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Abstract

Argentina suffered a depression in the 1980s that was as severe as the Great Depression experienced in the United States and Germany in the interwar period. Our paper examines this depression from the perspective of growth theory, taking total factor productivity as exogenous. The predictions of the growth model conform rather well with the observations during the ”lost decade” years. *Journal of Economic Literature* Classification Codes: E32.

Key Words: Argentina, depression, growth model.

1. INTRODUCTION

The unusual features and severity of the Great Depression in the United States has been the object of much speculation among economists and social scientists intrigued by a phenomenon still resistant to a widely accepted explanation. Lack of progress in understanding the Great Depression may be attributed, at least in part, to the unavoidable limitations of the "event study" methodology with which most scholars have approached the "case," possibly out of the perception that the Great Depression was an episode so rare that it is the only "real world" experience with depressions available for study.

In addition, implicit in this "case study" approach to the Great Depression is often the view that depressions are not just rare in frequency, but also in nature. That is, that they represent an essential "discontinuity" with the past and the future, perhaps because, for reasons not fully understood, the behavior that economic agents typically display in normal times is "suspended," as it were, and replaced during economic depressions with a different one. The difficulty with this view is that the very rarity of depressions conspires against the ability to identify which elements, if any, of the economic environment or agents' behavior during economic depressions is substantially different, to the point of "discontinuity," from "normal times."

This is an unfortunate state of affairs, because protracted and severe depressions are not as rare as many scholars are initially inclined to believe. In fact, this paper has been motivated by the evidence that not long ago, during the 1980s (the so-called "lost decade,") Argentina experienced an economic depression that was every bit as, if not more, severe as the U.S. Great Depression.

Faced with this evidence, it is only natural to ask: Can standard theory account for Argentina's lost decade of economic depression? The object of this paper is precisely to address this question with the aid of a fairly standard and parsimonious neoclassical growth model. We limit the inquiry to the class of neoclassical growth models to overcome the aforementioned limitations inherent in the "event study" approach, and study Argentina's lost decade with a methodology similar to that used in a number of recent studies that, following Cole and Ohanian's (1999) lead, have examined economic depressions in a variety of countries. The accumulation of evidence on economic depressions through the lens of the same neoclassical theoretical framework might provide useful insights into their nature and the extent to which depressions cannot easily be accounted for by theories, such as the neoclassical growth model — usually regarded as an adequate abstract representation of reality for “normal times.”

A quick summary of our methodology is as follows: we compute the total factor productivity (TFP) time series (Solow residuals) of a typical constant-returns-to-scale production function with standard growth accounting methods and calibrate a parsimonious neoclassical growth model to the Argentinean economy during “normal times,” or more rigorously speaking, to its implied steady state. We then compute the economic agents’ decision rules and feed the computed Solow residuals into the model economy to generate the path for real GDP per capita, capital stock, and employment (number of workers) induced by those decision rules. The comparison of the model-generated path for each variable with the actual data for the same variable makes it possible to infer which fraction of the year-to-year variations of such variables during the lost decade years can be accounted for by the actually observed TFP shocks.

Our findings provide no support for the “discontinuity” interpretation of Argentina’s lost-decade depression. The numerical experiments suggest that the predicted paths for real GDP per capita, capital stock, and labor input implied by a very parsimonious neoclassical growth model in “normal times” are not inconsistent in any obvious way with the observed dynamics of those variables during the lost decade.

The employment data we found available was somewhat incomplete (as discussed in Section 5 and the Appendix). But while the employment data would be considered insufficient for business cycle analysis, we feel that it is adequate for analysis of large movements such as depressions.

2. OVERVIEW OF THE ARGENTINE DEPRESSION

Argentina suffered a severe depression during the 1980s. Figure 1 plots an index of detrended real GDP per capita in Argentina from 1950 to 1997. The trend growth rate we use in 1.44%, as implied by the labor augmenting technological progress (the TFP factor) observed during the period 1950-1970.

According to the figure, by the end of the "lost decade," in 1990, Argentina's GDP per capita was a striking 33% below trend. For purposes of comparison, Cole and Ohanian (1999) report that U.S. GDP per capita was 35 percent below trend at the trough of the Great Depression in 1933. Furthermore, as the moniker "lost decade" suggests, Argentina's contraction lasted 10 years, 2.5 times longer than the 1929-33 contraction during the U.S. Great Depression.

