Capital Accumulation as a Determinant of Economic Growth and the Balance-of-Payments Constraint: The Case of Mexico, 1951-2014.

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Introduction

What is the main growth restriction of the economies? According to Thirlwall (1979), the Balance of Payments (BoP) is the main restriction. However, according to many authors from diverse theoretical perspectives, capital accumulation and technological progress are the main engine of economic growth. The aim of this paper is to reconcile both arguments; so, based on the ideas of the development theory and of Harrod, we consider that capital accumulation and the growth rate of capital productivity could affect the growth rate of demand for imports because they generate economic capacity which in turn could generate an import substitution process, and therefore they are, apart from the growth rate of exports, determinants of the long-run growth rate of output which is consistent with BoP equilibrium.

This paper is divided in six sections considering this introduction; in the second one we develop the "weak" version of Thirlwall's Law; in the third one we develop the growth model for a small open economy developed by Clavijo and Ros (2015) in which capital accumulation is the engine of growth, then we compare this model with Thirlwall's model; in the fourth one we develop a model in which capital accumulation and the growth rate of capital productivity are determinants of the long-run growth rate of output which is consistent with a constant position of the BoP as a percentage of the GDP; in section fifth we apply our model to the Mexican case for the 1951 – 2014 period, we find that the slowdown of the growth rate exhibited by the Mexican economy after the Debt Crisis of 1982 is a result of the

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slowdown of the capital accumulation and of the growth rate of capital productivity; finally, in section sixth we present our final remarks.

The "weak" version of Thirlwall's Law

Suppose a small open economy for which the growth rate of exports (x) is given (x^0):

$$x = x^0 \qquad (1)$$

and for which the growth rate of imports (m), measured in domestic output, is a function of the growth rate of output (g):

$$m = \psi g \qquad (2)$$

where ψ is the income elasticity of demand for imports. Dynamic BoP equilibrium, given an initial equilibrium between exports and imports, requires that the growth rate of exports be equal to the growth rate of imports:

$$x = m \qquad (3)$$

Substituting equations (1) and (2) in equation (3) and solving for g we get:

$$g_{tb} = \frac{x^0}{\psi} \qquad (4)$$

where g_{tb} is the long-run growth rate of output which is consistent with dynamic BoP equilibrium. As it can be seen in equation (4), capital accumulation does not have any role in the determination of the long-run growth rate of output, which is determined by the demand side, through the role of the growth rate of exports, and by the international specialization, through the role of the income elasticity of demand for imports.

Capital accumulation as the engine of growth for the case of a small open economy.

However, Ros and Clavijo (2015) argues that the main engine of the long-run growth rate of output is capital accumulation, they use the following questions in order to begin their arguments:

> "Why did the Japanese economy grow much faster that the Great Britain during the four first decades of the post-war period? Why has the Chinese economy grown between 4 and 5 times much faster than the Mexican economy during the last thirty years? Are those differences in growth rates due to differences in the pattern of trade specialization and the resulting differences in the income elasticities of exports and imports? Or do they have more to do with the fact that the investment rate in Japan was much higher than that of the Great Britain and that of China more than two times higher than that of Mexico?" (Ros and Clavijo, 2015: 81, own translation).

So, Clavijo and Ros (2015) develops a model in which the long-run growth rate of a small open economy is determined by capital accumulation but in which there is not a BoP restriction because capital flows are endogenous to the behavior of the domestic savings. Let suppose a small open economy in which there is an unlimited supply of labor[1] and the real wage in terms of the domestic output (*W/P*) is given; this economy produces only one good (*Y*) through the use of capital stock (*K*), labor (*L*) and technology (*A*); the production process can be expressed through the following production function:

$$Y = AK^{\alpha}L^{1-\alpha} \qquad (5)$$

where α and $1\text{-}\alpha$ are capital and labor elasticities of output respectively. The domestic output is used as a consumption good (*C*) and as an export good (*X*) whilst all the investment goods are imported and nothing more is imported. Firms maximize their profits and therefore they demand labor to the point in which the Marginal Product of Labor (*MgPL*) is equal to *W/P*:

$$\frac{W}{P} = MgPL = (1-\alpha)A\left(\frac{K}{L}\right)^{\alpha} \qquad (6)$$

Suppose that workers do not save at all, whilst a fraction (s_{Π}) of profits (Π) is saved by firms. Given all the previous assumptions, the equilibrium for the domestic goods market implies that:

$$Y = C + X \qquad (7)$$

or

[1] Clavijo and Ros (2015) assumes an economy in which there is not "…supply restrictions, in particular of the labor force" (Ros and Clavijo, 2015: 82, own translation).

$$Y = (W/P)L + (1 - s_\Pi)\Pi + X \qquad (7')$$

or, using equations (5) and (6)[2]:

$$A^{\frac{1}{\alpha}}\left[\frac{1-\alpha}{W/P}\right]^{\frac{1-\alpha}{\alpha}} K = \left[\frac{((1-\alpha)A)^{\frac{1}{\alpha}}}{(W/P)^{\frac{1-\alpha}{\alpha}}}\right] K + (1 - s_\Pi)\left[\frac{A^{\frac{1}{\alpha}}}{(W/P)^{\frac{1-\alpha}{\alpha}}} \cdot \frac{\alpha}{1-\alpha} \cdot (1-\alpha)^{\frac{1}{\alpha}} K\right] + X \qquad (7'')$$

solving equation (7'') for *X* we get:

$$X = s_\Pi \alpha A^{\frac{1}{\alpha}}\left[\frac{1-\alpha}{W/P}\right]^{\frac{1-\alpha}{\alpha}} K = s_\Pi \alpha \sigma K \qquad (8)$$

where σ is the capital productivity. As it can be seen, given that (*W/P*) is given, σ is also given and therefore *X* and *Y* depend directly of *K* in a proportional way. Now, suppose that the real exchange rate, defined as the ratio price of domestic output to price of imported capital goods (*P/P**), is given, this implies that the profitability rate (*r*) in terms of (*P**) is also given,

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[2] From equation (6), the labor level (*L*) is given by:

$$L = \left[\frac{(1-\alpha)A}{W/P}\right]^{\frac{1}{\alpha}} K \qquad (6')$$

On the other hand, Π is equal to *Y* minus (*W/P*)*L*:

$$\Pi = AK^\alpha L^{1-\alpha} - \left[(W/P)\left(\left[\frac{(1-\alpha)A}{W/P}\right]^{\frac{1}{\alpha}} K\right)\right] \qquad (6'')$$

so we substitute equations (5), (6') and (6'') in (7') in order to get (7'').

because (*W/P*) is given. Assume that the growth rate of capital is divided into two parts, an autonomous component ($\hat{K}_0$) and in induced component which depends of *r*:

$$\frac{I}{K} = \hat{K}_0 + hr \qquad (9)$$

where *h* is the profitability elasticity of net capital accumulation. So, the growth rates of *X*, *Y* and imports are equal to the growth rate of *K*. It is worth to note that if initially the trade balance is a negative value, it will be increasing over time in absolute terms, but it is not a problem because Clavijo and Ros (2015) assumes that capital flows are endogenous to the behavior of the domestic savings.

If we compare Clavijo and Ros' model with the "weak" version of Thirlwall's Law we have to identify that in the first case, implicitly is being assumed that the income elasticity of demand for imports is equal to one, so our comparison is based on that assumption. For both models, the long-run growth rate of output is equal to the growth rate of exports, however, for first one the causality runs from investment to exports and output, whilst for the second one the causality runs from exports to output.

