ENDOGENOUS GROWTH AND COMPARATIVE STANDARDS OF LIVING BETWEEN MEXICO AND THE US

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Abstract

This paper calibrates an AK model of growth for Mexico. Investment financing is modeled considering the domestic savings ratio as well as net factorial income and capital inflows of the balance of payments. Productivity A and the rate of depreciation of capital are found using econometric techniques.

According to this model, actual parameters determining growth in Mexico are compatible with a sustained long run rate of growth of about 3.6%. At the same time, under these circumstances the ratio of the Mexican GDP to US GDP would be growing in time. The model is very sensible to the parameters and depends strongly of Mexicans living in the US and transferring remittances to Mexico, nonetheless. If remittances were eliminated, the actual rate of domestic savings would not be compatible with positive growth in the long run, which implies that relatively speaking the domestic savings rate in Mexico is very low.

The paper concludes that to assure a positive growth that improves standards of living and the relative size of Mexico with respect to the US, it is necessary to implement policies oriented to increase the domestic savings rate and productivity. Otherwise there are high risks of macroeconomic crises in the future.

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INTRODUCTION

The last years have seen a very important development in growth theory. Differently from the traditional models by Solow and Swan (Solow (1956), Swan (1956)), in the eighties, Romer (1986) and Lucas (1988) proposed models where long run growth depends upon economic policy and other variables. The following years witnessed considerable research in endogenous growth theory due to people like Jones and Manuelli (1991), Rebelo (1992) and Barro and Sala I Martin (1995).

While there has been quite a lot of research in the new growth theory based in the experience of large economies like the US, Japan or the European Union, less research has been advocated to small or less developed economies. Applying the traditional Solow model to a small country under perfect capital mobility the result is that, in a very open context, the growth of the small country will be independent of growth in large economies. When observing real experiences, it is clear that the link between growth in small and large economies is strong, nonetheless, presumably because the latter influence small ones deeply.[1]

Neoclassical economics has been quite successful establishing how savings and investment interact to generate growth. It has been also very successful to model preferences and their influence on growth, but the success has been relatively low when trying to explain growth in small open economies. Post Keynesian economics have established why through the

[1] Growth in small open economies become independent of growth in large economies under perfect capital mobility because in a Solow's type model there is a negative relation between the exogenous foreign rate of interest and the capital-labor ratio. Therefore in order to maintain this relation capital grows at the exogenous rate at which labor grows and in absence of growth in exogenous productivity all the small economy finishes growing at the rate of growth of labor.

balance of payments equilibrium growth in developed economies affects growth in developing countries (see for example Kaldor (1970) and Thirlwall (1979)). However, the link between savings, investments and the balance of payments equilibrium do not seem to be analyzed quite properly in this approach.

The aim of this work is to try to fill a gap explaining how savings, investment and the balance of payments equilibrium interact to generate growth in a small open economy. The motivation is based in the existent strong relation between Mexico and the US generated by different factors:

Mexico is the third trade partner of the US. On the other hand, the US is by far the most important trade partner of Mexico since more than 70% of Mexican trade takes place with that country. At the same time, most of the foreign direct investment (FDI) that enters Mexico comes from the US; Also, hundreds of thousands of Mexican workers emigrate to the US yearly. The remittances these people send to its original country accounts for almost 2% of Mexican GDP; Finally, the majority of total Mexican debt outstanding was contracted with US private and public agencies.

These facts seem to be intuitively very consistent with the observed simple correlation between Mexican GDP and the correspondent figure for the US, which between 1980 and 2003 was near to 97%.[2] Nonetheless, they seem to be in accordance neither with a traditional kind of Solow's growth model with perfect capital mobility, nor with a macroeconomic model where there is a natural rate of unemployment.

To explain the determinants of Mexican growth as well as its relation with US growth, this paper sets a simple endogenous growth model of the AK type (see Rebelo (1992) (1992a)). Assuming the absorption approach through the balance of payments equilibrium, investment is financed by domestic plus foreign savings.

The model is calibrated and projected to the future. To do that we use historical data for the domestic savings ratio and actual data for remittances from Mexican workers in the US and foreign debt as a proportion of US GDP. Total productivity of capital (A) and the rate of depreciation of physical capital are estimated econometrically.

[2] The Johansen cointegration test for the log of Mexican GDP and the correspondent figure for the US cannot reject the existence of one cointegrating vector at 95% of confidence from 1980 to 2003.

Perhaps the main result of the paper is that actual parameters of the Mexican economy seem compatible with a sustained trajectory of future Mexican growth. However, the sustained trajectory is based in the permanence of worker remittances from the US. If this income disappeared, the other actual parameters would become incompatible with a long run growth trajectory. To solve this problem either US growth or domestic savings should increase quite above its forecasted figure. Since Mexico can do nothing to generate higher US growth, it has to work in increasing the savings rate.

According to the simulations of the paper, the size of the Mexican economy relative to the size of the US economy will grow slightly in time if actual parameters remain. The Mexican economy will continue being very small for a long time, however. Convergence in output levels could take almost a thousand years to materialize.

The paper is divided in four different sections: section I sets the AK model; section II solves analytically the model for a small open economy; section III calibrates the model for Mexico and performs long run growth simulations; section IV reflects on the role of labor in the AK model; The last section concludes.

I.- THE MODEL

We start from the very simple AK model of growth (See Rebelo (1992), (1992a)) in continuous time. In the small open economy output is a linear function of physical capital. Labor remains exogenous either as part of productivity A or being in a Leontief type of production function (see Hussein and Thirlwall (2000). See also section IV in this paper for a deeper explanation of this problem).

$$Y_t = AK_t \qquad (1)$$

Where Y is output, K capital and A the productivity of capital

This equation can be transformed in

$$g_{yt} = A\frac{dK_t}{dt}\frac{1}{Y_t} \qquad (2)$$

Which states that output growth (g_y) is a linear function of net investment (dK/dt) as a proportion of output.