To identify the sources of growth, we undertook a growth accounting exercise. The Appendix outlines our data sources and the method we used in constructing these series.

In our growth accounting exercise, we assume that the production function is given by

$$Y_t = A_t K_t^{\theta} L_t^{1-\theta} \tag{1}$$

where Y is aggregate output, A is TFP, K is aggregate capital, and L is aggregate employment.

Our growth accounting differs in appearance, but is equivalent to standard growth accounting. We decompose output per capita into three factors: the TFP factor $A^{1/(1-\theta)}$, employment intensity (L/N) and the capital intensity factor $(K/Y)^{\theta/(1-\theta)}$. This decomposition is convenient because the growth rate of the efficiency factor coincides with the trend growth rate of output per adult when employment per capita and capital intensity are constant.[2]

Table I presents the results of our growth accounting. The capital input share is set at 0.4 (see our discussion below on calibration). From 1950-1970, GDP per capita grew at almost 2 percent. The major contributor to this was TFP, which accounts for three-quarters of the growth. An increase in the capital-output ratio (capital intensity), was also important.

[2] The "factor intensity" formulation of the production function (1) used for purposes of our growth accounting can be obtained by multiplying both sides of that identity by $1/N_t * \left(Y_t/N_t\right)^{-\theta}$, where N_t is total population.

GDP per capita grew at a much slower pace during 1970-1979. This decline was primarily due to TFP, which regressed at an average rate of 0.3% during the decade.[3] The negative growth of TFP was offset by an substantial increase in the capital-output ratio.

The performance of output per capita and TFP during the 1980s makes their weak performance during the 1970s look good. Over the lost decade, GDP per capita fell by over 20 percent. TFP accounts for over 95 percent of this decline, as the productivity factor fell at an annual rate of 2.11 percent during the 1980s.[4]

The 1990-1997 period witnessed a dramatic turnaround. Output per capita grew at nearly 2.5 times its average during the 1950-1970 period. This growth was driven by an even more rapid growth in TFP. The rapid growth in TFP was partially offset by a decline in the capital-output ratio.

These facts suggest that TFP plays a key role in accounting for growth in GDP per capita in Argentina.

3. ANALYTIC FRAMEWORK

Model

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

Household preferences can be represented by:

$$E\sum_{t=0}^{\infty}\beta^{t}(1+\eta)^{t}\ (c_{t}^{\alpha}(1-l_{t})^{1-\alpha})^{1-\sigma}/(1-\sigma) \qquad (2)$$

where c_t represents consumption, l_t hours of work, α the intratemporal elasticity of substitution between consumption and leisure, η the population growth rate, and σ the coefficient of constant relative risk aversion.

Technology is described by

[3] Recall that the gross TFP factor is equal to $(1+\gamma)$, which implies that total factor productivity growth is equal to $(1+\gamma)^{(1-\theta)}$, or -0.18% on average for the period 1970-79.

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

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

$$z_{t+1} = \rho\, z_t + \varepsilon_t \quad (5)$$

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

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).

For the reasons given in the introduction, we considered the period 1950-70 as fairly representative of Argentina's long-run growth features. Accordingly, we set annual population and labor augmenting technological growth rates equal to the averages for that period, 1.7 percent and 1.44 percent respectively.

In Argentina, there are no National Income accounts. As a result, the labor and capital cost shares in GDP cannot be directly estimated. We assume that the labor input share is 0.60. While some estimates have the labor share at 40 percent of GDP, most researchers consider that this figure would be closer to 60 percent were it not for the substantial under-reporting of labor income in the informal sector of Argentina's economy.[5]

The capital-output ratio was set at the level it had right before the lost decade, in 1979, which was 2. The long-run share of investment in total GDP in Argentina has been around 20% percent, which implies an investment/output ratio of 0.20.[6] The above values implied a depreciation rate of 10%. This depreciation rate abstracts from total factor

[4] As explained in the previous footnote, this implies an average annual total factor productivity decline of around –1.2% for the lost decade.

[5] 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).

[6] Both the capital/output ratio and the investment/output ratio have been computed taking into account all investment categories in the National Accounts, including investment in residential structures.

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.

The steady-state real interest rate consistent with the other parameter values is 0.10 (again, for the reason already given, abstracting from long-run growth rates.)