Capital accumulation as a determinant of the long-run growth rate which is consistent with a constant position of the BoP as a percentage of the GDP

Clavijo and Ros (2015) does not take into consideration the main problem posted by Thirwall (1979) with respect to the long-run growth rate of output of the economies, the BoP restriction; but on the other hand, Thirwall (1979) does not take into consideration the role of capital accumulation; so in the following lines we develop a model in which capital accumulation and the growth rate of capital productivity are determinants of the long-run growth rate of output which is consistent with a constant position of the BoP as a percentage of the GDP through its effect on the growth rate of demand for imports.

According to the development economists, capital scarcity is the main problem of developing economies with respect to the development and growth process (see Nurkse 1953). So, it is important to take into account capital accumulation in the determination of the long-run growth rate of output, especially in the case of developing economies. Capital accumulation process has a double effect on the external restriction, on one hand, a negative effect because some capital goods have to be imported, but on the other hand, there is a positive effect derived of the import substitution that would be possible through the generation of economic capacity if it is used in order to produce some goods that otherwise have to be imported[3].

So, we assume that the growth rate of exports is given and it is equal to x^0, but we postulate the following equation to determine the growth rate of demand for imports:

$$m = -\varepsilon\hat{\theta} + \psi_I \frac{I}{K} + \psi(g - ce) \qquad (10)$$

[3] According to Lewis (1954), capital accumulation implies reallocations of the productive factors, specifically it shifts workers from the subsistence sector to the manufacturing sector, therefore, capital accumulation would produce a change in the productive structure of the economies and also in the composition of the aggregate demand. Moreover, Syrquin (1988) postulates that “Development economics can be characterized as dealing with issues of structure and growth in less developed countries. …economic development is seen as an interrelated set of long-run processes of structural transformation that accompany growth” (Syrquin, 1988: p. 205).

where I/K is the gross capital accumulation, *ce* is the growth rate of economic capacity, ε is the real exchange rate elasticity of demand for imports and ψ_I is the gross capital elasticity of demand for imports.

Moreover, our specification is useful in order to take into account the critique postulated by Ibarra (2015) with respect to the specification given by equation (2):

> "What we would observe empirically would be a high growth in global demand with a low growth rate of exports and a high growth of imports relative to the domestic demand. In both cases, if we run regressions in which we assume that the growth rates of exports and imports are explained solely by the behavior of the external and internal income, we will get coefficients that shown a low income elasticity of demand for exports and a high income elasticity of demand for imports." (Ibarra, 2015: 44, own translation).

Given the previous sentence, we think that the estimations of the income elasticity of demand for imports gotten through the specification given by equation (2) would be biased; suppose a good *z* whose income elasticity of demand is ψ_z and suppose that the economy does not produce at all anything of this good, if we use equation (2) in order to estimate ψ_z, we could get a unbiased estimation, but now suppose that the economy produces all that is required of good *z*, if we use equation (2) in order to estimate ψ_z, the estimated value will be zero, which is a biased estimation, however, if we use the specification given by equation (10), the estimated value of ψ_z would not be zero necessarily and its estimated value would be gotten through the excesses or shortages of the growth rate of output with respect to the growth rate of economic capacity; besides it, even if the demand for imports of good *z* is zero in the case that the economy is producing all of what is required, the estimation of ψ_I would indicate the capital goods imported necessary to increase the capital stock used in the production of the good z in 1%.

But there is another problem with Thirlwall's Law that, to where we know, has not been considered: in contrast to what was indicated by Pugno (1998), the long-run growth rate of output which is consistent with BoP restriction is not a steady state, except in the case in which the income elasticity of demand for imports is equal to one. Consider what happens with the ratio exports to output (*X/Y*) when the growth rate of output is equal to g_{tb} (equation (4)), the growth rate of the ratio *X/Y* is equal to:

$$x - g_{tb} = \left[\frac{\psi - 1}{\psi}\right] x \qquad (11)$$

which is higher/equal/lower than/to zero if ψ is higher/equal/lower than/to zero. The ratio *X/Y* is constant only when ψ is equal to one; when ψ is higher to one, *X/Y* is increasing and at some point it will be equal to one, so the economy will be producing just for the external market and there will not be domestic demand for domestic production, which is implausible; when ψ is lower than one, the ratio *X/Y* is decreasing and at some point it will be very close to zero, so the economy will be a closed economy and the BoP restriction will not have any sense, besides the fact that there is not any closed economy in the real world.

Now, the problem is not that the composition of the aggregate demand is changing. In fact, we think that it is very important to have in mind the endogenous change of the composition of the aggregate demand, but the problem is that we do not observe economies transiting to be closed economies or economies that just produce for the external market;

always there is some domestic demand for domestic goods and some external demand for domestic goods. So, on one hand the specification stipulated in the equation (10) will help us to understand why even although the income elasticity of demand for imports is not equal to one, the economies would not transit to be a closed economy or an economy that is just producing for the external market (see below). On the other hand, it is also very important to understand the changes in the composition of the aggregate demand because it would reflect the winners and losers of the growth regime of the economies. So, in order to consider the composition of the aggregate demand we disaggregate the growth rate of output in the specification of the growth rate of demand for imports[4]:

$$m = -\varepsilon\hat{\theta} + \psi_I \frac{I}{K} + \psi[(\omega id + (1-\omega)x) - ce)] \qquad (11)$$

where *id* is the growth rate of internal demand for domestic goods and ω and $1-\omega$ are the fractions of the total imports derived from the income generated by the internal demand for domestic goods and from the external demand for domestic goods respectively. Now, it is important to take into account that the Trade Balances of the economies do not always are in equilibrium but the important fact is that their position, especially if initially they are negative, do not be increasing as a percentage of the output (see McCombie and Thirlwall, 1997; Moreno-Brid, 1998; and Barbosa-Filho, 2001). So, in order to take into account this

[4] The disaggregation of output between internal demand and external demand for domestic goods does not indicate a good division between the winners and losers of the performance of the economy, but it could be a kind of proxy because whilst the output of tradable industries is demanded by internal and external demand, the output of non-tradable industries is just demanded by the internal demand.

characteristic we postulate the dynamic condition in order to maintain a constant position of the BoP as a percentage of the output:

$$\phi x^0 + (1-\phi)g = \phi x^0 + (1-\phi)(\lambda id + (1-\lambda)x) = m \qquad (12)$$

where ϕ is the ratio exports to imports (*X/M*) and λ and $1\text{-}\lambda$ are the ratios internal demand to output and exports to output respectively; if ϕ is higher/lower than one, the surplus/deficit of the trade balance has to grow at the same rate than output in order to be a constant percentage of output. Substituting equation (11) in equation (12) and solving for *id*, we get the growth rate of internal demand for domestic goods which is consistent with a constant position of the BoP as percentage of the output (id_{tbI}):

$$id_{tbI} = \frac{\varepsilon\hat{\theta} + [\phi + (1-\phi)(1-\lambda) - \psi(1-\omega)]x^0 - \psi_I \frac{I}{K} + \psi ce}{\psi\omega - (1-\phi)\lambda} \qquad (13)$$

Before we explain our equation, we assume that the growth rate of economic capacity is equal to the net capital accumulation plus the growth rate of capital productivity:

$$ce = \frac{I}{K} - \delta + \hat{a} \qquad (14)$$

where δ is the depreciation rate of capital and $\hat{a}$ is the growth rate of capital productivity. Substituting equation (14) into equation (13) we can re-write equation (13) as:

$$id_{tbI} = \frac{\varepsilon\hat{\theta} + [\phi + (1-\phi)(1-\lambda) - \psi(1-\omega)]x^0 + (\psi - \psi_I)\dfrac{I}{K} + \psi(\hat{a} - \delta)}{\psi\omega - (1-\phi)\lambda} \tag{15}$$

