From a Miracle to a Disaster: The Brazilian Economy in the Past 3 Decades

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Abstract

After showing a persistent and high growth rate since World War II, in the early 1980s, the Brazilian growth rate of per capita GNP fell abruptly. In this paper, we assess whether this fall can be explained by the behavior of technological progress (measured by Total Factor Productivity or TFP). We study the period between 1970 and 1998. We divide this period into two subperiods. In the first, the 1970s, per capita GNP grew at an average of 5.05% a year. In contrast with per capita GNP, TFP grew only until 1974, declining in the rest of the decade. After 1974, the growth rate of per capita GNP was sustained by an increasing investment as a share of GNP due to the increase in public (government plus state-owned firms) and private investments sustained by government subsidies that went from 1% to 4% of GNP in the second half of the 1970s. In the second subperiod, the 1980s and 1990s, both TFP and per capita GNP decreased until 1993, increasing thereafter. We also find in the second half of the 1980s that investment share was increasing while TFP was decreasing. In this second case, it went up mainly as a result of the higher cost of capital relative to consumption. Our main conclusion is that the behavior of technological progress can fairly describe the dynamics of the Brazilian economy during the period under study.

Keywords: Depression Analysis, Neoclassical Growth Model, Technological Progress.

JEL Codes: E27, E32, O40.
1. Introduction

The performance of the Brazilian economy after World War II can be clearly divided into two subperiods. In the first, which ends in the early 1980s, Brazil was one of the world’s fastest growing economies (see, for example, Figure 1 for a comparison with the leading economy in the past century). In the second, starting in the early 1980s, the Brazilian economy plunged into a lengthy recession that lasted until 1993 (see Bugarin et al., 2007). For instance, between 1968 and 1974, the average growth rate of Brazil’s per capita GNP was 8.6% (this is equivalent to the growth rate of China between 1978 and 1998. See Young (2003). The 1968-1974 period is termed by Brazilian economists as “The Brazilian Economic Miracle.” The second subperiod (after the early 1980s) was one of stagnation (see Bugarin et al., 2007). Between 1980 and 1998, the yearly growth rate of per capita GNP was 0.28%. Moreover, the growth rate of Total Factor Productivity (henceforth \(T F P\)) was negative until 1993, when it started recovering.

In this paper we study the Brazilian economy from 1970 to 1998 through the lens of the neoclassical growth model applied to the analysis of depressions. We assess whether the boom and the depression of the Brazilian economy can be explained by technological progress, measured by the growth rate of TFP (see Cole and Ohanian (1999, 2004), Prescott (2002) and the volume edited by Kehoe and Prescott (2007)). In comparison with Bugarin et al. (2007), in this project we expand the analysis back to the 1970s, addressing the question of the fall of productivity in 1973.\(^1\)

Our main results are the following. In the first subperiod, the Brazilian economy grew during the whole time. But the engine of growth changed. From 1970 to 1974, \(T F P\) was the main growth engine. From 1974 to 1979, \(T F P\) decreased, but the economy grew due to the increase in capital stock, driven by an increment in public (government plus state-owned firms) and private investments.

Even though the Brazilian GNP per working age grew, on average, 5.05% in the 1970s, \(T F P\) stopped growing in 1974, decreasing in the rest of the decade. To sustain the growth rate without technological progress, the government increased investment as a share of GNP, from 20% to 26% in the first half of the 1970s, and from 26% to 32% in the second half. This increment was planned and implemented by the government as part of its Second National Development Plan. The investment share was increased directly by boosting public investments (government plus government-owned enterprises), and indirectly by subsidizing private investments (see Figures 8–9). Total government subsidies to the private sector went from 1% to 4% in the 1970s, and due to this government behavior, our conclusion is that the Cass-Koopmans model has to be adapted to account for the behavior of the Brazilian economy.

