# ARGENTINA'S CAPITAL GAP PUZZLE

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## Introduction

Argentina's GDP per working age person in 2003 was about the same as it was twenty years earlier and around fifteen percent below trend (Figure 1). By international standards that has been a dismal performance whose ultimate sources are important to uncover to eventually reverse that country's seemingly secular decline.

The purpose of this paper is precisely to take a first step towards that understanding. To that effect, we examine Argentina's recent growth experience, which includes two deep recessions and a recovery, with the lens of a neoclassical growth model that takes total factor productivity as exogenous.

The assumption that total factor productivity (TFP hereafter) is exogenous is obviously limited, but it is a useful abstraction to answer a well defined question: which part of Argentina's GDP growth in the last twenty five years or so can be attributed to TFP growth and which part to factor accumulation? This question continues to be the object of considerable debate in the literature, since it has been argued that TFP-driven growth, as opposed to factor accumulation driven growth, can have very different implications.

For example, Young (1995) has argued that the economic miracle of the so-called Asian tigers has been mostly the result of higher labor participation rates and capital accumulation, not of improvements in overall (TFP) productivity.

That distinction is particularly important for the case of Argentina, because Figure 2 shows another striking fact about that country's recent economic history: capital per working age adult was in 2003 about twenty percent lower than it had been twenty years earlier. That implies that real wages for unqualified workers are today considerably lower than they were for their parents, as well as a substantial deterioration in the distribution of income. In order to correct this depressing fact, it is important to understand what may have caused it in the first place.

The situation is even more dramatic if one takes into account that, according to the neoclassical growth model, Argentina's capital stock per working age adult should have been in 2003 about twenty five percent higher than it was in 1980 if total factor productivity had kept growing at the one percent average annual rate at which it did over the period 1951-79. Instead, as mentioned before, the capital stock in 2003 was twenty percent lower than in 1980. That means that by 2003 Argentina's capital stock per working age population was about forty five percent lower than its trend value. We refer to this difference between what the capital stock per working age person should have been according to historical trends and what it actually was in 2003 as "Argentina's capital gap."

Figure 3 suggests a culprit for that gap: the level of total factor productivity was the same in Argentina in 2003 as it was in 1980, when according to its historical one percent annual growth rate, it should have been at least twenty five percent higher.

Thus, a natural candidate to account for Argentina's "capital gap" seems to be a worse than average total factor productivity growth (in fact, complete stagnation of it) during the last twenty five years.

That is precisely the hypothesis we explored in Kydland and Zarazaga (2002). There we found that indeed most of the decline of Argentina's capital stock over the so-called "lost decade" of the 1980s (a depression, in the definition of Kehoe and Prescott (2002)) can be attributed almost entirely to the dynamics of a declining total factor productivity over the same period.

In this paper, we extend that previous study up to the year 2003 and confirm the same finding for the more recent recession of the period 1999-2003: as it was the case for the previous recession of the 1980s, GDP and the capital stock declined also at the pace that the neoclassical growth model would have predicted in the face of declining total factor productivity.

In other words, at least for the case of Argentina, the neoclassical growth model seems to account remarkably well for the dynamics of that country's capital stock during recessions. Based on this observation, an impartial observer might be tempted to conclude that Argentina's declining capital stock is the counterpart of a long spell of declining total factor productivity.

Yet, comparison of Figures 2 and 3 would prove that conclusion premature. According to Figure 3, total factor productivity was the same in 2003 as it was in 1980, and therefore, the capital stock per working age person should have remained roughly constant, instead of declining the twenty percent mentioned earlier and apparent in Figure 2.

In other words, in the light of the neoclassical growth model, a weak performance of total factor productivity over Argentina's last two recessions can account for about half of that country's capital gap. The remaining half originates in the puzzling behavior that the capital stock exhibited over the boom of the 1990s. Over the period 1990-98, total factor productivity grew at stellar annual rates of four percent per year, yet the capital stock per working age adult barely grew at the historical average rate of about one percent, well below the rates that the neoclassical growth model would have predicted.

It is not clear yet why investment was in the 1990s lower than it should have been according to the neoclassical growth model. Some may argue that policies in place during those years may account for the anomaly. However, a distinct possibility is that the insufficient recovery of investment in the 1990s reflected a lack of investors' confidence, prompted by a prior history of recurrent devaluations, bank deposits freezes, and default in government obligations.

In summary, the poor performance of total factor productivity during the lost decade depression of the 1980s and the more recent 1999-2002 recession seems to be able to account for about half of "Argentina's capital gap," that is, of the deviations of the capital stock per working age person relative to trend. The other half remains unexplained. Recent literature on endogenous credit constraints however suggests a prime suspect for that anomaly: the presence of a severe time inconsistency problem, hinted at by a problematic past of defaults and confiscations.

Future research will have to explore that conjecture more formally, but the evidence and analysis presented in this paper suggests that capital markets don't "forgive and forget" defaults and confiscations as quickly as many experts and policymakers seem to believe. Like the mythical frogs happily swimming in the pot in which they are being slowly boiled, the citizens of defaulting countries may fail to notice the relentless deterioration of their standards of living inevitably associated with a capital stock that is not being fully replenished as it reaches obsolescence.

