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Is Puerto Rico Converging to the United States?

Fernando Lefort

Working Paper 1003

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* * *

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Is Puerto Rico Converging to the United States?

by

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IS PUERTO RICO CONVERGING TO THE UNITED STATES?

Abstract

The neoclassical theory of economic growth predicts that the rate at which an economy grows during its transition to the steady-state is proportional to its distance from that steady-state: the further the distance, the faster the growth, and vice versa. Considering that the US is the largest and wealthiest economy in the world, it is not surprising that during the post war period Puerto Rico linked itself with the US, and outperformed other economies which had lower, steady-state levels of per capita income. But does this mean that Puerto Rico is converging with the US? The principal conclusion of this research is that the economy of Puerto Rico is not converging to the steady-state level of per capita income of the United States. Three other significant results were:

- The integrating effect of statehood is actually a vital economic, and not just political, variable. It explains Puerto Rico's lack of economic convergence with the US.

- Without statehood, Puerto Rico will never develop sufficient economic strength to converge with the mainland economy. Because of the lack of economic convergence, statehood is, economically, a sink or swim matter.

- The cost of Commonwealth status is enormous. In 1994 the average Puerto Rican would have been making $6000 more per year, if Puerto Rico had been converging to the per capita income level of Mississippi (the poorest state in the Union).

At the end of the day, the question has always been: What would be the cost of statehood? My analysis concludes that the opposite question should have been asked: What *has been* the cost of Commonwealth?

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IS PUERTO RICO CONVERGING TO THE UNITED STATES?

By Fernando Lefort*

1 Overview

The main result of this study is that the per capita income of the Puerto Rican economy is not converging towards the per capita income of the United States. In other words, Puerto Rico is not closing the income gap that separates it from the US. Even after controlling for a set of standard determinants of growth variables, Puerto Rico remains well below the convergence frontier traced by the United States.

The motivation behind this study is twofold. First, it seeks to place the achievements of the Puerto Rican economy during the period after World War II in the correct perspective. The economic achievements of Puerto Rico during that time have been studied, and lessons have been drawn for other Latin American and Caribbean economies. The question is, however, should Puerto Rico be compared to those economies or, rather, to the economic performance of the United States within the same period? Puerto Rico is far more closely linked politically, economically, and socially to the US than to any other country, including those in Latin America and the Caribbean, and this high degree of integration between Puerto Rico and the US implies that the steady state level of per capita income of Puerto Rico is most likely closer to that of the US than to that of the economies of other countries in the region.

The neoclassical theory of economic growth predicts that the rate at which an economy grows during its transition to the steady state is proportional to its distance from that steady state -- the further the distance, the faster the growth, and vice versa. Considering that the US is the largest and wealthiest economy in the world, it is not surprising that during the post war period Puerto Rico linked itself with the

* This paper is part of my Ph.D. dissertation in Economics (1996) at Harvard University, supervised by Robert J. Barro.

US and outperformed other economies with lower steady state levels of per capita income. But does this mean Puerto Rico is converging to the US?

The second objective of this study is to investigate and draw conclusions about the effect Puerto Rico's political status has on the island's economy. Several American and Puerto Rican politicians believe that Puerto Rican statehood should be postponed until Puerto Rico reaches a level of per capita income closer to the US. Their thesis assumes that such political change would be easier once Puerto Rico has approached the level of economic development attained by the US. But is this possible for Puerto Rico?

Economically, this position only makes sense if Puerto Rico is in fact converging to the steady state per capita income of the US. If, instead, Puerto Rico is converging to a lower level of per capita income, then the Puerto Rican economy will continue to distance itself from its giant neighbor, and these preconditions for statehood will never be achieved. A regression analysis of this century's economic growth across the states, presented in this paper, reveals that territories (and Puerto Rico is a territory) have grown more slowly than states.

This paper concludes that the benefits of statehood, which include political power, full parity in federal funding and programs, and the psychological lift that attracts capital to politically stable environments, cause states to outperform territories. Thus, any policy leading to statehood will allow Puerto Rico to increase its long-run equilibrium income towards that of the US and will provide Puerto Rico with additional economic growth during the transition to such a higher steady state. By reducing the political uncertainty and building a more permanent economic and political relationship with the US, the change from commonwealth status to statehood would be the way for Puerto Rico to achieve a superior path of economic growth.

In particular, this study shows that: (i) Puerto Rico has been growing at a rate more than 2 percentage points lower than could be expected from an economy with the same initial level of income of Puerto Rico and converging towards the US; (ii) This lack of convergence has meant that Puerto Ricans today have a per capita income $6000 dollars lower than the one they could have got; (iii) The political status effectively explains the economic performance. American territorities have historically grown 2 percentage points faster after they have become states.

2 A Quick Look At The Convergence Hypothesis

This section offers a quick review of the main implications of the neoclassical theory of growth in terms of the convergence effect.

The neoclassical model of economic growth developed following pioneering work of Solow (1956) and Swan (1956) is mainly characterized by a production function exhibiting diminishing returns to capital. In such economies the rate of return to capital gets smaller as the economy grows wealthier and accumulates more capital. Because of the diminishing returns to capital, the rate of per capita accumulation of capital diminishes as the stock of capital increases. As a consequence, each economy approaches a unique long-run equilibrium or steady state. Intuitively, there is a point where the new additions to the stock of capital are only enough to account for depreciation and population growth. At that point no net additions of capital are made, and the economy stops growing.

Imagine an analogous infant who will eventually be a 6 foot adult. That is his steady state. In the process (transition) to achieve this adult size, he will grow very fast at the start, slowly converging to a zero growth rate until he reaches 6 feet.

During the transition towards this steady state, other things being equal, the rate of return in the economy and hence the rate of capital accumulation is inversely related to the initial per capita stock of capital. As a consequence, the theory predicts that the further away an economy is from its own steady state in terms of per capita income, the higher the rate of growth for this economy. This is the basis for the concept of convergence.

In the simplest neoclassical growth model, the steady state level of per capita income is determined by the technology available, the rate of population growth, the depreciation rate, and the savings rate. Therefore, only if a group of countries share the same technology (broadly defined to include institutions, political status, capital access, etc.), preferences, and other relevant parameters will their economies be expected to have the same long-term level of per capita income or steady state.

In general, the level of technology can be affected by government policies and regulations that distort the markets and by the degree of integration with other economies with other technologies. The savings rate can be considered to be exogenous or can be endogenously determined by the underlying preference parameters. After completing its transitional dynamics, an economy reaches its long-run level of per capita income when the different per capita variables start

growing at the same constant rate of growth given by the rate of exogenous technological progress. At that point, the economy is said to be in steady state, and its level of per capita income is known to be the steady state level.

Consider a group of economies that, because of cultural, political or physical proximity, share the same steady state value of per capita income. The neoclassical model of growth predicts that the countries with lower initial levels of per capita income will have higher rates of per capita income growth. Poorer economies will tend to converge or catch-up to wealthier ones, in per capita terms, if their economies differ only because of initial conditions. Thus, the theory of absolute convergence: of two economies aspiring to the same steady state levels, the economy with the lower, initial level of income will grow faster.

However, even the simplest of the neoclassical growth models, the Solow-Swan model, requires a restatement of this implication if all economies do not share the same steady state. What if different countries have different savings rates, population growth rates, or different technologies? It can be shown that economies with higher steady state levels will grow at a higher rate in per capita terms than those striving toward lower steady states. Hence, the theory of conditional convergence (after the revisions of the convergence hypothesis by Barro and Sala-i-Martin (1992), and Mankiw, Romer and Weil (1992)): of two economies with the same initial levels of income, the economy aspiring to the higher steady state will grow faster.