In the second subperiod (1980-1998), \(T F P\) decreased until 1993 and then

\(^1\)This fact was first described by Gomes et al. (2003) and by Ferreira et al. (2008).
started recovering. In this period, the Cass-Koopmans model could account reasonably well for the behavior of the Brazilian economy. We should stress two points with respect to this subperiod. First, hours worked differ from the model’s prediction. Particularly after 1993, the model predicted that hours worked should start increasing, but they did not. In fact, they kept decreasing until 1998. Second, the price of structures relative to consumer goods increased sharply in the second half of the 1980s. Our intuition for these facts is the following. First, the decline in hours worked after 1993 can be due to the new Constitution (1988), which reduced the workweek from 48 to 44 hours, and increased the tax on labor inputs – which was implemented by the government in the early 1990s. Second, the increment in the relative prices of structures (mainly real estate) can be explained by the growing demand for risk-free assets. In the second half of the 1980s, a series of currency stabilization plans (trying to control the spiraling inflation) repeatedly changed the rules of the financial market. Besides, there was a presidential election in 1989 and many candidates supported public debt default (which eventually took place in March 1990). To protect themselves, investors started buying real estate.

This study is organized as follows. Section 2 presents the Cass-Koopmans model and computer simulations after calibrating the model using Brazilian data. Sections 3 and 4 introduce changes in the benchmark case presented in Section 2.

See Gonzaga et al. (2003) for a more detailed analysis.
2. The Neoclassical Model and the Brazilian Economy

In this section, we will run computer simulations using a version of the Cass-Koopmans model of growth. We follow the approach developed by Kehoe and Prescott (2002). Therefore, the data had to be detrended using the rate of technological progress of the U.S. from 1930 to 2000, which averaged 1.44% per year.

There is a representative agent with perfect foresight about the exogenous productivity shocks to the economy. The utility function of the representative agent is given by

$$E \left\{ \sum_{t=0}^{\infty} \left[ \beta (1 + \eta)^t \left[ \log(c_t) + \alpha \log(1 - h_t) \right] \right] \right\}$$  (1)

where $c_t$ is consumption at time $t$, $h_t$ is the amount of time allocated by a consumer to market activities, and $\eta$ is the population growth rate. Since there is no distortion in our model economy, the allocation found in the competitive equilibrium is similar to the allocation found by the solution to the planner’s problem, which is to maximize Equation 1 subject to

$$c_t + k_{t+1} = (1 - \delta)k_t = z_t(1 + \gamma)^{(1-\theta)t}k_t^{\theta}h_t^{1-\theta}$$  (2)

where $\theta$ is the capital share and $z_t(1 + \gamma)^{(1-\theta)t}$ is the TFP. The TFP can be separated into two parts. The first one is the growth rate, given by $(1 + \gamma)^{(1-\theta)t}$. The second one, $z_t$, is the productivity shock, whose law of motion is given by

$$z_{t+1} = 1 - \rho + \rho z_t + \epsilon_t$$  (3)

$\epsilon_t$ is assumed to be a white noise process and $\rho \in (0, 1)$.

The next step is the calibration of our model using Brazilian data. In the 1950-1980 period, the population growth rate was $\eta = 2.9\%$ and, following the findings in Gollin (2002), we set $\theta = 0.35$. We calibrate the growth rate of technical progress (TFP) as $\gamma = 1.3\%$. This value of $\gamma$ is obtained according to a 2% trend of per working age GNP and a capital share in aggregate output of 35% [i.e. $(1.02)(1-0.35) = 1.013$].

We also set the depreciation rate to 9%.$^3$ Using Euler equation we get $\beta = 0.9$ for the average of the capital output ratio of 1.62, calculated for the 1970-1980 period. The stylized facts for the Brazilian economy show that agents spend 40% of their total available time on market activities (see Bugarin et al., 2007). Using this value in Euler equation for a 7-day workweek, we get $\alpha = 1.28$. From an estimation of an AR(1) regression in a detrended TFP, we get $\rho = 0.97$.