The large fraction of the decline in Argentina's capital stock that cannot be accounted for by a neoclassical growth model (that rules out defaults by assumption) suggests that those costs may be large. As already mentioned, this conjecture needs to be investigated more rigorously before jumping to conclusions, but the findings in this paper merit at least an early warning that countries may not, in the end, escape defaults and confiscations as unscathed as is widely believed.[1]

The remaining sections of this paper briefly describe the neoclassical growth model that we calibrated to the main features of Argentina's economy and discuss in more detail the findings summarized in this introduction.

## ANALYTIC FRAMEWORK

### Model

We use the stochastic growth model. All variables are in per capita terms.

Household preferences can be represented by:

$$E \sum_{t=0}^{\infty} \beta^t (1+\eta)^t \ (c_t^{\alpha}(1-l_t)^{1-\alpha})^{1-\sigma} / (1-\sigma) \tag{2}$$

where $c_t$ represents consumption, $l_t$ the fraction of the time endowment devoted to work, $\alpha$ the utility-function share parameter, $\eta$ the population growth rate, and $\sigma$ the coefficient of constant relative risk aversion (or the reciprocal of the intertemporal elasticity of substitution of the composite commodity.)

Technology is described by

$$c_t + x_t = z_t \, k_t^{\theta} \, [(1+\gamma)^t \, l_t]^{1-\theta} \tag{3}$$

$$x_t = (1+\eta) \, k_{t+1} - (1-\delta) \, k_t \tag{4}$$

$$z_{t+1} = \rho \, z_t + \varepsilon_t \tag{5}$$

where $k_t$ is the capital stock, $x_t$ is investment, $z_t$ a stochastic technological shock and $\theta$ is the capital input share in national income. The model assumes labor augmenting technological progress at the rate $\gamma$. On the balanced growth path, output, consumption and capital grow at the rate $(1 + \eta)(1 + \gamma)$.

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[1] It is reassuring that a similar "early warning" about the potentially large costs of sovereign debt defaults has also been issued in a recent paper by Reinhart, Rogoff and Savastano (2003).

**Calibration**

The model economy is calibrated by choosing parameters so that the balanced growth path matches certain steady-state features of the measured economies (see Cooley and Prescott (1995)).

We chose the period 1951-79 to establish the long run features of Argentina's growth rather than the whole period for which the relevant data are available (1951-97) because, in the spirit of calibration, the period 1951-79 does not include any of the observations corresponding to the two decades that are the object of study in this paper. That is, we calibrate Argentina's economy to its long run features as revealed by the information available to the economic agents by 1979 and ask whether a neoclassical growth model thus calibrated can account reasonably well for Argentina's relevant growth features afterwards, during the lost decade and subsequent recovery of the 1990s.

Consistent with that choice of reference period, the following parameters (with their actual values in parentheses) were set to their average value over 1951-79: annual growth rate of working-age population (1.55%), labor augmenting technological progress (TFP factor, 1.03 percent,) and the investment-output ratio (0.226).

It would be tempting to set the average capital-output ratio to its average over that period as well. However, unlike with the average TFP growth, this procedure is likely to underestimate the underlying long run capital-output ratio if in the reference period the economy is not on the balanced growth path, but converging to it from "above" or "below." As per the evidence discussed in the previous section, the latter seems to have been the case for Argentina during the reference period. Accordingly, the underlying long run capital-output ratio is likely to be closer in magnitude to the ratios actually observed toward the end of that period than to their average over that same period. Given that the observed capital output ratio for Argentina was still in an upward trend by the time it reached values of around 1.9 in 1978 and 1979, we adopted 2 as a reasonable guess for the value of that ratio in the long run.[2]

That calibrated capital-output ratio along with the investment-output share of 0.226 calibrated earlier implies a depreciation rate of about 11.3 percent, via the standard neoclassical growth model steady state relationship $\delta = (x/y)/(k/y)$. This depreciation rate

[2] However, sensitivity analysis suggests that the results are quite sensitive to the choice of this value.

abstracts from total factor productivity growth and population growth because the model economy used for the numerical experiments assumes no growth. Hansen (1997) has shown that this way of calibrating the depreciation rate ensures a better correspondence between the series generated by the model and the actual data of an economy with growth.

Another parameter that is particularly challenging to calibrate for the case of Argentina is the capital share parameter $\theta$ of the production function. The National Income accounts typically used to that effect in countries like the US are not available in Argentina, which can therefore estimate its GDP only from the Product accounts. As a result, the labor and capital cost shares in GDP cannot be calculated directly from reported factor incomes. Therefore, we set the capital input share, $\theta$, to 0.40, as if Argentina's production technology were the same as that of the US. While some estimates have the capital share at 60 percent of GDP, most researchers consider that this figure would be closer to 40 percent were it not for the substantial under-reporting of labor income in the informal sector of Argentina's economy.[3]

The steady-state real interest rate, was set equal to 8.7 %, as implied by the steady state relationship $r = \theta.Y/K - \delta$, (again, abstracting for the reasons previously given from long-run growth rates.)

