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Flávia Mourão Graminho

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Edited by Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

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A Neoclassical Analysis of the Brazilian "Lost-Decades"*

Flávia Mourão Graminho†

Abstract

After the World War II, Brazil was one of the fastest growing economies in the world, growing at an average rate of more than 7% from 1950 to 1980. While Brazilian per capita GDP was roughly 15% of the U.S. per capita GDP in 1950, it achieved 30% in 1980. However, since then, Brazil has been growing at small or even negative rates, and in 1998 its per capita GDP was back to 20% of the U.S.. This paper investigates possible reasons for what is usually called the Brazilian "lost decades", based on an accounting procedure applied to a simple neoclassical model as in Chari et al. (2006). After decomposing four types of shocks (productivity, labor, capital and income accounting), each of them is fed back into the model and the predicted and actual data are compared. It is shown that, for the case of the Brazilian "lost decades", productivity shocks seem to be the most important factor in explaining the behavior of output and consumption during the eighties, and labor shocks are the main responsible for the behavior of the variables of interest during the nineties. Increased barriers to competition and the changes imposed by the 1988 Constitution in labor markets are possible explanations for the results.

Keywords: Real business cycles; Brazil; Lost decade

JEL Classification: E32

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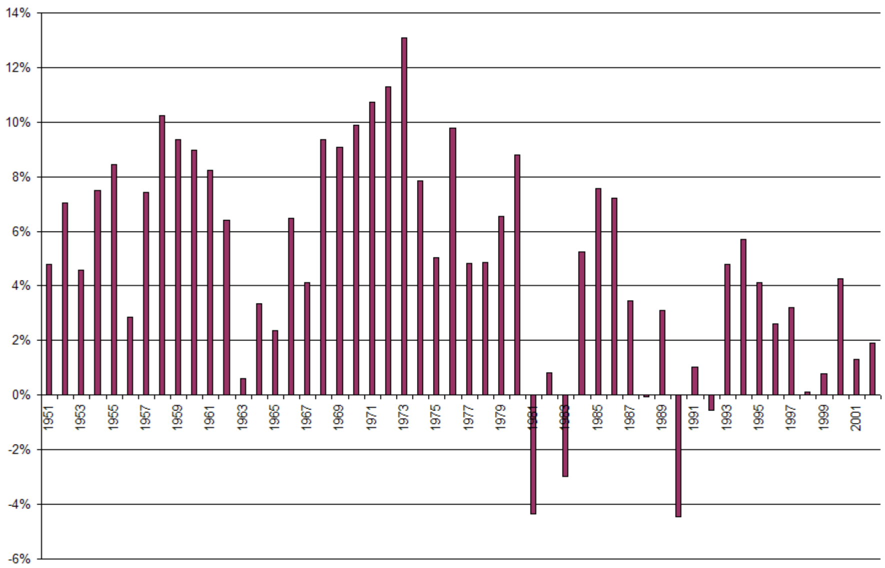
†Research Department, Banco Central do Brasil. E-mail: flavia.graminho@bcb.gov.br

1 Introduction

After 1950, Brazil became one of the fastest growing economies in the world. From 1950 to 1962, the annual real GDP increased at an average rate of 7.4%, and from 1968 to 1980, it achieved 9%. Relative to the U.S. per capita GDP, Brazil increased from 15% in 1950 to more than 31% in 1980. Figures 1.1 and 1.2 illustrate the behavior of these two variables.

Figure 1.1: Brazilian growth experience: 1951–2002

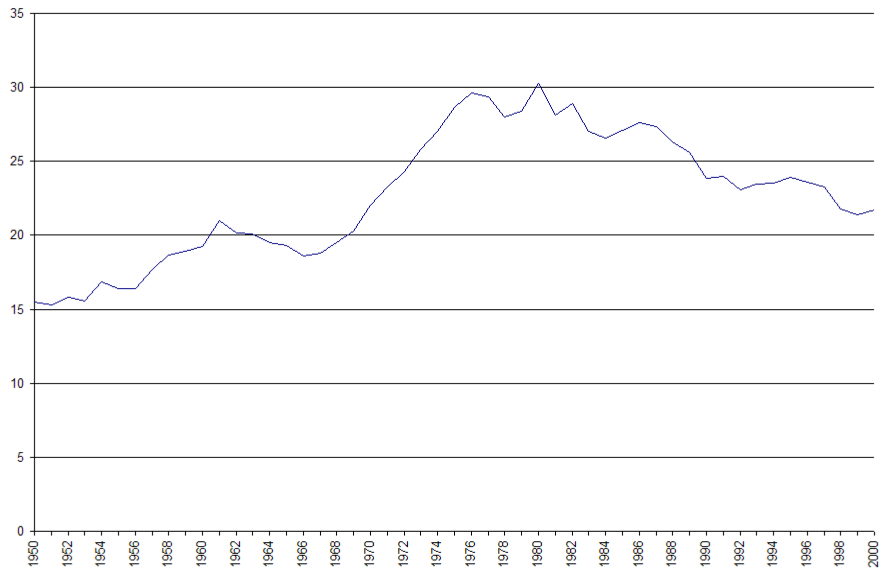


Growth rate of real Brazilian GDP. Source: IBGE.