In order to do a simple explanation of our result, let's assume, as in the original paper of Thirlwall (1979), that the trade balance is equal to zero (it means that $\phi=1$), and that the external demand for domestic goods tends to zero (it means that $(1-\lambda)$ and $(1-\omega)$ tend to zero). Then, $\hat{\theta}$, x and $\hat{a}$ have a positive effect on id_{tbI}; if $\psi-\psi_I$ is higher/equal/lower than/to zero, I/K has a positive/null/negative effect on id_{tbI}; and finally, δ has a negative effect on id_{tbI}. We can get the long-run growth rate of output which is consistent with a constant position of the BoP as a percentage of the output (g_{tbI}) in the following way:

$$g_{tbI} = \lambda id_{tbI} + (1-\lambda)x \tag{16}$$

Substituting equation (15) in equation (16) we get:

$$g_{tbI} = \frac{\lambda\varepsilon\hat{\theta} + [\lambda\phi + (\omega-\lambda)\psi]x^0 + \lambda(\psi - \psi_I)\dfrac{I}{K} + \lambda\psi(\hat{a} - \delta)}{\psi\omega - (1-\phi)\lambda} \tag{17}$$

Again, in order to do a simple explanation of our result, let's assume that the trade balance is equal to zero (it means that $\phi=1$), and that the external demand for domestic goods tends to zero (it means that $(1-\lambda)$ and $(1-\omega)$ tend to zero). Then, $\hat{\theta}$, x and $\hat{a}$ have a positive effect on g_{tbI}; if $\psi-\psi_I$ is higher/equal/lower than/to zero, I/K has a positive/null/negative effect on g_{tbI}; and finally, δ has a negative effect on g_{tbI}.

So, given x^0, an increase of I/K affects in a positive/null/negative way to g_{tbI} if ψ is higher/equal/lower than/to ψ_I (see Figures 1a, 1b and 1c) whilst $\hat{a}$ has a direct relationship with g_{tbI} (see Figures 1d, 1e and 1f).

Figura 1a
Case: $\psi_g > \psi_I$

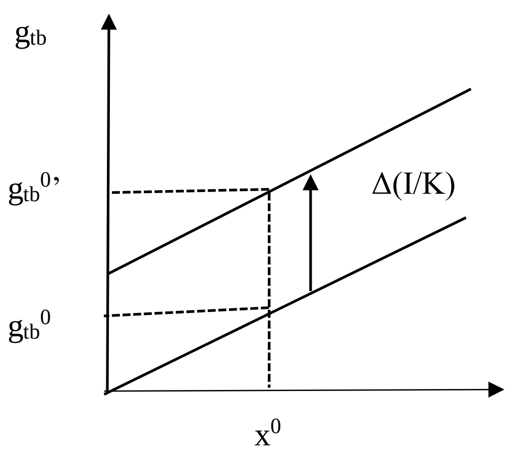


Figura 1b
Case: $\psi_g = \psi_I$

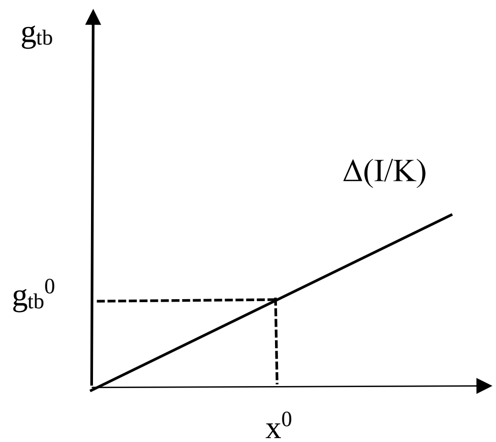


Figura 1c
Case: $\psi_g < \psi_I$

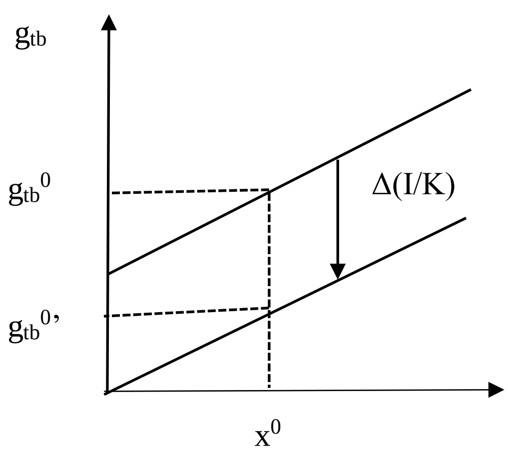


Figura 1d
Case: $\hat{a} > 0$

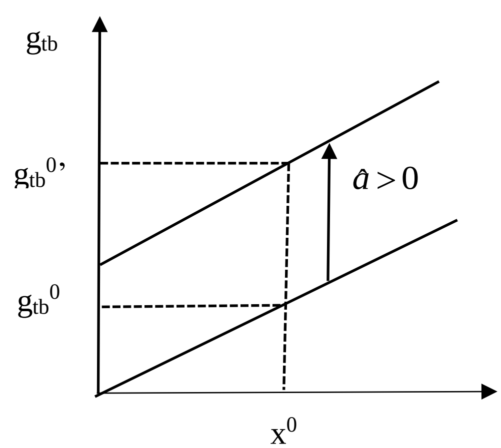


Figura 2e
Case: $\hat{a}=0$

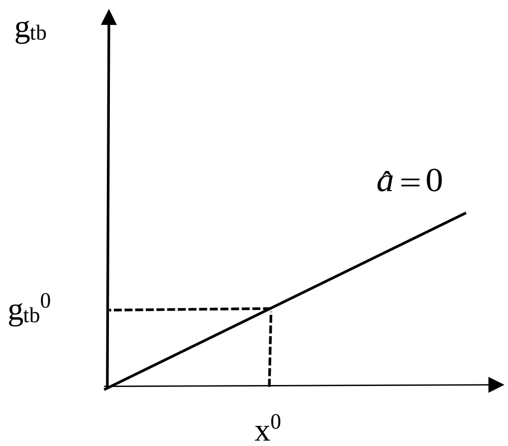
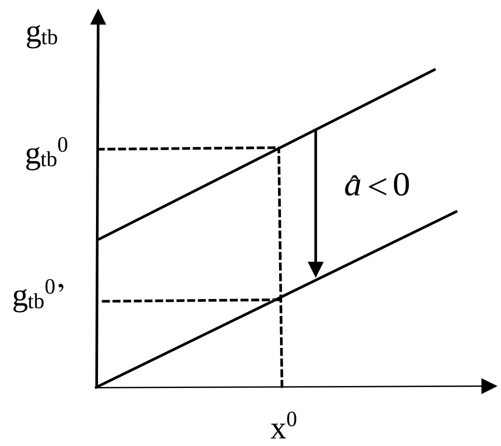


Figura 2f
Case: $\hat{a}<0$



Moreover, using the equation (17) we can observe that the ratio *X/Y* does not just depend of ψ, but it also depends of ψ_I, x^0, *I/K*, $\hat{a}$ and δ. Let's assume that the trade balance is equal to zero (it means that $\phi=1$), that the external demand for domestic goods tends to zero (it means that ($1-\lambda$) and ($1-\omega$) tend to zero) and that θ is constant, the growth rate of the ratio *X/Y* when the economy is growing at the value given by g_{tbI} is equal to:

$$x-g_{tbI}=\left[\frac{\psi-1}{\psi}\right]x-\left[\frac{\psi-\psi_I}{\psi}\right]\frac{I}{K}-(\hat{a}-\delta) \qquad (18)$$

So, even if ψ is higher than one, *X/Y* will be decreasing if ψ is higher than ψI and *I/K* and $\hat{a}$ are high enough.