The utility-function share parameter, $\alpha$, was set to imply that the average household member spends a fraction 0.3 of its time endowment in the labor market, a standard assumption for the US that casual inspection of the available data suggests reasonable for Argentina as well.

The coefficient of constant relative risk aversion was set at the level used in similar studies for the United States, that is, $\sigma = 2$.

Finally, the persistence parameter $\rho$, the autoregressive component of the total factor productivity shock, was established from an autoregression on the Solow residuals (TFP) computed in the previous section of the paper for the period 1951-79, and set,

[3] De Gregorio and Lee (1999) find that the labor share could be as large as 0.7, according to the indirect measure proposed by Sarel (1997).

accordingly, equal to 0.56. The innovation ($\varepsilon_t$) is assumed to be an i.i.d. process with mean zero and standard deviation $1/(1-\rho)^2$.

### Computation

In our numerical experiments, we exploit the second welfare theorem to compute the solution of a dynamic stochastic general equilibrium neoclassical growth model. Since $\sigma > 1$, $0 \leq \alpha \leq 1$ and $0 \leq \theta \leq 1$, the conditions for the second welfare theorem hold. In particular, the utility function is concave, and the production function defines a convex set for the resource constraint. This will guarantee that the solution to the social planner's problem can be decentralized as a competitive equilibrium. Notice that this problem is a version of the stochastic growth model first developed by Brock and Mirman (1972).

Our strategy to compute the only solution of the model is to find the value function and associated policy (or allocation) functions. Following Kydland and Prescott (1982) we substitute the resource constraint in the utility function and rewrite the resulting expression as a quadratic approximation around the steady state. This defines a linear quadratic problem with well known properties. In particular, the policy (or allocation) functions are linear in the state variables and can be readily computed with standard numerical methods (see Hansen and Prescott (1995)).

Following the standard convention in that approach, the policy functions and resulting allocations are computed under the assumption that economic agents form expectations about the future rationally, based on the information available at the beginning of each period.

## EXPERIMENTS

### Purpose

In this section, we ask what fraction of the growth rates of the relevant economic variables over the period 1980-2003 can be accounted for by a stochastic neoclassical growth model in which exogenous shocks to TFP are the only source of uncertainty. To that effect, as indicated in the previous section, we compute the equilibrium decision rules and simulate the path of the relevant variables of the model by feeding the measured TFP into the equilibrium decision rules.

**Findings**

As Figures 4 and 5 make apparent, the growth model with TFP taken as exogenous can account with remarkable precision for the dynamics of output and capital accumulation during the protracted and deep recession of the 1980s, in fact, a depression, according to Kehoe and Prescott's definition.

The model seems to miss completely the dynamics of capital stock after the lost decade, but that is the result of a considerable overestimation of that stock over the expansion of the 1990s. Once that effect is taken away, as in Figures 7, 8 and 9, by restarting the simulations with the actual level of capital stock observed in 1999, the neoclassical growth model shows again a striking ability to replicate the trajectory of GDP and of the capital stock during recessions.

Inspection of Figure 8 confirms the presence of an asymmetry in the ability of the neoclassical growth model to account for the dynamics of capital accumulation: although it captures it rather well during recessions, it seems to considerably overestimate the capital stock during expansions. The "1990s excess capital shallowing puzzle," reflected in a lower than predicted capital-output ratio and first discussed in Kydland and Zarazaga (2003), is apparent also from Figure 9.

Thus, perhaps somewhat surprisingly, taken together these findings suggest that the relevant question for future research might be not so much whether the neoclassical growth model can account for depressions, but for booms. A resolution of the "1990s puzzle" for Argentina could have therefore important implications for growth theory in general.

In the next section we offer some conjectures that might help to explain that anomaly.

## CONJECTURES FOR THE RESOLUTION OF CAPITAL GAP ANOMALY

Given Argentina's history of defaults and confiscation of deposits, a valid conjecture to account for its capital gap relative to trend is the possibility of endogenous credit constraints of the type discussed in Kehoe and Levine (2001) and Alvarez and Jermann (2000). A growing body of literature suggests that small open economies face borrowing constraints that are binding not as much during downturns but during expansions (see, for example, Kehoe and Perri (2002)). The reason for that counterintuitive outcome is that lenders do not have much interest anyway in investing in a country undergoing a period of low or declining productivity growth. By contrast, capital owners would like to invest a lot during a period of high productivity growth. The presence of default risk reduces their incentives to do so, however, because investors realize that it is at good times, after it has been able to lure capital into the country, that its governments will have the highest incentives to increase taxes on capital, perhaps to the point of confiscation.

Thus, a possible explanation of why investment remained so weak (relative to the model) in Argentina during the 1990s is that potential investors, their memories of that country's sovereign debt default in the mid 1980s and confiscation of deposits in 1990 still fresh, remained wary of similar episodes in the future and, accordingly didn't risk their capital in Argentina as much as the neoclassical growth model would predict. Indeed, those fears have materialized recently, when in 2001 Argentina implemented the largest confiscation of deposits in its history and then proceeded to declare a massive default on its sovereign debt obligations.