$^3$The choice of the depreciation rate is controversial. For simplicity, we use a similar choice made by several authors in Kehoe and Prescott’s (2007) volume.
To simulate the model, we set the initial values for the variables to their 1970 value. The results are shown in the figures. The dotted lines represent the data whereas the bold lines represent the model’s simulation.

By looking at Figures 2 and 3, we note that the Cass-Koopmans model cannot account for the behavior of the Brazilian economy for the whole period. In particular, investment and capital stock go in the opposite direction from that predicted by the model in the 1970s. Hours worked also show a discrepancy between the model and the data in the second half of the 1980s.

With respect to the observed series of hours worked, the interpretation of this finding is not straightforward. A possibility we think should be considered is the institutional framework introduced by the new Constitution of 1988. In particular, a mandatory reduction in the workweek was introduced. Moreover, given the objective of pursuing a more balanced public sector budget and a remarkable decentralization of tax revenues brought about by the reformed Constitution, many new contributions (taxes) were created from 1989 onward. These distortions

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4To give a measure of how much the model can account for the data we did the following: we ran a simple linear regression of each of the Brazilian series on their respective series generated by the model. We used the adjusted $R^2$ as this measure. For GNP, consumption, investment, capital stock, and hours worked, the adjusted $R^2$ was, respectively, 0.48, 0.75, 0.15, -0.03, and 0.35.

5At the federal level, there are two categories of levies – impostos, or taxes per se, and
(a) Consumption (Brazil 1970 – 1998)

(b) Investment (Brazil 1970 – 1998)

(c) Capital (Brazil 1970 – 1998)

(d) Hours Worked (Brazil 1970 – 1998)

Figure 3
Data (..) and Model Economy (-)
increased the taxation on labor inputs, as well as on labor income, even further, affecting agents’ optimal intertemporal decisions. These changes in the tax system increased Brazil’s overall tax burden as a proportion of GNP from 22.4% in 1988 to 31.7% in 1998.

To study the behavior of investment and capital stock, we divide the analysis of the period into two subperiods: the 1970s on the one hand and the 1980s and 1990s on the other. To understand the behavior of investment in the 1970s, we separate public investment (government plus state-owned firms) from the private one. First, public investment increased in the second half of the 1970s, while TFP decreased (see Figures 4 and 5). Second, private investment also increased in the second half of the 1970s, while TFP declined (see Figures 4 and 5). We do not want to explain public investment decisions, since the government does not necessarily follow price signals. But private investment decisions do follow them. To understand the behavior of private investment and make it compatible with the Cass-Koopmans model, we need to look at subsidies. Government subsidies to the private sector went from 1% to 4% of GNP in the 1970s (see Figure 9). This rise in public investment as well as in private investment through government subsidies caused GNP per working age to keep increasing in the rest of the decade, even after TFP started decreasing.

3. The Brazilian Economy in the 1970s: A Miracle

In this section, we first give some evidence that the average growth rate of the Brazilian economy changed between 1970 and 1980. This change justifies studying the economy in two subperiods: the 1970s and the 1980s/1990s. Second, we carefully study the Brazilian economy in the first subperiod: 1970-1979. During this decade, Brazil’s economy, measured by per capita GNP, grew by an average of 5.05% a year. This period is known as the Brazilian economic miracle.

First let us compare the country’s economy in the 1970s with the 1980s and 1990s to show that it abruptly changed in 1980 in terms of the growth rate. To do that, we make use of a growth account (for further details, see Kehoe and Prescott (2002)).

Suppose that the economy’s aggregate production function is given by

\[ Y_t = A_t K_t^{\theta} H_t^{(1-\theta)} \]

where \( K_t \) is the aggregate capital stock, \( H_t \) is the total hours worked, \( \theta \) is the capital share and \( A_t \) is the TFP.

contribuições, or contributions. The revenues from the former go into the general fund and are subject to constitutionally mandated revenue sharing with the states and municipalities, among other obligations, while the latter are earmarked (often rather loosely) for specific programs and kept by the federal government. Hence (and somewhat counterintuitively), enacting contributions gives the government more discretionary spending power.
Using the above equation, we can decompose the growth rate of output per worker into three parts: one due to the growth of $A_t$, one due to the growth of $K_t$ and finally one due to the growth of $H_t$.