The literature usually associates the high growth rates experienced in Brazil to a policy of substitution of imports, in which the government subsidized the exchange rate for the purchase of intermediate inputs for the industrial production. During the period 1968-1980, there was a belief that, by increasing demand and decreasing idle capacity, it would be possible to decrease costs (due to economies of scale) and hence decrease inflation. Therefore, the high rates of growth are commonly associated with an increase in government spending and credit.

In 1980, however, there was a reversal in the behavior of the economy, and from 1981 to 1998, the average annual growth rate of the real GDP was 2.1%.

Figure 1.2: Brazilian per capita GDP relative to USA (%): 1950–2000



Source: PWT.

If we take into account that the average population growth rate was 2.6% during the same period, the economy actually shrunk, after roughly three decades of fast growth. Moreover, the drop in growth rates was widespread across the economy, although the industrial sector had a larger decline. Table 1.1 shows the growth rates of different sectors across the economy, during the periods 1971-1980 and 1981-1992.

Table 1.1: Sectoral growth rates

	1971-1980	1981-1992
Agriculture	4.8	2.9
Industry	9.4	-0.1
- Manufacturing	9.0	-0.5
- Construction	10.3	-1.6
Services	9.4	2.4

Source: Bonelli and Pinheiro (1999)

This paper intends to diagnose what types of shocks might have accounted for the downturn of the Brazilian economy during the 1980's and 1990's, using the methodology in Chari et al. (2006). The idea is that, if the standard growth model describes how the economy should behave on the smooth steady state growth path, deviations from the equilibrium equations of the economy indicate shocks that affected the economy. Given those shocks, we simulate the series of output, consumption, investment and hours worked, and compare them to the actual data. With this analysis, it is possible to evaluate which types of quantitative models of economic fluctuations would be more suitable to describe the behavior of the Brazilian economy during the “lost decades”.

2 Growth Accounting

First, let's look at the behavior of the Brazilian economy from 1950 to 2000, through a simple growth accounting exercise. Consider the following simple production function:

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

In this case:

$$\Delta \ln Y_t = \Delta \ln A_t + \alpha \Delta \ln K_t + (1-\alpha)\Delta \ln L_t$$

In this exercise, Y is real GDP, K is real capital stock and L is number of hours worked, and the revenue share of capital (α) is equal to 1/3. The results are in table 2.1, computed from the data in IBGE.

Table 2.1: Growth Accounting I

	Y	K	L	A
1950–1959	4.96%	5.92%	2.44%	1.69%
1960–1969	4.14%	4.81%	3.04%	0.65%
1970–1979	5.69%	6.36%	3.95%	1.32%
1980–1989	1.85%	3.16%	2.79%	-1.41%
1990–1999	2.00%	1.89%	0.37%	1.19%
1950-2000	2.52%	2.80%	1.87%	0.77%

Annual growth rates %.

Table 2.1 shows the results of the growth accounting exercise for Brazil during different phases of the economy. In general, growth rates in Brazil were driven by capital accumulation.

The next question is how efficient Brazilian technology was, compared to the technology frontier during these periods. In other words, if we take productivity in the United States to be the frontier productivity, the question is how relatively efficient Brazil was. This can be best expressed by the production function in Parente and Prescott (2004):

$$Y_t = E_t z_t K_t^{\alpha} L_t^{1-\alpha}$$

where z_t is the U.S. total factor productivity, and E_t is relative efficiency. This yields:

$$\Delta \ln Y_t = \Delta \ln E_t + \Delta \ln z_t + \alpha \Delta \ln K_t + (1-\alpha) \Delta \ln L_t$$

Using the U.S. TFP estimated in Gomes et al. (2003), we find the resulting efficiency growth rates in table 2.

Table 2.2: Growth Accounting II

	z	E
1950-1959	0.79%	0.96%
1960-1969	1.40%	-0.85%
1970-1979	0.46%	0.90%
1980-1989	0.53%	-2.04%
1990-1999	0.40%	0.81%
1950-2000	0.56%	0.27%

Annual growth rates %.