Figure 1

Absolute and Conditional Convergence

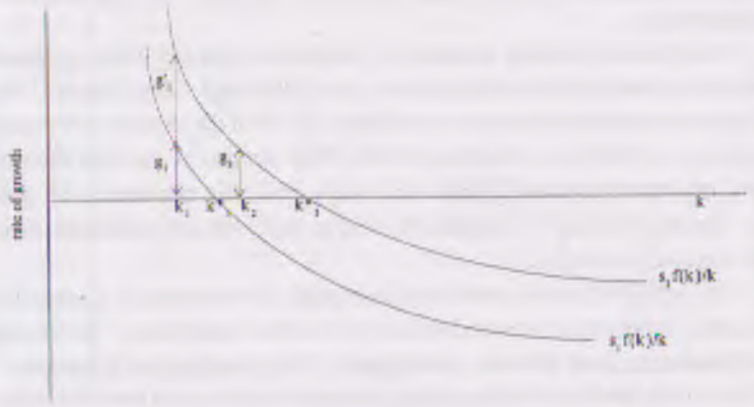


Figure 1 illustrates the difference between these two concepts.[1] Consider two economies sharing the same steady state income k_2^* but with different initial conditions k_1 and k_2. As the figure clearly shows, the economy with lower initial level of income will grow faster (i.e. $g_1' > g_2$, absolute convergence). Consider, instead, two economies with the same initial level of income k_1, but with different steady state values, k_1^* and k_2^*, respectively. In this case, in spite of the fact that both economies share the same initial level of per-capita income, conditional on their steady states, the economy with the higher steady state level will grow faster ($g_1' > g_1$, conditional convergence).

The speed of convergence is an important parameter to be assessed, not only as a theoretical curiosity, but also because of its economic implications. A low speed of convergence implies that countries spend much of the time far away from their steady state. A speed of convergence of 2.5 percent suggests that the average time that an economy spends to cover half of the distance to its steady state is around 30 years. Therefore, medium-term growth rates will be dominated by the

[1] The figure plots the rate of growth on its vertical axis, and the stock of capital on its horizontal axis.

transitional dynamics, only marginally affected by changes in the steady state positions. In contrast, high speeds of convergence imply that the economies spend much of the time in the vicinity of their steady state. Therefore, short-term rates of growth are strongly affected by shocks to steady states and by the long-term steady state growth rate.

There have been many attempts to estimate the speed at which economies approach their steady states in the empirical growth literature. Since Romer (1986), there is a consensus on the absence of evidence in favor of the absolute convergence hypothesis at a global level. Regressions using large samples of countries show that rates of growth of per-capita income are usually positively correlated with initial levels. There have been two approaches used to deal with the differences among steady states across countries.

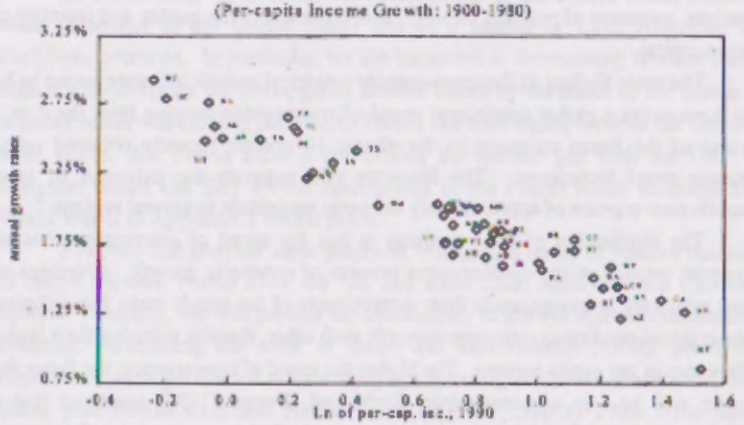
The first one involves restricting the sample of economies to a group that, presumably, is homogenous enough to share a common steady state. In this case, we are measuring local absolute convergence. The second approach has been to deal with a cross section of heterogeneous countries and to control the estimation of the speed of convergence using a set of variables that proxy for the differences in the steady state positions across countries. This is called the global conditional convergence.

Following the local absolute convergence approach, Barro and Sala-i-Martin (1992), in their analysis for the contiguous 48 states, found a speed of convergence of around 2 percent per year. Figure 2 reproduces their well-known graphical evidence of convergence, showing that the poorest states at the beginning of the century (the Carolinas, Mississippi, Georgia and Alabama) have been growing on average twice as fast as wealthier states.

Figure 2

Convergence Across U.S. States

(Per-capita Income Growth: 1900-1980)



For example, South Carolina, the poorest state, had 22.4 percent of the per capita income of New York in 1929, by 1990 this ratio had become 71.8 percent. Mississippi was the poorest state in 1940. It had 22 percent of the per capita income of Delaware, then the wealthiest state in America. By 1990, Mississippi, still the poorest state, already had 50 percent of the income of the wealthiest state, now Connecticut. In 50 years, Mississippi has been able to reduce by half the distance that separates it from the wealthiest states.

Given the degree of cultural and economic integration among the different states, the convergence effect must be the main reason that Mississippi grew at a rate twice as high, on average, as that of the much wealthier Northeastern states during the last 50 years. Figure 2 is also a useful illustration of the "convergence frontier." The imaginary line connecting North Carolina in the upper left of the figure and California in the lower right corner gives an approximate idea of the position that economies sharing the same convergence rate and steady state level must have. Therefore, the fact that most states are aligned over this frontier gives an idea of the high degree of homogeneity displayed by the continental United States.

Under the conditional convergence approach, differences in steady states across countries are controlled including, among others, the investment ratio to GDP, measures of distortions like government consumption and black market premium, measures of political stability, and, measures of the quality and quantity of human capital.

The main finding of the cross-country empirical growth literature seems to be that there exists a global conditional speed of convergence ranging from the 2 or 3 percent of the Barro estimates to the almost 10 percent recently obtained using dynamic panel techniques. The literature also suggests the existence of local absolute convergence of approximately the same magnitude in several regions. [2]

The implication of these findings is that the speed of convergence has an important impact on the medium-term process of economic growth. Countries or states relatively homogenous in their determinants of the steady state, but differing in their initial conditions, converge towards each other, thereby reducing their initial differences in per capita income. The higher the speed of convergence, the faster the process will be. In a recent paper, Sachs and Werner (1995) point out that a sufficient condition for higher than average growth of poorer countries is that poorer economies follow reasonably efficient economic policies. They find strong evidence of convergence among those countries following open trade policies and with clearly established property rights.

In addition, for a given speed of convergence, increases in the steady state level of per capita income at which an economy is converging will raise the per capita income growth rate during the transition, since the economy will have to cover a longer distance in the same time. For that reason, an economy that is able to increase its long-run steady state per capita income by improving the technology available, increasing the public's confidence in its institutions, reducing market distortions, augmenting the quality of its labor force or opening its economy to a more developed region, will enjoy an increase in its average rate of growth due to the convergence effect.

[2] In a series of regressions using cross-sectional and pooled-panel approaches, the estimates obtained for the speed of convergence have fluctuated between 2.5 and 3 percent per year. A rate of convergence that fluctuates between 5 and 9 percent has been found in studies that apply econometric techniques, which correct for unobservable differences across countries (i.e., individual effects) arising from differences in the technology available.

3 Evaluating The Performance Of Puerto Rico

In this section, we evaluate the performance of the Puerto Rican economy when compared to the United States and to a sample of Latin American and Caribbean countries. In particular, we are interested in determining whether Puerto Rico is effectively on the convergence frontier traced by the states of the Union. A negative result will indicate that Puerto Rico is not converging towards the US, or in other words, that Puerto Rico is not closing the income gap with the US. An interested reader can find several descriptions of the Puerto Rican economy after World War II in Appendix 1 of this paper.

First, we will provide some graphical evidence in terms of relative measures of output between Puerto Rico, the US, and some Latin American and Caribbean nations. Secondly, we will present the conclusions of growth regressions empirical evidence. Extending the work of Barro and Sala-i-Martin (1992), panel data regressions were performed with a sample consisting of the 48 mainland United States plus Puerto Rico and Hawaii for the period 1940 to 1990. The actual equations and analysis can be found in Appendix 2 of this paper.

The empirical evidence provided by these regressions shows that during this period, Puerto Rico clearly performed below the predicted growth rate implied by its initial level of per capita income, even after controlling for a standard set of control variables. Puerto Rico is the only economy in the sample showing such a serious under-performance. Interpreting these results in light of neoclassical theory of growth, it is possible to argue that even though Puerto Rico partially narrowed the income gap with the US, it is not converging towards the per capita income of the United States. Finally, I will show some evidence that the political status of the island could well be the main reason for this under-performance.

3.1 Graphical Evidence

A first exercise to evaluate the performance of Puerto Rico relative to other economies is to make pair wise comparisons of a measure of output per capita for different economies. I use GDP per capita measured at current international prices for Puerto Rico, the US, and a set of Latin American and Caribbean economies, obtained from the Pen World tables version 5.6.

