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AND THE 1990S THROUGH THE LENS OF A NEOCLASSICAL GROWTH
MODEL**

Finn E. Kydland
Carnegie-Mellon University

Carlos E. J. M. Zarazaga
Federal Reserve Bank of Dallas

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Corresponding author:
Carlos E. J. M. Zarazaga
Research Department
Federal Reserve Bank of Dallas
2200 N. Pearl St.
Dallas, TX 75201
USA
Phone: (214) 922-5165
FAX: (214) 922-5194
E-mail: carlos.zarazaga@dal.frb.org

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Finn E. Kydland
Carnegie-Mellon University

Carlos E. J. M. Zarazaga
Federal Reserve Bank of Dallas

The paper examines the evidence for Argentina's economic growth during the 1980s (the so-called "lost decade") and the 1990s. Standard growth accounting points to total factor productivity as the main driving force of Argentina's economic growth during those two decades, a finding which readily suggests a neoclassical growth model interpretation of that experience. The paper examines that hypothesis by simulating the outcomes of a rather parsimonious growth model calibrated to the Argentinean economy in which stochastic shocks to the rate of technological change, that is, to total factor productivity, are the engine of growth. The numerical experiments show that such an interpretation can account fairly well for the dynamics of labor and capital input, that is, of employment and investment, both during the 1980s and the 1990s. We argue that the results validate a "TFP-based" neoclassical growth approach to Argentina's growth experience in the recent past.

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Corresponding author:
Carlos E. J. M. Zarazaga
Research Department
Federal Reserve Bank of Dallas
2200 N. Pearl St.
Dallas, TX 75201
USA
Phone: (214) 922-5165
FAX: (214) 922-5194
E-mail: carlos.zarazaga@dal.frb.org

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I - INTRODUCTION

The 1980s have been dubbed the “lost decade” in Latin America because during those harsh ten years GDP per capita declined in that region at an average annual rate of 1.5%, in contrast with the 2.3% and 1.8% increases of the immediately preceding and immediately following decades, respectively.¹

Chart 1 shows not only that Argentina did not escape that general trend, but also that the decline had started much earlier, in the mid 1970s. If the size of a downturn is measured as the percentage change from the highest GDP per capita after the last time that variable was below trend to the lowest GDP per capita before the first time that variable was above trend again, then the 1974-90 decline was not only rather pronounced, about 20%, but also the longest in Argentina’s recorded history.

It is true that the decline from 1974 to 1979 could be dismissed as a simple “reversion to the mean” phenomenon. But this observation does not take away the fact that per capita GDP was still 20% below trend in 1990. Not even during the worse years of the Great Depression had Argentina experienced such a large decline relative to trend.

The sharp decline of the 1980s was followed by a strong recovery in the 1990s. With the benefit of hindsight, the rebound was not that surprising from a “reversion to the mean” perspective. However, that was not the prevailing view at the

time. Rather, the widely held interpretation was that the significant rates of growth observed in that decade were a manifestation of a fundamental change in Argentina's growth process that had eventually put that country in the path to a rapid convergence to the GDP per capita levels of the "developed countries club." That optimism was not entirely unwarranted, since Argentina did engage in the 1990s in deep structural reforms that in theory should have improved its competitiveness and productivity.

Serious growth accounting efforts pioneered by Elias (1992) and subsequent extensions of that work by Meloni (1999) have indeed found that total factor (or multifactor) productivity (TFP hereafter) declined in the 1980s and increased in the 1990s. Such a finding suggests a neoclassical interpretation of the economic growth experience of Argentina in those two decades. The main goal of the paper is precisely to explore that hypothesis with the aid of a parsimonious neoclassical growth model in which the rate of growth of total factor productivity is the engine of growth.

The simulations of the theoretical model presented in the paper show that such a neoclassical interpretation can account fairly well for the dynamics of labor and capital inputs, that is, of employment and investment, both during the 1980s and the 1990s. In other words, our numerical experiments validate the "TFP-based" neoclassical growth model interpretation of Argentina's growth experience in the recent past. Such validation is not inconsequential for economic policy recommendations. For example, it suggests that the productivity gains experienced in the 1990s seem to have been essentially static in nature. Once exhausted the "once-and-for-all" productivity gains of the 1990s--induced perhaps by the structural reforms introduced in that decade--economic growth returned to historical averages at best. Unfortunately, this means that despite the hopes

¹ World Penn Tables and Economic Study for Latin America and the Caribbean, 1998-99, ECLAC, p. 65.

and promises of higher growth from the efforts and economic reforms made in the 1990s, Argentina still doesn't seem to have found the key to the sustained productivity growth necessary for that country's GDP per capita to converge to that of the "developed countries club" in the foreseeable future.

The rest of the paper is divided as follows: Section II describes briefly the main features of Argentina's growth performance during the 1980s and 1990s, Section III summarizes the growth accounting exercises through which several authors have attempted to disentangle the sources of growth during those two decades, Section IV discusses the policies and shocks that could have been responsible for the dynamics of Total Factor Productivity in the period under analysis, Section V presents the theoretical model at whose light the paper examines the empirical evidence, Section VI presents the results of the numerical experiments and discusses their implications, and Section VII makes some concluding remarks.

II - AN OVERVIEW OF THE EVIDENCE

Analyzing the "lost decade" from a neoclassical growth theory perspective requires bringing into the discussion the standard elements of that model: labor and capital inputs, Solow residuals, and so on. It is also necessary to discuss some notion of "trend" which, for the purpose of Chart 1, for example, was defined simply as a linear trend computed with a regression for the period 1900-75 and projected to the subsequent years.

The motivation for adopting this methodology is the desire to stay close to the one followed in the aforementioned paper by Cole and Ohanian, because the ability to make

comparisons between Argentina and US can shed light on the similarities and differences, and therefore, on the nature, of these two countries' "long and severe recessions", or "depressions," as the case may be.²

Such comparisons are important, because they can change the perception of the phenomenon under study. For example, Cole and Ohanian report that the Great Depression had features that seemed to be unique to the US economy, because the 1929-33 decline was deeper and the subsequent recovery weaker than in most other countries they considered.

Thus, while US GDP per capita declined 30 % from peak in 1929 to trough in 1933, in other countries the corresponding fall was, on average, only about 9%. And while most other countries were already at or above their 1929 GDP per capita levels ten years later, the US GDP per capita was still about 5% below that benchmark in 1939.

It is unfortunate that Argentina was not among the countries that Cole and Ohanian included in their "control group" because the US Depression looks much more like a "garden variety" type by Argentinean standards.

To illustrate this point, Argentina's GDP per capita fell below trend in 1982 and it was still below trend by about 9% even ten years later, in 1992. In the same direction points the fact that it took about the same time for both the US and Argentina to return to their trend GDP per capita levels after their respective downturns: thirteen years for Argentina (1982-94) and twelve for the US (1930-41). In fact, even longer declines were

² Cole and Ohanian measure the GDP growth trend as the average GDP growth per worker over the period 1919-29 and 1947-97 and then project that trend over the period 1930-39, using 1929 as the starting year. But this procedure is almost equivalent to running a linear regression with a time trend, because it turns out that the actual GDP per capita in the US in 1929 was not very far from trend, as measured by the fitted values from the regression (see Chart 2).

not unusual for Argentina, as it took that country sixteen years to return to trend GDP per capita level, where it was when the 1930-46 downturn started.

It is true that the magnitudes of the declines for the US during the Great Depression and for Argentina during the “lost decade” were different. In 1933, GDP per capita was 40% below trend in the US while, as mentioned earlier, in Argentina in the last and worst year of the lost decade, in 1990, it was below trend by “only” half that much. But a 20% deviation from trend is still a very dramatic figure.

Can neoclassical growth theory account for a decline (relative to trend) of the magnitude observed in Argentina during the lost decade? The answer to this question may have implications for the merits of the competing hypothesis that have been offered to explain what appears to be the unique phenomenon of the US Great Depression.

For example, Cole and Ohanian have isolated some institutional features of the US economy, in particular, the National Industry Recovery Act, (NIRA hereafter) as a possible explanation for the deeper and longer than average (by both US and international standards) 1930-39 downturn. But this “NIRA hypothesis” might lose some of its appeal if neoclassical growth theory also failed to account for Argentina’s “long and severe recessions,” because an institutional feature similar to NIRA was not present, at least not in an obvious way, in Argentina during the years of the “lost decade.”

By the same token, the success of the neoclassical theory to account for what happened in Argentina during the lost decade will tend to confirm that some very special feature of the US economy, not present in other economies, must have contributed to the severity of the Great Depression. In that case, the NIRA may be a good candidate to explain that unusual US episode, because all sorts of regulations and heavy forms of

government intervention--such as price and exchange rate controls, interest rate caps, and high import tariffs--were pervasive in Argentina during the “lost decade,” but those policies seem to be much less capable of inducing collusive practices than legislation such as the NIRA. It is precisely this collusive bias, Cole and Ohanian argue, that makes that institutional feature of the US economy the prime suspect for the unusually severe and long downturn experienced by that country during the Great Depression years.

Consistent with the stated goal of studying the lost decade from the perspective of the neoclassical growth model, the next section will present the basic ingredients necessary for the quantitative implementation of that approach, that is, the evidence pertaining to labor and capital inputs, factor shares, and Solow residuals.

III – THE DETAILS OF THE GROWTH ACCOUNTING FOR ARGENTINA

Unfortunately, the magnitude of the decline is not the only thing that the lost decade has in common with the period 1929-32. Lack of data is equally dismal, as Argentina does not have any systematic series of employment and capital stock. A private think tank (FIEL) started to collect some data on employment in the industrial sector at the beginning of the 1970s, but those series were discontinued in 1990.

As a consequence, researchers have had to appeal to all of their imagination to construct series that make it possible to have at least a rough estimate of the Solow residuals. Elías (1992) has pioneered this effort for Argentina and other main Latin American countries and this paper uses his employment and capital stock series for the period 1940-80 and the subsequent extension by Meloni (1999) of those series to the period 1980-97.

III.1 - Methodological issues on labor and capital input estimates for Argentina

III.1.1 – Labor input

Since Argentina does not keep official statistics on market hours worked, the only hope to measure labor input is with data on numbers of workers, or aggregate employment. Even series for this latter variable are not available for the whole period of analysis, for which it was necessary to estimate it with different procedures that varied with the information available at each point in time.