From tables 2.1 and 2, we can see that Brazilian real GDP growth was mostly sustained by capital accumulation. During the 1980–89 period, Brazilian productivity fell in both absolute and relative terms. In the 1990s, productivity increased by almost the same amount as in the 1970s, but output failed to grow by the same amount as in the "Miracle" of the earlier period, suggesting that other reason was responsible for the poor growth performance of the 1990s.

3 A Simple Stochastic Model

In this section, I decompose Brazilian economic variables into four shocks, which are deviations from equilibrium equations in a standard neoclassical growth model. This analysis is intended to "diagnose" the main causes of the Brazilian downturn, and is based on the work of Chari et al. (2006). As the authors show, there is an equivalence between a large class of models and this simple model with time-varying wedges, and with this analysis, we can identify which models are better suited to explain the behavior of the Brazilian economy during the so-called "lost decades".

Consider a simple real business cycle model in which the representative consumer maximizes expected utility over per capita consumption c_t and hours worked l_t, and population grows at rate ν. The labor and capital income are taxed, and can be used to purchase consumption and investment goods. Capital follows the usual law of motion. The problem of the consumer can be written as:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left(\log(c_t) + \psi \log(1 - l_t)\right) N_t$$

subject to

$$\begin{aligned}
&c_t + x_t = (1 - \tau_{l_t}) w_t l_t + (1 - \tau_{k_t}) r_t k_t \\
&(1 + \nu) k_{t+1} = (1 - \delta) k_t + x_t \\
&k_0 \text{ given}
\end{aligned}$$

where τ_{k_t} and τ_{l_t} are taxes on capital and labor income, respectively. These taxes constitute government consumption, and are not rebated to the consumer.

The firm maximizes profits using a production function with a labor augmenting technological growth parameter z_t, which grows at rate γ.

$$\max A_t k_t^\alpha (z_t l_t)^{1-\alpha} - r_t k_t - w_t l_t$$
$$z_t = z_0(1+\gamma)^t$$

where A_t is a productivity parameter. Under the assumption of labor augmenting technological growth, the economy with no distortions will follow a balanced growth path, with output, consumption, investment, capital, and wages increasing at rate γ.

The total amount of resources y_t can be consumed, invested, or consumed by the government. We assume a balanced government budget constraint, such that $g_t = \tau_{l_t} w_t l_t + \tau_{k_t} r_t k_t$.

In order to find the equilibrium equations, we have to make the problem stationary. Define:

$$\hat{c}_t = \frac{c_t}{(1+\gamma)^t}$$
$$\hat{k}_t = \frac{k_t}{(1+\gamma)^t}$$
$$\hat{y}_t = \frac{y_t}{(1+\gamma)^t} = A_t \hat{k}_t^\alpha (z_0 l_t)^{1-\alpha}$$

The stationary problem of the firm becomes:

$$\max A_t \left(\frac{k_t}{(1+\gamma)^t}\right)^\alpha \left(\frac{z_0(1+\gamma)^t}{(1+\gamma)^t} l_t\right)^{1-\alpha} - r_t \frac{k_t}{(1+\gamma)^t} - \frac{w_t}{(1+\gamma)^t} l_t$$
$$\max A_t \hat{k}_t^\alpha (z_0 l_t)^{1-\alpha} - r_t \hat{k}_t - \hat{w}_t l_t$$

Therefore, the first order conditions of the firm are:

$$r_t = \alpha \frac{\hat{y}_t}{\hat{k}_t}$$
$$\hat{w}_t = (1-\alpha)\frac{\hat{y}_t}{l_t}$$

The stationary problem of the consumer is:

$$\max E_0 \sum_{t=0}^{\infty} (\beta(1+\nu))^t \left(\log\left(\frac{c_t}{(1+\gamma)^t} \right) + \psi \log(1-l_t) + t\log(1+\gamma) \right)$$

subject to

$$\frac{c_t}{(1+\gamma)^t} + \frac{x_t}{(1+\gamma)^t} = (1-\tau_{l_t})\frac{w_t}{(1+\gamma)^t} l_t + (1-\tau_{k_t}) r_t \frac{k_t}{(1+\gamma)^t}$$

$$(1+\gamma)(1+\nu)\frac{k_{t+1}}{(1+\gamma)^{t+1}} = (1-\delta)\frac{k_t}{(1+\gamma)^t} + \frac{x_t}{(1+\gamma)^t}$$