At the same time, the trade balance is simply, by the national accounts identity, the difference between output and domestic expenditure

$$X_t - m_t = Y_t - C_t - \frac{dK_t}{dt} - \delta K_t - G_t \qquad (3)$$

Where X are exports, m imports, C is domestic consumption and G is government consumption. dk/dt + δK is gross capital formation and δ is the rate of depreciation of capital. All relative prices are assumed constant.

The balance of payments identity can be described as

$$X_t - m_t + T_t - r^* D = \frac{-dD}{dt} \qquad (4)$$

Where T are net remittances to the domestic economy r^* is the foreign interest rate and D is the foreign debt stock outstanding net of international reserves. The left hand side term is the domestic current account and –dD/dt is the net capital account. dD/dt is net indebtness, which includes new debt minus accumulation of international reserves.

(4) simply states that the net result of a current account surplus is a reduction of foreign net debt.

Substituting (3) in (4) and rearranging terms

$$Y_t - C_t - G_t + T_t - r^* D_t = \frac{dK_t}{dt} + \delta K_t - \frac{dD_t}{dt} \qquad (5)$$

(5) is the absorption approach version of (4). Higher domestic savings Y-C-G plus net remittances from abroad minus interest payments of the debt are resources employed to increase gross investment and/or to reduce the foreign debt stock.

Dividing (5) by Yt and using equation (2)

$$g_{yt} = A(s + \frac{T_t}{Y_t} - r^* \frac{D_t}{Y_t} + \frac{dD_t}{dt}\frac{1}{Y_t}) - \delta \quad (6)$$

The rate of growth of output will be higher the higher is productivity A, the domestic savings rate s (1-(C/Y)-(G/Y)), remittances as a proportion of GDP and indebtness also as a proportion of GDP. Higher interest payments will reduce the rate of growth, however.

If the technology were the one described by (1), (6) would be an identity. To convert an identity in a model it is necessary to assume some behavioral equations. The first one is that the domestic saving rate is constant. Secondly, remittances are related more to foreign output than to domestic output. This seems logical since those who remit resources live abroad. We assume a linear relation between remittances and foreign output:

$$T = \tau Y^* \quad (7)$$

The third assumption is that debt as a proportion of foreign output remains constant, which means that debt is supplied constrained and linked to the capacity of lending abroad. This is relatively a plausible assumption in some cases, especially when foreign public debt is huge and governments last for a short period of time. If that is the case, the demand for higher indebteness is very high because the short term government can increase growth in its period without paying the interest payments of that new debt. Instead, in any case they have to pay interest payments for old debt.

The third assumption means then that

$$\frac{1}{Y_t}\frac{dD_t}{dt} = D_{y*} g_{y*} \frac{Y_t^*}{Y_t} \qquad (8)$$

Where D_{y*} is the size of public debt as a proportion of foreign output and g_{y*} is the rate of growth of foreign output.

Substituting (7) and (8) in (6) and rearranging

$$g_{yt} = A\{s + [\tau - (r^* - g_{y*})D_{y*}]\frac{Y_t^*}{Y_t}\} - \delta \qquad (9)$$

(9) is the long run dynamic equation for growth, which depends positively on productivity, the domestic savings rate, the rate of remittances and the rate of growth of foreign output. It depends negatively on the foreign rate of interest and in the rate of depreciation of capital. The sign of the levels of foreign output and domestic output on growth is ambiguous. If the term [τ-(r^*-g_{y*})] is positive, then higher foreign output will affect positively the rate of growth of domestic output and the level of domestic output will affect negatively its rate of growth. If instead that sign is negative, it will be the other way around.

II.- LONG RUN SOLUTIONS AND THE STABILITY OF THE MODEL

If the rate of growth of foreign output is constant, equation (9) can be transformed in the following exact differential equation:

$$\frac{dY}{dt} = (As - \delta)Y_t + A[\tau - (r^* - g_{y*})D_{y*}]Y^*(0)\exp(g_{y*}t) \qquad (10)$$

After tedious calculations, (10) can solve for the trajectory of output Y(t) in the form (See Chiang (1992 p. 480-482)):

$$Y(t) = H\exp(As - \delta)t + Z\exp(g_{y*}t) \qquad (11)$$

Where

$$H = \{Y(0) - \frac{A[\tau - (r^* - g_{y*})D_{y*}]Y^*(0)}{(g_{y*} + \delta - As)}\} \qquad (12)$$

$$Z = \frac{A[\tau - (r^* - g_{y*})D_{y*}]Y^*(0)}{(g_{y^*} + \delta - As)} \qquad (13)$$

The reduced form for the rate of growth of output is

$$g_{y_t} = \frac{dY}{dt}\frac{1}{Y_t} = \frac{(As-\delta)H\exp(As-\delta)t + g_{y*}Z\exp(g_{y*}t)}{H\exp(As-\delta)t + Z\exp(g_{y*}t)} \qquad (14)$$

(14) can be restated in the two following different ways

$$g_{yt} = \frac{(As-\delta)H\exp(As-\delta-g_{y*})t + g_{y*}Z}{H\exp(As-\delta-g_{y*})t + Z} \qquad (15)$$

$$g_{yt} = \frac{(As-\delta)H + g_{y*}Z\exp(g_{y*}-(As-\delta))t}{H + Z\exp(g_{y*}-(As-\delta))t} \qquad (16)$$

When As-δ< g_{y*} the limit when t approaches infinity in (15) implies that the rate of growth of domestic output converges to the rate of growth of foreign output

$$\lim_{t\to\infty}]_{As-\delta<gy*}\, g_{yt} = g_{y*} \qquad (17)$$

Instead, when As-δ>g_{y*} the limit when t approaches infinity in (16) implies that the rate of growth of domestic output converges to a measure of net domestic savings as a percentage of total capital.

$$\lim_{t\to\infty}]_{As-\delta>gy*}\, g_{yt} = As-\delta \qquad (18)$$

Though the general solution for the problem is this, there are cases where the small economy collapses. Eventually, this happens always when g_{y*} > As-δ and net factorial income plus capital inflows are negative, namely $\tau-(r^*-g_{y*})D_{y*}<0$, but it can also happen sometimes when As-δ>g_{y*} and $\tau-(r^*-g_{y*})D_{y*}<0$. Instead, if net factorial income plus capital inflows are positive the domestic economy never collapses.