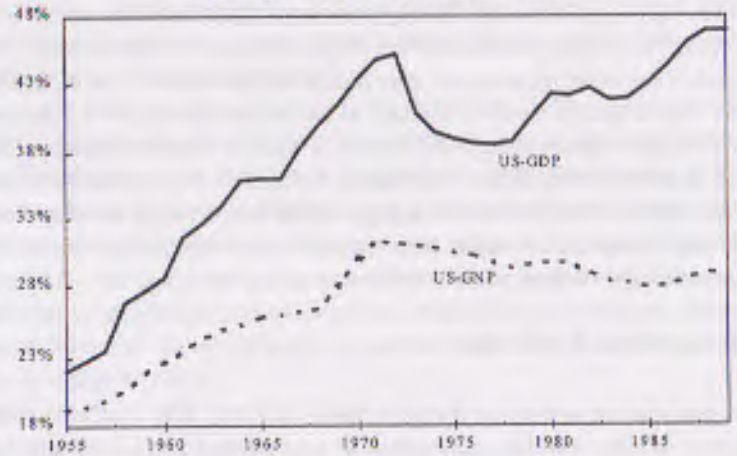
Figure 3a clearly indicates that the Puerto Rican economy grew faster relative to the American economy until 1972. It shows Puerto Rican current per capita GDP and GNP as a percentage of the same measures for the US. Between 1955 and 1972, Puerto Rican per capita GDP moved from 22 percent to 45 percent of American per capita GDP. Per capita GNP follows a similar pattern although less pronounced, increasing from 19 percent to 30 percent. The figure also shows that after 1973, the catch up force has been practically non-existent when comparing GDP's, and it has been clearly reversed in terms of per capita GNP. There is no clear signal that Puerto Rico will reduce the output gap given its present political status.

Is this the normal behavior of other economies in Latin America and the Caribbean Basin? Figures 3b to 3i plot relative measures of current output per capita for some Latin American and Caribbean countries relative to the US and Puerto Rico. A quick look at figures 3b-i shows that most economies in the region have under-performed both Puerto Rico and the US.

Figure 3a

Relative Performance of Puerto Rico:

Ratio of per-capita output to U.S. output



When compared to other Latin American and Caribbean economies, the performance of the Puerto Rican economy is good in general. All the economies in the sample became poorer compared to Puerto Rico between 1955 and 1973. All of

them show a quick recovery relative to Puerto Rico after the oil shock, indicating that it hit the Puerto Rican economy particularly hard. After the oil shock Puerto Rico reassumed the over-performance relative to most economies in the sample, although much less aggressively.

In summary, Puerto Rico showed an outstanding catch-up effect in the early post-WWII period compared to the US, out-performing all other Caribbean and Latin American economies. However, since 1973 Puerto Rico's per capita output growth rate has decreased relative to other economies in the region, and there is no clear indication that it will ever be able to close the income gap with the US.

Figure 3b

Relative Performance of

Costa Rica

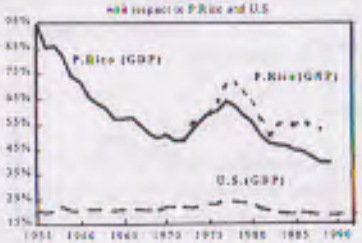


Figure 3c

Relative Performance of

Dominican Republic

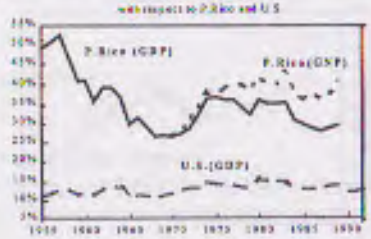


Figure 3d

Relative Performance of

El Salvador

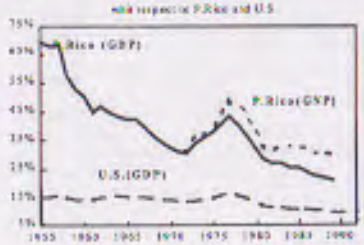


Figure 3e

Relative Performance of

Haiti

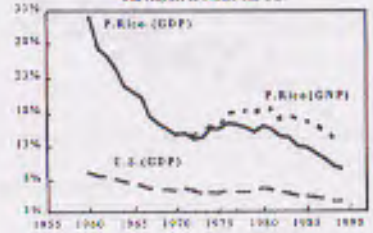


Figure 3f
Relative Performance of
Guatemala

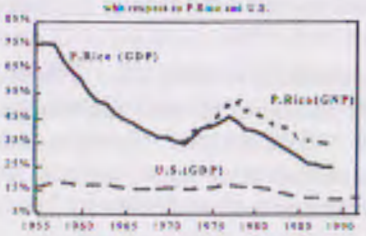


Figure 3g
Relative Performance of
Argentina

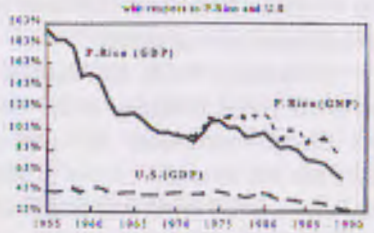


Figure 3h
Relative Performance of
Bolivia

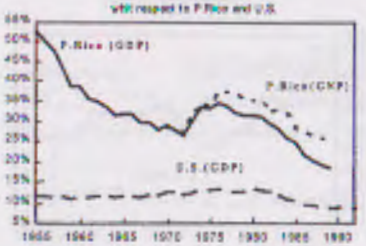
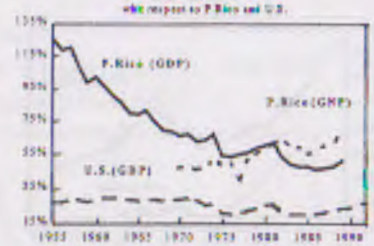


Figure 3i
Relative Performance of
Chile



3.2 Panel Data Evidence Conclusions

The results arising from the panel data analysis (the equations for which can be found in Appendix 2) clearly show that Puerto Rico has been growing at a much lower rate than the one implied for a state with its initial income level. To make this point clear, figure 4a shows the actual average annual rates of growth of per capita income for the 49 states included in the sample and Puerto Rico for the 50 year period under study. The data comes from the statistical abstract of the US, and it is net of federal transfers. The figure also plots the predicted rates of growth using the ordinary least squares estimates presented in column 2 of table 1 (see Appendix 2). Because this estimation procedure obtained the lowest convergence rate, it is the most conservative estimate of Puerto Rico's under-performance. The figure clearly shows that Puerto Rico has not been moving along the US convergence frontier.

Figure 4a

Puerto Rico and the U.S. Convergence Frontier

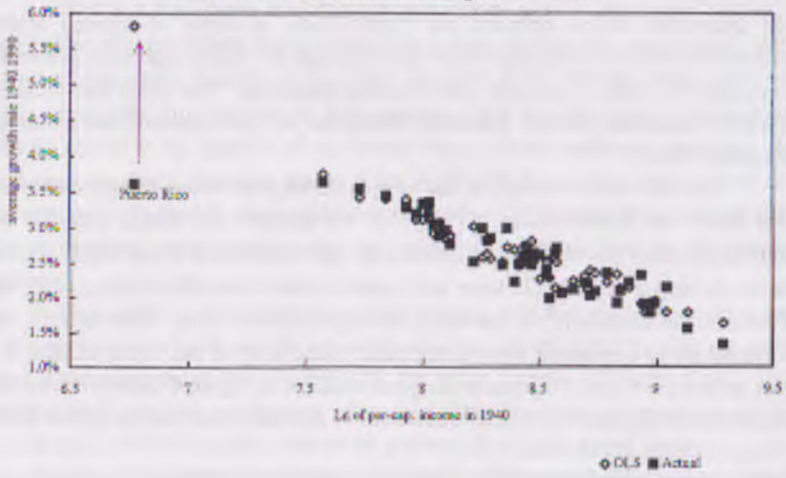


Figure 4b

Puerto Rico and The U.S. - Individual Effects

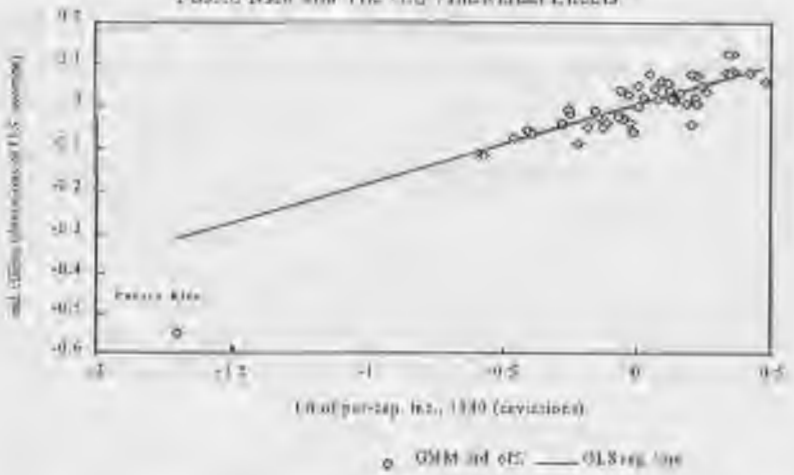


Figure 4b presents more evidence in the same direction. It makes clear that the individual effects obtained for Puerto Rico, in terms of income levels, estimated for the 49 states and Puerto Rico through the GMM regression presented in column 4 of table 1, are well below the regression line. The figure also includes the OLS regression line for individual effects on per capita income and a dummy for Puerto Rico.