In terms of stationary variables, the problem becomes:

$$\max E_0 \sum_{t=0}^{\infty} (\beta(1+\nu))^t \left(\log(\hat{c}_t) + \psi \log(1-l_t) + \text{ constant}\right)$$

subject to

$$\hat{c}_t + \hat{x}_t = (1-\tau_{l_t})\hat{w}_t l_t + (1-\tau_{k_t}) r_t \hat{k}_t$$

$$(1+\gamma)(1+\nu)\hat{k}_{t+1} = (1-\delta)\hat{k}_t + \hat{x}_t$$

The first order conditions of the consumer are:

$$\psi \frac{\hat{c}_t}{1-l_t} = (1-\tau_{l_t})\hat{w}_t$$

$$\frac{1}{\hat{c}_t} = \frac{\beta}{1+\gamma} E_t \left[\frac{1}{\hat{c}_{t+1}} \left((1-\tau_{k_{t+1}}) r_{t+1} + 1 - \delta \right) \right]$$

Last, the government budget constraint, in terms of stationary variables, is:

$$\hat{g}_t = \tau_{l_t}\hat{w}_t l_t + \tau_{k_t} r_t \hat{k}_t$$

The competitive equilibrium is a sequence of allocations $\left\{ \hat{y}_t, \hat{c}_t, \hat{k}_t, \hat{x}_t, l_t \right\}_{t=0}^{\infty}$ and prices $\{\hat{w}_t, r_t\}_{t=0}^{\infty}$ such that:

1. Consumers maximize utility, subject to the budget constraint;
2. Firms maximize profits;
3. The government budget constraint is satisfied;
4. Markets clear, that is:

$$\hat{c}_t + \hat{x}_t + \hat{g}_t = \hat{y}_t$$

The equations that characterize the competitive equilibrium are:

$$\psi \frac{\hat{c}_t}{1 - l_t} = (1 - \tau_{l_t})(1 - \alpha)\frac{\hat{y}_t}{l_t} \tag{3.1}$$

$$\frac{1}{\hat{c}_t} = \frac{\beta}{1+\gamma} E_t \left[\frac{1}{\hat{c}_{t+1}} \left((1 - \tau_{k_{t+1}})\alpha \frac{\hat{y}_{t+1}}{\hat{k}_{t+1}} + 1 - \delta \right) \right] \tag{3.2}$$

$$(1+\gamma)(1+\nu)\hat{k}_{t+1} = (1-\delta)\hat{k}_t + \hat{x}_t \tag{3.3}$$

$$\hat{y}_t = A_t \hat{k}_t^{\alpha} (z_0 l_t)^{1-\alpha} \tag{3.4}$$

$$\hat{c}_t + \hat{x}_t + \hat{g}_t = \hat{y}_t \tag{3.5}$$

Following a notation based on Chari et al. (2006), I define the following wedges, which represent distortions to the equilibrium condition of the model: the *efficiency wedge* A_t, the *labor wedge* $(1 - \tau_{l_t})$, the *capital wedge* $(1 - \tau_{k_t})$, and the *income accounting* wedge $\hat{g}_t$.

The efficiency wedge resembles a productivity, or technology, parameter. The labor and capital wedges are distortions in the first order conditions of the consumer, and are interpreted as taxes in this model. But other more elaborate models, such as models with liquidity constraints and investment financing frictions, can be mapped into a model with a capital wedge, for example. The income accounting gap represents all income that is not spent in private consumption nor investment, thus represents government consumption in this model.

I assume distortions in this economy are stochastic, and that each shock follows a first order autoregressive process.

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_{A_t}, \varepsilon_{A_t} \sim N(0, \sigma_A^2) \tag{3.6}$$

$$\tau_{l_t} = \rho_l \tau_{l_{t-1}} + \varepsilon_{\tau_{l_t}}, \varepsilon_{\tau_{l_t}} \sim N(0, \sigma_{\tau_l}^2) \tag{3.7}$$

$$\tau_{k_t} = \rho_l \tau_{k_{t-1}} + \varepsilon_{\tau_{k_t}}, \varepsilon_{\tau_{k_t}} \sim N(0, \sigma_{\tau_k}^2) \tag{3.8}$$

$$\log\left(\frac{g_t}{\bar{g}}\right) = \rho_g \log\left(\frac{g_{t-1}}{\bar{g}}\right) + \varepsilon_{g_t}, \varepsilon_{g_t} \sim N(0, \sigma_g^2) \tag{3.9}$$

where $\bar{g}$ is the steady state level of the government wedge. The values of the other shocks in the steady state are assumed to be $\bar{\tau}_l = 0$, $\bar{\tau}_k = 0$, and $\bar{A} = 1$ (so that $\log \bar{A} = 0$).

In order to find the recursive equilibrium law of motion and decision rules for output, consumption, investment and hours worked, I log linearized the system of equations (3.1)–(3.5) around the non-stochastic steady state, and used the Method of Undetermined Coefficients.