In the following section we apply our model to the Mexican case in order to explain the behavior of its growth rate of output during the period 1951 – 2014.

The case of Mexico, 1951 – 2014.

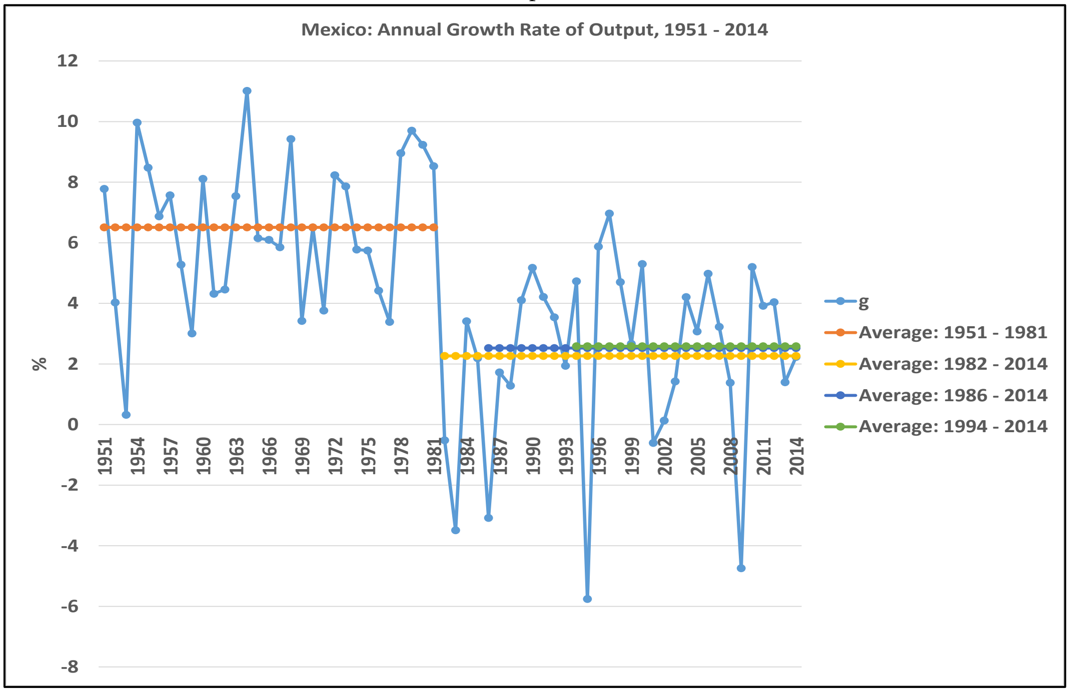
As it can be seen in Graph 1, the average of the growth rate of GDP of the Mexican economy from 1951 to 1981 was equal to 6.51%, which is part of the Golden Age of Industrialization period, the loss of macroeconomic stability during the seventies and the oil boom period from 1978 to 1981[5]. Then, the average of the growth rate of GDP from 1982 to 2014 was decreased to 2.27%. If we consider the liberalization period as beginning on 1986, with the insertion of Mexico in the General Agreement on Tariffs and Trade (GATT), the average of the growth rate of GDP is almost equal to the corresponding to the 1982 – 2014 subperiod, 2.53%. And if we consider just the North American Free Trade Agreement (NAFTA) subperiod, which goes from 1994 to 2014, the average is equal to 2.59%. So, the liberalization process did not result in a higher growth rate of GDP considering the strong decrease exhibited after the Debt Crisis of 1982.

According to the "weak" version of Thirlwall's Law, the strong decrease of the growth rate of GDP of the Mexican economy can be explained by two means: a decrease of the growth rate of exports and/or an increase of the income elasticity of demand for imports[6]. As it can be seen in Graph 2, the average of the growth rate of exports for each one of the subperiods that we are considering is almost the same, from 1951 to 1981 it was equal to 6.65%, from 1982 to 2014 it was equal to 7.94%, from 1986 to 2014 it was equal to 7.73% and from 1994 to 2014 it was equal to 8.34%. So the average of the growth rate of exports was a bit higher during the depressive subperiods with respect to the high growth subperiod exhibited from 1951 to 1981.

[5] According to Moreno-Brid and Ros (2009), the Gold Age of Industrialization period of the Mexican economy was from 1940 to 1970.

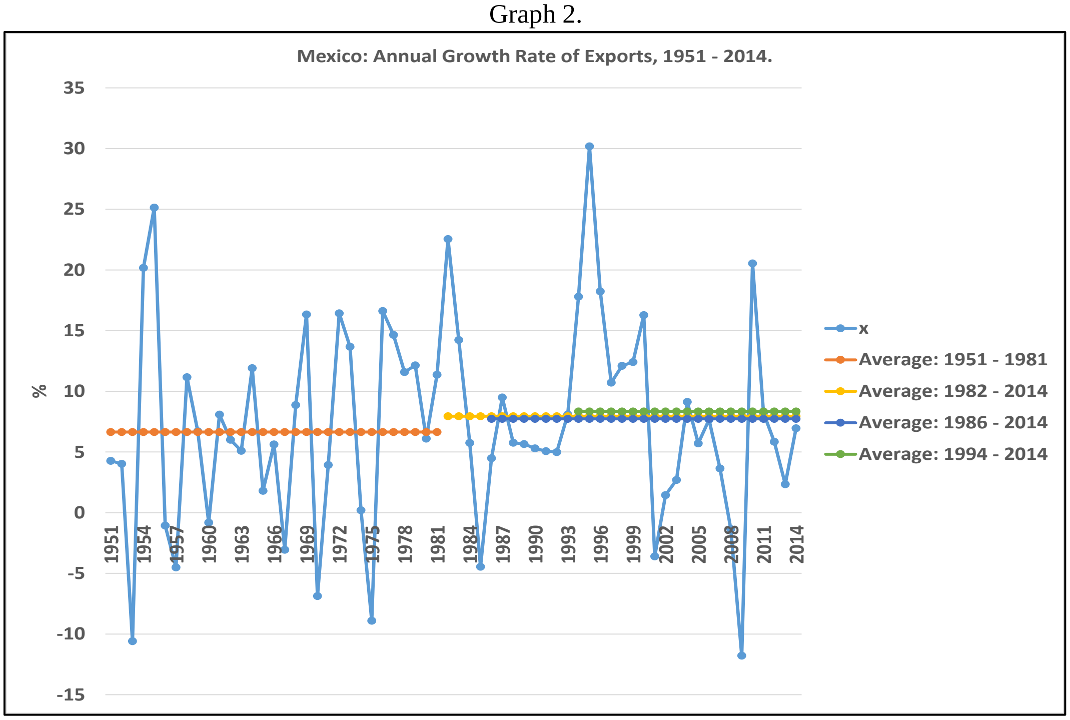
[6] See Moreno-Brid (1998b and 1999), López and Cruz (2000) and Guerrero de Lizardi (2006) for some applications of the Thirlwall's Law for the case of Mexico.

Graph 1.



Source: Author's elaboration using data from INEGI.

Graph 2.



Source: Author's elaboration using data from INEGI.