The fraction of time spent in the labor market, *l*, was set at 0.3. 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 ρ, the autoregressive component of the total factor productivity shock was established from an autoregression on the detrended Solow residuals (TFP) computed in the previous section of the paper for the period 1950-79, and set, accordingly, equal to 0.73. The innovation (ε_t) is assumed to be an i.i.d. process with mean zero and standard deviation $1/(1-\rho)$.

Computation

In our numerical experiments, we exploit the second welfare theorem to compute the solution of a dynamic general equilibrium neoclassical growth model. Since $\sigma > 1$, $0 \le \alpha \le 1$ and $0 \le \theta \le 1$, 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 Cooley and Prescott (1995)).

4. EXPERIMENTS

Purpose

In this section, we ask what happens if TFP is taken as exogenous and no other exogenous factors change. To do this, we compute the equilibrium decision rules and simulate the model by feeding the measured TFP into the equilibrium decision rules.[7]

Findings

The growth model, with TFP taken as exogenous, can account for the performance of output during the Argentine depression. Figure 2 presents the predicted and actual output series. Measured productivity can account for about three-fifths of the decline in output relative to trend. The model also predicts that Argentina should have experienced output growth during the 1990s, but at a rate two-fifths higher than in the data.

The growth model also does a good job of accounting for capital. Figure 3 presents the predicted and actual data relative to trend. The detrended capital input declined in the lost decade, on average, at a 4.4% annual rate, while the average decline predicted by the model is 1.9%. In other words, total factor productivity seems to be able to account for roughly 40% of the actual decline of the capital stock during the lost decade.

The slower rate of decline of capital input predicted by the model relative to the data suggests that the model overestimates capital stock. Indeed, according to Figure 3, the model overestimates the capital stock by about 37% by the end of the lost decade. It is worth mentioning that, although not negligible, this figure is on the same order of magnitude as the equivalent discrepancy that Cole and Ohanian (1999) report for the U.S. Great Depression.

The overestimation of the capital stock during the lost decade is sufficiently small that we have confidence in the ability of the neoclassical growth model to account for Argentina's lost-decade depression. In fact, there are theoretical reasons to conjecture that the discrepancy is the result of having abstracted from an important dimension of reality in our parsimonious model economy. Argentina is a small open economy, but the model economy is a closed one. This observation is relevant, because in an open

[7] We also solved the model for the perfect foresight case, and found similar results.

economy the interest rate is fixed at the world level. Thus, capital input must fall more than in a closed economy in response to a negative productivity shock, because in the latter, the shock induces a downward pressure on the interest rates that buffers the reduction in the capital stock that would otherwise be needed to restore equilibrium conditions. An obvious topic for future research is to establish whether or not an open economy can more closely replicate the decline of the capital stock during the lost decade.

The performance of the model is more satisfactory with respect to the labor input. Figure 4 shows that the model economy slightly underestimates total employment throughout the lost decade. While the model predicts an average annual decline of 0.5% percent in the number of workers during the lost decade, in the data employment remains almost flat, declining at a 0.1% annual rate on average. An anomaly that does stand out from the figure is the discrepancy between the data and the predictions of the model during the recovery of the 1990s.

We conjecture that these anomalies are linked to government employment policies. We discuss the conjecture in more detail in the next section.[8]

5. A POSSIBLE RESOLUTION OF THE LABOR PUZZLE DURING THE 1990s: GOVERNMENT EMPLOYMENT POLICES

In our experiment, we found that the model predicted that labor input should have increased considerably more than the measured labor input during the 1990s. We conjecture that government policy in Argentina help explain this anomaly.

It has often been claimed that employment in provincial governments and state-owned enterprises in Argentina have operated as a covert form of unemployment insurance. Argentina was a heavily regulated economy until 1990 and it is well known that "payroll-credited" unemployment insurance payments are the common device through which centrally planned economies can artificially reduce measured unemployment below the levels prevailing in developed countries.

[8] There is also the approximation issue of how far from the implied balanced growth path the actual economy was in the period 1950-70 adopted as reference for the calibration. Some source of concern in this

Until recently, the information in the household surveys did not distinguish employment in the private or the public sectors. This deficiency cannot be solved with data from other sources, because information on employment in the public sector is virtually nonexistent. The official statistics report systematic information on government employment only for the Central Administration, and even so, they do not always include contract personnel, which usually fluctuates more than the permanent staff.