The social consequences of Argentina's capital accumulation gap are devastating for the poorer segments of the population, as a declining capital is inevitably associated with lower labor productivity and, therefore, lower wages. As capital becomes the relatively scarcer factor of production, its relative price increases and induces a deterioration in the distribution of income as well. These predictions of the neoclassical growth model seem to be roughly consistent with the rise of poverty and inequality observed in Argentina over the last years.

This study suggests, therefore, that rebuilding Argentina's capital stock and bringing it back to what it should have been according to trend is a fundamental component of any attempt to reduce poverty and social marginalization. We had conjectured, however, that the capital-shallowing process responsible for that unfortunate evolution of social indicators is the result, at least in part, of a long history of confiscation of deposits and debt defaults that has seriously dented investors' confidence in the country. In the light of that conjecture, any attempt to fight poverty without solving the time inconsistency problem revealed by that problematic history will be likely doomed to failure.

It is therefore important that future work explores more rigorously the extent to which the "risk of default" conjecture can account quantitatively for the impoverishing capital-shallowing process that Argentina has been experiencing over the last twenty five years or so, ultimately responsible for that country's recent rise in poverty and inequality that is worrying experts, policymakers, international financial institutions, and well-intended citizens in Argentina and all over the world.

**Figure 1**
**ARGENTINA**
**GDP per working age person (Index)**

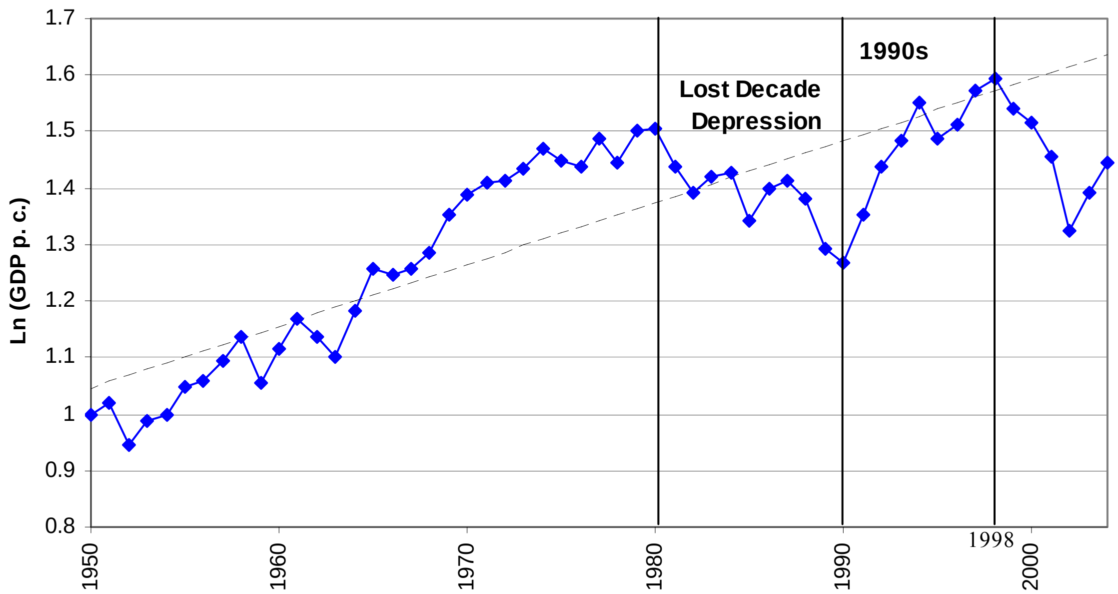


**Figure 2**
**ARGENTINA**
**Capital input per working age person**
**LOWER CAPITAL: LOWER REAL WAGES, WORSE DISTRIBUTION OF INCOME**