If we use a very simplistic way to determine the income elasticity of demand for imports consistent with a dynamic BoP equilibrium by dividing the growth rate of exports between the effective growth rate of GDP[7], we can see that from 1951 to 1981, the implicated income elasticity of demand for imports was equal to 1.02; from 1982 to 2014 it was equal to 3.50; from 1986 to 2014 it was equal to 3.06 and from 1994 to 2014 it was equal to 3.23 (see Table 1). So, the income elasticity of demand for imports consistent with a dynamic BoP equilibrium more than tripled after the Debt Crisis of 1982.

Table 1.
Implicated income elasticity of demand for imports, 1951 – 2014.

Subperiod	1951 - 1981	1982 - 2014	1986 - 2014	1994 - 2014
Growth rate of GDP (average)	6.51%	2.27%	2.53%	2.59%
Growth rate of exports (average)	6.65%	7.94%	7.73%	8.34%
Implicated income elasticity of demand for imports	1.02	3.50	3.06	3.23

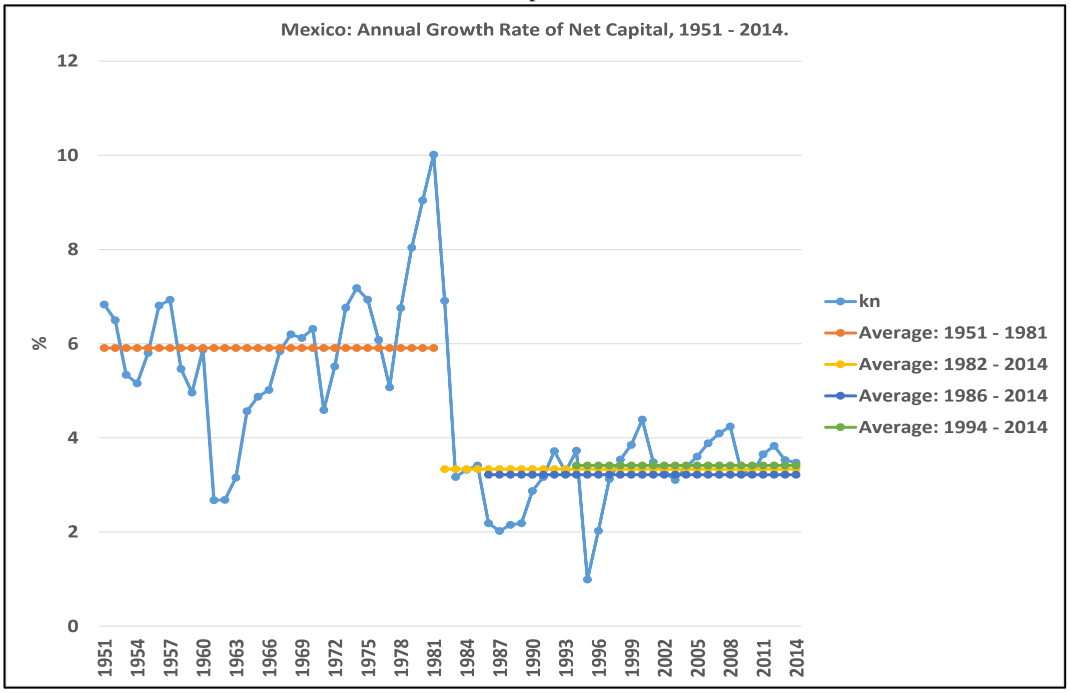
Source: Author's elaboration using data from INEGI.
Note: The implicated income elasticity of demand for imports is equal to the division of the growth rate of exports between the effective growth rate of GDP.

However, according to our model, capital accumulation and the growth rate of capital productivity are also important in the determination of the long-run growth rate of the economy. As it can be seen in Graph 3, the growth rate of net capital followed the same behavior as the exhibited by the growth rate of GDP; from 1951 to 1981 its annual average was equal to 5.91%; from 1982 to 2014 it was equal to 3.34%; from 1986 to 2014 it was equal to 3.22% and from 1994 to 2014 it was equal to 3.41%. So, after the Debt Crisis of 1982 the liberalization process done through the GATT and the NAFTA did not modify the path of net capital accumulation which was lower comparative to the 1951 to 1981 subperiod.

[7] We solve equation (4) for ψ in order to get the income elasticity of demand for imports consistent with a dynamic BoP equilibrium.

If we compare the annual average of the net capital accumulation from 1951 to 1981 with the exhibited during the 1982 – 2014 subperiod, its value fell down 2.57 percentage points.

Graph 3.

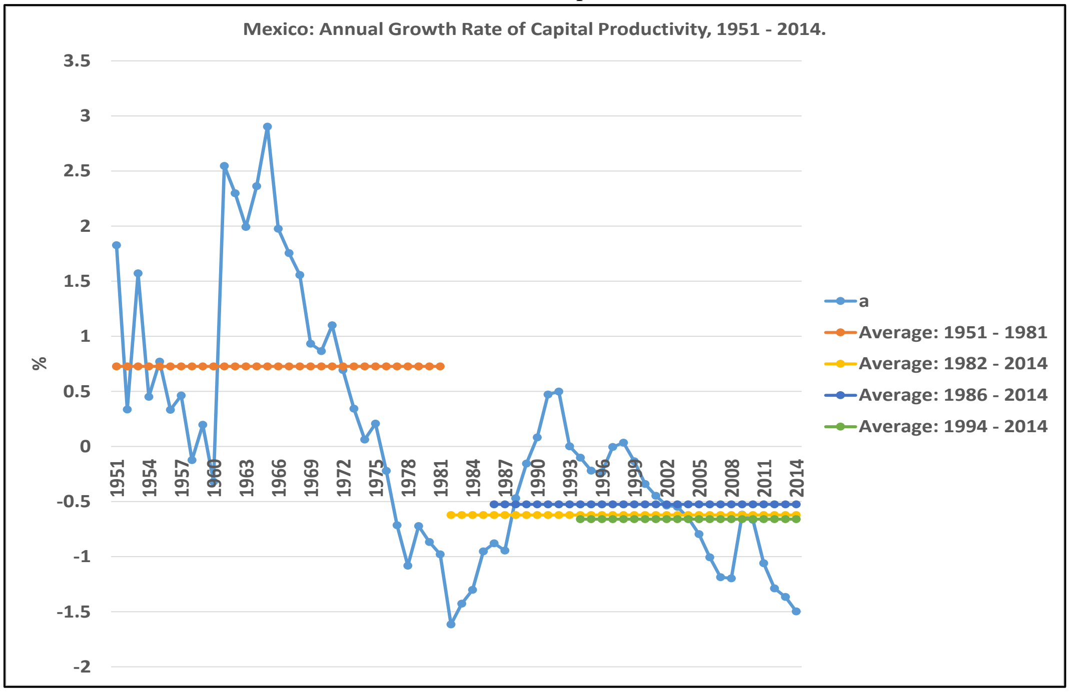


Source: Author's elaboration using data from Hofman (2000) and INEGI.

With respect to the growth rate of capital productivity[8], its annual average was equal to 0.73% from 1951 to 1981, it was equal to -0.62% from 1982 to 2014, it was equal to -0.53% from 1986 to 2014 and it was equal to -0.66% from 1994 to 2014. So after the 1951 – 1981 subperiod, there was not just a decrease of the net capital accumulation but also a decrease of the growth rate of capital productivity (see Graph 4).

[8] The determination of capital productivity is shown in the appendix.

Graph 4.



Author's elaboration using data from Hofman (2000) and INEGI.