There is, however, some indirect evidence which suggest the magnitude of government employment programs. Information on the number of workers employed by provincial administrations from nonofficial sources, such as in Chisari *et al*. (1993), suggests that employment at the provincial and national administration levels may have represented between 10 and 13 percent of the total number of workers in the period of analysis. However, this figure does not include employment in the vast number of state-owned enterprises that were still under government control during the lost decade. There are no official records of the number of workers employed in those government conglomerates. One way to establish a rough upper bound for that figure is to assume that all the increase in unemployment between the end of 1990 and 1995 corresponded exactly to the number of workers who lost their "hidden unemployment" benefits in those firms to the hands of the large-scale privatization process that took place during those years. Under that extreme assumption, the total number of workers in the public sector during the lost decade may have been on the order of 20-25 percent of total employment.

This fraction of total employment is not negligible and suggests that government policy can resolve the decline in the labor input in the data during the 1990s. In particular, the termination of previously created artificial jobs during the far-reaching privatization program implemented in those years may explain why employment during the recovery phase of the 1990s declined, instead of increasing substantially, as the model would predict. This conjecture is not without challenges, because the introduction of "employment subsidies" will require to include in the analysis the government budget constraint. It is possible, for example, that any government employment programs that may have been in place prior to the 1990s were financed with the inflation tax, which was

regard is that the capital stock grew over that period at a 4.9 % annual rate on average, about twice the rate consistent with the balanced growth path of the calibrated economy.

an important source of revenue before 1991. A more rigorous assessment of this conjecture will need to take into account, therefore, the effects that the taxes needed to finance the employment subsidies had on capital and labor inputs. It should be clear in any case that the thorough exploration of this conjecture is a promising topic for future research.

6. CONCLUSION

This paper has explored the quantitative predictions of a rather parsimonious neoclassical growth model economy relative to the actual economy. Overall, our findings suggest that neoclassical growth theory can account for a great deal of Argentina's economic depression during the "lost decade" of the 1980s. Our findings provide no support for the "discontinuity" interpretation of Argentina's lost-decade depression.

It is not obvious, however, how to resolve the most puzzling aspect of the evidence: why total factor productivity declined at an average rate of 2 percent for the unusually long time of a decade and why it recover so spectacularly at a 4% annual growth rate in the subsequent period. We leave this for future research.

Table I
Accounting for Growth:

Time period	GDP	Factor		
		TFP factor	Capital intensity	Employment intensity
1950-1970	1.93 %	1.44 %	0.86 %	-0.34 %
1970-1979	0.99 %	-0.31 %	1.49 %	-0.23 %
1979-1990	-2.22 %	-2.11 %	-0.35 %	0.22 %
1990-1997	4.94 %	5.79 %	-1.36 %	0.51 %