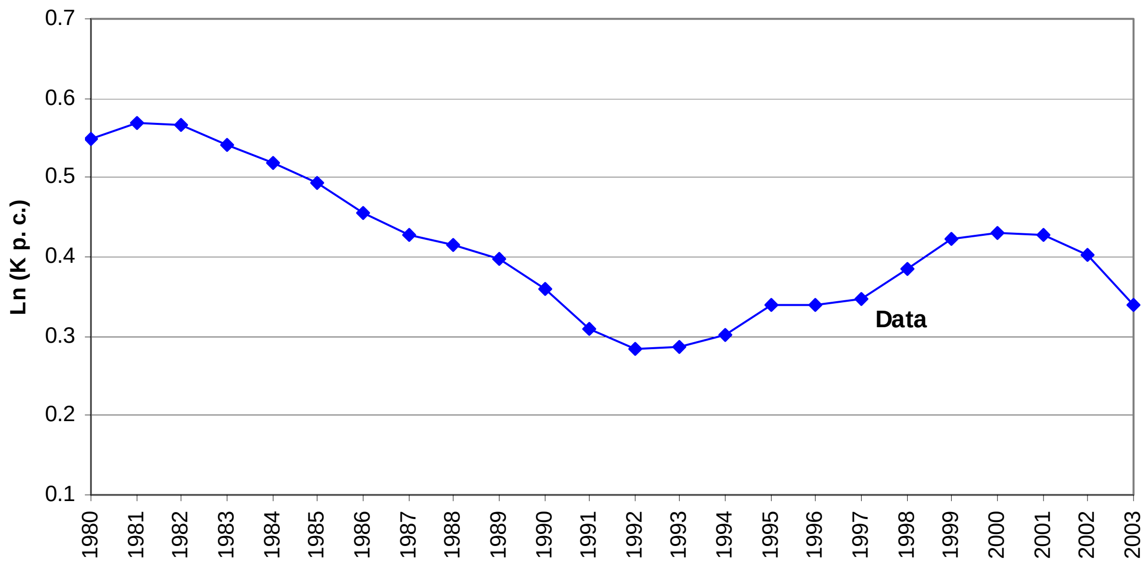



**Figure 3**
**ARGENTINA**
**TFP Level**

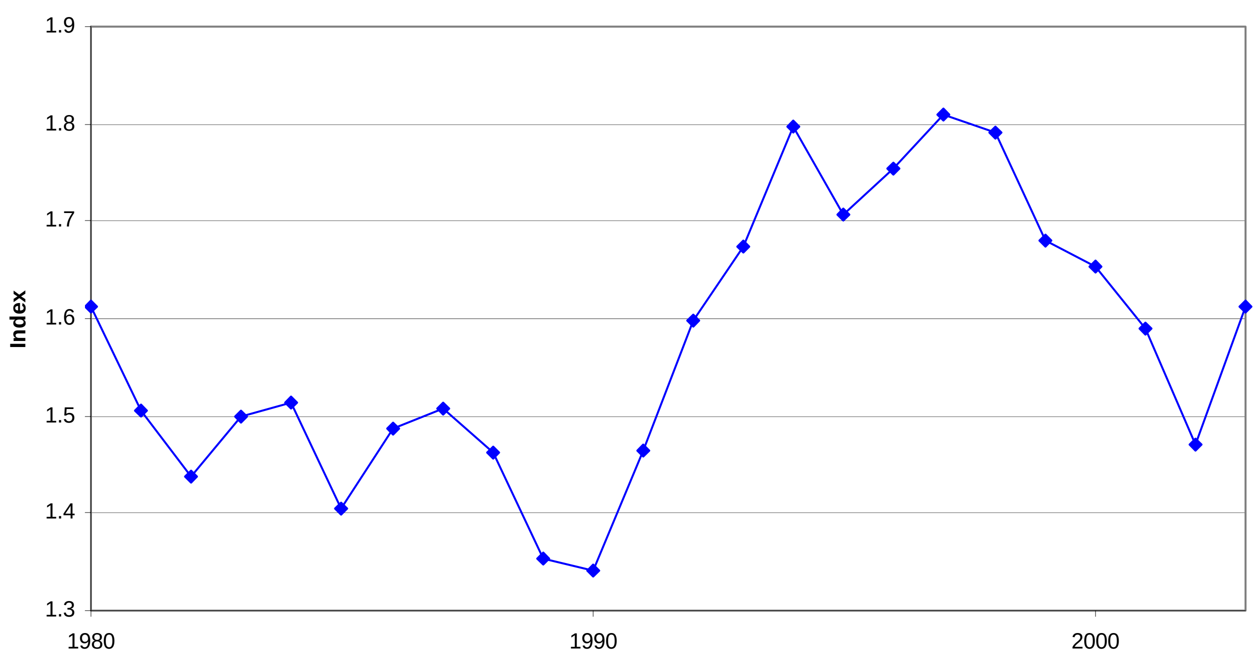


**Figure 4**
**ARGENTINA**
**GDP**