Dividing the last equation by $N$, the working age population, and taking the log of the resulting expression, we get

$$\frac{\log \left( \frac{Y_{t+s}}{N_{t+s}} \right) - \log \left( \frac{Y_t}{N_t} \right) }{s} = \frac{1}{1-\theta} \left[ \log A_{t+s} - \log A_t \right] / s + \frac{\theta}{1-\theta} \left[ \log \left( \frac{K_{t+s}}{Y_{t+s}} \right) - \log \left( \frac{K_t}{Y_t} \right) \right] / s + \left[ \log \left( \frac{H_{t+s}}{N_{t+s}} \right) - \log \left( \frac{H_t}{N_t} \right) \right] / s.$$

Using a capital share of 0.4, the yearly growth figure of the Brazilian economy in the two subperiods is ($Y$ is the annual GNP, $N$ is the working age population and $H$ is the total number of hours worked).

<table>
<thead>
<tr>
<th>Period</th>
<th>change in $Y/N$ due to TFP</th>
<th>due to $K/Y$</th>
<th>due to $H/N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-1980</td>
<td>5.05</td>
<td>1.50</td>
<td>2.14</td>
</tr>
<tr>
<td>1981-1998</td>
<td>0.28</td>
<td>-0.62</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Using the results from the growth figures, we can see the sharp contrast between
Brazils economic performance in the two subperiods. First, the annual growth rate of GNP per working age person drops from 5.05% in the 1970s to 0.28% in the 1980s and 1990s. Second, $TFP$, which was growing by 1.5% in the 1970s, decreased during the 1980s and 1990s to an annual rate of 0.62%. Finally, hours worked also decreased in the 1980s and 1990s, in contrast to the 1970s.

Now that we have given evidence for the different performance between the 1970s on the one hand and the 1980s and 1990s on the other, we turn our attention to the first subperiod. The economy grew throughout the 1970s, but the main source of growth was quite different across the years (see Table 2).

Table 2

<table>
<thead>
<tr>
<th>Period</th>
<th>change in $Y/N$ (%)</th>
<th>due to $TFP$ (%)</th>
<th>due to $K/Y$ (%)</th>
<th>due to $H/N$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-1980</td>
<td>5.05</td>
<td>1.5</td>
<td>2.14</td>
<td>1.41</td>
</tr>
<tr>
<td>1971-1974</td>
<td>9.24</td>
<td>5.48</td>
<td>0.88</td>
<td>2.87</td>
</tr>
<tr>
<td>1975-1980</td>
<td>2.27</td>
<td>-1.15</td>
<td>2.97</td>
<td>0.44</td>
</tr>
</tbody>
</table>

First, as in Gomes et al. (2003), $TFP$ was the main source of GNP growth per working age person in the first half of the 1970s. In contrast, in the second half of that decade, capital was the main source of growth. Second, while the yearly growth rate of $TFP$ was 5.48% in the first half of the 1970s, in the second half, it was negative (-1.15%). Third, the growth rate of GNP per working age person, though positive in the second half of the 1970s, was less than one-third the rate in the first half of that decade.

If we followed the Cass-Koopmans model, we would see GNP per working age person declining in the second half of the 1970s, since $TFP$ was decreasing. Instead, what we see is the engine of growth switching from $TFP$ to capital. Capital stock kept growing even after $TFP$ stopped increasing and started decreasing sharply (see Figure 5).

To understand the behavior of capital stock, we need to examine aggregate investment. Clearly, the Cass-Koopmans model seems incapable of accounting for the behavior of either aggregate capital or aggregate investment in the second half of the 1970s.