In order to apply our model, we estimate the next equation of the determinants of the annual growth rate of demand for imports:

$$m_t = \beta_0 DU + \beta_1 \hat{\theta}_t + \beta_2 \frac{I_t}{K_t} + \beta_3 (id_t - ce_t) + \beta_4 (x_t - ce_t) + u_t \qquad (19)$$

where t is a subscript indicating time, DU represents a Dummy variable in the required cases (see below), β_i are the parameters to be estimated and u_t is a white noise. In Table 2 we present our results of the estimation of the equation (19) by the Ordinary Least Square Method.

Table 2.

Dependent variable: m_t				
Subperiod	1951 - 1981	1982 - 2014	1986 - 2014	1994 - 2014
Independent variable				
$\hat{\theta}_t$	-0.61* (-3.87)	-0.84* (-9.05)	-0.59* (-4.28)	-0.66* (-2.34)
I_t/K_t	0.69* (5.45)	0.86* (5.50)	0.84* (4.89)	0.80* (6.44)
id_t-ce_t	1.94* (4.18)	1.56* (3.02)	1.50* (3.05)	1.19* (3.23)
x_t-ce_t		0.48* (4.09)	0.74* (7.17)	0.75* (10.46)
D51	15.67** (2.61)			
D58	-11.93** (-2.08)			
D79	11.81*** (1.95)			
D80	13.52** (2.22)			
D83		-22.30* (-4.37)		
D86		25.45* (4.92)	15.02** (2.51)	
D88		17.48* (3.74)	20.52* (4.26)	
D94		10.43** (2.26)		
D95		17.57** (2.51)		
D13				-7.29** (-2.34)
Jarque-Bera test	0.87	0.31	0.16	4.04
LM test	0.99	0.98	0.79	0.33
White test	0.40	0.95†	0.88	0.14
Ramsey test	0.53	0.73	0.32	0.31
Number of observations	31	33	29	21

Source: Author's elaboration using data from Hofman (2000), World Penn Table, Banxico and INEGI.

Notes: D?? means a Dummy variable with value equal to one in the year 19?? (20??) and zero otherwise.

LM test was done including one lag.

White test was done including cross terms except in the case marked by †.

Ramsey test was done including one fitted term.

We show the unit root test for the time series used in the appendix.

We can use the estimated parameters of equation (19) in order to determine the long-run growth rate of internal demand for domestic goods which is consistent with a constant position of the BoP as a percentage of the GDP; β_1 represents ε, β_2 represents ψ_I, β_3 represents $\omega\psi$, and β_4 represents $(1-\omega)\psi$. Therefore, id_{tb} can be determined as:

$$
\begin{aligned}
id_{tb} = {} & \frac{-1}{\beta_3-(1-\phi)\lambda}\cdot\frac{\beta_0}{t}+\frac{\beta_1}{\beta_3-(1-\phi)\lambda}\hat{\theta}+\frac{[\phi+((1-\phi)(1-\lambda))-\beta_4]}{\beta_3-(1-\phi)\lambda}x+ \\
& +\frac{[\beta_3+\beta_4-\beta_2]}{\beta_3-(1-\phi)\lambda}\frac{I}{K}+\frac{[\beta_3+\beta_4]}{\beta_3-(1-\phi)\lambda}(\hat{a}-\delta)
\end{aligned}
\qquad (20)
$$

where t indicates the number of years of each subperiod for which the econometric model was run. In order to get g_{tbI} we just use equation (16). In Table 3 we present our estimations of ψ_I, ψ, id_{tbI} and g_{tbI} for each subperiod through the use of the annual average values of β_0, $\hat{\theta}$, x, I/K, $\hat{a}$, δ, ϕ and λ.

As a first point we can say that in contrast with previous studies in which the explanation of the slowdown of the growth rate of the Mexican economy after the Debt Crisis of 1982 is attributed to the increase of the income elasticity of demand for imports, we find that the income elasticity of demand for imports is almost the same if we compare the subperiods 1951 – 1981 and 1982 – 2014; it was 1.94 in the first one and 2.04 in the second one. Moreover, if we consider the GATT and the NAFTA periods, its values are also very similar, 2.23 and 1.94. And even more, although the gross capital elasticity of demand for imports is not considered in the Thirlwall’s model and therefore it is not considered for the previous authors, we can observe that its behavior is more or less constant for all the subperiods analyzed. So, we can say that the slowdown of the growth rate of the Mexican economy after the Debt crisis of 1982 is not explained by an increase of the income elasticity of demand for imports.

The autonomous growth rate of demand for imports, which is measured through the Dummy variables, and the annual change rate of the real exchange rate were not very important in the determination of id_{tbI} and g_{tbI}; as it can be seen in Table 3, their contributions were lower than one percentage point for each one of the subperiods considered.

The growth rate of exports contributed with almost the same to id_{tbI} during the 1951 – 1981 and the 1982 – 2014 subperiods, 3.06 and 3.02 percentage points respectively, whilst its contribution was lower for the other two subperiods, 1.64 from 1986 to 2014 and 1.93 from 1994 to 2014. With respect to the contribution of x on g_{tbI}, we can say that it was a bit higher from 1982 to 2014 (4 percentage points) than the exhibited from 1951 to 1981 (3.26 percentage points). From 1986 to 2014 the contribution is a bit lower than the exhibited from 1951 to 1981 (2.94 percentage points). And finally, from 1994 to 2014 its contribution is almost equal to the exhibited from 1951 to 1981 (3.58 percentage points). So we cannot attribute to the growth rate of exports the origin of the slowdown of the growth rate of output exhibited by the Mexican economy after the Debt crisis of 1982.

According to Shaikh and Moudud (2000) the growth rate of capital productivity is in part autonomous and in part induced for the capital accumulation itself, so we describe the contribution of capital accumulation on id_{tbI} and g_{tbI} taking into account the three of its components all together: I/K, $\hat{u}$ and δ. There was a strong decrease of the contribution of I/K on id_{tbI} from 1982 to 2014, in fact it was decreased to a negative value with respect to the exhibited from 1951 to 1981 (-0.34 and 3.65 percentage points). From 1986 to 2014, its contribution is almost null and from 1994 to 2014 it was negative (-0.39 percentage points). With respect to the contribution of I/K on g_{tbI}, there was a strong decrease from 1982 to 2014 with respect to the value exhibited from 1951 to 1981 (-0.28 and 3.45 percentage points). From 1986 to 2014 its contribution is almost null and from 1994 to 2014 it was negative (-

0.29 percentage points). So we can attribute to *I/K* the slowdown of the growth rate of output of the Mexican economy after the Debt Crisis of 1982.

Another way to check the importance of capital accumulation on the determination of g_{tbI} is through the disaggregation of *m* between its determinants; we present this information in Table 4, as it can be seen, the autonomous growth rate of demand for imports is positive, although low, for all the subperiods except for the NAFTA one in which its annual average is equal to -0.35%. The real exchange rate exhibits a low effect on the determination of the growth rate of demand for imports for each one of the subperiods of analysis. Given that the income elasticities of demand for imports exhibited in each subperiod is almost the same, it is normal to find that the growth rates of demand for imports derived from the growth rate of income have been lower after the Debt Crisis of 1982. And finally, we can see that the net effect of capital accumulation on the demand for imports is negative from 1951 to 1981 (-6.32%) but positive from 1982 to 2014 (0.58%); it is important to have in mind the behavior of income and gross capital accumulation elasticities of demand for imports in order to understand that the problem was a reduction of the net capital accumulation and of the growth rate of capital productivity.