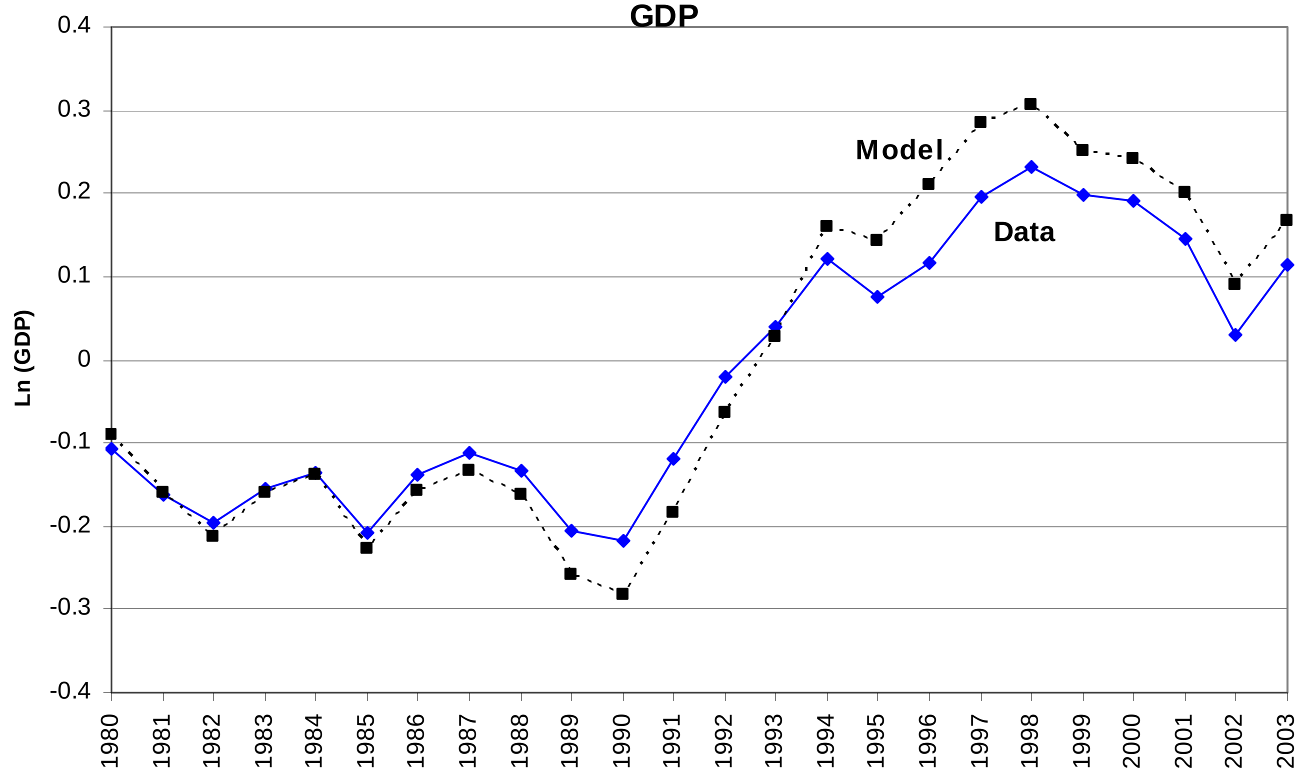



**Figure 5**
**ARGENTINA**
**Capital Input**

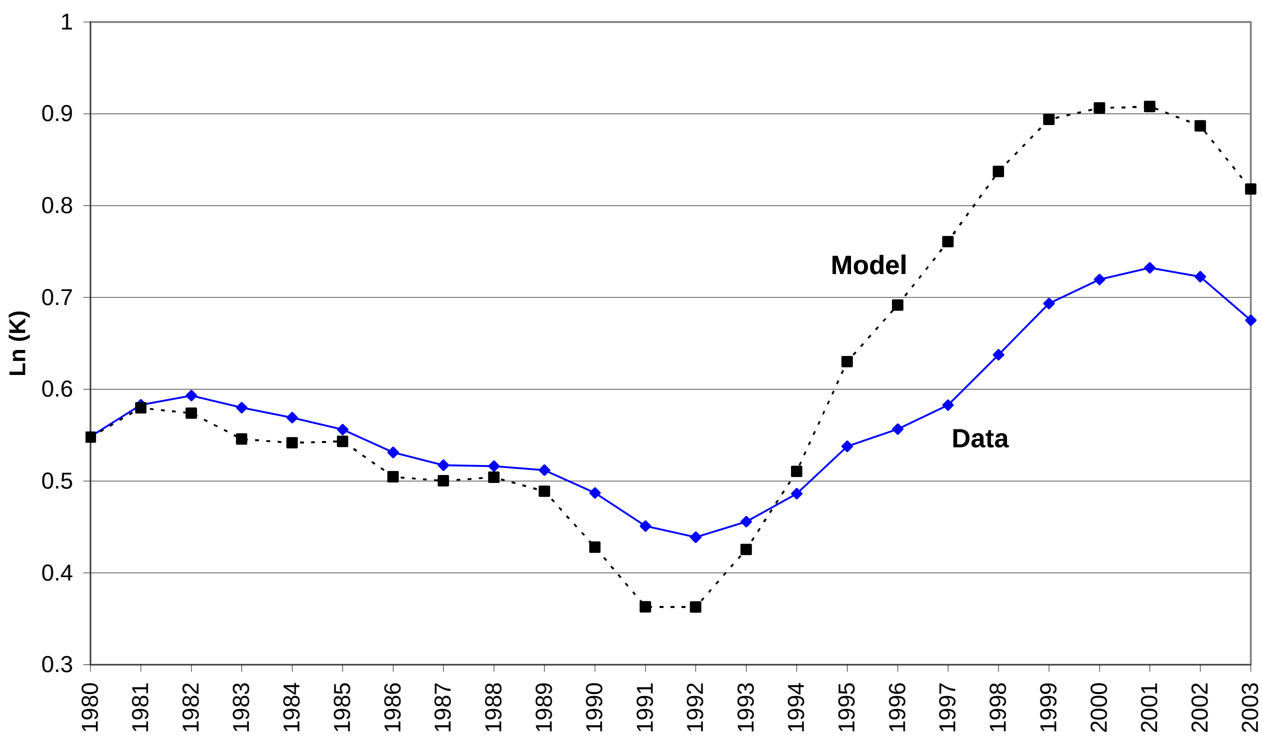


**Figure 6**
**ARGENTINA**
**Capital-output ratio**