FIGURE 1

DETRENDED Real GDP per capita
1979 = 100

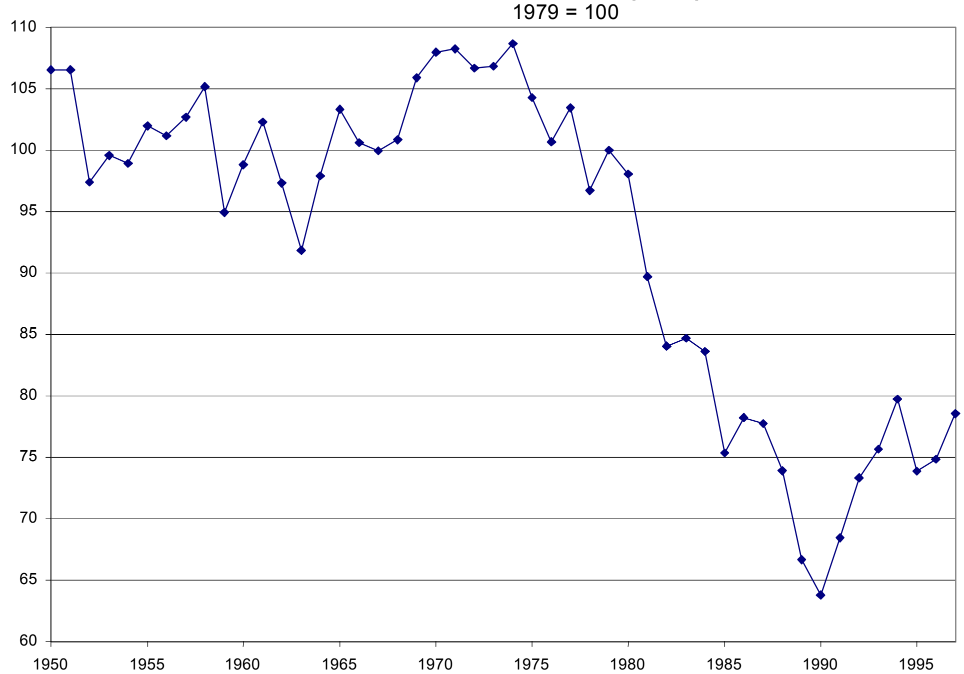


TABLE II
Growth Rates (in %)

	Capital Input		Labor Input		Real GDP per capita	
	Data	Model	Data	Model	Data	Model
1980	0.94	-0.20	-0.56	-0.23	-1.47	-0.60
1981	-2.23	-2.39	-2.02	-2.64	-8.11	-7.02
1982	-5.40	-3.35	-0.01	-1.20	-5.88	-4.76
1983	-4.94	-1.16	-1.04	2.61	1.23	4.76
1984	-4.72	-0.49	0.65	0.71	-0.79	1.16
1985	-6.00	-3.28	-0.46	-3.13	-9.46	-8.62
1986	-5.07	-0.63	2.10	2.95	4.29	5.98
1987	-3.55	-0.19	1.15	0.47	-0.17	0.82
1988	-3.93	-1.47	0.15	-1.38	-4.50	-3.84
1989	-6.02	-4.19	-0.68	-2.96	-9.39	-8.88
1990	-7.16	-3.98	-0.66	0.25	-3.83	-2.07
1991	-3.59	-0.09	2.57	3.99	7.81	8.64
1992	0.40	3.25	0.96	3.26	7.61	9.03
1993	1.23	4.40	-0.43	1.30	3.66	5.60
1994	3.63	6.37	-1.92	2.31	5.88	8.94
1995	-0.89	3.11	-4.30	-2.80	-6.90	-3.42
1996	0.27	3.47	-0.60	0.61	1.76	3.61
1997	4.55	3.31	4.56	0.10	5.47	2.42
Av. 1980-90	-4.37	-1.94	-0.07	-0.48	-3.43	-2.10
Av. 1991-97	0.80	3.40	0.12	1.25	3.61	4.97
Av 1980-97	-2.36	0.14	-0.03	0.23	-0.71	0.65
Std. Dev	3.50	3.15	1.94	2.25	5.81	5.92