In order to check the robustness of our results we contrast the differences between *id* and id_{tbI}, and between *g* and g_{tbI}, with the annual average of change of the trade balance as a percentage of the GDP (see Table 5). As it can be seen, when the effective values are higher/lower than the values consistent with a constant position of the BoP as a percentage of the GDP, the annual average of change of the Trade Balance as a percentage of the GDP is negative/positive. It is worth to note that from 1982 to 2014, the Mexican economy has been growing a bit more than one percentage point lower than the growth rate which is consistent with a constant position of the BoP as a percentage of the GDP.

Final remarks

If we reconsider the questions advanced by Ros and Clavijo (2015):

> "Why did the Japanese economy grow much faster that the Great Britain during the four first decades of the post-war period? Why has the Chinese economy grown between 4 and 5 times much faster than the Mexican economy during the last thirty years? Are those differences in growth rates due to differences in the pattern of trade specialization and the resulting differences in the income elasticities of exports and imports? Or do they have more to do with the fact that the investment rate in Japan was much higher than that of the Great Britain and that of China more than two times higher than that of Mexico?[9]" (Ros and Clavijo, 2015: 81).

Our answer is yes, the Mexican economy exhibited a strong decrease of its growth rate of output after the Debt Crisis of 1982 due to a strong decrease of its capital accumulation and in consequence of its growth rate of capital productivity; its growth rates of net capital accumulation and capital productivity from 1951 to 1981 were equal to 5.66% and 0.73% respectively, whilst from 1982 to 2014 were equal to 3.12% and -0.62%.

The income and gross capital stock elasticities of demand for imports did not change considerably as to consider them as part of the explanation about the decrease of the long-run growth rate of the Mexican economy. In the same way, the growth rate of exports was more or less the same before and after the Debt Crisis of 1982, in fact it was a bit higher after

[9] Own translation.

the disruption, so the growth rate of exports neither can be considered as the explanation of the slowdown of the long-run growth rate of output of the Mexican economy.

It is worth to note that the internal demand for domestic goods is the adjustment variable used in order to control the growth rate and to fulfill the external restriction, from 1951 to 1981 its annual growth rate average was equal to 6.52% whilst from 1982 to 2014 it was equal to 1.23%; it could reflect not only the bad performance of the non-tradable sectors but also the strict control over the real wages.

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Table 3.

Subperiod	ψ_I	ψ	DU	$\hat{\theta}$	x	I/K	$\hat{a}$	δ	**id_{tb}**	DU	$\hat{\theta}$	**x**	I/K	$\hat{a}$	δ	**Capital accumulation**
			Annual average values							Contribution						
1951 – 1981	0.69	1.94	0.94	-1.83	6.65	8.76	0.73	3.11	**5.53**	-0.54	-0.64	**3.06**	6.32	0.81	-3.47	**3.65**
1982 – 2014	0.86	2.04	1.47	0.88	7.94	6.60	-0.62	3.47	**2.24**	-0.88	0.44	**3.02**	4.64	-0.76	-4.22	**-0.34**
1986 – 2014	0.84	2.23	1.23	-0.94	7.73	6.49	-0.53	3.49	**0.57**	-0.78	-0.36	**1.64**	5.79	-0.75	-4.98	**0.06**
1994 – 2014	0.80	1.94	-0.35	-0.18	8.34	6.75	-0.66	3.56	**1.73**	0.28	-0.10	**1.93**	6.31	-1.05	-5.65	**-0.39**
Subperiod			DU	$\hat{\theta}$	x	I/K	$\hat{a}$	δ	**g_{tb}**	DU	$\hat{\theta}$	**x**	I/K	$\hat{a}$	δ	**Capital accumulation**
			Annual average values							Contribution						
1951 – 1981	0.69	1.94	0.94	-1.83	6.65	8.76	0.73	3.11	**5.59**	-0.51	-0.61	**3.26**	5.96	0.77	-3.28	**3.45**
1982 – 2014	0.86	2.04	1.47	0.88	7.94	6.60	-0.62	3.47	**3.37**	-0.70	0.35	**4.00**	3.72	-0.61	-3.39	**-0.28**
1986 – 2014	0.84	2.23	1.23	-0.94	7.73	6.49	-0.53	3.49	**2.10**	-0.61	-0.28	**2.94**	4.55	-0.59	-3.91	**0.05**
1994 – 2014	0.80	1.94	-0.35	-0.18	8.34	6.75	-0.66	3.56	**3.43**	0.21	-0.07	**3.58**	4.69	-0.78	-4.20	**-0.29**

Source: Author's elaboration using data from Hofman (2000), INEGI, Banxico and the World Penn Table.

Table 4.

Subperiod	Autonomous	$\hat{\theta}$	I/K	g	I/K (Import substitution)	Total
1951 – 1981	0.94	1.11	6.03	12.62	-12.35	8.34
1982 – 2014	1.47	-0.74	5.67	5.71	-5.09	7.02
1986 – 2014	1.23	0.56	5.43	7.84	-5.54	9.52
1994 - 2014	-0.35	0.12	5.37	7.71	-4.90	7.95

Source: Author's elaboration using data from Hofman (2000), INEGI, BANXICO and the World Penn Table.

Table 5.

Subperiod	$id - id_{tb}$	$g - g_{tb}$	$\Delta(xmy)$
1951 – 1981	0.99	0.92	-0.10
1982 – 2014	-1.02	-1.11	0.15
1986 – 2014	0.86	0.42	-0.09
1994 – 2014	-0.51	-0.84	0.07

Source: Author's elaboration using data from Hofman (2000), INEGI, Banxico and the World Penn Table.

Appendix

A. Description of time series used.

We used data series from Hofman (2000), INEGI and The World Bank in order to generate time series for GDP (*Y*), Exports (*X*), Imports (*M*), Total Investment (*I*), Machinery and Equipment Investment (*MEI*), Non-Residential Structures Investment (ICO), Net Capital Stock (*K*), Net Capital Stock in Machinery and Equipment (ME), Net Capital Stock in Non-Residential Structures (CO)[10] and Economic Capacity (*CE*)[11]. All series are measured at 2008 prices. In order to generate a time series of the real exchange rate (θ) we use data from The World Penn Table and the Bank of Mexico.

B. Estimation of the Economic Capacity of the Mexican Economy.

B.1 Theoretical background.

Following Shaikh and Moudud (2000) we estimate the economic capacity of the Mexican economy as a cointegration relationship with the net capital stock, the difference is that we also consider in an explicit way its components, the net capital stock in Machinery and Equipment (ME) and the net capital stock in Non-Residential Structures (CO).

We postulate the following identity:

$$Y \equiv \frac{Y}{CE} \cdot \frac{CE}{K} . K \qquad \text{(B.1)}$$

[10] We use the perpetual inventory method in order to get the net capital stock series.
[11] The description of the methodology in order to get *CE* is on the next section.

Then we define u as the utilization rate of the economic capacity (*Y/CE*) and k as the capital-capacity ratio (*K/CE*). Taking natural logs of equation (B.1) we get:

$$\ln Y = \ln K - \ln k + \ln u \qquad \text{(B.2)}$$

We assume that output fluctuates around capacity over the long-run, so the actual utilization rate of economic capacity fluctuates around some desired or normal utilization rate of economic capacity ($u^*=1$). So we define the following equation:

$$\ln(u) = \upsilon_u \qquad \text{(B.3)}$$

where υ_u is a random error term. In the case of k, we assume that it changes over time according to the following equation:

$$\ln k = \ln B + b_1 \ln K - b_2 \ln ME - b_3 \ln CO + \upsilon_k \qquad \text{(B.4)}$$

where υ_k is a random error. Equation (B.4) allows us to consider not only the total net capital stock, but also its composition. Substituting equations (B.3) and (B.4) in (B.2) we get:

$$\ln Y = -\ln B + (1-b_1)\ln K + b_2 \ln ME + b_3 \ln CO + \upsilon_k + \upsilon_u \qquad \text{(B.5)}$$

We can re-write equation (B.5) as:

$$\ln Y = \Omega_0 + \Omega_1 \ln K + \Omega_2 \ln ME + \Omega_3 \ln CO + \upsilon \qquad \text{(B.6)}$$

where Ω_0 is equal to $-lnB$, Ω_1 is equal to $(1-b_1)$, Ω_2 is equal to b_2, Ω_3 is equal to b_3 and υ is equal to $\upsilon_k+\upsilon_u$. So, we can estimate the equation (B.6) through a contegration technique in order to get the Economic Capacity.