No other state economy in the sample shows a deviation comparable to the one shown by Puerto Rico. In spite of the positive correlation between the individual effect and the level of income, the low initial level of per capita income is not enough to explain the large and negative individual effect displayed by the Puerto Rican economy.[3] In summary, during the period from 1940 to 1990 the different states converged towards the steady state level of per capita income at a rate between 2.6 and 6.0 percent per year. Indeed, as figure 8 clearly shows, the absolute convergence frontier is noticeable to the bare eye. In the period under

[3] The evidence provided in table 1 of Appendix 2 and shown in figures 3a and b indicates that Puerto Rico grew at an annual rate between 2.2 and 3.3 percentage points below the one predicted for a state with the initial level of income of Puerto Rico.

study, the poorer states out-performed the wealthier in proportion to the difference in initial levels of income. Even though the Puerto Rican economy grew faster than almost any other economy in the sample, the evidence indicates that the rate of growth attained was not enough to allow Puerto Rico to converge towards the 49 United States in the sample. Obviously, the greater the true convergence rate operating among the states, the bigger the Puerto Rican under-performance. After controlling for the structural composition of income, and time and location dummies, the under-performance exhibited by the Puerto Rican is almost 3 percentage points per year.

Explaining The Income Gap: Conditional Convergence

The results obtained in the section above show that Puerto Rico is not on the frontier of absolute convergence drawn by the United States. There is a huge gap between the rate at which Puerto Rico has been growing and what we would expect from an economy with the steady state level of income of the US and the initial level of income of Puerto Rico. In this section, I look for an explanation of Puerto Rico's post-WWII economic under performance. The equations and analysis can be found in Appendix 2.

Why is it that Puerto Rico has not been able to grow at this higher predicted rate? The obvious reason is that Puerto Rico does not have the same steady state value of per capita income of the states included in the sample under analysis. Only after controlling for a set of determinants of the long-run level of income we should expect to be capable of explaining Puerto Rico's under-performance. In that case, we could conclude that in order for Puerto Rico to be able to close the income gap with the US, the variables that determine the steady state of the Puerto Rican economy must reach levels equivalent to those attained by the United States.

The results of the equations provide strong evidence that Puerto Rico has been growing at a lower rate than the one expected for an economy with the same steady state income of the US and with the initial income of Puerto Rico. This result remains largely unchanged after controlling for other determinants of the steady state level of income, such as the percentage of high school graduates in the population, the government's share of income, and the per capita level of federal transfers. The remaining gap between the actual and predicted individual effect

for Puerto Rico must be attributed to some other unobservable variable. Differences in technology in a broad sense between Puerto Rico and the mainland US appear as the standard explanation for the gap. The high degree of integration of the Puerto Rican and American economies, however, make it implausible to attribute the gap to differences in the access to particular production techniques or any other purely non-economic factor.

A remaining candidate is the more obvious difference in political institutions. Puerto Rico is the only economy of the sample without the clear and permanent political status of statehood. The uncertainty about the future political status of the island might certainly have hurt Puerto Rico's ability to induce increases in the stock of capital at the rate predicted by the theory for an economy with initial low income and high steady state level of income.

Does Statehood Matter?

As mentioned above, one of the possible causes for the inability of the Puerto Rican economy to converge towards the United States is the unresolved political status of the island. Statehood involves a stable legal system, a definitive institutionality, complete access to the widest market in the world, and the end of the uncertainty faced by any investor in the island with respect to the future rules of the game. Statehood could also imply that Puerto Ricans would be able to determine the nature and increase the extent of federal aid to the island. However, statehood also implies the end of tax incentives and the imposition of federal income taxes on the island's residents.

Our hypothesis is that the political status of an economy affects its growth performance. All the economies in the sample previously analyzed, but Puerto Rico, are states, however political status is certainly not the only difference between them and Puerto Rico. In order to disentangle the statehood hypothesis from alternative explanations not already discarded in the section above, I constructed a specific test of the statehood hypothesis. I use per capita income data from 48 states from 1880 to 1940. These series were obtained from Barro and Sala-i-Martin (1992). The idea of the test is the following. Several of the 48 states included in this sample changed their political status from territories to states during the period under study. In particular, North and South Dakota, Montana and Washington became states in 1889. Idaho and Wyoming in 1890,

Utah in 1896, Oklahoma in 1907 and New Mexico and Arizona in 1912. I run then a standard growth panel regression using cross-sections 20 years apart including a variable for political status. This variable takes values between zero and one. It is 0 for all those observations for which the economy was a territory. If the economy changed status during the period it takes the proportional value. For instance it is 10/20 for Montana for the period 1880-1900, since Montana became a state in 1890.

I found that the coefficient in the non-statehood variable is large, negative, and significant. Given the initial level of per capita income and the structural composition of their income, the economies of the states have grown on average 2 percentage points faster than those of the territories. Although these results must be interpreted carefully, it is clear they highlight the existence of positive effects of the statehood status for growth.

4 The Cost of Converging to a Lower Steady State

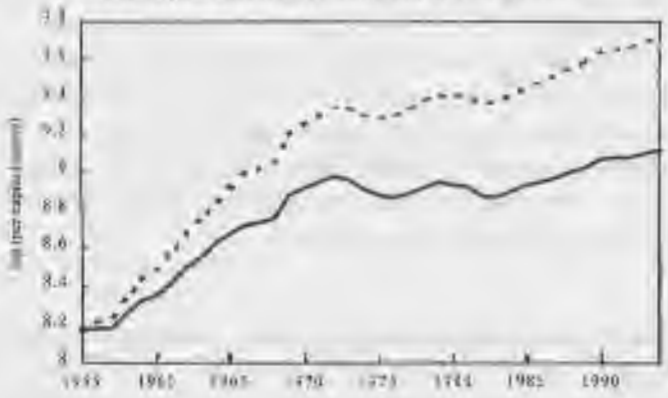
The empirical evidence of this paper shows that Puerto Rico has been converging to a lower steady state than the United States. A resulting, simple exercise is to compare the actual trajectory of per capita income followed by the Puerto Rican economy to the one it would have reached, had Puerto Rico been converging to the United States.

Assume that Puerto Rico and Mississippi have already reached their steady states. Hence, the difference in per-capita levels of steady state income between the two economies is approximately 9,000 dollars of 1994. Under this assumption, table 4 (Appendix 2) presents some of the resulting per-capita income simulations, using different convergence rates. The table indicates the amount of per capita income that Puerto Ricans have lost for not converging towards the United States. Using the conservative convergence rate of 2.7 percent found in the study, it is possible to show that in 1994, the average Puerto Rican had an income of almost $6,000 less than the one he would have received, had the Puerto Rican economy converged to Mississippi, the poorest state in the Union. Accumulating this loss from 1955 to 1994 implies that each Puerto Rican could have been

10,000 dollars wealthier by 1994. Figure 5 illustrates this scenario comparing the two trajectories of per capita GNP.

Figure 5

Per capita Income of Puerto Rico: Two Stories



5 Summary and Conclusions

Because of its relationship with the US, Puerto Rico is economically, politically, socially and geographically in a unique position relative to other less developed economies. This study shows that the development strategy pursued by Puerto Rico during the last 50 years has been, at most, only partially successful in exploiting all the economic possibilities arising from that preferred position.

The evidence found in this paper indicates that Puerto Rico is converging to a lower steady state than the one to which the United States is converging -- a shortfall that has meant Puerto Rico has been growing at a rate around 2.5 percentage points lower than the one we could expect from an economy with its initial level of per-capita income and the steady state level of income of the United States. Simple simulations performed using the convergence rates obtained in this paper show that the per capita income level of Puerto Rico could have been almost

twice its actual value by 1994, completely closing the income gap with the poorest states, had Puerto Rico been converging towards Mississippi's actual income level since 1955.