To show this we propose:

Proposition: If net factorial income plus capital inflows are negative: $\tau-(r^*-g_{y*})D_{y*}<0$, then the small open economy will always collapse at some future if $g_{y*}>As-\delta$ and will collapse sometimes when $As-\delta>g_{y*}$. The economy will never collapse when net factorial income plus capital inflows are positive ($\tau-(r^*-g_{y*})D_{y*}>0$).

Proof:

If $g_{y*}>As-\delta$ and $\tau-(r^*-g_{y*})D_{y*}>0$, then: $Y(0)-Z=H$ may be greater, equal or smaller than zero (see (12)) but $Z > 0$.

Therefore, the trajectory of output in the small open economy can be rewritten as (see (11), (12) and (13)):

$$Y(0)\exp(As-\delta)t - Z\exp(As-\delta)t + Z\exp(g_{y*}t) > 0 \qquad (19)$$

This expression has to be always positive for every period t, since $Y(0)>0$ and $As-\delta<g_{y*}$.

If $g_{y*}<As-\delta$ and $\tau-(r^*-g_{y*})D_{y*}>0$, then $Z<0$ and $Y(0)-Z=H>0$, but this implies rewritten (11)

$$Y(0)\exp(As-\delta)t - Z(\exp(As-\delta)t - \exp(g_{y*}t)) > 0 \qquad (20)$$

Which happens because $Z<0$ and since $As-\delta>g_{y*}$, the term $\exp(As-\delta)t-\exp(g_{y*}t)$ is necessarily greater than zero for every positive t.

If $g_{y*}>As-\delta$ and $\tau-(r^*-g_{y*})D_{y*}<0$ the economy collapses eventually. In this case $Z<0$, which means that $H>0$, but because the rate of growth of foreign output is large, (11) implies that at some point the term $Z\exp(g_{y*}t)$ must go above the term $H\exp(As-\delta)t$ in absolute value, which means that Y becomes negative and the economy collapses.

If $g_{y*}<As-\delta$ and $\tau-(r^*-g_{y*})D_{y*}<0$ the economy may or may not collapse. The economy will not collapse if the initial output $Y(0)$ is sufficiently high. In this case $Z>0$, which means that H may be greater, equal or smaller than zero. If $H\geq 0$ because $Y(0)$ is sufficiently high, the economy never collapses (see (11)). However, if H<0 the economy definitely collapses since Y=H exp (As-δ)t + Z exp(gy*t) with As-δ>g_{y*} implies that at some point the term H exp (As-δ)t overpass the term Z exp (g_{y*}t) in absolute value, generating a negative value for Y.

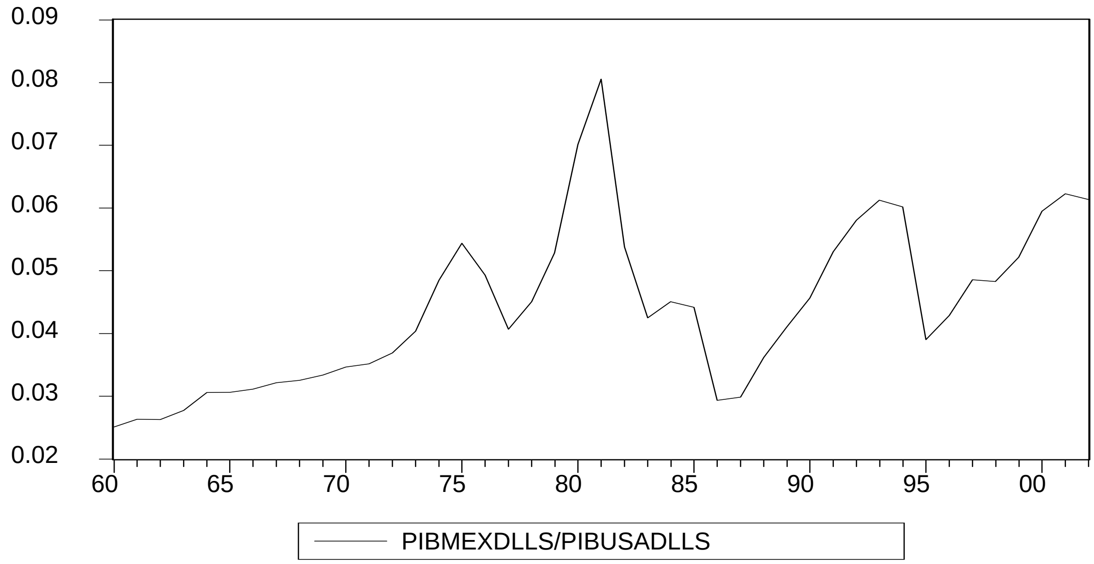
An economy subject to a high debt overhang may face a situation where its parameters are inconsistent with sustainability in the long run. In a strict sense economies do not collapse, but inconsistent parameters indicate that at some point there must be an enormous effort to increase domestic savings in order to survive. These efforts may include a strong fiscal adjustment or high increases in interest rates to generate higher savings. In monetary environments adjustments can include high inflation to produce forced savings through the inflation tax.

III.- MEXICAN GROWTH: STABILITY AND THE INFLUENCE OF UNITED STATES GROWTH IN THE AK MODEL

The previous model may be calibrated to check for stability and long run solutions in particular small open economies. We do that for the case of Mexico, where we take the growth and the level of output of the US as the relevant parameters of reference of the large partners. This is quite consistent with the fact that more than 70% of the total Mexican trade takes place with the US, but also because almost all remittances proceed from the US and a very high proportion of the Mexican debt outstanding comes also from the same country.