Define as $\dot{z} = \log\left(\frac{z}{\bar{z}}\right)$, the log deviations of the variables from the steady state. Then, the equilibrium conditions can be characterized by equations (3.6)–(3.9), in addition to the following equations:

$$\bar{c}\dot{c}_t + \bar{x}\dot{x}_t - \bar{y}\dot{y}_t + \bar{g}\dot{g}_t = 0 \tag{3.10}$$

$$\dot{y}_t - \log A_t - \alpha \dot{k}_t - (1-\alpha)\dot{l}_t = 0 \tag{3.11}$$

$$(1-\bar{l})(\dot{c}_t - \dot{y}_t + \tau_{l_t}) + \dot{l}_t = 0 \tag{3.12}$$

$$\bar{x}\dot{x}_t - (1+\gamma)(1+\nu)\bar{k}\dot{k}_{t+1} + (1-\delta)\bar{k}\dot{k}_t = 0 \tag{3.13}$$

$$E_t\left[\dot{c}_{t+1} - \dot{c}_t - \left(1 - \frac{\beta}{1+\gamma}(1-\delta)\right)(\dot{y}_{t+1} - \dot{k}_{t+1} - \tau_{k_{t+1}})\right] = 0 \tag{3.14}$$

Based on these equations, we can find the decision rules and simulate the model introducing each wedge separately and in groups, in order to assess which shock can account for most of the Brazilian downturn of the 1980s and the 1990s.

3.1 Calibrating Parameters and Computing the Wedges

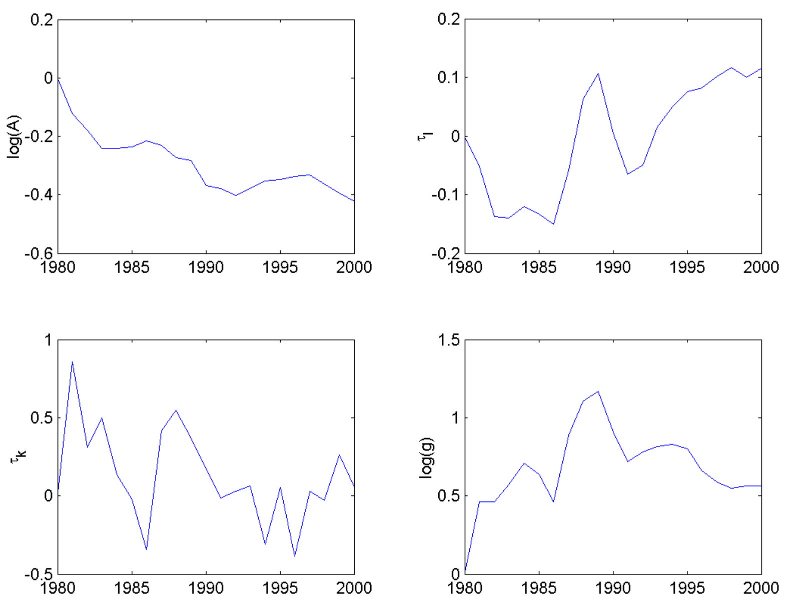
In order to calibrate the parameters, I will assume that all variables were in their steady state values in 1980. The labor parameter ψ was calibrated given the stylized fact that, on average, individuals spend one third of the time working. The trend parameter γ was calibrated as 2.56%, which was the trend of per capita output, from 1960–2000. The population growth rate was calibrated as 2.9%, which was the average growth rate of population in the second half of the century. Table 3.1 summarizes the calibrated parameters.

Table 3.1: Calibrated parameters

α	ν	γ	ψ	δ	β
0.3333	0.0290	0.0256	2.1843	0.1000	0.9935

The estimated gaps, in log deviations from the steady state, are shown in figure 3.1.

Figure 3.1: Estimated wedges: 1980–2000



Estimated wedges, according to equations (3.1)–(3.5), in deviations from their steady state values.