The convergence to a lower steady state than the US implies that the income gap will not be closed just by waiting for it to happen. Unless Puerto Rico's steady state level of income increases substantially, the Puerto Rican economy will never be able to close the income gap with the US. In this sense, there is no meaningful economic reason for postponing the decision about statehood for Puerto Rico.

Although growth theory does not provide a recipe for faster growth, it does indicate that if Puerto Rico manages to improve the variables that determine its long-run equilibrium income, the convergence effect guarantees a higher rate of growth during the transition towards the new steady state. Statehood could be able to improve these variables by increasing political stability and thereby increasing the flow of investment from the mainland -- and elsewhere -- in a more natural way than tax incentives ever could.

Several examples demonstrate the positive effects of a cooperative relationship between a less developed economy and a wealthy, developed country or region. Middle-income European economies like Spain in the 60's and Greece, Ireland and Portugal have been profiting from their geographical position for a long time, gradually closing the gap with the wealthiest European economies. The most important political and economic accomplishment of these economies in the last 40 years has been their entry into the European Economic Community by increasing the advantage of the geographical proximity to a wealthier economic region. As shown by Laure and Torres (1991), the combination of market reforms and integration into the EEC have allowed Spain and Portugal to outperform wealthier European countries in the last ten to fifteen years.

All these examples, however, are minor cases of economic cooperation when compared to the potential for Puerto Rico. Were Puerto Rico to become a state, the convergence effect should guarantee Puerto Rico a higher rate of economic growth and its citizens higher income levels. Through the statehood process, Puerto Rico can become an integral part of the largest and wealthiest economy in the world, resolving once and for the question of political uncertainty associated with commonwealth and thereby fully enjoying the economic benefits of the catch-up process.

Appendix 1: The Puerto Rican Economy After World War II

The purpose of this section is to provide a simple description of the economic performance of Puerto Rico during the period after World War II. I will show that the performance of the Puerto Rican economy was solid in terms of growth and other economic indicators at least until the early 1970's. It was during that period that Puerto Rico was able to reduce the output gap with the US and become an industrialized economy, with economic and social indicators comparable to more developed economies.

After World War II, Puerto Rico implemented policies in order to move from an agricultural economy to an industrial one. A first stage of economic reforms from the early 1940's to 1949 focused mainly on a program of land reform, development of infrastructure, and reorganization of institutions. A second stage of economic development reforms by the name "Operation Bootstrap" were set in place from 1945 to 1953. This second phase was designed to increase industrial production by attracting private capital, especially from American investors, through privatization of government owned enterprises and tax incentives.

No major economic reforms were undertaken after 1953. From then on, the Puerto Rican government adapted its policies, especially those regarding tax incentives, in a way to satisfy American investor's needs and keep them coming to the island. In the following 35 years, subsidiaries of American corporations established in Puerto Rico, leading the subsegment income in the contribution of manufacturing to GNP from 15 percent in 1950 to more than 50 percent in 1990. In 1952, the Commonwealth of Puerto Rico was established.

After the oil shock in 1973, the Puerto Rican economy slowed down. The reasons for this are not definitive, but several events may have had an exogenous effect. They include: the application of the minimum wage to Puerto Rico; the failure to adjust fully to the aftermath of the oil shock; and, the shift of tax induced American investment from labor to capital intensive industries. Nevertheless, the United States economy came through the oil shock and resumed its economic growth, so another reason for the Puerto Rican slowdown might be found elsewhere.

Figure A1.1 shows the steep climb of the Puerto Rican economy until 1973 and how it tapers off thereafter. It depicts Puerto Rican real GDP per capita from 1955 to 1994. Puerto Rico has managed to increase its per capita GDP at an average rate of 3.7 percent per year between 1955 and 1994. The growth has not been steady. Until 1972, per capita GDP grew at an average annual rate of 5.9 percent, out-performing most of the other middle-income economies of the world. However, after 1972, the Puerto Rican economy grew at a discrete 2.1 percent per year in per capita terms, with a low 0.4 percent between 1973 and 1983.

Figure A1.1
Puerto Rico
Real GDP per capita
(international prices of 1985)

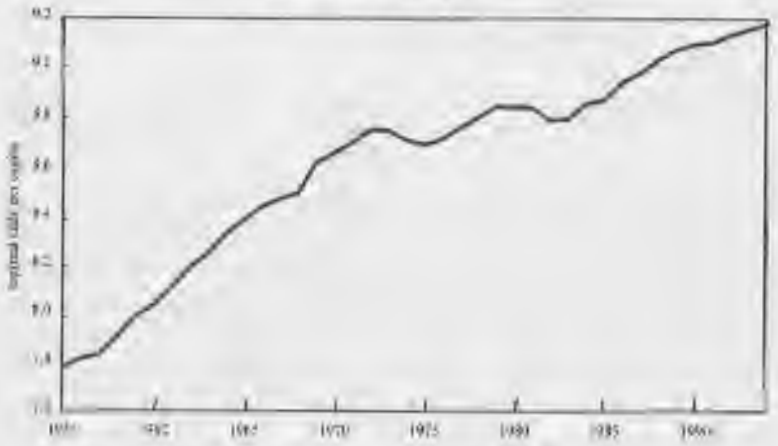


Figure A1.2 shows the effects of "Operation Bootstrap," designed to increase industrial production by attracting capital from external investors. It was believed that after a first stage of intensive use of external sources, domestic capital would follow up, completing the transition towards an industrial economy. Domestic capital never did materialize to a significant degree as successive Puerto Rican governments came to rely increasingly on tax-induced external funding sources.

The figure shows total investment as a share of GDP from 1955 to 1994. The average rate of investment was 29.2 percent between 1955 and 1972. It dropped to 17.0 percent between 1973 and 1983, and further down to 14.3 from 1984 to 1994. The external funds, mainly from the mainland represented 40.7 percent of total sources in 1955, reaching almost 80 percent by 1980. The internal sources of investment have been mainly depreciation reserves and government savings, with negative private savings.

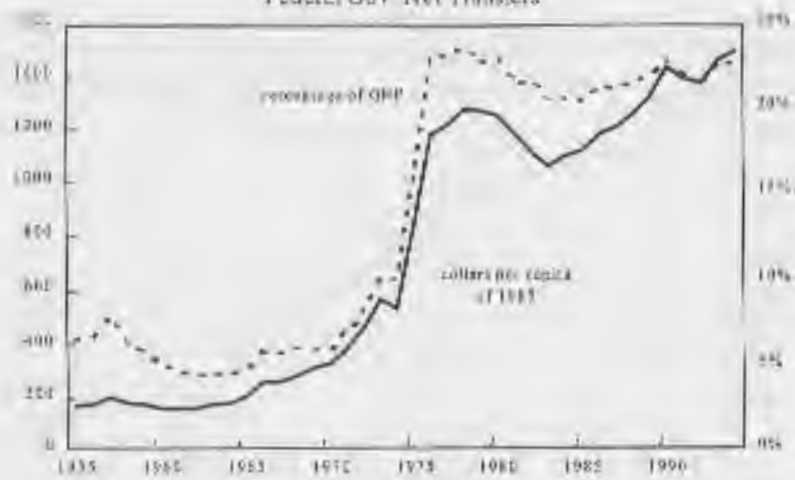
Figure A1.2
Puerto Rico:
Investment Share of GDP

The presence of so many external sources in capital (in the form of repatriated returns to the mainland) is an obvious drain on the Puerto Rican economy. Figure A1.3 shows the significant disparity between GDP and GNP. It shows GNP as a percentage of GDP from 1955 to 1994. The figure shows that the share of output belonging to Puerto Ricans has steadily decreased from more than 100 percent in the early 1950's to less than 70 percent in 1994.

Figure A1.3
Puerto Rico:
Gross National Product
(percentage of GDP)

The income effectively received by the Puerto Ricans would have been even smaller had Puerto Rico not received a large amount of transfers from the US federal government. Figure A1.4 shows the amount of net federal transfers, both to individuals and the Puerto Rican government, in per capita dollars in 1985 and as a percentage of per capita GNP. The figure shows that these transfers have amounted, on average, to almost 22 percent of per capita GNP since 1974. Even though Puerto Rico receives fewer federal transfers in per capita terms than any other state, they represent a larger share of per capita income because of the much lower per capita income level of the island.