Through time, the US has been a much larger economy than Mexico's. The relation between Mexican GDP and US GDP shows a moderate upward trend since 1960. However, starting in the mid seventies there is quite a lot of variance in that ratio.

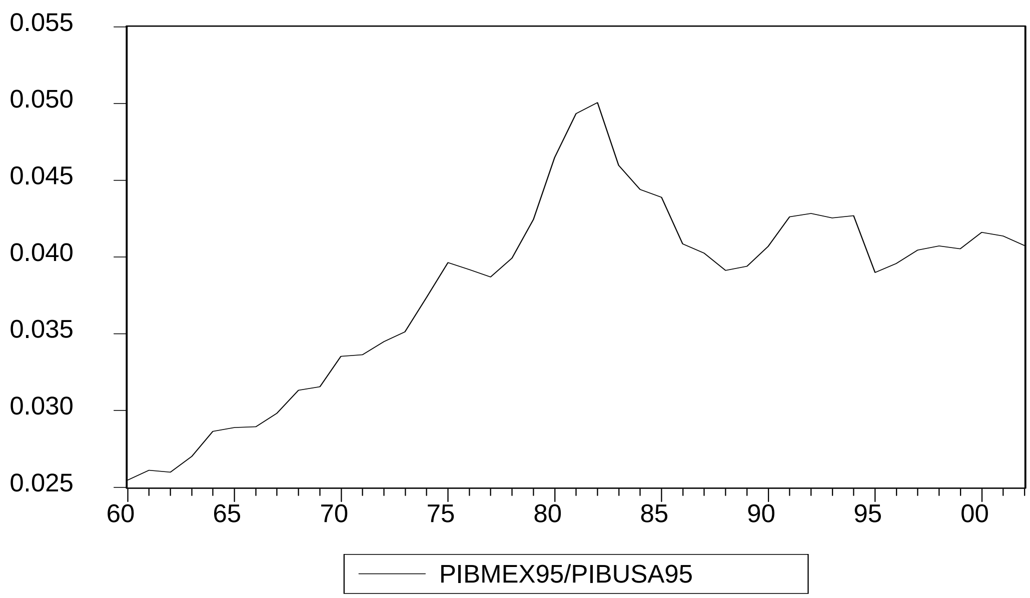
Graph 1: Ratio of Mexican GDP/US GDP



The ratio is referred to Mexican current GDP in current dollars divided by US GDP in current dollars.

Source: World Development Indicators 2004. The World Bank

Graph 2: Mexican GDP/US GDP



The ratio is referred to Mexican GDP in constant dollars of 1995 divided by the US GDP in the same terms.

Source: World Development Indicators 2004. The World Bank

Graph 1 shows the relation between the nominal GDP in current dollars of Mexico with respect to the same figure in the US. Starting in the sixties, the Mexican GDP was just about 2.5% of the total US GDP. The figure reached a first maximum of 5.4% in 1976, year in which Mexico experienced the first macroeconomic crisis of the new era. The recovery of the second half of the seventies took the Mexican economy to a new maximum of 8% of the US GDP in 1982, year of the second large macroeconomic crisis.

During the 1980's period, the growth of the Mexican economy was lower than the correspondent figure in the US and Mexican GDP became smaller with respect to the US economy. This situation changed since 1988. In 1994 the Mexican economy reached another local maximum of 6% of the US economy. The 1995 crisis changed this pattern but the economy recovered fast and in 2002 was 6% of the US again.

The strong adjustments between the Mexican GDP and the same figure for the US is quite influenced by the adjustment of the real exchange rate. In periods of crises in Mexico (1976, 1982, 1995) the nominal devaluation has been accompanied by a sharp real exchange rate depreciation, which immediately reduces the nominal level of the Mexican GDP in dollars and produces the strong movement on the ratio of the GDP's. Measuring the GDP in constant US dollars theoretically eliminates this problem.

Graph 2 shows the ratio of Mexican GDP to US GDP in constant US dollars of 1995. The figure suggests that from 1960 to 1982, and except for 1976, the Mexican economy was systematically growing at higher rates than the US economy. From that point the ratio of GDP's has been much more volatile showing cyclical patterns and there is not a defined trend.

Both graphs suggests that while possibly in the sixties and seventies there was a trend for convergence between Mexico and the US, starting in the eighties that phenomenon is absent at least in output levels.

We performed an exercise to check whether actual and historical parameters of the Mexican economy are, first, consistent with the existent of the economy in the long run; second, sufficient to create convergence between Mexico and the US either in growth rates or even in output levels. The exercise is also useful to show the sensibility of growth and long run levels of output to small changes in parameters.

Data consistent with the model described in sections II and III is presented in table I

Table 1: Assumptions for simulations of the Mexican case (basic scenario)

Net external debt/US GDP (D_{y*}) (2003)	0.00916
Remittances/US GDP (τ) (2004)	0.00145
Implicit interest rate for net foreign debt (r^*) (2003) (%)	10.8
Domestic savings rate (s) (Average 1980-2004) (%)	0.19
Initial US GDP ($Y^*(0)$) (billions of US dollars) (2004)	11728
Initial Mexican GDP (Y(0)) (billions of US dollars) (2004)	667.1
US GDP long run growth (%)	3.5
Productivity A	0.7786
Rate of depreciation δ (%)	11.2
Parameter H	4074.5
Parameter Z	-3407.4

Source: For the Mexican net foreign debt: Informe Annual del Banco de México 2003; for the US GDP: Bureau of Economic Analysis (www.bea.gov); for remittances: Banco de México (www.banxico.org.mx); for the implicit interest rate of foreign debt: own calculations based on information of Informe Anual de Banco de México 2003; For the domestic savings rate: own calculations based on information of Instituto Nacional de Estadística, Geografía e Informática (www.ingei.gob.mx); For the other parameters own calculations.