Lack of data did not leave any other option but to assume that, for the period 1944-79, total employment was equal to the economically active population, that is, to the total population between 15 and 65 years old. Obviously, this procedure overestimates the actual employment, because it includes those individuals who are either unemployed or not participating in the labor force. However, this overestimation of the *level* would be inconsequential for the purposes of estimating the average rate of growth of employment over periods of time long enough to ensure that the sample averages of the unemployment and labor force participation rates coincide with their long run averages.

Unfortunately, the U-shaped pattern of the unemployment rate revealed in Chart 3 suggests that the length of time required to satisfy that condition may be too long for practical purposes and, in particular, that it has not been satisfied by the relentless climb of the unemployment rate in the last twenty years.

Lack of appropriate records do not make it possible to establish the nature of the variations in unemployment before 1980 and, therefore, to dismiss the possibility that its

behavior in the period 1963-79 has been mostly the consequence of changes in the employment status of a labor force whose size as a fraction of the total population has remained, by contrast, fairly stable over time. In that case, the growth of the population in working age may have underestimated employment growth and consequently, overestimated productivity growth, over the period 1963-1979. This implies that the difference in productivity growth between the lost decade and the immediately preceding period may not be as large as suggested in Chart 4, which for purpose of exposition displays separately the average productivity growth of the lost decade and of the immediately preceding and following periods.

Employment data are somewhat better starting in 1980, when more systematic information became available through the Permanent Household Surveys. These surveys reflect information on demographic and economic variables, such as education, employment status, and income, of about 14,000 households from the main urban areas of the country, gathered twice a year through personal interviews.

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 at an estimate of the total number of employed in each urban area. The estimation of the number of employed 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.

To complicate things further, until recently the information in the household surveys did not distinguish employment in the private or the public sector and this deficiency cannot be solved with data from other sources, because information on employment in the public sector is virtually non-existent. Only figures for the Central Administration have been published regularly, and even so they not always included contract personnel, that tends to fluctuate more than the permanent staff.

More important, data on employment at local governments, such as provinces or municipalities, and in state-owned enterprises, are not available. This is a source of major concern for the purpose of estimating productivity growth because it has often been claimed that employment in provincial governments and state owned enterprises has operated in Argentina as a covert form of unemployment insurance in a country in which formally there isn't any. This conjecture is not completely unfounded, as 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.

There are two indirect pieces of evidence about this potential "hidden unemployment" problem. One is the already mentioned Chart 3, which shows that unemployment skyrocketed in Argentina precisely in the period when its economy was experiencing the highest growth rates in twenty years, right at about the same time the privatization process of all major public enterprises was initiated in 1991.

Of course, from an economic point of view, it shouldn't make any difference whether some form of unemployment insurance is openly paid as such or disguised as labor compensation with the simple expedient of listing the unemployed in the payrolls of government agencies. But the alternative methods do make a difference for the arithmetic of growth accounting, because under the second mechanism the unemployed will be counted in the labor force and the potential overestimation of the employment may lead to a corresponding underestimation of total factor productivity gains.

The other symptomatic evidence that the aggregate employment series prepared by the Ministry of Labor may mismeasure labor input is that that series is much less volatile than employment in the manufacturing sector of Argentina which, as reported in Kydland and Zarazaga (1997), exhibits a volatility similar to that of the US.

III.1.2 – Capital input

As it is the case for most countries in the world, even those that are fairly developed, the official government statistics of Argentina do not produce a consistent series of capital stock on a regular basis. Most authors, therefore, have estimated this series with the Perpetual Inventory Method, applying a variety of assumptions regarding the initial capital stock and depreciation schemes.

As mentioned earlier, the net reproductive tangible capital stock (non-residential structures and machinery and equipment) series used for the growth accounting exercise in this paper is the one constructed by Elías in the aforementioned study, for the period 1944-79, and its subsequent extension by Meloni for the period 1980-97.

The capital stock was constructed from the gross investment series, using a rectangular depreciation scheme that assumed an asset life of 40 years for non-residential

structures and of 15 years for machinery and equipment. These figures imply annual depreciation rates of 2.5 % and 6.67%, respectively. Given that gross investment series are available since 1900, these assumptions made it possible to reconstruct the capital stock from 1940 on.

A serious limitation of the Perpetual Inventory Method is that it treats all units of capital homogeneously and that it does not measure capital stock, therefore, in terms of efficiency units. Another problem with capital input measures obtained with the Perpetual Inventory Method procedure is that such measures implicitly assume that the capital stock is fully utilized. As in the case of employment, this assumption should not be too problematic for the study of growth issues over periods of time that are long enough, but in Argentina even a decade could be too short to satisfy this criteria, as made apparent by the long downward trend that the capacity utilization rate exhibits in Chart 5, which follows suspiciously close the decline of TFP during the sixteen years of the lost decade.

Such behavior of the capacity utilization is difficult to reconcile with a stable or growing employment during those same years, another potential inconsistency that hints at the presence of non-negligible errors in the measurement of both capital and labor inputs.

III.I.3 - Labor and Capital Income Shares in GDP

Another problematic aspect of the data is that GDP in Argentina is estimated only from the Product Accounts side, because National Income accounts are not available. This implies that it is difficult to assess the labor and capital income shares in GDP. Some estimates have the labor share at 40% of GDP, but most researchers consider that

this figure would be closer to 60% were it not for the substantial under-reporting of labor income in the informal sector of Argentina's economy. Consequently, we have adopted the latter figure for purposes of calculating the Solow residuals.

III.2 - The evolution of Total Factor Productivity in Argentina

Chart 6 plots total GDP, the labor and capital input series, and the Solow residuals for the years 1945-97.

The Chart suggests that TFP suffered a significant decline during the years of the "lost decade," followed by a significant recovery during the 1990s. This pattern is more apparent in Chart 7, where the TFP has been detrended with the HP filter. The magnitudes of the decline and subsequent recovery are not trivial: -1.4% per year in the period 1974-90 and 4.3% per year in the period 1991-97.

However, it is important to keep in mind that for the reasons given earlier, these TFP figures reflect, to some unknown extent, measurement errors. For example, the strong recovery of TFP in the 1990s may capture, at least partially, the effect that unemployment previously hidden in public enterprises became open after the far-reaching privatization program of the 1990s.

On the other hand, it is likely that a non-negligible fraction of the increase in TFP during the 1990s is genuine, because the policies implemented during those years are typically associated with productivity gains. For example, the period 1991-2000 marks the first decade since 1930 in which Argentina's economy has operated without absolutely any price and exchange rate controls, or interest rate caps.³

³ Except for an interest rate ceiling in consumer credit cards introduced this year, which can be considered a very minor distortion relative to the ones that were present in the past.

A feature of the Solow residuals for Argentina that can be more fully appreciated in Chart 8 is that that country's TFP fluctuations replicate very closely those of the GDP per capita. This is a consequence of the arithmetic of growth accounting when factor inputs are less volatile than GDP, as it is the case of the capital stock and employment series for Argentina displayed in Chart 6. While this relatively smooth behavior is typical of the capital stock, it is not of the employment series, at least not in countries like the US.

In any case, the behavior of TFP and employment during the lost decade suggests that the neoclassical growth model will confront a challenge that is almost the flip side of the one it confronts for the Great Depression years. The puzzle seems to be that in the US employment fell too much in the years 1930-33, while in Argentina it didn't fall at all in the lost decade, despite the steep and protracted decline that TFP experienced during those years (see Chart 6.)

The anomaly seems to go in the same direction as for the US Great Depression, however, in the recovery phase: contrary to the predictions of the neoclassical growth model, employment didn't show substantial gains in either experience, even if TFP grew significantly in the US in the period 1934-39 and in Argentina in the period 1991-97.

The apparent lack of response of employment to changes in TFP in Argentina can eventually be the result of labor market restrictions, such as those that have been present in that country since the 1940s. Firing costs may explain, for example, why firms in Argentina seem to delay layoffs during downturns and postpone hiring decisions during upswings more than their counterparts in the US, where the labor market is rather

flexible. On the other hand, it is not clear that the labor market restrictions in Argentina are worse than those that have been traditionally present in most European countries.

Another channel through which firing costs can account for the lack of response of employment to changes in TFP is by the distortion they introduce in the extensive-intensive margins of labor market decisions. To avoid the firing tax, firms may find it more convenient to keep their workers working fewer hours than to lay them off. As a consequence, the movement in and out of the labor force may have occurred, at least to some extent, through changes in the number of effective hours worked, rather than in the number of workers. In that case, of course, TFP would be overestimated, and the lack of reaction of employment to TFP changes would reflect, at least in part, a figment of the data. Unfortunately, it is impossible to verify this possibility because data on total hours worked, as stated early, are not available.

In any case, if the decline of the lost decade was indeed TFP driven, then it is of the utmost importance to understand the factors responsible for such significant loss of productivity. It is hard to believe that the fall in TFP was purely technological in nature. More likely, many of the heavily interventionist government policies in place during the lost decade may have been responsible for the outcome.

Unfortunately, there were so many regulations and changes in policy regimes during the period that it is very difficult to single out a particular one (such as the NIRA in the US) to which eventually attribute the decline and much less, of course, to quantify its contribution to it.

Given these limitations, the next section will provide a qualitative, rather than a quantitative, assessment of the extent to which policies and government regulations in

place during the lost decade may have impinged on employment, capital accumulation, and TFP.

IV - GOVERNMENT POLICIES AND SHOCKS DURING THE LOST DECADE

IV.1 - Price controls and “directed” credit policies

Price controls, multiple exchange rate regimes and the associated capital controls, and government directed credit are all policies that, is well known, will eventually lead to the misallocation of resources and therefore, to declines in TFP.

That these various types of government controls have indeed have an important impact in the productivity of the Argentinean economy is apparent from the sharp recovery of TFP after all forms of price and credit controls were lifted in 1991.

It is more difficult, however, to attribute the TFP decline of the lost decade to those forms of government intervention, because they had been present in Argentina, in one way or the other and almost without exception in the whole period 1940-90. In fact, only three brief periods during all those years, 1958-63, 1976, and 1981-82 were completely free of some form of price controls.

Of course, price controls, government allocated credit policies and the like may have been more intense during the lost decade than before, but validation of this view would require an almost impossible to come by measure of the relative intensity of the government interference with the allocation of resources in different periods.

IV.2 - Monetary and Fiscal Policy

It is well known that the lost decade was also the “hyperinflationary decade” for Argentina. Table 1 shows that inflation started to escalate in 1975, until it almost reached Cagan’s critical hyperinflationary threshold of 50% a month in 1989.