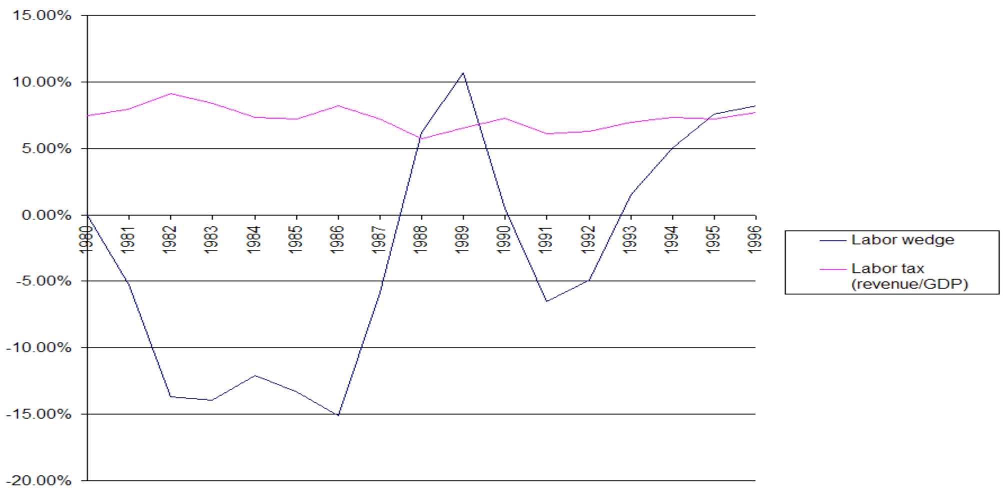
Productivity, described by the efficiency gap, falls considerably and almost monotonically during the period 1980–2000. There are two exceptions to the fall, the period 1985–86, and a timid increase during 1992–97. In 2000, productivity is 42.27% lower than in the beginning of the period. The labor wedge falls during the first half of the 1980s, but has a sharp increase from 1986–89, and from from 1992–98. The capital gap is the most volatile of the computed wedges and has a great amplitude of variation. The income accounting wedge represents the income that is not consumed nor invested, and it achieves its peak in 1989, being 116.79% higher than its 1980 value.

Three remarks should be made in respect to the computed wedges. First, their levels depend on the specific parameters we calibrate, such as the trend parameter. Other parameters would yield results that are qualitatively the same, but numerically different. The same applies to the specific functional form I assume for the utility, of which will depend the calculation of the labor wedge, for example. Second, all wedges are computed with respect to their 1980 values, which are assumed to be the steady state. Third, these are distortions from the consumer's first order conditions, in general. Although the interpretation presented here is in the form of taxes, the wedges actually represent much more than that. They represent *any* distortion that may affect labor and capital markets.

As an illustration of how different our computed wedges can be from legal taxes, figure 3.2 shows the realized labor tax (labor tax revenue as a proportion of GDP), in comparison to the labor wedge. Note that during most of the eighties the labor wedge was negative (equivalent to a "subsidy" to labor, relative to 1980), while the realized tax rate was about 7%. After 1986, there is a spike in the labor wedge, which lasts until 1989. During this period, the new Constitution of Brazil was being discussed (it passed in 1988). It increased many distortions in the labor market, increasing turnover costs. Some examples include a reduction in the workweek hours (from 48 to 44 hours per week), an increase in the severance pay, an increase in the cost of the extra hour worked, and an increase in the maternity and paternity leaves. The changes in labor regime imposed by the 1988 Constitution will be discussed in detail in section 5.

Therefore, although the computed wedges can describe qualitatively the behavior of overall distortions, they should be analyzed in the context of the model, and have less numerical meaning by themselves.

Figure 3.2: Labor wedge X Realized labor tax, 1980–1996



Realized labor tax is labor tax revenue as a fraction of GDP. Source: Varsano et al. (1998).

3.2 Simulating the Model

After computing the wedges, I simulated the model by feeding each shock separately into the model, and the graphs are shown in figures 3.3–3.6. I also show two quantitative measures of how well the model matches the data: the correlation coefficient between the simulated and actual data, and the Theil's U coefficient, which is computed as:

$$U - Theil = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_{actual_i} - x_{predicted_i})^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}x^2_{actual_i}} + \sqrt{\frac{1}{n}\sum_{i=1}^{n}x^2_{predicted_i}}}$$

The U-Theil varies between 0 and 1, with 1 meaning maximum disagreement.

When feeding the efficiency gap only into the model, the simulation explains actual output and consumption data almost perfectly, with a correlation of 0.96 and 0.94, and a U-Theil of 0.10 and 0.08, respectively. It also does a good job explaining investment, with a correlation of 0.97 and a U-Theil of 0.25. However, it is clear from the graph and statistics that the efficiency shock explains almost no part of the behavior of hours worked.

The introduction of the labor gap alone into the model is able to better explain the behavior of hours worked, although during the period 1987–91 there is a sharp difference between the simulated and the actual series. The correlation coefficients of consumption and output are relatively high, but not much as in the case with only the efficiency gap. And their U-Theil is very high, indicating a bad forecast.