3.1 Aggregate investment

Capital stock in Brazil is not computed based on firms’ balance sheets. All available capital stock series depend, to some degree, on the investment series, or when it is officially available, on gross fixed capital formation. Hence, the path of the latter is key in order to understand the behavior of the former.

The present section describes the behavior of the Brazilian investment series. We focus on its source, private and public (government plus state-owned firms). As we will see, this differentiation is important to understand the behavior of the Brazilian economy.
Figure 5
Total Factor Productivity (Brazil 1970 – 1998)

Figure 6
Aggregate Investment as a Share of GNP (Brazil 1970 – 2000)
Figure 6 shows investment as a share of GNP for 1970-1998 (both in real terms). Investment increased significantly in the 1970s. The average investment share grew from 16.42% between 1947 and 1969 to 25.26% in the 1970s, declining to 20.05% between 1980 and 2000.

Following the neoclassical model, we should expect investment to peak during the 1970-1974 period, when the Brazilian economy (and technological progress in general) was growing very fast, and not in the second half of the 1970s, when TFP was already declining. But, in fact, the investment share peaked in the second half of the 1970s when TFP was decreasing rapidly (see Figures 6 and 5).

When we separate public from private investment, we can see what happened. Right after TFP began to decline, public investment increased markedly. In Figures 7 we can see a sharp increase in the share of public investment from both components, government and state-owned firms. Figure 7-(b) shows that the share of public investment in aggregate investment went from 32.3% between 1970 and 1974 to 40% between 1975 and 1979 (between 1975 and 1978 it reached 42.5%). Clearly, public investment increased sharply in the 1970s, at least in part offsetting the decline in TFP, causing per capita GNP to keep growing.
Even though public investment could have disregarded the rate of return on capital, private investment should not follow the same pattern. If $TFP$ is going down, then private investment should also decline, since the return on capital decreases with $TFP$. But when we look at Figure 8 we see that in the 1970s not only public but also private investment increased after $TFP$ started decreasing.

![Figure 8](image)

Private and Public Investment as a Share of GNP (Brazil 1970 – 1998)

To understand the behavior of private investment we need to look at government subsidies to the private sector. As we can see in Figure 9 in the second half of the 1970s government subsidies to the private sector as a share of GNP increased from less than 1% at the beginning of the decade to 4% in 1980. In Figure 10 we plot both series of private investment and subsidies as a share of GNP. The effect of the subsidies on private investment is clear. Even though $TFP$ was declining in the second half of the 1970s, government subsidies were enough to increase private investment, maintaining the economic growth rate.

In summary, in the first half of the 1970s, when $TFP$ was increasing, the share of public and private investment in aggregate investment was constant. In the second half of the 1970s, public and private investment increased. In this period, the increment of public plus private investment was enough to offset the reduction in $TFP$, maintaining the growth rate of per capita GNP.

The behavior of public investment and government subsidies to the private sector can be understood by looking at the objectives pursued by the Brazilian government’s Second National Development Plan. As a response to the first oil shock in 1973, the Brazilian government created this plan to try to keep the same
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Figure 9
Government Subsidies to the Private Sector as a Share of GNP (Brazil 1970 – 1998)

Figure 10
Subsidies and Private Investment as a Share of GNP (Brazil 1970 – 2000)
average per capita GNP growth rate reached in the first half of the 1970s.\textsuperscript{6}

If the government’s main objective is to maintain per capita GNP growth, but there is no technological progress (in fact, $TPF$ was decreasing), accumulation of capital can achieve this continued growth. Clearly, this implies disregarding all prices, and increasing the stock of capital is not efficient, but the economy can still grow as long as new investment can be financed. This is what occurred in Brazil after 1974, when the country was running huge current account deficits, financed by international borrowing.\textsuperscript{7}

4. The Brazilian Economy in the 1980s and 1990s: A Disaster

In this section, we analyze the Brazilian economy in the 1980s and 1990s. We follow the same steps for the 1970s, as explained above.