The possibility that inflation will reduce growth is well established in the literature. One channel, analyzed by Stockman (1981), is through mandatory reserve requirements for financial intermediaries. The presence of reserve requirements reduces growth because they impose an implicit tax on loans and, therefore, investment. Indeed, until recently, policies of high reserve requirements have been the rule rather than the exception in Argentina. The negative correlation between investment and inflation suggested in Chart 9, at least at high rates of the latter, is consistent with the predictions of that theory.

It is important to emphasize that in most theoretical models in the literature, inflation has an impact on growth through the changes it induces on the level of factor inputs, capital accumulation and labor, but not on TFP. Thus, it is interesting to note that the lost decade decline of TFP came about in Argentina at around the same time inflation had started to accelerate. This effect is even clearer in Chart 10, which plots the trends of TFP, gross investment, and the inflation rate, obtained from applying the HP filter to each of the periods 1953-73 and 1974-97 separately.

As it ought to be expected, the behavior of monetary aggregates (as measured by deposits on demand, time deposits, and bankers’ acceptances) has been the mirror image of that of the inflation rates, suggesting the positive correlation between monetary aggregates and TFP represented in Chart 11. To the extent that credit to the private sector

depends on the funds available in the financial system, the Chart also suggest a positive association between credit and TFP.

Of course, the negative correlation between TFP and high inflation rates that Chart 10 strongly suggests does not imply that inflation caused the decline in TFP. In fact, the opposite might be true. A decline in TFP may have reduced growth and, therefore, prospect fiscal revenues, forcing the government to rely more heavily on the inflation tax to finance its expenditures and to service the foreign debt, an item that turned out to be particularly burdensome to the public budget in the last years of the lost decade, characterized by record high nominal interest rates in international capital markets.

Indeed, as Table 1 shows, government spending and fiscal deficits increased dramatically throughout the years of the lost decade. When the attempt to finance the large fiscal deficits with money creation ended in the hyperinflationary collapse of 1989, the government proceeded in 1990 to an outright confiscation of deposits. By the so-called Plan Bonex, the government forced the holders of time deposits to exchange their time deposits for government bonds denominated in dollars with ten years maturity. The scheme implied capital losses in the order of 60% for those deposit holders who had to liquidate their position at the current market prices. Not surprisingly, investment hit a 20-year low on that last year of the lost decade.

IV.3 - External Shocks

Being a small open economy, Argentina is relatively sensitive to the conditions prevailing in international commodity and capital markets.

The lost decade was marked by two important developments in international markets. First, the advent of the Volcker era in the US and the implementation of a tighter monetary policy resulted, as mentioned before, in a significant increase in world nominal interest rates.

Second, after reaching a peak in 1973, the terms of trade (defined as the international price of exports over the international price of imports) started to deteriorate, and fell to record low levels in the last years of the 1980s. Although the decline of the terms of trade throughout the lost decade may have had an impact on the TFP during that period, visual inspection of Chart 12 does not uncover any obvious connection between those two variables.

V - ANALYSIS OF THE DATA THROUGH THE LENS OF A NEOCLASSICAL GROWTH MODEL

In this section we argue that Argentina's growth experience in the last two decades can be aptly captured with a rather standard, parsimonious growth model, calibrated to some key features of the Argentinean economy. The numerical experiments will emphasize the crucial role that Total Factor Productivity growth, as opposed to the relative price of capital or labor, for example, have played in the trajectory of GDP per capita during the 1980s and 1990s.

In our numerical experiments, we exploit the second welfare theorem to compute the solution of a dynamic general equilibrium model. In other words, we make use of the fact that, under standard assumptions, the solution to a social planner's problem is also a competitive equilibrium. Thus, our problem will consist of finding the value function and associated policy functions that solve the following social planner problem:

$$\text{Max E} \sum_{t=0}^{\infty} \beta^t (1 + \eta)^t \left\{ \frac{\left[c_t^\alpha (1 - l_t)^{1-\alpha} \right]^{1-\sigma}}{1 - \sigma} \right\}$$

subject to:

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

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

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

where all variables are in per capita terms and c_t represents consumption, l_t hours of work, k_t the capital stock, z_t a stochastic technological shock, β the discount factor, η the rate of population growth, α the intratemporal elasticity of substitution between consumption and leisure, σ the coefficient of constant relative risk aversion in the representative consumer's preferences and θ the labor input share in national income. The model assumes a labor augmenting technological progress at the rate γ , consistent with a balanced growth path at which, in steady state, output, consumption and capital grow at the rate $(1 + \eta)(1 + \gamma)$.

Notice that the intertemporal dimension of the problem is introduced by the term in the resource constraint representing gross investment, that is:

while the stochastic nature of the problem is introduced by the productivity shock, z_t .

After imposing the restrictions $\sigma > 1$, $0 \leq \alpha \leq 1$ and $0 \leq \theta \leq 1$, the above specifications satisfy the conditions for the second welfare theorem to hold. In particular, preferences are 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 stochastic growth model first developed by Brock and Mirman ().

Our strategy to compute the only solution of the model is to find the value function and associated policy (or allocation) functions that solve the above maximization problem. A computational difficulty in following this approach is that it is well known that with a constant relative risk aversion utility function there is no closed form solution for the value function. Therefore, we follow the strategy of Kydland and Prescott (1982) of substituting the resource constraint in the utility function and then approximating this utility function around the steady state with a second order Taylor expansion. This defines a linear quadratic problem whose solution is well known. In particular, policy (or allocation) functions will be linear in the state variables and this permits a straightforward computation of the policy functions (and associated value function) through standard numerical methods (see Cooley and Prescott (19xx)). Of course, the results will have to be interpreted with care, in particular in the context of the present paper, because they will hold only in the neighborhood of the steady state.

Calibration of the model

As stated earlier, the computation strategy relies in a linear quadratic approximation around the steady state. Calibration of the model requires, therefore, specifying the values for the relevant steady state macroeconomic relationships, as well as of the parameters of the utility and production functions.

An insight into the relevant macroeconomic relationships whose value is necessary to establish at the steady state can be obtained by solving the maximization problem above for $\sigma = 1$, that is, for a logarithmic specification of the utility function.

The first order condition with respect to capital yields:

$$\frac{(1+\gamma)(1+\eta)}{C_t} = \frac{\beta(1+\eta)\left[\theta k_{t+1}^{\theta-1} h_{t+1}^\theta + 1 - \delta\right]}{C_{t+1}}$$

which in balanced growth path implies:

$$\frac{(1+\gamma)}{\beta} + \delta - 1 = \theta \frac{y}{k} \quad (1)$$

The law of motion for the capital stock in steady state implies:

$$(1+\gamma)(1+\eta)\frac{k}{y} = (1-\delta)\frac{k}{y} + \frac{x}{y}$$

or, equivalently,

$$\frac{k}{y} = \frac{\frac{x}{y}}{\delta - 1 + (1+\gamma)(1+\eta)} \quad (2)$$

Notice that once the parameter values of the utility and production functions have been defined, it is possible to infer the steady state k/y ratio from equation (3) and infer from it the real interest rate for the steady state, which is equal to the first term in the left hand side of equation (1).

We now describe briefly the choices of parameter values:

- 1) The depreciation rate δ was chosen consistent with the value used to construct the capital stock series by the permanent inventory methods. Weighting the depreciation rates in machinery and equipment on one hand and on non-residential structures on the other by the participation of each of these components in aggregate investment suggests a value of 0.05.
- 2) Annual population and productivity growth from the data suggests $\eta = 0.018$ and $\gamma = 0.01$, that is, population growth and productivity growth of 1.8% and 1% respectively,

- 3) The long share of investment in total GDP in Argentina has been around 20%, suggesting therefore an investment/output ratio, x/y , of 0.2.
- 4) From equation (3), the above values dictate a steady state capital/output ratio of 2.5
- 5) The capital input share in national income use in the computation of the TFP suggests a value for θ of 0.4. Using equation (1), the steady state interest rate consistent with the other values is 0.08.
- 6) The fraction of time spent in the labor market, l_t , was set at 0.3. This parameter value assumes that the typical household devotes to work about 1/3 of its available time (eight hours out of twenty-four).
- 7) The coefficient of constant relative risk aversion and the intratemporal substitution of consumption and labor were set at the level of similar studies for the United States, that is, $\sigma = 2$ and $\alpha = 0.33$.

Finally, the persistence parameter ρ , the autoregressive component of the total factor productivity shock was established from an autoregression on the Solow residuals or Total Factor Productivity Growth computed in the previous section of the paper for the period 195-79 and set, accordingly, equal to 0.8

VI - NUMERICAL EXPERIMENTS

The parameterization of the model just described made it possible to compute the optimal decision rules for consumers, workers and firms and, therefore, to simulate the path of the endogenous variables of the model. Our strategy was to solve the model as the agents would have as of 1979, that is, as if the agents expected that total factor productivity growth during the 1980s and 1990s would have the same statistical properties it had exhibited until then, that is, as if total factor productivity growth evolved over time according to the equation:

$$z_{t+1} = 0.8 z_t + \varepsilon_t$$

where ε_t is an i.i.d. process with 0 mean and standard deviation $1/(1-\rho)$.

We then simulate the path of the capital stock and employment that obtains from feeding the model with the Solow residuals actually observed during the 1980s and 1990s.

Figure 13 shows the result of the simulations. As it can be verified, the trajectory of the capital and labor inputs predicted by the model traces remarkably well, at least qualitatively, the directions of change actually observed. Since the figure provides the variables in log, subtraction of the simulated variable from the observed one provides the order of magnitude of the percentage discrepancy between the two series. Thus, the predicted evolution of the labor force underestimates the actual one by a mere 5%. The discrepancy is larger, about 50%, for capital input. That is, the model predicts a much larger decline in the capital stock than the one actually observed. However, this is probable a result of the perfect capital mobility assumption implicit in the neoclassical model. The introduction of time-to-build or costs of adjustments are likely to improve the empirical performance of the model in that dimension.

VII – CONCLUSIONS

This paper has made a first pass at studying the Argentinean economic growth experience of the last two decades with a rather standard neoclassical model, calibrated to some key features of that country's economy. Despite its stripped down simplicity, the model seems to be able to replicate much better than expected the dynamics of labor and capital inputs during the lost decade.

Unfortunately, it is unclear which fraction of the discrepancies are just a figment of the data, or a deficiency of the model. The potential presence of both kinds of problems is made apparent by a comparison of the predicted and actual capital stock series. Figure 13 shows that the model would replicate fairly well the behavior of capital input, had not it been for a very large decline in the model-generated capital stock series in the period 1988-90. Without that big drop, the capital stock at the beginning of the 1990s would have been higher in the model and, therefore, much closer to the data, given that both in the model and in the data the capital stock remain basically flat during the 1990s. This observation strongly suggests that a non-negligible fraction of the discrepancy in the late 1980s could be attributable to the severe measurement errors in

the capital stock mentioned earlier. It is possible, however, that at least part of the underestimation of the capital stock during the 1990s reflects the model omission of the decline of the relative price of capital that allegedly took place in that decade. We plan to remedy that omission in a future version of this paper.

