for a dummy variable with value equal to 1 in the relevant year or period, and 0 otherwise. *d*(*Z*) means the first time difference of variable *Z*.
Source: elaboration on data from the *World Development Indicators* database of the World Bank, and the *World Penn Table 9.0* database.

Table A2 – Unit root tests

		Period	ADF test	Lags Used	Phillips-Perron test	Bandwidth
Canada	g_t	1971-2014	–4.68*	0	–4.61*	3
	$\psi^a{}_t$	1971-2014	–6.82*	1	–11.59*	41
	u_t	1971-2014	–5.32*	0	–5.43*	10
	g_t	1971-1993	–3.22**	0	–3.20**	2
	$\psi^a{}_t$	1971-1993	–4.37*	1	–3.78*	7
	u_t	1971-1993	–3.89*	0	–3.90*	1
	g_t	1994-2014	–3.39**	0	–3.39**	0
	$\psi^a{}_t$	1994-2014	–5.19*	1	–7.22*	20
	u_t	1994-2014	–3.79**	0	–3.73*	3
Mexico	g_t	1974-2014	–4.84*	0	–4.80*	2
	$\psi^a{}_t$	1974-2014	–7.19*	1	–10.98*	8
	u_t	1974-2014	–5.55*	0	–5.51*	4
	g_t	1974-1993	–2.57	0	–2.55	3
	$\psi^a{}_t$	1974-1993	–5.63*	0	–6.49*	5
	u_t	1974-1993	–4.32*	0	–4.33*	2
	g_t	1994-2014	–4.83*	0	–6.13*	5
	$\psi^a{}_t$	1994-2014	–6.86*	1	–11.59*	20
	u_t	1994-2014	–3.59**	0	–3.60**	1
United States	g_t	1971-2014	–4.77*	0	–4.57*	6
	$\psi^a{}_t$	1971-2014	–7.26*	0	–7.26*	2
	u_t	1971-2014	–5.59*	1	–5.22*	15
	g_t	1971-1993	–3.90*	0	–3.86*	4
	$\psi^a{}_t$	1971-1993	–5.07*	0	–5.07*	0
	u_t	1971-1993	–4.58*	1	–4.47*	6
	g_t	1994-2014	–2.46	0	–2.46	0
	$\psi^a{}_t$	1994-2014	–5.03*	0	–5.06*	2
	u_t	1994-2014	–3.18**	1	–2.58	2

* : statistically significant at 1% level; ** : statistically significant at 5% level.

Notes: the number of lags included is based on the Schwarz Information Criterion, and the optimal bandwidth is based on Newey-West Criterion. For the case of Mexico in the period 1974-1993, g_t, assuming the existence of an intercept break point at 1981, was found to be I(0). The ADF test is equal to –4.61, which is statistically significant at the 5% level. For the case of the USA in the period 1994-2014, the ADF-GLS test showed that g is I(0), while the DF-GLS test is equal to –2.52, which is statistically significant at the 5% level. $d(Z)$ means the first time difference of variable Z.

Source: elaboration on data from the *World Development Indicators* of the World Bank, the *World Penn Table 9.0* database, and the *Termómetro de la Economía Mexicana* database of the webpage Mexico Maxico (www.mexicomaxico.org).

Yet, we have argued in this paper that none of the received empirical analyses have dealt with the role of both the growth rate of economic capacity and capital accumulation in the determination of the natural rate of economic growth. If the former variables are taken into account, then the latter is shown to be endogenous not just to the growth rate of output itself or to the growth regimes (León-Ledesma and Thirlwall, 1998), but also to both the growth rate of economic capacity and capital accumulation, the importance of effective demand notwithstanding. Hence, if there is no capital accumulation at all, the natural rate of growth will be equal to zero, as, given a normal utilisation of economic capacity, the *normal* natural rate of growth will be equal to the growth rate of the economic capacity. We have also argued that the effective demand problem raised by León-Ledesma and Thirlwall (1998) can be consistently combined with the capital accumulation problem set forth by some classical development economists (Lewis, 1954; Nurkse, 1953; Prebisch, 1970).

Finally, with the aim of testing our hypothesis empirically, we estimated the depressive, normal and expansive natural economic growth rates of Canada, Mexico and the United States for different spans of time. Our results show that those growth regimes appear to be related to the utilisation coefficients of economic capacity, while the elasticities of the natural rates of growth with respect to the expansive and depressive regimes vis-à-vis the normal rate of growth are related to effective demand problems. Interestingly, it was also found that the depressive, normal and expansive natural rates of growth decreased ever since the inception of NAFTA (1994), due to the concomitant decline of the growth rate of economic capacity.

Given the long-run relationships reported in table A1.2, CE was estimated for each of the NAFTA countries as follows: we generated a milestone series, as it were, using those long-run relationships and got its annual growth rate. Next, each country's highest annual growth rate of Y reached in any particular year was taken to be equal to CE ($Y = CE$) and, using the milestone annual growth rate series, the final CE series was generated. The CE series was used to get ψ as the ratio Y/CE. Lastly, with the aim of estimating equation (12) for each country in the sample, the ADF and the PP unit root tests were applied to determine the integration order of g, ψ^a and u for the NAFTA economies. Table A2 summarises the results.

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