Net foreign debt is calculated as foreign debt reported by Banco de México minus international reserves owned also by that institution. Remittances are calculated as the net result of the balance of transfers in the current account of the balance of payments. The domestic saving rate is calculated as the difference between Mexican GDP total consumption (public and private) and accumulation of inventories divided by GDP.

To calculate productivity A and the rate of depreciation of capital δ we assume the original AK model. Data on the size of the physical capital in Mexico is either inexistent or very partial and without a long history. Equation (1) in discrete time and in the presence of random shocks can then be transformed in:

$$g_{yt} = A(I_{byt} - \delta \frac{K_{t-1}}{Y_{t-1}}) + e_t \qquad (21)$$

Where I_{byt} is gross investment in time t divided by GDP in the previous period. e_t is a random shock normally distributed with zero mean. Also, since theoretically A is Y/K, (21) may be written in econometric terms as:

$$g_{yt} = \pi_0 + \pi_1 I_{byt} + j_t \qquad (22)$$

In this case π_0 is an estimator of $-\delta$ and π_1 is an estimator of A. j represents the residuals of the regression.

Regression (22) was run in annual terms for the period 1980-2003.The results estimated by ordinary least squares (OLS) and by the generalized method of moments (GMM) are presented in table 2.

Table 3: Regression of growth to calculate productivity and the rate of depreciation of capital (t-statistic in parenthesis).

	OLS	GMM
π_0	-0.129	-0.112
	(-3.6)	(-7.4)
π_1	0.83	0.78
	(4.2)	(9.3)
R^2	0.46	0.42
D.W.	1.7	1.65
F	18.0	-
Q(12)	6.6	6.5
LM(2) F	0.3	-
ADF(1) for residuals	-3.2	-3.2
JB	1.6	1.6
CUSUM	Inside the 5% confidence limits	-
CUSUMSQ	Inside the 5% confidence limits	-
J statistic	-	0.25
ADF(1) for gy*	-3.7	-3.7
ADF(1) for Iby	-3.6	-3.6

Source: Own calculations

R^2: Coefficient of determination

D.W. Durbin-Watson statistic

F: Fisher statistic for goodness of fit

Q(12): Box-Lijung statistic of the correlogram

LM(2)F: F statistic of the LM test for serial correlation

ADF(1): Augmented Dickey-Fuller statistic with one lag.

CUSUM: CUSUM Test for stability of the parameters

CUSUMSQ: CUSUMSQ test for stability of the parameters.

J-statistic: Statistic to show the validity of overidentified restrictions in a GMM model

Instruments for the GMM regression: GDPUS, GDPMEX t-1, $I_{priv\ t-1}$, $I_{pub\ t-1}$, X_{t-1} (I_{priv} is private investment, I_{pub} is public investment, X represents non oil exports).

The calculated regression shows a good performance. The rate of growth of GDP and the ratio of total gross investment to GDP are both stationary variables according to the Dickey-Fuller tests, which means that the regression is a traditional one. Endogeneity might be present in the real life since changes in the error term can be correlated with the ratio of total investment to GDP. For that reason we run the regression by OLS and also by GMM. In this last case we use instruments that should not be correlated with the contemporaneous error term.

It is surprising that according to the CUSUM and CUSUMSQ tests in the OLS estimation the parameters of the regression are, apparently, stable. This is because if labor is involved in the parameter A, then this one should be growing in time and π_1 would not be stable. A possible explanation for this finding- which we will retake in the next section- is the possible complementary of labor and capital in the production function. In a linear production function the AK model can survive completely without modification since production is constrained by the most scarce factor of production in the market. If we assume that labor is the abundant factor, then the AK model would fit very well reality.

The results of the model show that the productivity factor A is around 0.8 and that the rate of depreciation of capital is between 11% and 13%. For the simulation coming next we use the parameters estimated by the GMM technique, which should be free from endogeneity problems.

We projected equations (13) and (14) as well as the ratio of Mexican GDP to US GDP starting in 2005. Basic assumptions are shown in table 1. We use the historical domestic saving rate measured as the average of the years 1980-2004. This figure is not far from what happened in 2004 (19% historically and 19.4% in 2004). The reason why we take the historical number is because the figure seems relatively stable in the medium term. Instead, we used more actual figures for other variables like the foreign debt or remittances. In the case of debt, we consider that the actual figure (2003 values) is more relevant than the same variable in the past because debt is a stock that under certain conditions may not be reversible. With respect to the remittances, the figure is not at all stationary. It has been growing with respect to US GDP as well as Mexican´s. As far as today is concerned, it seems prudent to maintain this figure as a percentage of US GDP constant but it could be actually higher (we took the figures for 2004).

The exercise assumes implicitly that other variables of the current and capital account remain zero in net terms. Those factors involve, for instance, foreign direct investment (FDI). The assumption implies that in the long run what enters as FDI leaves the economy probably as a utility remission from Mexico to abroad. In the last years, FDI has been greater that remitted benefits abroad, which apparently implies that the assumption of zero effect over the balance of payments is a conservative one.

When using the parameters already shown in table 1, the result is very similar to the 2004 investment-GDP ratio, however. This means that the net result of FDI minus remittances from this concept is being compensated with other net exists on the capital account.

There are three scenarios in the simulation: The first is a basic one with the assumptions shown in table 1; second scenario (scenario A) simulates what would happen if ceteris paribus there would be a reduction of remittances to zero; third scenario (scenario B) shows a situation where there is a reduction of the domestic savings rate in one point of GDP with respect to the basic scenario. Main results appear in table 4:

Table 4: Main results of the growth exercise in the AK model

	Basic scenario	Scenario A	Scenario B
g_y short run (2005-2020) (%)	4.6	2.7	3.9
g_y long run (%)	3.6	Economy non viable	3.5 convergence to US in growth rates.
Y/Y* short run (2005) (%)	5.7	5.6	5.7
Y/Y* long run (%)	The Mexican economy converges to the US economy	Economy non viable	8.9
As-δ	3.6	3.6	2.8

Scenario A supposes zero remittances starting in 2005.
Scenario B assumes the savings rate falls from the average of 19% GDP to 18%
Source: Own calculations

If parameters continued in the future as they have been in the last years (basic scenario), the Mexican economy would have a relatively good performance in the long run. Growth will be higher than US´s and the economy would catch up the US economy in the very long run. Since in this case $As\text{-}\delta > g_{y*}$ and $\tau\text{-}(r^*\text{-}g_{y*})D_{y*} > 0$, H>0 and Z<0 (see table 2), but then equations (11) and (20) imply that the economy is viable and equation (18) means that the long rate of growth of output converges to As-δ, which in this case is equal to 3.6%.