Figure A1.4
Puerto Rico:
Federal Gov. Net Transfers



Economists often blame the disproportionately large amount of transfers for the lack of private savings generated by Puerto Ricans. It has been argued that federal transfers have financed consumption, especially considering that since 1974 direct benefits to individuals (mainly in the form of social security and food stamps) account for more than 70 percent of total federal aid. In fact, by the late 1980's consumption was already over 95 percent of GNP, and by 1990 disposable personal income exceeded GNP.

Another notable characteristic of Puerto Rico is the totally external orientation of the economy. Figure A1.5 shows the concentrations of imports and exports -- what has been argued to be one of the main problems of the Puerto Rican development strategy. By the late 1980's, exports plus imports amounted to almost 140 percent of GDP. This trade is largely concentrated with the US. More than 90 percent of exports are sent to the mainland and almost 70 percent of imports come from the US.

Figure A1.5
Puerto Rico:
Openness: Exports plus Imports
(Share of GDP)

American firms attracted through the tax incentives to the island have constituted themselves in export enclaves with almost no forward or backward linkages with the Puerto Rican economy. These firms would import raw materials, put them together, and export finished products directly to the mainland, building almost no interactions with the local economy[4].

In addition to the tax incentives offered by "Operation Bootstrap", low wages were a significant incentive for American corporations with operations in the island. Taylor (1957) calculated that wages 25 percent higher than those prevailing by 1953 would have been enough to offset the tax advantages and discourage most of the American firms from moving to the island. Puerto Rican average wages were only 30 percent of American wages by 1955, almost 60 percent by the mid 1980's, and they are 75 percent today. Partially responsible for this increase in relative wages in the island has been the minimum wage legislation. In 1977 the federal minimum wage began to be applied to Puerto

[4] See Hexner, Jenkins, Ladd and LaMotte (1993).

Rico, with several exceptions for determined industries. By 1981 almost all the Puerto Rican economy was subject to the federal minimum wage.

Despite this disproportionate minimum wage, there is no evidence that this legislation has had any effect on unemployment. Unemployment rates have always been high in Puerto Rico, ranging from a low of 10.3 percent in 1970 to a high of 23.4 percent in 1983. The average unemployment rate for the postwar period has been 16 percent. This unemployment rate is particularly high if one considers that the participation rate in Puerto Rico has been less than 45 percent since 1980, that unemployed Puerto Ricans have the choice to move to the mainland, and that the government of Puerto Rico has been generating more than 20 percent of total employment since 1980.

Summary

In spite of all the problems that the Puerto Rican development strategy has had, following WWII Puerto Rico was able to move closer, in terms of per capita output, to wealthier and more developed economies. In particular, the Puerto Rican economy did narrow, to some extent, its income gap with the US. This catch-up effect has often been described as a consequence of the beneficial effects achieved by the cooperation between a developed and an underdeveloped economy.

Baumol and Wolff (1994) first elaborated on the catch-up effect by Puerto Rico during the postwar era. They show that labor productivity in Puerto Rico grew from less than 25 percent of the US level in 1950 to 75 percent in 1990. A similar pattern is observed for per capita GDP, although it is less pronounced. They also point out that several social and economic indicators for Puerto Rico demonstrate that the Puerto Rican economy has experienced in many areas development comparable to wealthier economies. They conclude that Puerto Rico's post-WWII history demonstrates how much can be accomplished when a wealthy, developed economy cooperates and interacts with one that is initially less developed.

Using a growth accounting analysis, they found that the existence of an educated labor force was the primary reason for Puerto Rican rapid economic growth during the postwar period, explaining over a third of the increase in per

capita GDP. The catch-up effect explains between 16 and 38 percent of the growth, Puerto Rico's investment rate another 16-21 percent, and its trade openness and scientific manpower accounts for much of the remainder.

A neoclassical growth interpretation suggests that substantially increasing Puerto Rico's ability to accumulate physical and human capital (the development strategy initiated after the war) might have moved the economy's long-run expected income toward the US, initiating a process of convergence which explains the relatively long period of high growth rates. Unfortunately, as this study shows, Puerto Rico is no longer converging toward the US and therefore no longer enjoys the positive economic effects of convergence.

Appendix 2: Panel Data Evidence: Equations, Tables and Analysis

2.a Estimation Procedure

The empirical analysis of the economic performance of Puerto Rico is conducted by estimating standard growth regressions, which arise from the following empirical equations. It has been shown elsewhere that the standard Solow-Swan and Ramsey Cass-Koopmans models imply that the average growth between $t-\tau$ and t is given by

$$\frac{\ln y_{i,t} - \ln y_{i,t-\tau}}{\tau} = \beta_1 - \beta \ln y_{i,t-\tau} + \beta_2 X_{i,t-\tau} + \delta_t + \eta_i + \zeta_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where

$$\beta = \frac{1 - e^{-\lambda\tau}}{\tau}$$

λ is the annual rate of convergence, $y_{i,t}$ the per-capita income of economy i in time t, $X_{i,t}$ is a set of explanatory variables controlling for differences in

steady states, η_i is an unobservable individual effect, ζ_t is a time-specific effect, and ε_{it} is an error term.

A significantly negative coefficient on lagged per-capita income is consistent with the convergence prediction of the neoclassical model of growth. Ceteris paribus, the further away an economy is to its steady state, the higher will be its rate of growth of per-capita income.

2.b Puerto Rico and the US

The purpose of the following estimations is to assess the central question of the paper. Namely, whether Puerto Rico is converging to the U.S. If Puerto Rico behaved as an American state, its per capita income would have been converging during the last fifty years towards that of the wealthier states. In this case, the Puerto Rican economy would lay on the convergence frontier traced by the American states as shown in figure 1b, displaying absolute convergence with the US.

Absolute Convergence

I use two different procedures for testing whether Puerto Rico belongs to the American convergence frontier. The simplest one assumes that the 49 American states in the sample share the same technology and institutions and, therefore, no major unobservable differences or individual effects among them. In this case, I can just estimate a simplified version of equation (1) through pooled ordinary least squares including a dummy variable for Puerto Rico. The equation would not include the term η_i and therefore,

$$\frac{\ln y_{it} - \ln y_{it-1}}{T} = \beta_0 + \beta \ln y_{it-1} + \phi_1 y_{it-1} + \alpha D_i + \zeta_t + \varepsilon_{it} \qquad (2)$$

Following Barro and Sala-i-Martin (1992) I included in equation (2) as an additional explanatory variable, the variable s_{it} that proxies for common effects related to the sectoral composition of per-capita income for each state. The inclusion of this variable accounts for sectoral shocks that affect the performance of states with similar income composition in the same direction. As long as the

initial level of per-capita income is related to the income composition, the removal of s_{it} would seriously bias the estimation of the convergence rate. The variable s_{it} is given by

$$s_{it-1} = \sum_j w_{ijt} \left[\ln y_{jt} - \ln y_{jt-1} \right]$$

where w_{ijt} is the participation of sector j in state i's personal income, and y_{jt} is the amount of per-capita income originated in sector j at a national level.

A negative significant α would indicate that Puerto Rico has not been growing at the rate implied by its initial level of per capita income, had Puerto Rico and the 49 states shared the same steady state. It would indicate, therefore, a rejection of the hypothesis that Puerto Rico has behaved like a US state.

In a more general setting one could still argue for the presence of individual effects asserted above, if there are differences in the set of available technologies due, for instance, to morphological differences across states.

The estimation problems arising from the presence of correlated individual effects in equation (1) have been extensively analyzed.[5] In general, an OLS regression of equation (1) will provide inconsistent estimates of all parameters. In particular, the estimate of λ will be biased downwards due to the obvious correlation between the lagged per-capita income and the individual effect.

Following Caselli, Esquivel and Lefort (1994), I also perform general method of moments estimation of equation (1).[6] In the case of this regressions, an unusually large and negative individual effect for Puerto Rico would support the hypothesis that Puerto Rico does not behave as a typical U.S. state. Given that the individual effects are likely to be correlated with income, we should require the individual effect for Puerto Rico to be unusually large (in absolute value) after controlling for income.

---

[5] See Caselli, Esquivel and Lefort (1994) for a review of the estimation problems and solutions.

[6] The procedure consists of eliminating the individual effects by taking differences to equation (1) and instrumenting the right-hand side variables using all their lagged values. In the absence of serial correlation in the error term ε_{it}, this estimator provides consistent estimates of the parameters in equation (1). For a more extensive description of the estimator see Arellano and Bond (1992), and Caselli, Esquivel and Lefort (1994).