The results for the labor input are also better than expected. In particular, the model-generated worked hours series traces very closely the fluctuations in employment observed in the data. It is true that the latter series is not the exact empirical counterpart of the former, but in any case the similar behavior suggests that a more refined version of the model will eventually be able to capture some key features of the labor input dynamics of Argentina. In particular, the introduction of firing costs can eventually offset the downward trend in the model-generated employment series during the 1980s. With such a friction, the model is more likely to generate an employment series that will be less responsive to productivity shocks and more likely to mimic, therefore, the relatively flat behavior exhibited by the actual employment series.

We hope that future work along the lines just suggested will help to establish the extent to which a relatively simple neoclassical growth model offers a useful abstraction to address quantitative questions about Argentina's economic growth.

CHART 1
ARGENTINA - GDP per capita

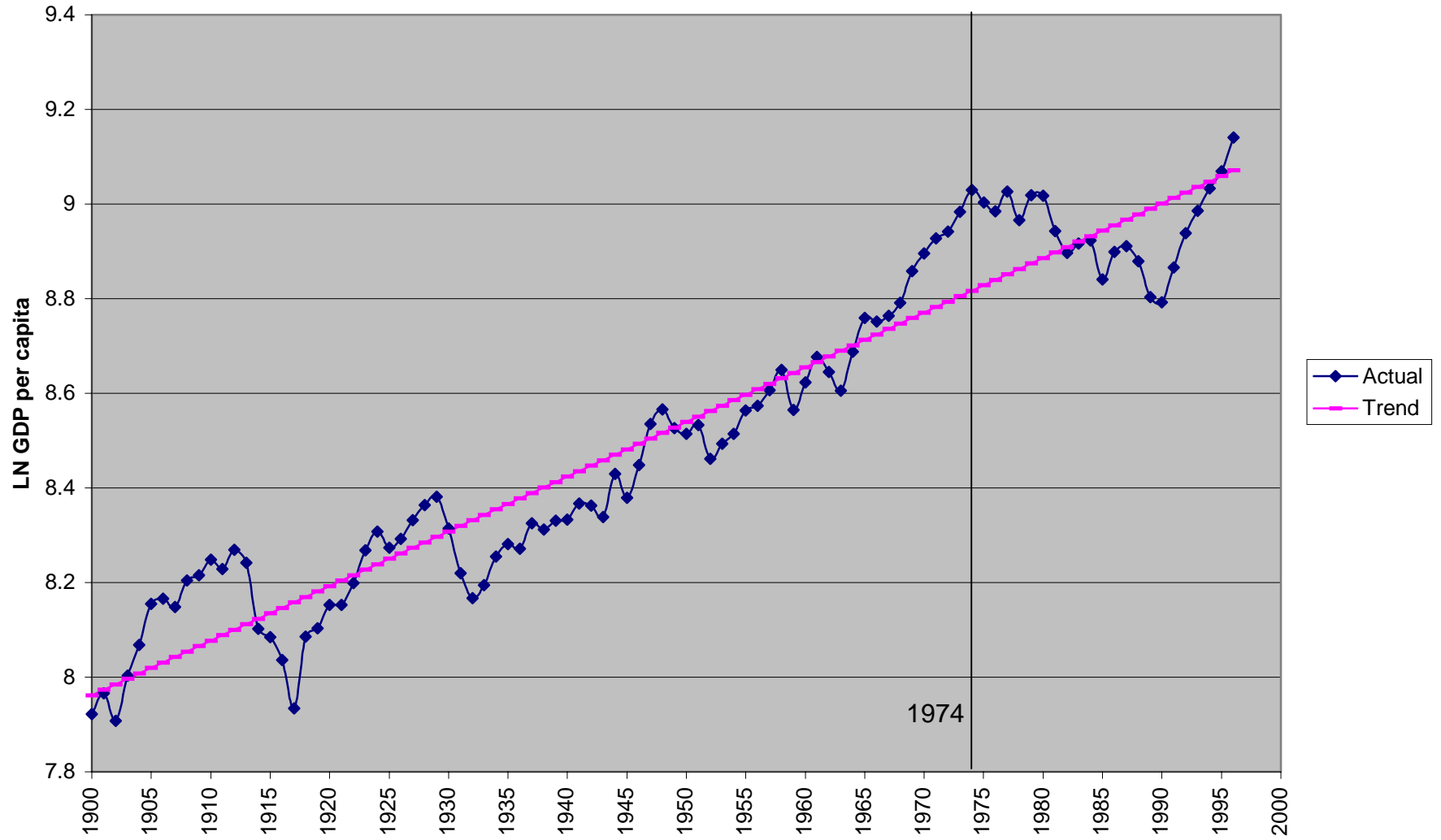


CHART 2
USA - GDP per capita

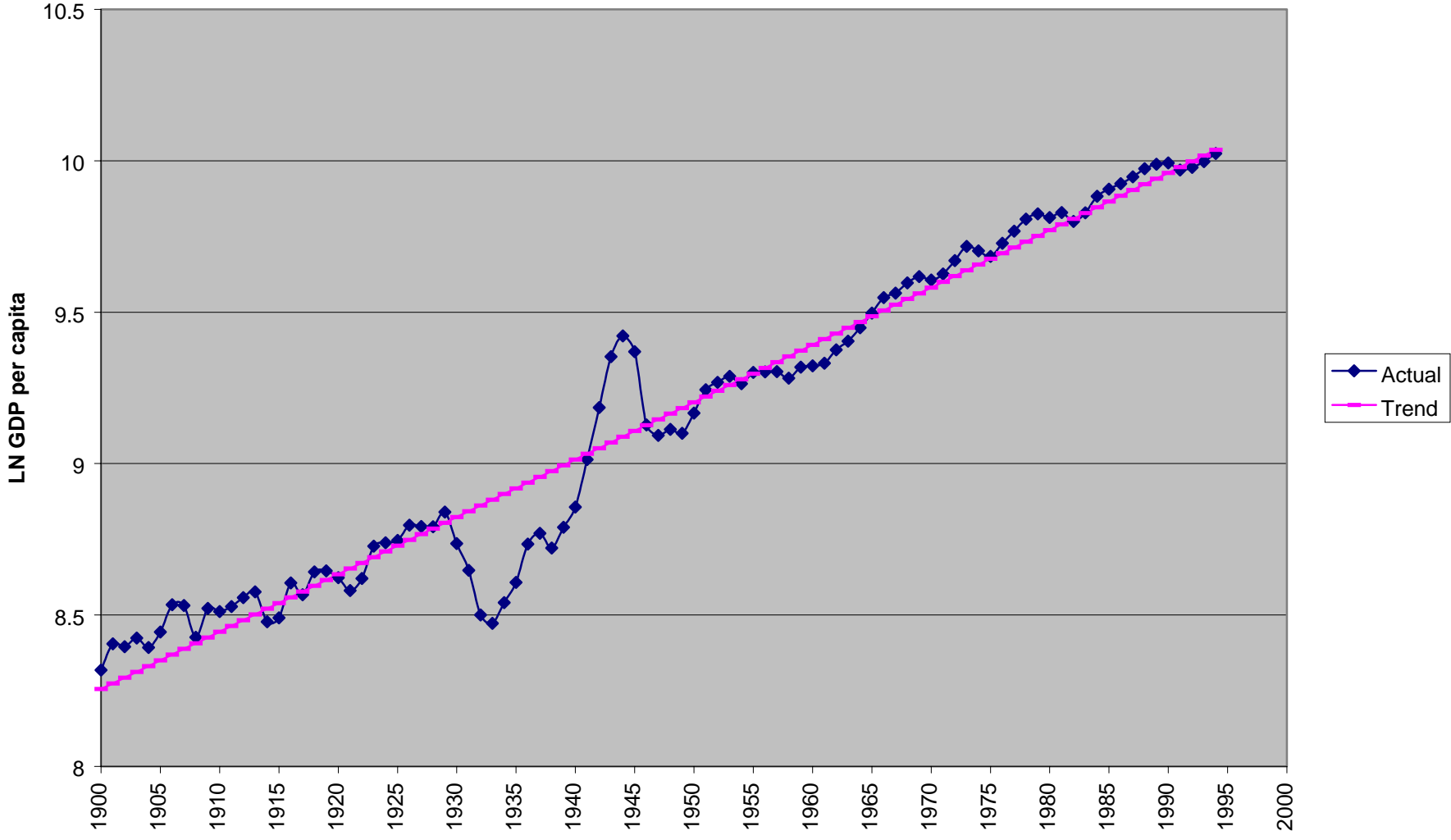


CHART 3
GDP and Unemployment

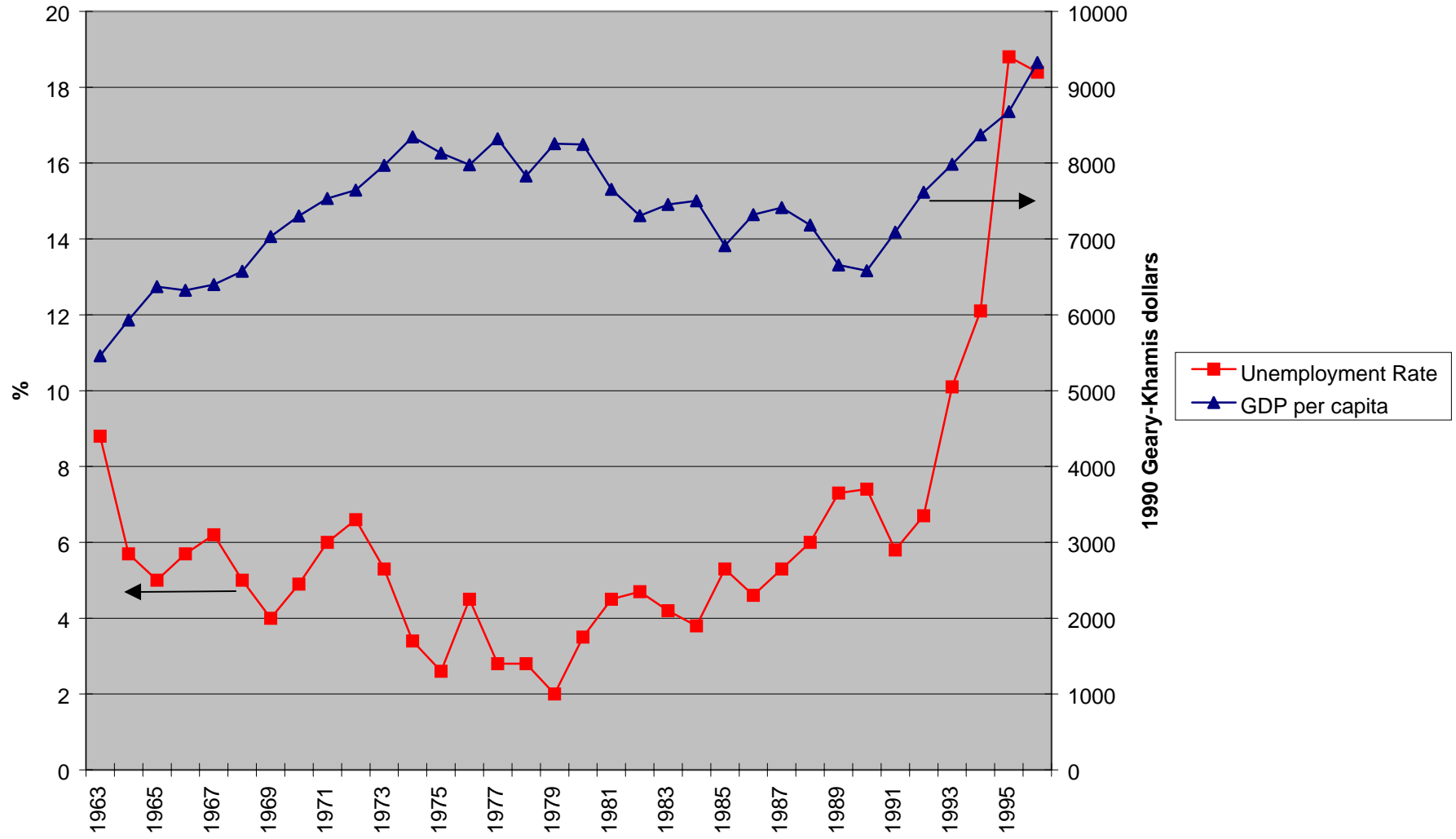


CHART 4
TFP GROWTH

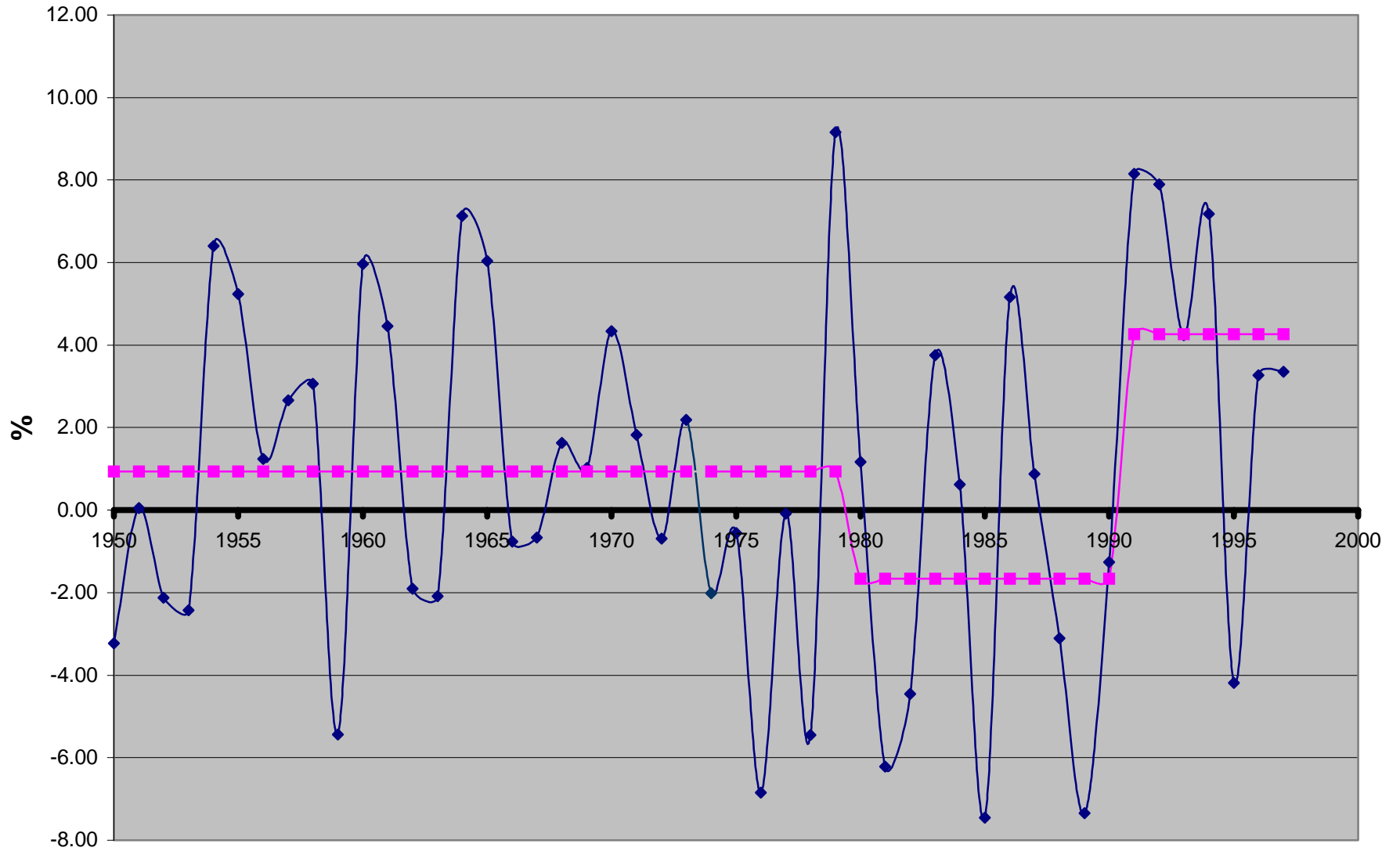


CHART 5
TFP and Capacity Utilization

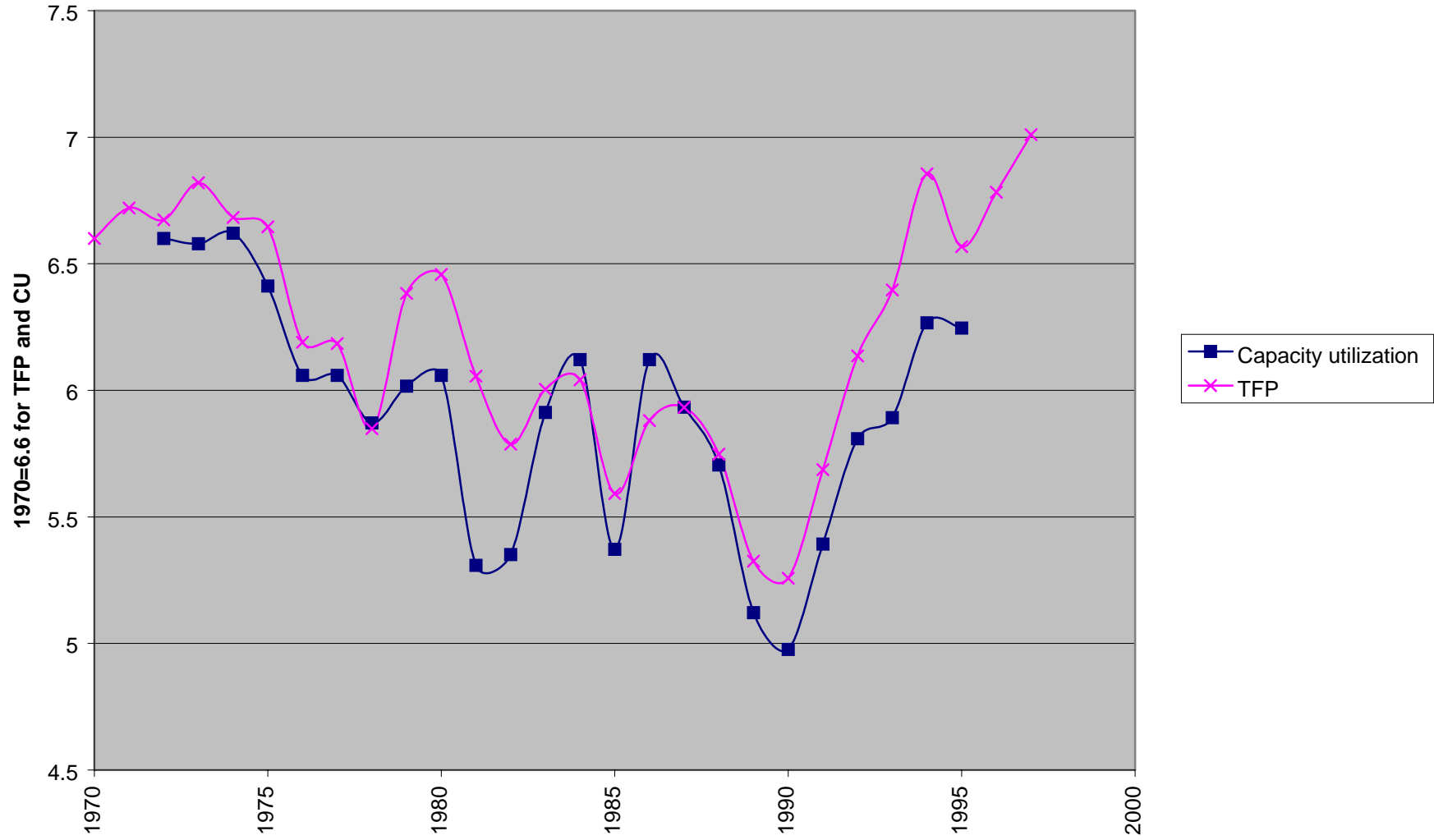


CHART 6
Growth accounting