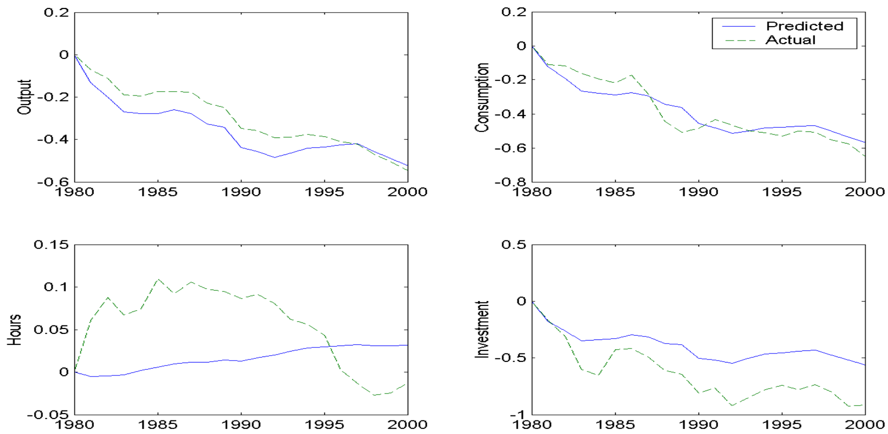
The model simulated with only the capital gap has very little explanatory power over all the analyzed series, not only for the small correlation coefficients, but also for the U-Theil coefficients that are very close to one. The government gap also does a very bad job in predicting the actual data, with the possible exception of the behavior of hours in the end of the 1980s.

Therefore, this first analysis presents strong evidence that the main responsible for the behavior of the Brazilian economy was the fall in productivity. However, even though it may explain a great part of output and consumption, and a good part of investment, the behavior of hours is still very much unexplained. For this reason, I take a closer look at the 1980s and 1990s in the next section.

4 A Closer Look

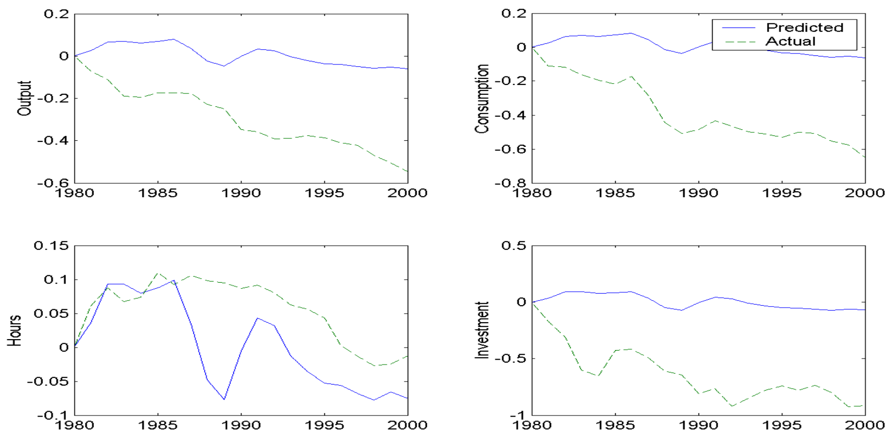
In section 3 I identified the productivity shock as being the main responsible for the overall behavior of the Brazilian economy during the 1980s and the 1990s. In this section, I perform the same type of analysis as before, but for the two decades separately. For the eighties, this is just to reduce the sample to 1980–1989 when calculating correlation and U-Theil coefficients, and drawing graphs. For the nineties, I will assume that 1990 was the steady

Figure 3.3: Simulated model with efficiency gap: 1980–2000



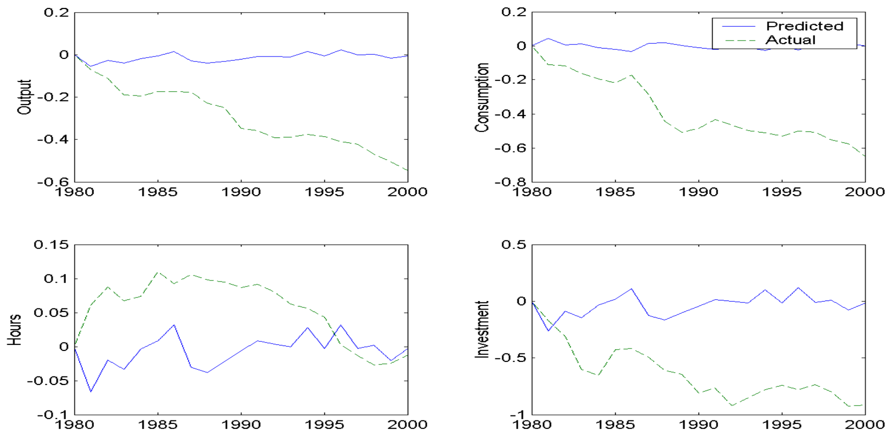
	correlation coefficient	U-Theil
output	0.9567	0.1036
consumption	0.9447	0.0802
hours	-0.5770	0.7267
investment	0.9732	0.2468