A long run growth of 3.6% implies that in the very long run the Mexican economy not only converges to the US economy, but it surpasses it. However, the simulation shows that a process in which the Mexican economy becomes greater than the US economy would last for almost one thousand years. According to this exercise, in the next fifty years the Mexican economy would pass from 5.7% of the US economy to 9.1%. At the end of the 21th century, the Mexican economy would be only 12.5% of the US economy.

Scenario A shows a situation that is not viable in the long run, which happens because the term $\tau\text{-}(r^*\text{-}g_{y*})D_{y*} < 0$. Though $As\text{-}\delta > gy^*$, the initial value of Y(0) is insufficient to make H greater than zero and eventually the economy collapses. The exercise seems useful because it shows the importance of remittances in the process of growth of Mexico. The reduction of τ from 0.145% of the US GDP to zero would reduce the short run Mexican growth almost two percentage points, from 4.6% to 2.7%. Furthermore, in this case growth is falling continuously until it becomes negative and eventually produces a collapse. This one is punctually calculated in more than one hundred years from now.

Scenario B shows the sensibility of growth to the domestic savings rate. If this figure pass from 19% of GDP to 18%, the US rate of growth g_{y*} becomes greater than As-δ. As the theoretical part of this paper shows, when that is the case and the term $\tau-(r^*-g_{y*})D_{y*}>0$, the rate of growth of the small economy converges to g_{y*} and in many cases, like this one, there can never be convergence in output levels. The Mexican economy would increase its participation with respect to the US economy from the actual 5.7% to 8.9% but it would never pass from that limit number.

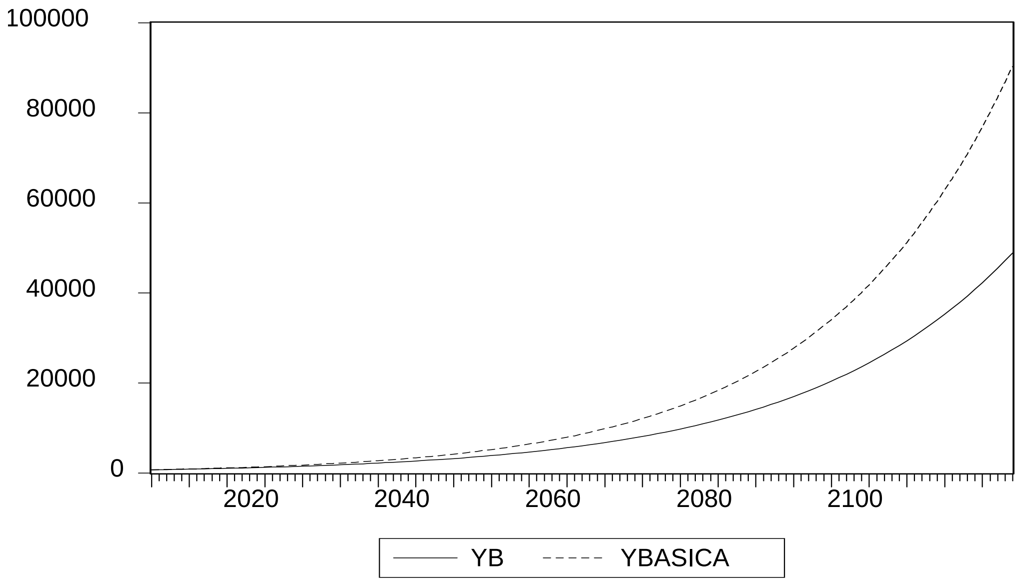
Small changes in the domestic saving rate have a short run impact that is not very high but may have dramatic changes in the long run performance of an economy. In these simulations the reduction of 1 percentage point in the domestic savings rate generates a reduction of 0.7 percentage points of growth in the short run (from 4.7% to 3.9%). However, in the long run, when the savings rate is like the actual one, the Mexican economy becomes large and when the rate is one percentage point less it remains small always, which means that changing the parameter upwards can make all the difference in the positive side.

Figure 1 shows output trajectories for the Mexican output Y in the basic scenario and in scenario B where the domestic savings rate is one percentage point less. In 2005 the economy in the basic scenario is just 0.7% greater than in scenario B. However, in 2050 the economy in the basic scenario would be 34% greater than in scenario B and in 2100 70% greater. In the long run the impact is very high.

Figure 2 shows the effects of a reduction of remittances to zero. The economy continues growing at positive rates for a long time. However, it reaches a maximum output level and then starts falling very fast and collapses.

Figure 3 shows the ratio of the Mexican economy to the US economy in the three scenarios.