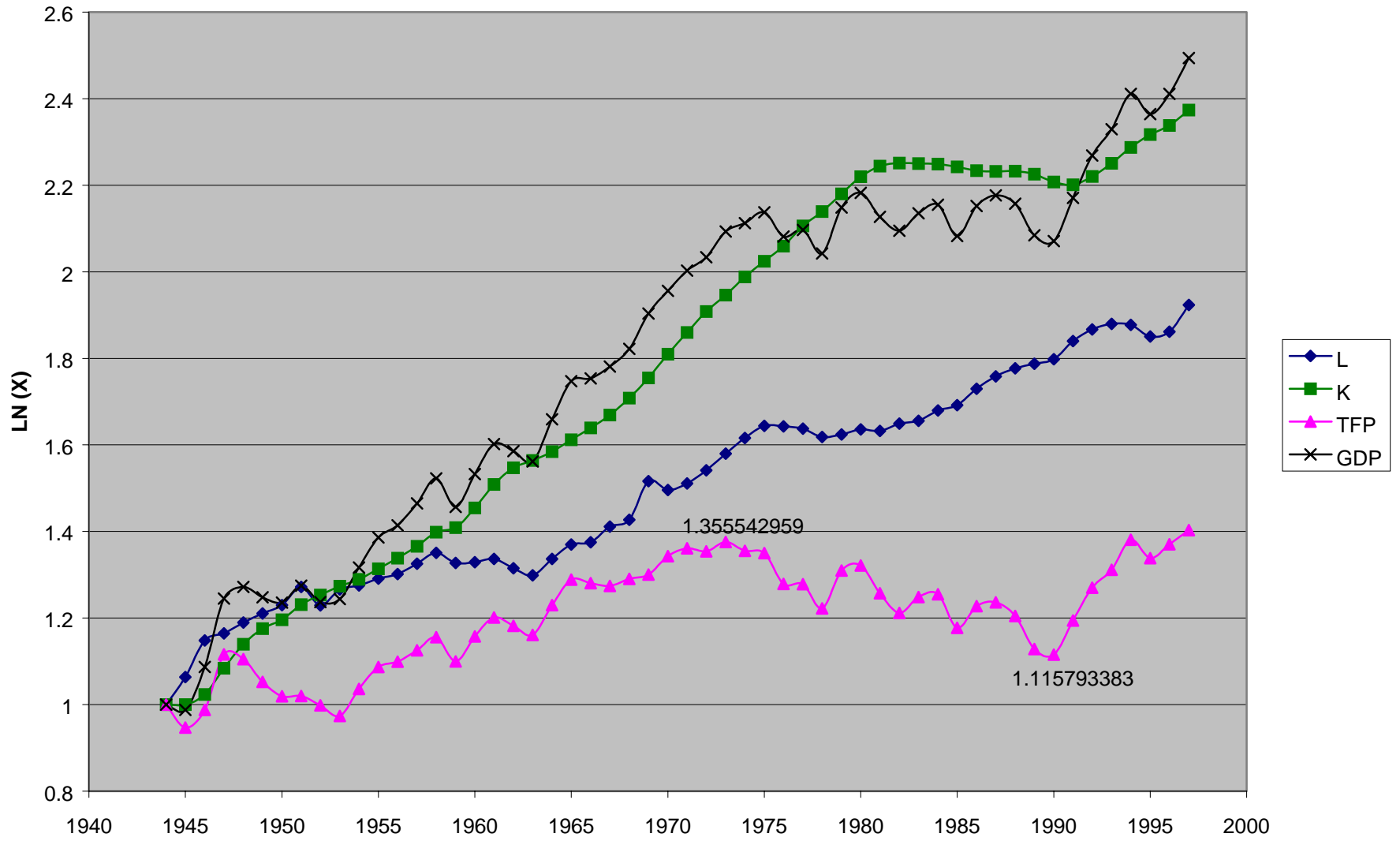


CHART 7
TFP - Actual and HP trend

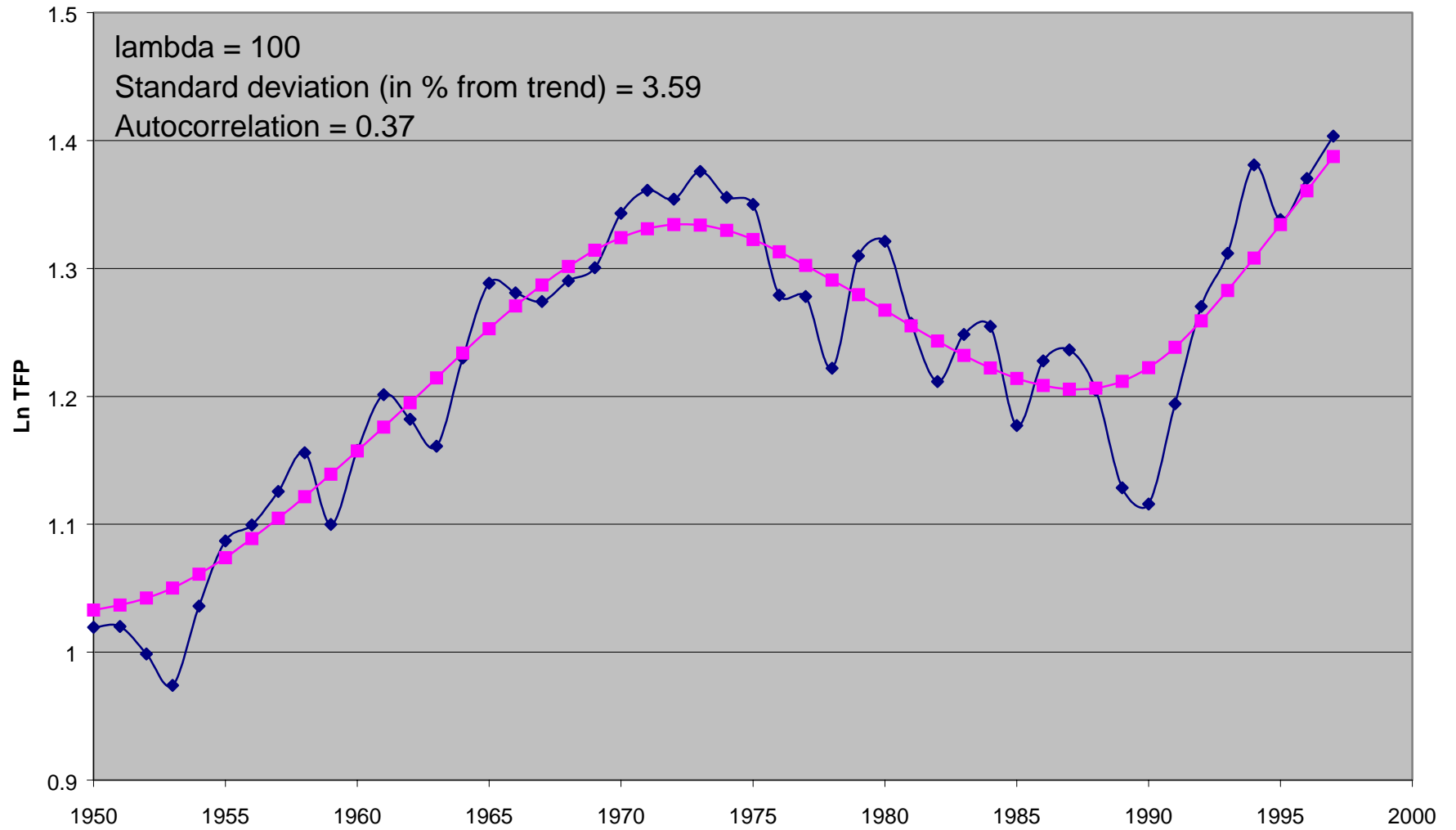


CHART 8
GDP per capita and TFP

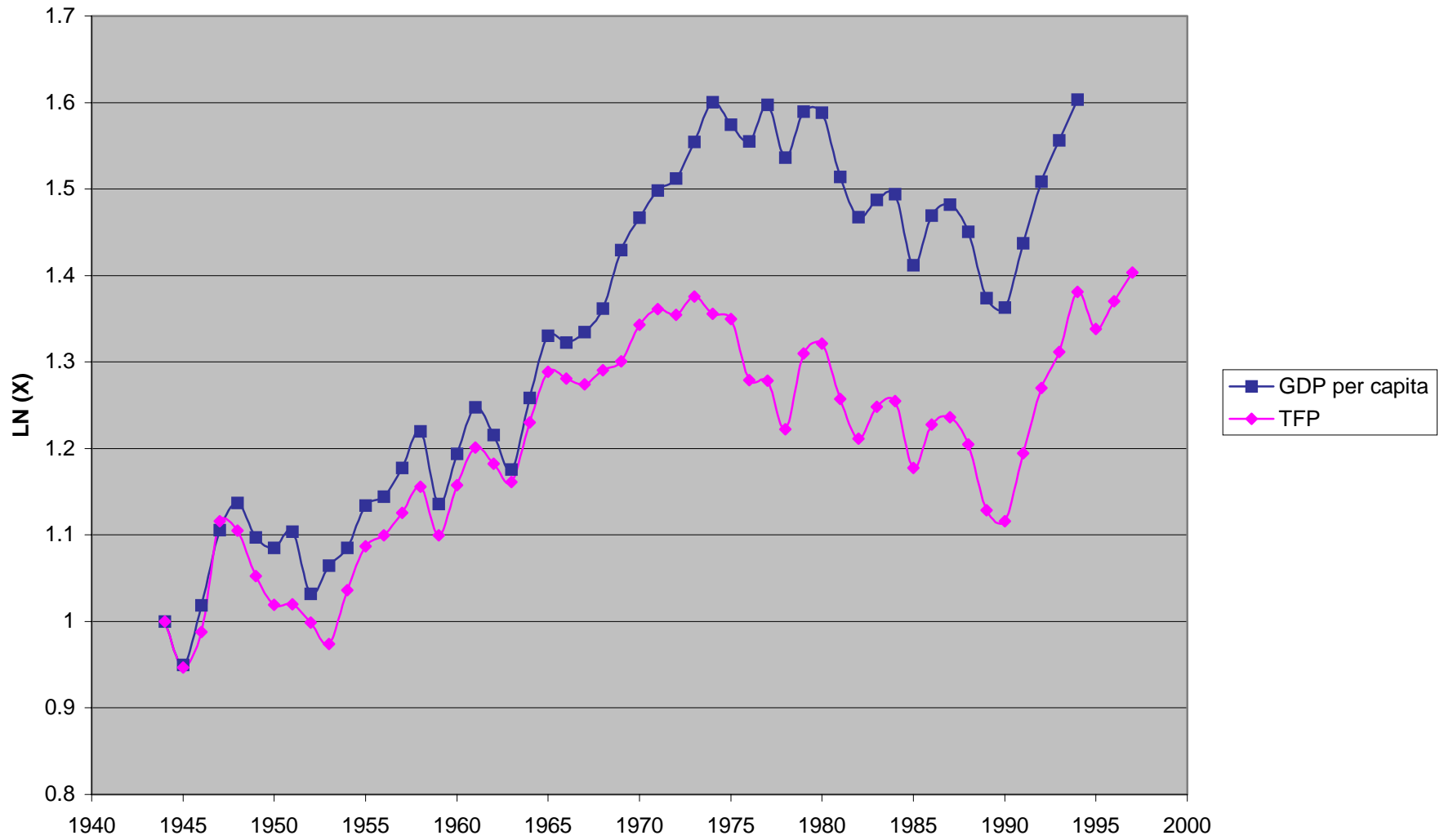


CHART 9
TFP, Gross Investment, and Inflation

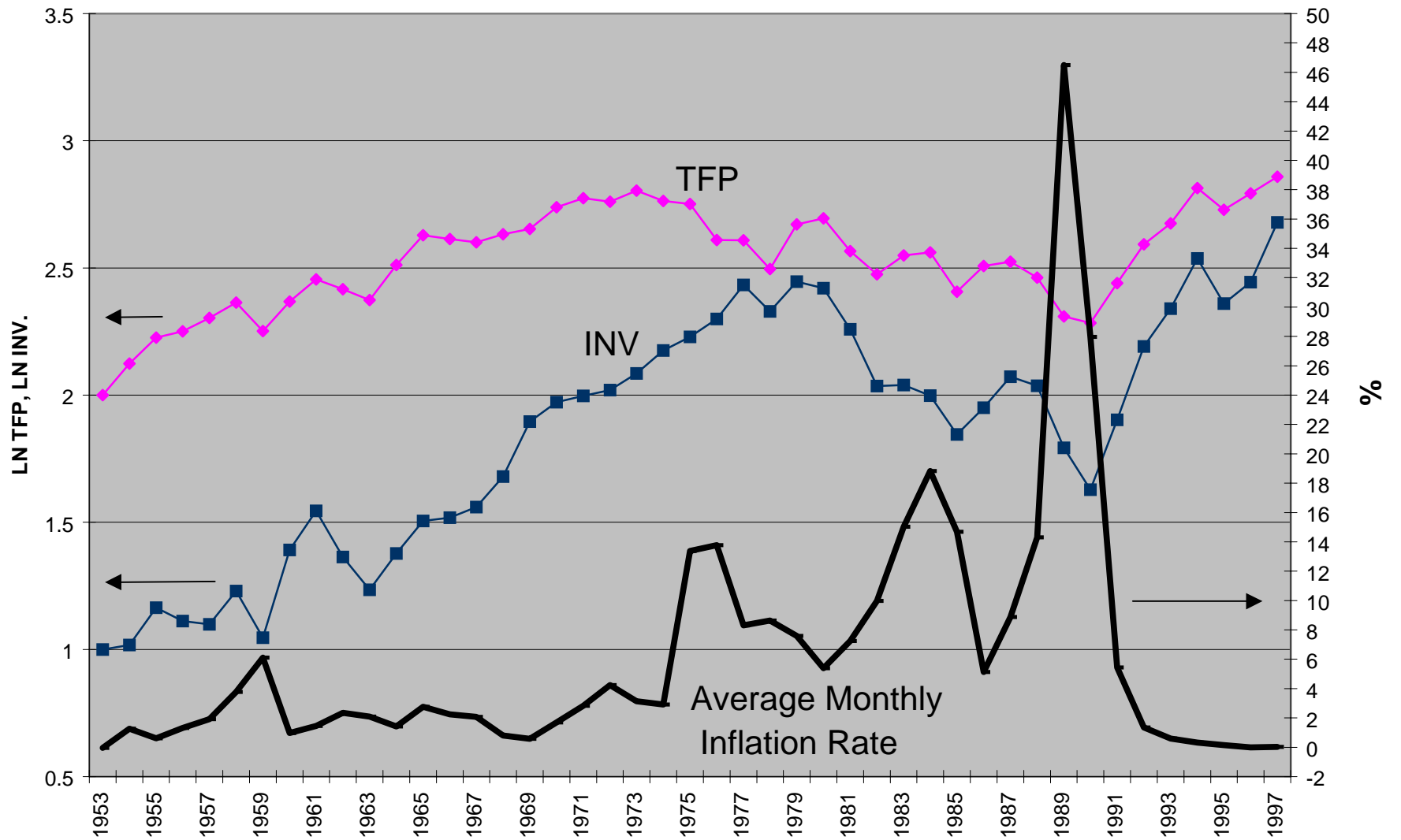


CHART 10
TFP, Gross Investment, and Inflation - TRENDS

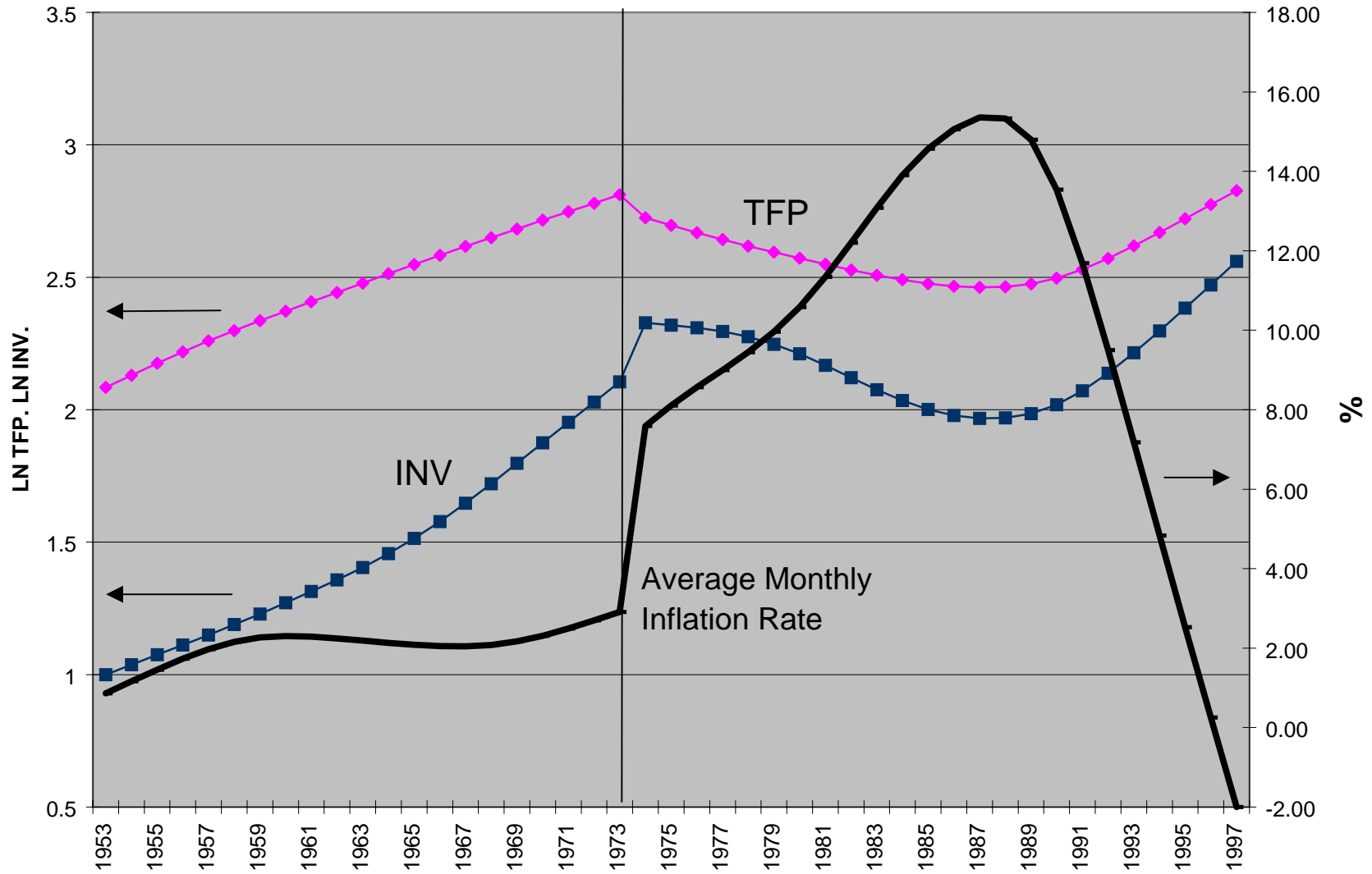


CHART 11
TFP, Inflation, and Financial Intermediation

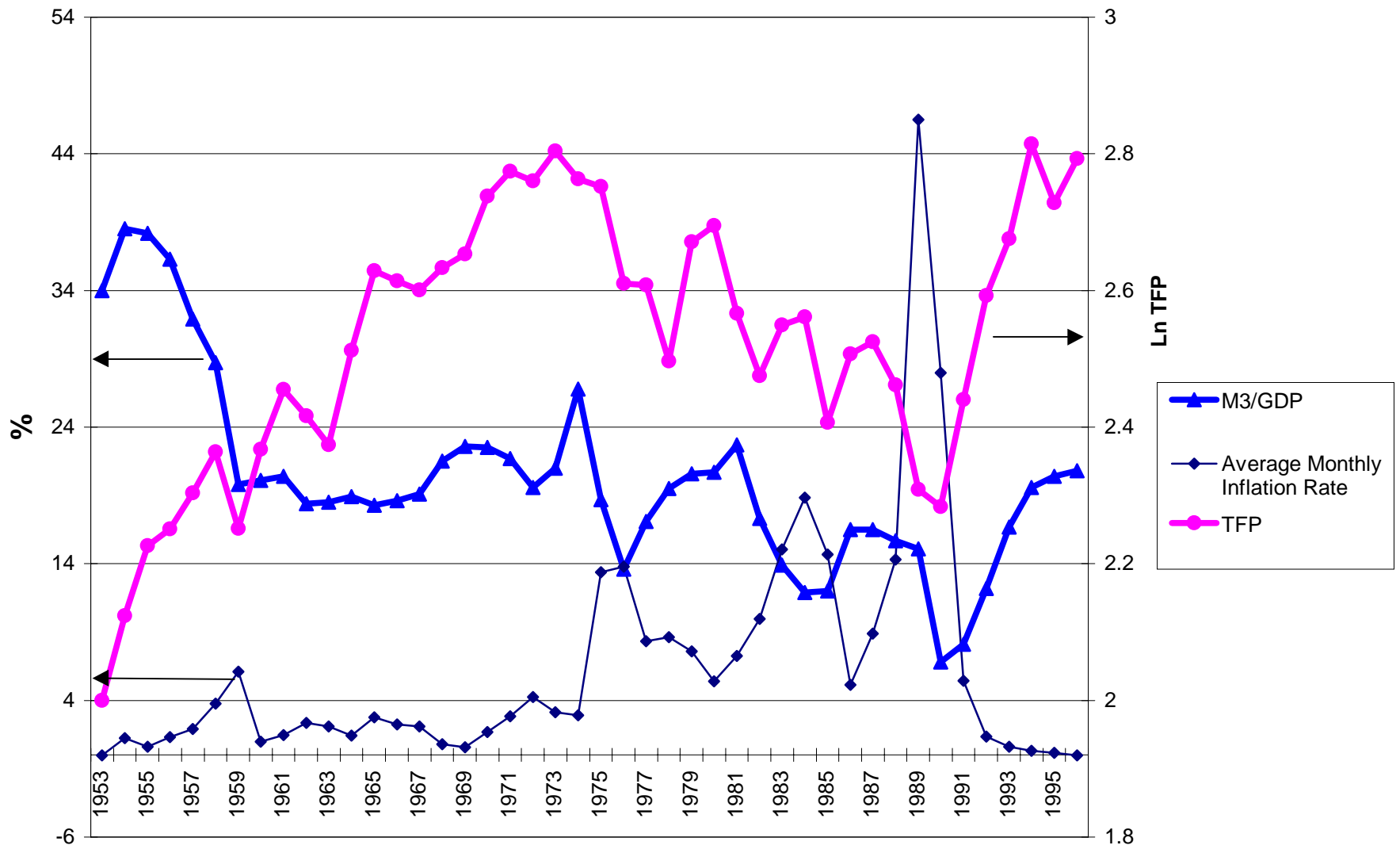


Chart 12
Terms of Trade, GDP, and TFP

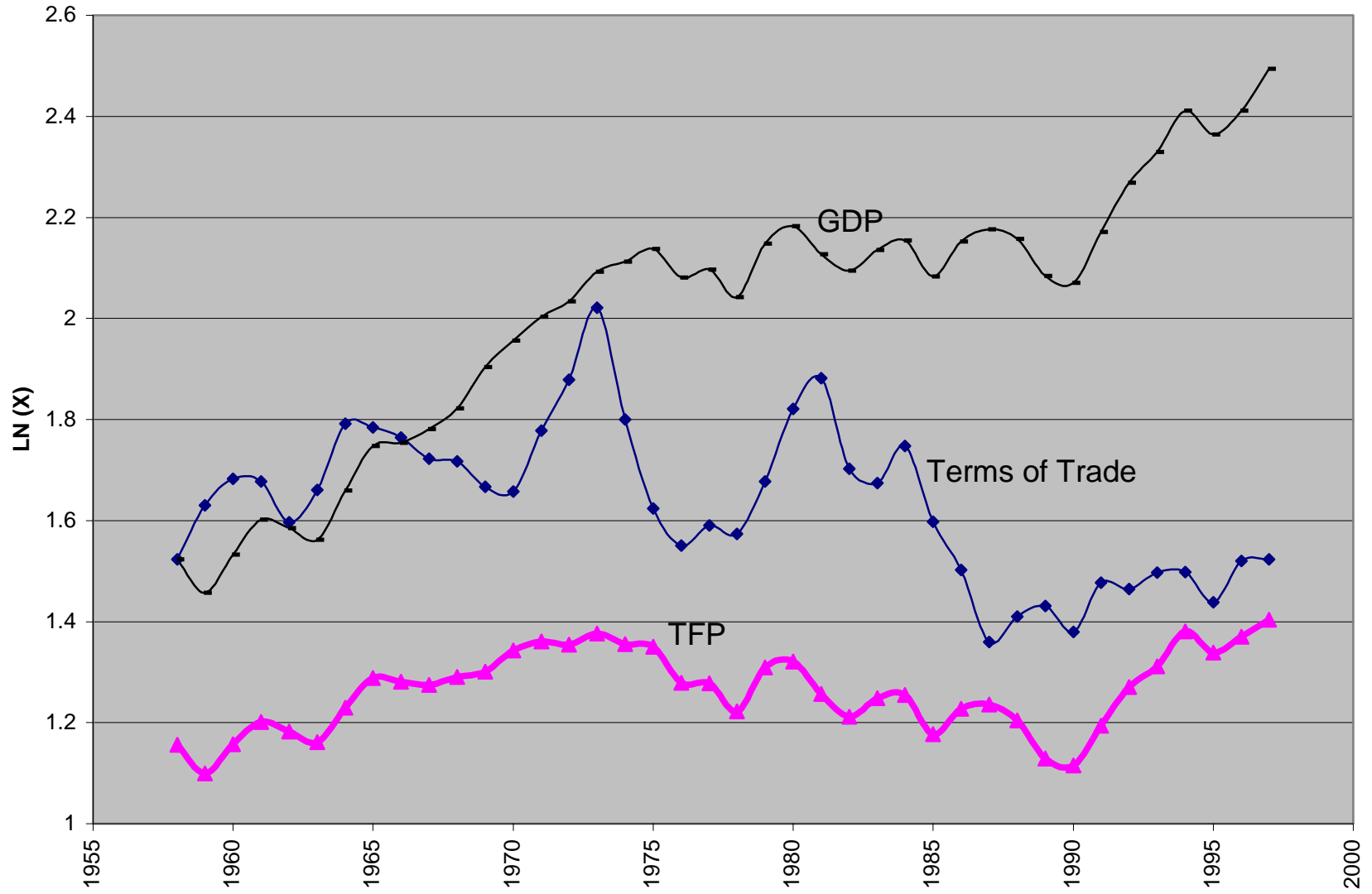


Figure 13
Insumo de trabajo: empleados y horas trabajadas

delta = 0.08
 r = 0.08
 k/y = 2.5
 i/y = 0.20

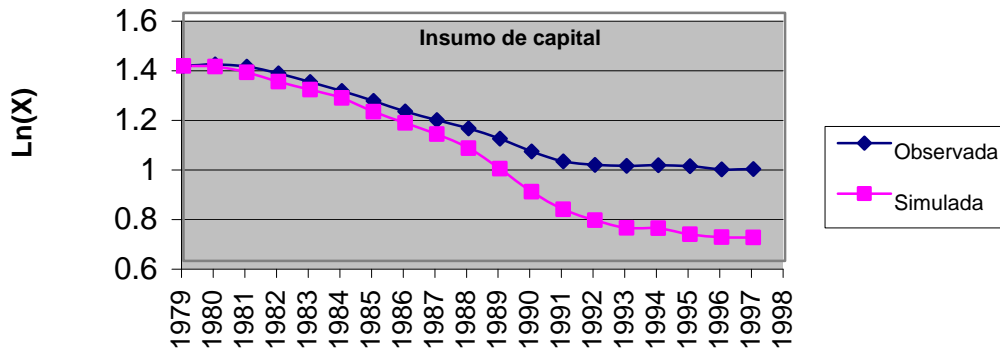
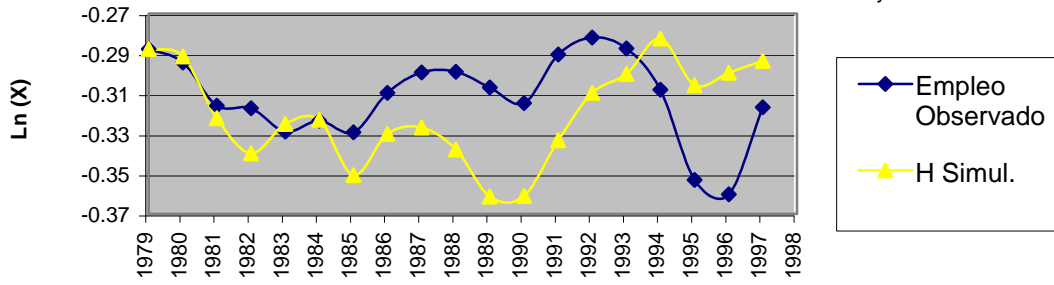


TABLE 1					