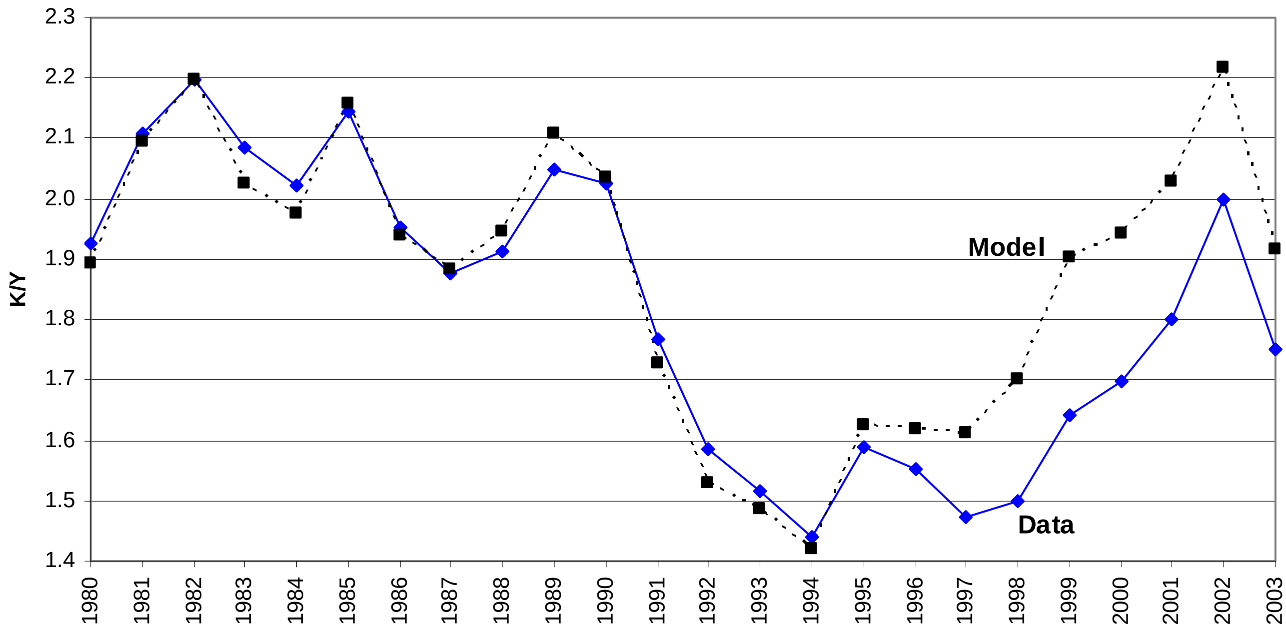



**Figure 7**
**ARGENTINA**
**GDP**

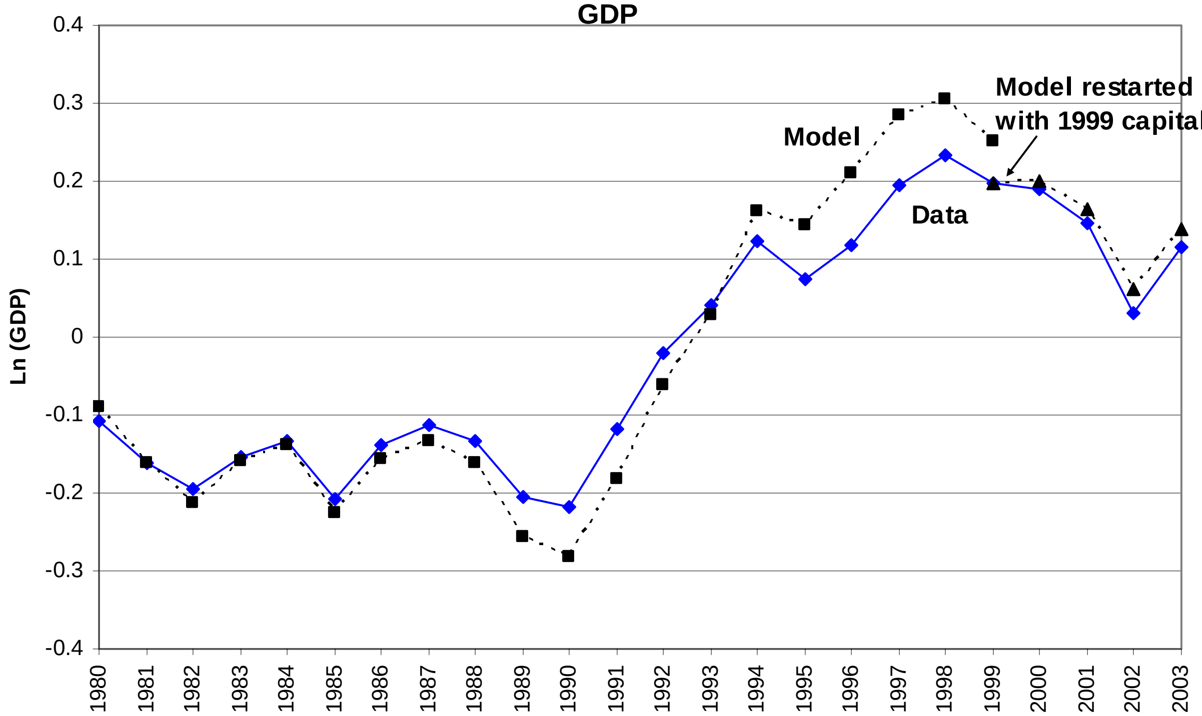


**Figure 8**
**ARGENTINA**
**Capital Input**

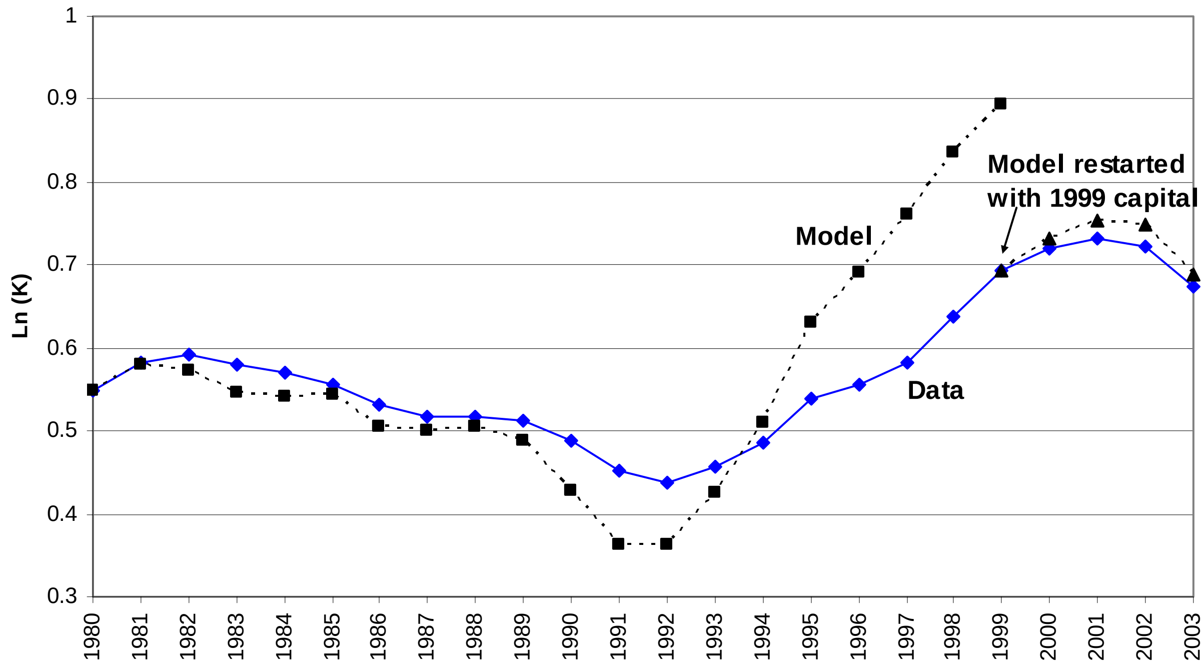