FIG. 2. Detrended GDP per capita

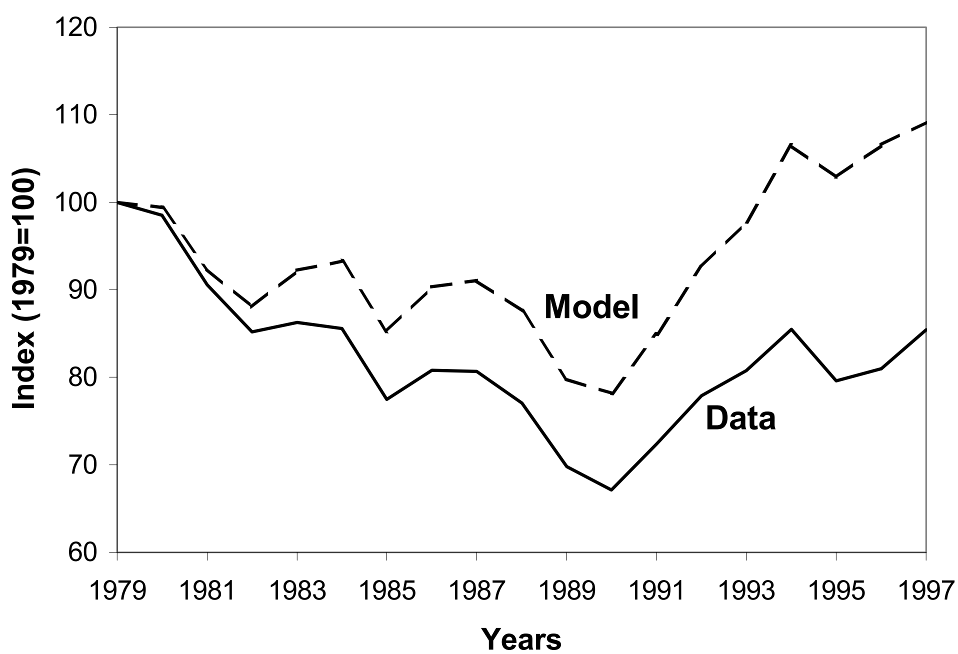


FIG. 3. Detrended capital stock per capita

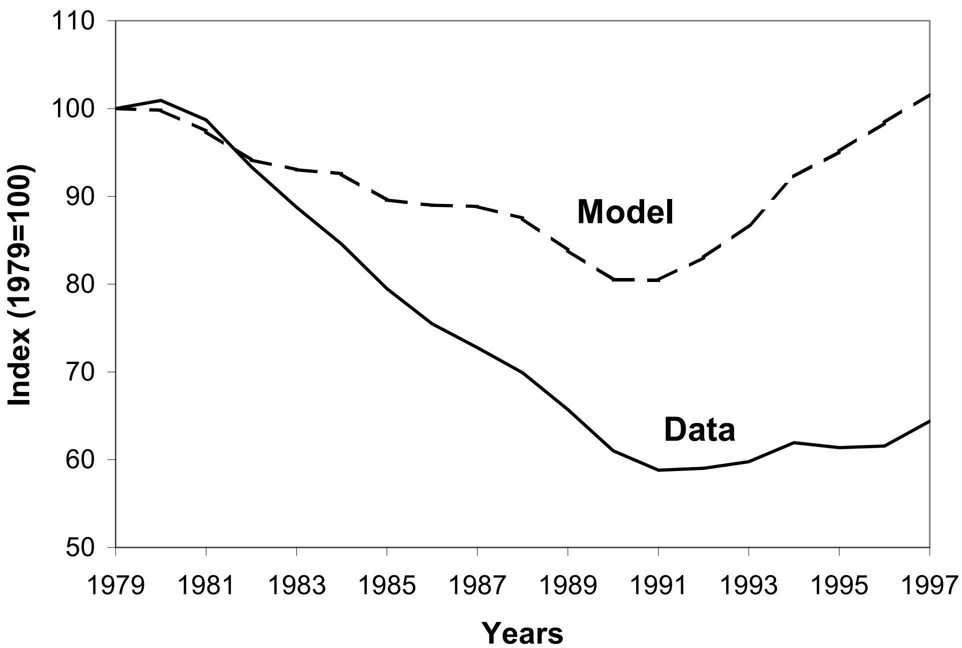
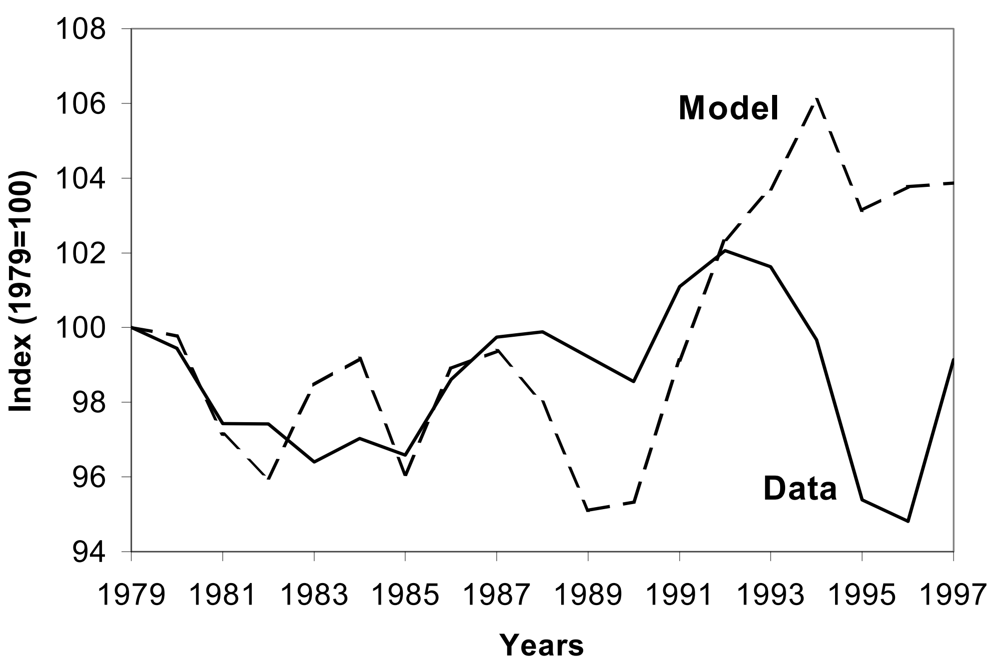