Year	Inflation rate Monthly average (%)	M3	Government Expenditure	Fiscal Deficit	Terms of Trade 1970=100
1953	-0.03	34			114.52
1954	1.26	38.5			100.10
1955	0.61	38.2			99.90
1956	1.32	36.3			89.60
1957	1.92	31.9			86.51
1958	3.78	28.7			87.63
1959	6.12	19.8			97.50
1960	0.96	20.1			102.80
1961	1.46	20.4	34.7	3.3	102.28
1962	2.35	18.4	33.8	6.2	94.30
1963	2.09	18.5	32.7	5.4	100.60
1964	1.42	18.9	30.6	5.1	114.60
1965	2.77	18.3	28.3	3	113.75
1966	2.25	18.6	31.6	1.8	111.60
1967	2.08	19.1	31.6	1.3	107.03
1968	0.80	21.5	31.6	1.4	106.40
1969	0.57	22.6	30.5	0.8	101.25
1970	1.70	22.5	30.4	0.9	100.23
1971	2.83	21.7	30	3.5	113.15
1972	4.24	19.6	30.2	5.2	125.10
1973	3.13	21	33.8	7.3	144.25
1974	2.92	26.8	41.7	9.4	115.65
1975	13.38	18.7	39.1	15.1	96.98
1976	13.77	13.6	39.4	11.5	90.08
1977	8.32	17.1	37.7	4.8	93.70
1978	8.64	19.5	43.9	6.9	92.20
1979	7.59	20.6	41.7	7.3	102.28

TABLE 1					
Year	Inflation rate Monthly average (%)	M3	Government Expenditure	Fiscal Deficit	Terms of Trade 1970=100
			as % GDP		
1980	5.39	20.7	43.8	8.4	118.10
1981	7.25	22.7	48.2	14.1	125.48
1982	9.98	17.3	46.9	15.5	104.85
1983	15.03	13.9	48.9	15.7	101.98
1984	18.83	11.9	44.5	11.4	109.70
1985	14.68	12	46.4	9.6	94.48
1986	5.13	16.5	43.1	9.2	85.86
1987	8.88	16.5	46.1	15.1	74.40
1988	14.31	15.7	48.1	15.8	78.30
1989	46.49	15.1	40.7	10.7	79.95
1990	27.97	6.8	40	13.3	75.94
1991	5.43	8.1	39.1	10.3	83.67
1992	1.36	12.2	38.2	5.9	82.62
1993	0.60	16.7			85.36
1994	0.32	19.6			85.44
1995	0.15	20.4			80.53
1996	-0.01	20.8			87.37
1997	0.03				87.70