Before proceeding, we should point out that it is important to control for inflation at the sector level. Hence, we made some corrections in the investment series to control for changes in the price of investment relative to consumption goods. Without this adjustment, the model cannot account for the behavior of investment and capital stock in the Brazilian economy after the second half of the 1980s.\textsuperscript{8}

The growth figures for the Brazilian economy for the 1981-1998 period are given below in Table 3 ($Y$ is the annual GNP, $N$ is the working age population, $K$ is the capital stock and $H$ is the total number of hours worked).

\textsuperscript{7}See Geisel (1975) and Gaspari (2004) and Malan and Bonelli (1977).
\textsuperscript{8}We are following the procedure developed by Bugarin et al. (2007).
First, the GNP growth rate per working age person is quite low for the whole period, but it varies a lot across the subperiods shown above. Second, except for the last subperiod, capital accumulation played a major role in avoiding negative GNP growth per working age person. $TFP$ declined at an ever-faster rate from 1980 to 1992. $TFP$ became the engine of growth only in the last subperiod, when the rate of technological progress became comparable, again, with that observed in the 1970s. Finally, the average number of hours worked had been declining since 1989.

This last phenomenon is not straightforward, but we want to stress two possibilities. The first one is the new Constitution of 1988, which reduced the workweek from 48 to 44 hours. The second is tax on labor. From the beginning of the 1990s, the Brazilian government has been steadily increasing the tax burden. These distortions further increased the taxation on labor inputs, as well as on labor income, affecting agents’ optimal intertemporal decisions. These changes in the tax system increased the tax burden as a proportion of GNP from 22.4% in 1988 to 31.7% in 1998.

In this subperiod, the model can account reasonably well for the behavior of the Brazilian economy, except for hours worked. To show this point, we reproduce Figures 3 just for the subperiod analyzed in this section, that is, 1980-1998. The results are in Figures 11-12.
Brazilian Detrended GNP Per Working Age: Data (..) and Model Economy (-) (Brazil 1980 – 1998)
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Figure 12
Data (...) and Model Economy(-)
5. Conclusion

In this paper, we ask if the neoclassical model can account for the behavior of the Brazilian economy from 1970 to 1998. As we have seen, with some adjustments, this model can account reasonably well for the observed behavior.

For the 1970s, we have to separate public investment (government plus state-owned companies) from the private one. While private investment can be explained by the Cass-Koopmans model after we introduced subsidies, public investment has to be understood as an attempt by the government to keep the economy growing even after \textit{TFP} started decreasing.

For the 1980s and 1990s, the model also performs well. In this subperiod, we have to control for changes in relative prices. This adjustment is necessary because the increase in the price of investment relative to consumption in the second half of the 1980s overestimates investment, and consequently the capital stock. Once we control for changes in the relative price, the neoclassical model can account fairly well for the behavior of the Brazilian economy.

A problem still left to be explained is why \textit{TFP} declined so much and for such a long time (almost 20 years, from 1974 to 1992). We raise some possibilities. First, there is the huge amount of state-owned companies created during the 1970s. As is well known, such firms generally have lower productivity than private ones (see Schmitz, 2001, Megginson and Netter, 2001). Government companies’ low productivity can also drive down private companies’ productivity (see Schmitz and Teixeira, 2008). Second, in 1974, the Brazilian economy entered a period of increasing barriers to foreign trade, created by the government, based on an import substitution model (a prime example being the “Informatics Law,” which slapped prohibitive import duties on computer equipment, aiming to foster the domestic industry, but wound up instead holding back the entire economy and creating a huge black market). These barriers lasted until the end of the 1980s, being completely eliminated only with trade liberalization in the early 1990s. There is an increasing amount of evidence that trade restrictions reduce productivity (see Muendler, 2004, Herrendorf and Teixeira, 2005, Wacziarg and Welch, 2008).

Last but not least, there is a combination of two facts: government subsidies to private companies and an outdated bankruptcy law. These two elements together, in a closed economy, can keep inefficient companies in business, reducing aggregate productivity and technological progress.

References


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