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Equation (4) indicates the increase in per-capita income obtained as a consequence of an increase in the steady state level of per-capita income.[8] Table A2.5 presents simulations of the cost for Puerto Rico of converging to a lower steady-state. The calculations make use of equation 4 to simulate income trajectories under different parameter values.

[8] The results from simulations of equation 4 performed under different scenarios are reported in Table 5.

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Figure A2.1b

Puerto Rico and Latin America: Individual Effects

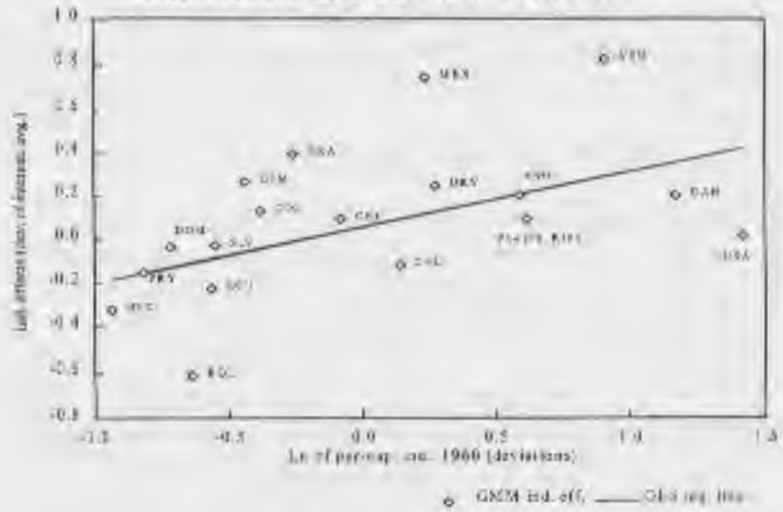


Table A2.4

Cross-Country Regressions of per-capita GDP

	OLS	GMM
β	0.0781	0.0301
	(0.0029)	(0.0086)
educ	0.0049	0.0154
	(0.0021)	(0.0076)
fertility rate	0.0591	-0.0596
	(0.0141)	(0.0550)
I/GDP	0.1311	0.1334
	(0.0224)	(0.0362)
G/GDP	-0.0481	0.1219
	(0.0198)	(0.1433)
ln (1+BMP)	-0.0231	-0.0348
	(0.0043)	(0.0118)
revolutions	0.0086	0.0064
	(0.0054)	(0.0137)
λ	0.0247	0.117
	(0.0037)	(0.0276)

2.e The Cost of Converging to a Lower Steady State

In order to compare the actual trajectory of per capita income followed by the Puerto Rican economy to the one it would have reached had it moved along the US convergence frontier, I use well known results on neoclassical growth theory. The trajectory of income per-effective worker, $\tilde{y}$, around the steady state, $\tilde{y}^*$, is governed by the following relationship

$$\ln(\tilde{y}_t) = e^{-\lambda(t-k)} \ln(\tilde{y}_{t-k}) + (1 - e^{-\lambda(t-k)}) \ln(\tilde{y}^*) \qquad (3)$$

This trajectory is a function of the convergence rate λ. A simple transformation of equation (3) allows us to simulate the trajectory of income under different convergence rates and steady state values.

$$\ln(y^1_t) = \ln(y_t) + (1 - e^{-\lambda t}) \left[\ln(\tilde{y}^{*1}) - \ln(\tilde{y}^*) \right] \qquad (4)$$

Table A2.5

The Cost of Converging to a Lower Steady-state
(Steady-state to which Puerto Rico is converging)

	Mississippi		US Average	
Convergence Rate	Income lost in 1994	Total Income lost since 1955	Income lost in 1994	Total Income lost since 1955
2 %	3,777	67,365	6,159	107,335
3.7 %	5,800	110,928	9,864	183,232
6 %	7,143	148,745	12,462	252,363

Equation (4) indicates the increase in per-capita income obtained as a consequence of an increase in the steady state level of per-capita income.[3] Table

[3] The results from simulations of equation 4 performed under different scenarios are reported in Table A2.5.

the coefficient in the non-statehood variable is large, negative, and significant. That is, given its initial level of per capita income and structural composition of their income, the economies of the actual states have grown faster after they became states. Although these results must be interpreted carefully, it is clear that they highlight the existence of positive effects for growth of the statehood status.

2.d Puerto Rico, Latin America And The Caribbean

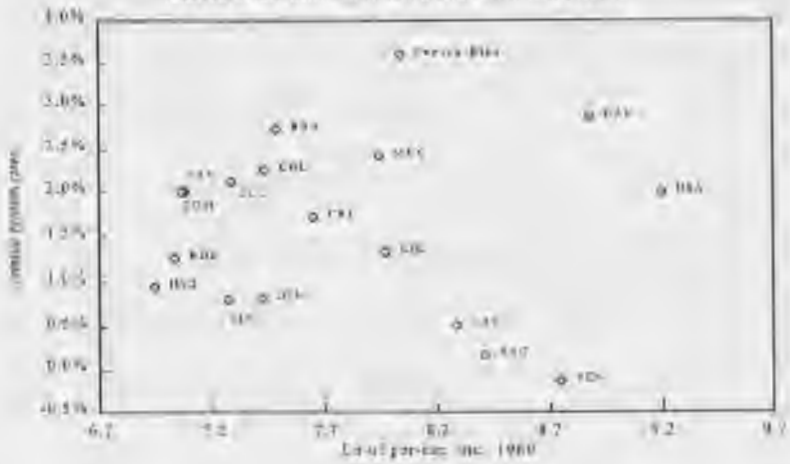
In spite of the apparent under-performance of the Puerto Rican economy with respect to the US, the post-WWII economic history of Puerto Rico has been used as an example of successful economic development.

In this section I use the recently available data from the Penn World Tables version 5.6, that provide data on GDP at international prices for Puerto Rico allowing the international comparisons to be made. I used the Barro and Lee (1994) sample of 97 countries plus Puerto Rico. Figure A2.1a clearly summarizes the successful Puerto Rican story. I have selected from the sample of 97 countries all the Latin American and Caribbean economies plus USA, Canada, and Puerto Rico. The figure makes clear that Puerto Rico out-performed all the economies with similar or lower per-capita income as of 1960.

In order to identify sources of growth for Puerto Rico, I ran panel regressions built using cross-sections of 98 countries (included Puerto Rico) at five year intervals from 1960 to 1990. I included as explanatory variables some of the most common control variables used in the standard literature on empirical growth. For education I use the percentage of the population over 25 years old with secondary school completed. I also included fertility rates, investment rates, government expenditure ratios, black market premium, and number of revolutions. Table 4 summarizes the results. As before, I ran regressions using a standard OLS procedure and a GMM estimation. The convergence rates are 2.28 percent an 9.49 percent respectively. The estimated coefficients for the education variable are positive and significant, but small. The coefficients on all other variables are reported in Table A2.4 as well. They are similar to those obtained in previous studies.

Figure A2.1a

Puerto Rico and Latin America: Growth Rates



The results for Puerto Rico and Latin America and the Caribbean are summarized through figure A2.1b. The figure presents individual effects obtained in the determinants of growth GMM regression presented in Table A2.4 column 2, for the sample and period previously described. The figure shows that Puerto Rico does not present a particularly large individual effect. That is, most of Puerto Rico's good performance is explained for the accumulation process through investment, its human capital, its initial position, and other variables. Once we take into consideration those determinants of the economy steady state, there is not much left unexplained. The relatively low individual effect (lower than the one for the U.S.) indicates that most of the relative performance of Puerto Rico, when compared to a broad set of countries, is explained by its relatively high steady state level of per-capita income, which is captured by the control variables included in the regressions.

positive and significant in all regressions. The coefficient of the education variable is not significantly different from zero in the OLS regressions, but negative and highly significant in the GMM regressions. The negative sign obtained is consistent with the percentage of the adult population with complete high school educations being a proxy for the initial level of human capital and therefore reflecting initial conditions. The coefficient in government expenditure and aid from the Federal Government are significant and positive in both sets of regressions. Federal aid has a large effect on growth, is especially in the GMM regressions. This is interesting, since the general method of moments estimation procedure takes care of potential problems of endogeneity of the explanatory variables that might certainly arise, especially in the case of this last variable.