Figure 1: Output trajectories in the basic scenario and in scenario B

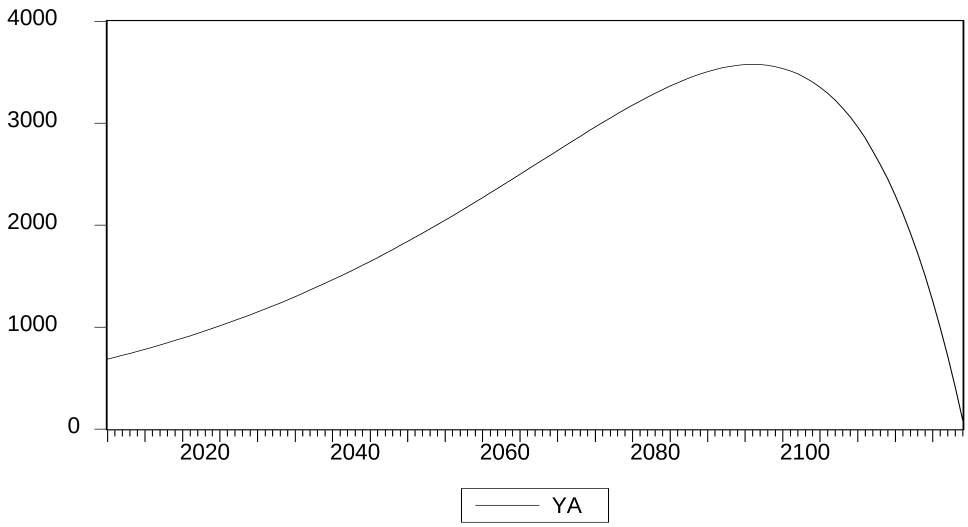


Yb: Output in scenario B

YBASICA: Output in basic scenario.

Source: Own calculations

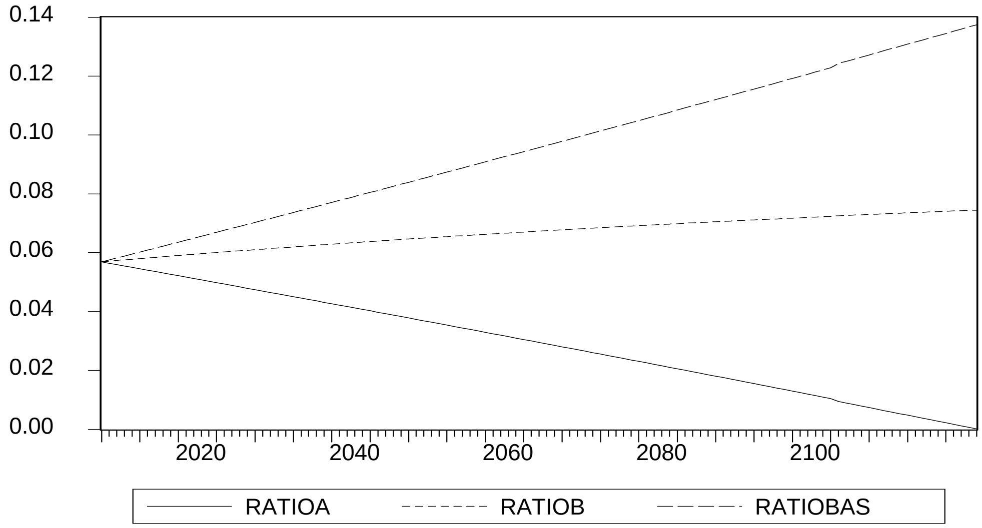
Figure 2: Output trajectory in scenario A



YA: Output in scenario A

Source: Own calculations

Figure 3: Ratio of Mexican GDP to US GDP



Ratiobas: Ratio in the basic scenario

Ratioa: Ratio in scenario A

Ratiob: Ratio in scenario B

Source: Own calculations

IV.- LABOR IN THE AK MODEL

The last results can be criticized at empirical level because labor does not intervene in growth. In the AK version of Rebelo (Rebelo (1992) (1992a)) labor is implicit in the parameter A. If it is constant, all the theoretical results found in the first two sections of this work can be rescued. However, at empirical level there should be a criticism because in Mexico employment must continue growing in the next years. Therefore, A is not a constant parameter.

Nonetheless, another version of the AK model is simply the Harrod-Domar production function where capital and labor are perfect complements (see Hussein and Thirlwall (2000)). If that is the case:

$$Y_t = Min(AK_t, BL_t) \qquad (23)$$

When labor is an abundant factor of production relatively to capital, (23) becomes:

$$Y_t = AK_t \qquad (24)$$

And the demand for labor determines the total employment of the economy and is defined as

$$L_t = \frac{Y_t}{B} \qquad (25)$$

The simplest version of this model requires labor force growing equally or above output Y to generate a situation where savings and investment generate endogenous growth. Given the simulation presented here before, in the basic scenario labor force should be growing at near 4% annually for the AK Harrod-Domar version to be relevant. But labor force in Mexico is growing at 2.2%. Sooner or later, the original AK Harrod-Domar model would be restricted by the modest growth of the labor force and the rate of growth of output would be constrained by that factor.

Different authors and theories may be advocated to rescue a modified version of the AK Harrod-Domar model even in cases where the rate of growth of the labor force is low. In the mid-fifties, Kaldor (1957) asserted that the capital-output ratio (referring capital as physical capital) of industrialized economies had remained relatively constant (the AK model) while the capital-labor ratio had rose due to increases in the productivity of labor. Part of this argument had been first advocated by Verdoorn (1949), which established the so-called Verdoorn law, a proposition stating that in the manufacturing sector of many economies the rate of growth of output leads to an increase in the productivity of labor (see for example Mamgain (2003) for a good description of the Kaldor-Verdoorn laws).

A generalization of the Verdoorn law to the economy as a whole can be interpreted as the parameter B in equations (23) and (25) depending positively on the size of labor. If that is the case, the elasticity of the demand for labor to output is smaller than one. Therefore, an increase in output coming from higher savings-investments in the AK equation will generate higher labor productivity. It also will increase the capital-labor ratio and could be much more compatible with a low rate of growth of the labor force.[3]

Additionally to the Verdoorn law, it is the efficiency wages hypothesis. In its earliest version (Solow (1979)) this approach makes the productivity of labor to depend on the real wage. In the terms we are adopting here, B would be also a function of the real wage.