B.2 Unit root test for the time series used for the estimation of equation (B.6).

Table B.2

Variable	Subperiod	ADF test	Lags included[a]	PP test	Bandwidth included[b]	Zivot-Andrews test[c]	Lags included[a]
lnY	1951 – 2014	-0.76	0	-0.82	2		
d(lnY)	1951 – 2014	-5.63*	0	-5.64*	2	-8.39*[d]	0
lnK	1951 – 2014	-1.26	1	-0.73	5		
d(lnK)	1951 – 2014	-2.83**	1	-2.50	3	-6.12*[e]	1
lnME	1951 – 2014	-1.53	1	-0.83	5		
d(lnME)	1951 – 2014	-2.44	0	-2.37	4	-4.80**[d]	1
lnCO	1951 – 2014	-1.47	1	-0.58	5		
d(lnCO)	1951 – 2014	-2.16	0	-2.30	2	-4.71**[e]	0

*Statistically significant at the 1% level.
**Statistically significant at the 10% level.
Source: Author's elaboration using data from Hofman (2000) and INEGI.
Notes: ln? means natural log of the variable ?. d(ln?) means first difference of ln?.
All level tests were done assuming the existence of intercept and trend whilst all first difference tests were done assuming the existence of intercept except the tests done through the Zivot Andrews test for which it is also assumed the existence of trend.
[a]The number of lags included was based on the Schwarz Information Criterion except the case of d(lnME) for the Zivot Andrews test for which we use one lag in a discretional way.
[b]Optimal bandwidth based on Newey-West criterion.
[c]Unit root test assuming the existence of one structural break.
[d]Breakpoint: 1982.
[e]Breakpoint: 1983.

B.3 Bound Test Approach to Cointegration.

As it can be seen in the Table B.2, all series, *lnY*, *lnK*, *lnME* and *lnCO* are I(1). Now, we use the bound test approach to cointegration (see Peasaran, Shin and Smith, 2001). So, first, we run an unrestricted error correction model, the estimated results are presented in the Table B.3.

Table B.3

Dependent Variable: d(lnY)		
Independent variable		
Constant	3.09*	3.02
lnY(-1)	-0.54*	-3.19
lnME(-1)	0.80*	3.03
lnCO(-1)	2.39*	3.08
lnK(-1)	-2.76*	-3.05
d(lnME)	1.50**	2.35
d(lnCO)	0.20	0.08
d(lnK)	0.32	0.10
d(lnY(-1))	0.19	1.10
d(lnCO(-1))	4.13*	3.88
d(lnK(-1))	-5.38*	-4.68
d(lnY(-2))	0.21	1.57
d(lnY(-3))	0.15	1.62
d(lnY(-4))	0.18**	2.38
R^2	0.89	
Jarque-Bera test	0.28	
LM test (one lag included)	0.49	
White test (does not include cross terms)	1.57	
Ramsey Reset test (one fitted term included)	0.94	

*Statistically at the 1% level.
**Statistically significant at the 5% level.
Source: Author's elaboration using data from INEGI and Hofman (2000).
Note: ln? means natural log of the variable ?; d(ln?) means first difference of ln?; (-?) means the number of lags used for the corresponding variables.

Now, we get the F-statistics for the null hypothesis that all the parameters corresponding to the dependent and independent variables in levels in table A.2 are equal to zero and we compare that value with the critical value reported in Peasaran, Shin and Smith (2001) for the case of cointegration relationship with unrestricted intercept and no trend. As it can be seen in table B.4 we can accept the existence of a cointegration relationship between lnY and lnK, lnME and lnCO given that the F – statistics computed is higher than the upper critical value.

Table B.4

F statistics	Lower critical value (5%)	Upper critical value (5%)
3.71	2.79	3.67

Source: Author's elaboration using data from INEGI and Hofman (2000).
Note: Critical values were taken from Pesaran, Shin and Smith (2001).

Given our previous results we can postulate the long-run equation determining the economic capacity of the Mexican case for the period 1950 – 2014 as:

$$\ln Y^{E} = 5.76 + 1.49 \ln ME + 4.45 \ln CO - 5.13 \ln K \qquad \text{(B.7)}$$

where Y^E is the estimated series of Y. We can assume that the GDP was equal to the economic capacity in the year with the maximum rate of growth of the GDP and then we use this reference point and Y^E in order to generate a complete series for *CE*. Once we get *CE*, we divide *CE* between *K* in order to get *a*.

C. Unit root test for the time series used for the estimation of equation (19).

Table C.1

Variable	Subperiod	ADF test	Lags included[a]	PP test	Bandwidth included[b]	Zivot-Andrews test[c]	Lags included[d]
m	1951 – 1981	-4.10*	2	-3.92*	8		
m	1982 – 2014	-4.95*	0	-4.95*	0		
m	1986 – 2014	-5.38*	0	-5.38*	1		
m	1994 - 2014	-5.32*	0	-5.32*	0		
$\hat{\theta}$	1951 – 1981	-4.33*	1	-4.03*	12		
$\hat{\theta}$	1982 – 2014	-5.44*	1	-5.34*	2		
$\hat{\theta}$	1986 – 2014	-5.09*	0	-5.19*	5		
$\hat{\theta}$	1994 - 2014	-4.99*	0	-5.05*	3		
I/K	1951 – 1981	-0.83	0	-1.05	2	-5.73**	1[e]
I/K	1982 – 2014	-6.27*	0	-5.98*	2		
I/K	1986 – 2014	-2.45	0	-2.53	2	-4.90**	4[f]
I/K	1994 - 2014	-2.55	0	-2.59	1	-5.22**	1[g]
id-ce	1951 – 1981	-5.59*	0	-5.83*	6		
id-ce	1982 – 2014	-5.30*	0	-5.55*	8		
id-ce	1986 – 2014	-5.26*	0	-6.21*	11		
id-ce	1994 - 2014	-4.63*	0	5.41*	8		
x-ce	1951 – 1981	-6.58*	1	-6.99*	19		
x-ce	1982 – 2014	-4.04*	0	-3.96*	6		
x-ce	1986 – 2014	-3.92*	0	-3.90*	3		
x-ce	1994 - 2014	-3.14**	0	-3.14**	0		

*Statistically significant at the 1% level.
**Statistically significant at the 5% level.
Source: Author’s elaboration using data from Hofman (2000), INEGI, World Bank, World Penn Table and Bank of Mexico.
Notes: All series are in growth rates terms.

All test were done assuming the existence of intercept except in the case of $\hat{\theta}$ for which we do not assume the existence of intercept.

[a]The number of lags included was based on the Schwarz Information Criterion.

[b]Optimal bandwidth based on Newey-West criterion.

[c]Unit root test assuming the existence of one structural break.

[d]The number of lags included was based on the Akaike Information Criterion.

[e]Breakpoint: 1960.

[f]Breakpoint: 2001.

[g]Breakpoint: 2003.