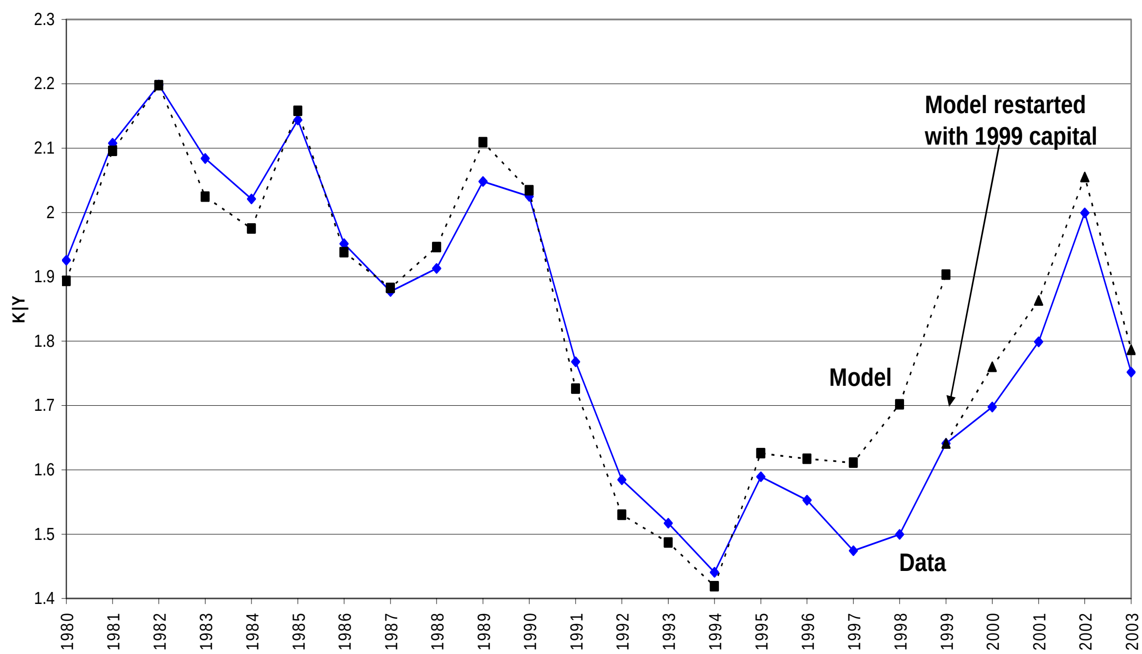



**Figure 9**
**ARGENTINA**
**Capital-Output Ratio**



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