FIG. 4. Hours per capita



APPENDIX

GDP and Population

The GDP series is from Meloni (1999), and is in 1986 pesos. The population data is from Madison (1995) and International Financial Statistics.

Labor

The labor input is measured as the number of workers. For the period 1940-79, labor input is based on an employment series reported in Elías (1992). He used a series on wage earners' employment published by the Central Bank of Argentina for some of the years in the period, and completed the missing years by interpolating labor force participation rates from Population Censuses run every 10 years.[9]

The procedure followed by Elías might understate the actual employment growth for years in which employment is estimated using labor force participation rates from Census records. Labor force participation rates includes both employed and unemployed workers. Unemployment rates experienced a continued decline between the year it began being measured (1963) and the last year of this period (1979). This underestimation of labor input may result in the mismeasurement of the Solow residuals for at least some of the years in the period 1963-79.

Employment data from 1980-1991 are from the "Encuesta Permanente de Hogares" (Permanent Households Survey). The Ministry of Labor uses these surveys to compute, for each urban center, the fraction of the total number of individuals in all households interviewed that have reported some form of employment. It then applies the resulting proportion to the overall population of the corresponding district to arrive to an estimate of the total number of employed in each urban area. The estimation of the number of employed in areas not covered by the survey is accomplished by applying to the estimated total population in those areas the average of the employment coefficient just described, weighted by the population of all urban centers other than the capital of the country, the Buenos Aires Metroplex area.

One difficulty with these surveys is that it is not clear how well the households included in them represent the characteristics of the whole population.

Capital and Investment

We constructed a capital stock series from investment figures in 1986 prices from 1911 to 1997. The investment series was kindly provided by Osvaldo Meloni (1999). We adopted a depreciation method that combined the geometric and linear (Hofman (1991), Meloni (1999)) depreciation schemes. We assumed that nonresidential structures have a useful life of 40 years and machinery and equipment 15 years.[10] As in a linear depreciation scheme, the assets lose any residual value after the last year of their lifetime. The depreciation at period t of productive capital invested n periods ago is given by I_{t-n} δ^n, where δ is the depreciation rate and $n \leq T$. The depreciation rate δ was chosen so that the residual value of the relevant asset at the last year of its useful life would be I_{t-T}/T, that is, to satisfy the equation $(1-\delta)^T = 1/T$. This method implied annual depreciation rates of 16.5 percent for machinery and equipment and of 8.81 percent for nonresidential structures.

The capital stock we use excludes residential investment. The National Accounts of Argentina impute housing services according to procedures that have varied over time and are hard to relate in a systematic way to any homogeneous concept of a residential capital stock. Thus, there is no clear correspondence between those imputed services in GDP and any capital stock series constructed with the Perpetual Inventory Method. This omission will have some impact on our measures of Total Factor Productivity.

Implicit in the standard growth accounting method we used to measure TFP is the assumption that all factors of production, in particular capital input, are fully utilized. However, independent evidence suggests that capital utilization in Argentina declined substantially during the lost decade. Equivalently, that actual capital input may have fallen more than suggested by the variations in the capital stock. Although there are no widely accepted measures of capital input adjusted for capital utilization, it is important to keep in mind that the large decline in TFP just reported may be the result, at least in part, of the underestimation of the decline in capital input.

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[9] Elías's study contains only a very brief account of the procedures used to construct this series. Some of the additional details just outlined were reported as documented in a written response by the author to a specific query we made in that regard.

[10] The capital stock estimates for the United States assume a linear depreciation scheme with useful life of the assets that are roughly in line with the ones assumed in this paper.

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