Taking equation (25) and making B a linear function of total labor and the real wage we get

$$L_t = \frac{Y}{B_0 L^{\beta} w^{\alpha}} \qquad (26)$$

Which instead implies

$$L_t = \frac{Y_t^{\theta}}{B_0^{\theta} w_t^{\alpha\theta}} \qquad (27)$$

$$\theta = \frac{1}{1+\beta} \qquad (28)$$

(27) is a demand for labor that depends upon output with an elasticity smaller than one and depends negatively in the real wage w because of the efficiency wages argument.

Taking logarithms in (27) and then rates of growth and solving for the rate of growth of real wages

$$g_w = \frac{g_y}{\alpha} - \frac{g_l}{\alpha\theta} \qquad (29)$$

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[3] The Verdoorn law is actually a very similar concept than the Romer externality (Romer (1986)). In the Verdoorn case, the productivity of labor depends upon the total size of labor, while in the Romer case, the productivity of capital depends upon the total size of capital.

So, even in the case where the labor force grows at zero or even at negative values, a modified AK Harrod-Domar version could survive if the Verdoorn law and the efficiency wages hypothesis hold. In cases where the rate of growth of the labor force pass from a positive rate to a zero one, the rate of growth of wages would increase in order to maintain the relation AK=BL.

CONCLUSIONS

According to our research, actual and historical parameters of the determinants of Mexican growth are compatible with a long run growth that could be around 3.6% in the best case. If these parameters continue in the same observed level, Mexico could improve its relative size position with respect to the US.

Growth exercises are very sensible to changes in the parameters. At the same time, Mexican growth depends upon strongly in the fact that the sum of factorial income plus capital entrances show a positive number. If that were not the case, then actual parameters would not be compatible with sustained growth. Since theoretically in this case the economy would collapse, there should be strong changes in parameters to make the economy viable.

One of the main results of the exercises is that remittances from Mexican workers in the US are crucial to maintain a sustained trajectory of growth. That constitutes an uncomfortable result. Economic policy has only very few instruments to maintain or increase such remittances.

Mexican growth is also quite influenced by US growth through its effect in the net foreign debt burden. A reduction of US growth increases the net burden of foreign debt generating lower resources to invest and therefore producing lower growth in Mexico. Again, Mexico does not have policy instruments to generate higher US growth.

The previous analysis shows that Mexican growth is extremely vulnerable to factors that the country cannot control. Exercises show that growth is also very vulnerable to the domestic savings rate, however. In its positive side, this result implies that economic policy has to work very hard to generate a higher savings rate. A fiscal reform, better financial services and an environment enhancing the rule of law and generating more certainty could induce a much higher savings rate in the future, which would make a strong difference in the growth performance.

FDI was not considered explicitly in the analysis. The assumption in this respect was that all entrances of FDI were compensated by an exit of benefits abroad or by other not considered factors in the capital account. So far, the net flow of FDI has been positive but there have been other concepts compensating this effect in such a way that the investment/GDP ratio estimated without considering FDI is very similar to the real figure.[4]

There are many ways of extending this work: one possibility is to model more explicitly the domestic savings ratio as a function of the domestic rate of interest and other parameters. The same could be done with foreign remittances or even with FDI.

A second possible extension will consist of making indebtness endogenous. Private capital has substituted in an important way public capital as a way of financing. The former is endogenous, nonetheless, and responds to interest rates and other factors, something that could be incorporated in the future.

A big challenge when working with models that show constant returns in physical capital is to know how such capital is distributed in the world. In a Solow´s type model, a complete openness of the capital account would imply that, if possible[5], capital would go from where it has lower marginal productivity to where it is more productive. Equalization of marginal productivities would determine the distribution of capital between the two open economies.

In economies showing constant returns in physical capital, the marginal productivities of capital can never be equal at least that productivity A were the same everywhere. Rebelo

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[4] Nonetheless, the assumption of an infinite positive flow of FDI does not seem accurate. Advocating the Modigliani-Miller theorem it would be possible to assert that FDI behaves in a similar way than foreign debt. Rebelo (1992a) makes this assumption, actually. If that were the case, a higher stock of foreign capital in the country would generate a net exit of resources in the long run, in the same way that happens with foreign debt when the external rate of interest r is higher than the rate of growth of the GDP in the US.
Assuming zero net flows of FDI constitutes a conservative strategy in between of what is happening today in Mexico (FDI gross flows are greater than the exit of benefits) and what theoretically would happen in the long run when FDI behaves in a similar way than debt (net exits are greater because exists surpass net entrances).
We recognize, as many other authors, that in practice FDI does not behave in the same way than debt and that it might have effects on productivity not considered in this paper (see for instance Goldstein and Razin (2005) for an explanation of differences between FDI and portfolio investment). It is plausible that even in the case where FDI net flows are zero or negative in the long run, the net effect on the economy might be positive because productivity (A in the case of the AK model) is enhanced.

[5] Rebelo (1992[a]) asserts that capital might be irreversible, that is to say that sometimes once it is put in one place it cannot move anymore.

(1992a) asserts that in these cases all the capital of the less productive economy would go to the most productive one if possible. The solution may be much more complex, however. In a type of Harrod-Domar AK model without extraordinary profits, a sufficient large stock of labor everywhere, coped with quite a lot of flexibility for real wages, would easily indeterminate the distribution of capital among different economies. This is also a topic where more research is desirable in order to check whether or not it is possible to make foreign debt endogenous.[6]

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[6] Suppose that the production function is Y=Min(AK, BL), labor is an abundant factor of production everywhere and there are not extraordinary profits, which means that AK=rK+wL, where r is the rate of interest and w is the wage rate. If this is the case r=(B-w)A/B and w=(A-r)B/A. An openness of the capital account would equalize r everywhere. Those countries with higher productivity A and B would have higher wages w. However, the distribution of capital among the economies would be completely inderminate for a given international rate of interest, or this one would be indeterminate to generate an equilibrium distribution of physical capital. If that is the case, it is not possible to make the foreign debt endogenous in a small economy, it will have to be exogenous, generated by sentiments or other factors but not by market fundamentals.

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