Table A2.2

Cross-State Regressions for per-capita Income

	OLS	OLS	GMM
β	0.7302	0.6862	0.0387
	(0.0266)	(0.0243)	(0.0012)
Inic. comp.	0.248	0.5647	0.2894
	(0.0333)	(0.0958)	(0.0138)
H-S Grad.	0.0035	3.0137	-0.1511
	(0.0086)	(0.9106)	(0.0033)
GOV	0.0270	0.3044	3.0377
	(3.0081)	(0.3074)	(0.0805)
FAID	0.0796	0.0678	0.2274
	(0.0312)	(0.0293)	(0.0046)
DUM loc	Yes	no	no
DUM time	No	yes	yes
DUM price	-0.0335	-0.0324	
	(0.0048)	(0.0048)	
λ	0.0314	0.0377	0.0905
	(0.0026)	(0.0035)	(0.0032)
ind. effects: DUM price			-0.0116
			(0.0035)

The β estimates are not comparable across estimation procedures.

Table A2.2 also shows that the under-performance of Puerto Rico is still severe. There is almost no change in the OLS estimate of the Puerto Rican dummy: it is 3.24 percent when I include the time dummies. However, the

individual effect obtained through the GMM estimation is somewhat smaller. The OLS dummy obtained for Puerto Rico's individual effect indicates that the average rate of growth during the transition path was 1.1 percentage points lower than expected.

Table A2.3

Determining the Effect of Statehood on Growth

	1880-1940
β	0.6923
	(0.0580)
Agric. share	-0.0576
	(0.0201)
non-STATEHOOD	-0.002
	(0.0001)
DUM loc	yes
λ	0.0184
	(0.0036)

In order to test the hypothesis that the political status of an economy affects its performance in terms of growth, I use per capita income data from 48 states from 1880 to 1940. These series were obtained from Barro and Sala-i-Martin (1992). The idea of the test is the following. Several of the 48 states included in this sample changed their political status from territories to states during the period under study. In particular, North and South Dakota, Montana and Washington became states in 1889. Idaho and Wyoming in 1890, Utah in 1896, Oklahoma in 1907 and New Mexico and Arizona in 1912. I run then a standard growth panel regression using cross-sections 20 years apart including a variable for political status. This variable takes values between zero and one. It is 0 for all those observations for which the economy was a territory. If the economy changed status during the period it takes the proportional value. For instance it is 10/20 for Montana for the period 1880-1900, since Montana became a state in 1890.

Table A2.3 presents the results of this regression. Following Barro and Sala-i-Martin, I included also the share of income originating in agriculture as a measure of the structural composition of income. I also included dummies for the south, west and mid-west areas. The results are striking. Table A2.3 shows that

I estimate different variants of equations (1) and (2) for a panel of five cross-sections, at 10-year intervals, covering the period 1940-1990. The regressions were run using ordinary least squares and general method of moments procedures. In the OLS regressions I also included regional dummies for south, midwest, and west geographical location, and a time dummy for each period. The GMM regressions were run in deviations with respect to the mean. The individual effects obtained in the GMM regressions were run against income levels using OLS.

Table A2.1

Cross - State Regressions for per-capita Income

	OLS	OLS	GMM	GMM
β	0.7684	0.6867	0.0578	0.0546
	(0.0122)	(0.0210)	(0.0022)	(0.0024)
Inc. const	0.2732	0.5166		0.1684
	(0.0326)	(0.0950)		(0.0563)
DUM loc	yes	yes	no	no
DUM time	no	yes	yes	yes
DUM prico	-0.0221	-0.0331		
	(0.0046)	(0.0047)		
λ	0.0263	0.0376	0.0548	0.0605
	(0.0016)	(0.0031)	(0.0068)	(0.0044)
ind. effects@PM price				-0.0258
				(0.0048)

The β estimates are not comparable across estimation procedures.

I use personal per-capita income obtained from the Statistical Abstract of the U.S. that includes data for Puerto Rico from 1940 on. The data is net of federal transfers. Table A2.1 summarizes the results obtained in both sets of regressions. The convergence rate obtained using pooled least squares is 2.63 percent when including only location dummies and 3.76 percent when time dummies are also included. The estimate of λ obtained using the general method of moments procedure is 5.48 percent and 6.05 percent per year respectively. In all cases, the standard errors are small, implying significant coefficients and small confidence intervals with no overlapping regions. The coefficient obtained with the general method of moments estimator is unquestionably larger than the ones obtained via least squares.[7] The coefficient on the structural-composition of income variable is always positive and significant.

The coefficient on the dummy variable for Puerto Rico included in the OLS regressions is large, negative and significant. It indicates that Puerto Rico grew during the period 1940-90, on average at a rate between 2.2 and 3.3 percentage points lower than that of an economy with the same steady state as the United States, but with the initial per capita income of Puerto Rico. The table also shows the coefficient of a dummy variable for Puerto Rico in the OLS regression of the individual effects on the level of income. Interpreting this coefficient in terms of growth rate under-performance indicates the extraordinarily large and negative individual effect obtained for Puerto Rico accounts for 2.58 percentage points of lower annual growth rate. These results clearly indicate that Puerto Rico does not behave like another state. The Puerto Rico economy has been growing at a much lower rate than the one implied for a state with its initial income level.

2.c Explaining the Income Gap: Conditional Convergence

When an economy does not belong to the convergence frontier, it is because it does not share the same steady state income determinants. Therefore, I include in the above regression a set of standard determinants of growth variables that proxy for steady state conditions. Although the under-performance is somewhat reduced, I still find a large and unexplained growth gap.

I estimate equations 1 and 2 including as explanatory variables beginning of period values of per capita income the state's structural composition of income, and the percentage of the population over 25 years old with complete high school educations or more. I include, in addition, the per capita level of state and local government expenditure, and the per capita level of federal aid received by the state. Table A2.2 presents the results. Controlling for the extra set of variables increases, as expected, the estimated speed of convergence to 3.77 percent and 5.14 in the OLS regressions with and without including time dummies respectively. The speed of convergence reaches 9.51 percentage the GMM regression. The coefficient for the structural composition of income variable is

[7] The difference between both set of estimates is smaller, however, than the one shown by Caselli, Esquivel and Lefort (1994) for a large sample of heterogeneous countries, indicating that the omitted variable bias is less severe for this sample.

I estimate different variants of equations (1) and (2) for a panel of five cross-sections, at 10-year intervals, covering the period 1940-1990. The regressions were run using ordinary least squares and general method of moments procedures. In the OLS regressions I also included regional dummies for south, midwest, and west geographical location, and a time dummy for each period. The GMM regressions were run in deviations with respect to the mean. The individual effects obtained in the GMM regressions were run against income levels using OLS.

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Cross - State Regressions for per-capita Income

	OLS	OLS	GMM	GMM
β	0.7684	0.6867	0.0578	0.0546
	(0.0123)	(0.0210)	(0.0022)	(0.0024)
Inc. comp	0.2732	0.5166		0.1684
	(0.0326)	(0.0950)		(0.0563)
DUM loc	yes	yes	no	no
DUM time	no	yes	yes	yes
DUM prico	-0.0221	-0.0331		
	(0.0046)	(0.0047)		
λ	0.0263	0.0376	0.0548	0.0605
	(0.0016)	(0.0021)	(0.0058)	(0.0044)
Ind. effects-DUM prico				-1.0238
				(0.0048)

The β estimates are not comparable across estimation procedures.

I use personal per-capita income obtained from the Statistical Abstract of the U.S. that includes data for Puerto Rico from 1940 on. The data is net of federal transfers. Table A2.1 summarizes the results obtained in both sets of regressions. The convergence rate obtained using pooled least squares is 2.63 percent when including only location dummies and 3.76 percent when time dummies are also included. The estimate of λ obtained using the general method of moments procedure is 5.48 percent and 6.05 percent per year respectively. In all cases, the standard errors are small, implying significant coefficients and small confidence intervals with no overlapping regions. The coefficient obtained with the general method of moments estimator is unquestionably larger than the ones obtained via

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2.c Explaining the Income Gap: Conditional Convergence

When an economy does not belong to the convergence frontier, it is because it does not share the same steady state income determinants. Therefore, I include in the above regression a set of standard determinants of growth variables that proxy for steady state conditions. Although the under-performance is somewhat reduced, I still find a large and unexplained growth gap.

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[7] The difference between both set of estimates is smaller, however, than the one shown by Caselli, Esquivel and Lefort (1994) for a large sample of heterogeneous countries, indicating that the omitted variable bias is less severe for this sample.