Figure 3.4: Simulated model with labor gap: 1980–2000



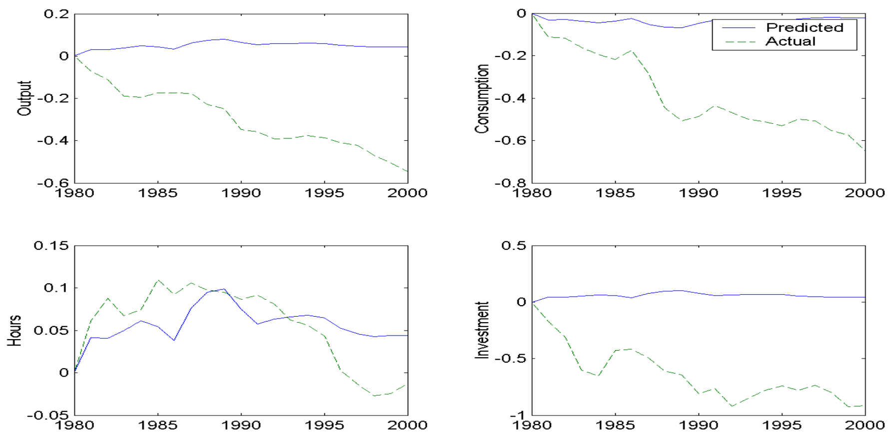
	correlation coefficient	U-Theil
output	0.6807	0.8539
consumption	0.7720	0.8819
hours	0.6350	0.5397
investment	0.4945	0.9091

Figure 3.5: Simulated model with capital gap: 1980–2000



	correlation coefficient	U-Theil
output	-0.4206	0.9139
consumption	0.1836	0.9501
hours	-0.1628	0.8578
investment	-0.3058	0.8542

Figure 3.6: Simulated model with income accounting gap: 1980–2000



	correlation coefficient	U-Theil
output	-0.4341	0.9892
consumption	0.1933	0.8457
hours	0.5425	0.2945
investment	-0.4280	0.9945

state, and simulate the model for 1990-2000. By doing this, I normalize the wedges (or the deviations of wedges from their steady state values) to be zero in the first period, and it is possible to identify the most significant shocks for the 1990s only.

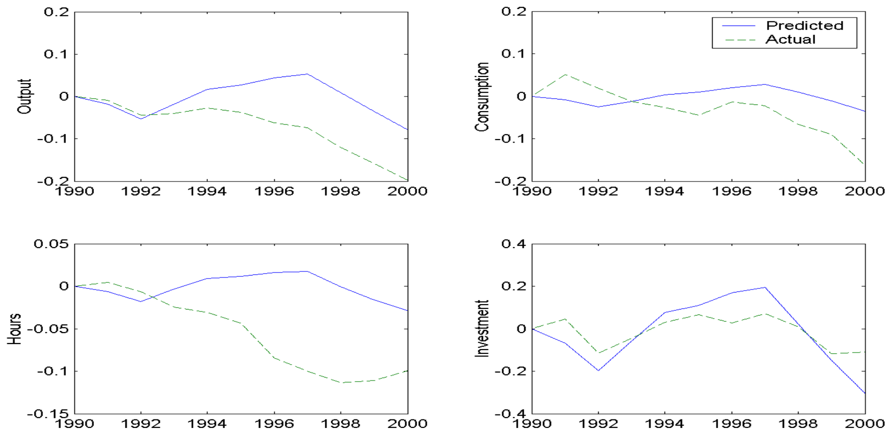
Table 4.1 shows the correlation and U-Theil coefficients for the simulated and actual data, from 1980–89. As we can see from the reported statistics, the efficiency gap is still the main responsible for the behavior of output, consumption, and investment during the eighties. However, if we want to explain the behavior of hours during the eighties, it is the inclusion of the income accounting wedge that yields the best results. The labor and capital wedges, on the other hand, have a very small explanatory power over variables of interest.

Interestingly, when we analyze the 1990s, we obtain a very different result. The efficiency gap is still the one that best explains investment, but it fails to explain the continued fall in output of the nineties. The income accounting wedge is able to explain some of the movement in output and hours worked, but fails to account for the behavior in consumption and investment. The capital shock still fails to explain the behavior of all the variables of interest.

The biggest difference between the 1980s and the 1990s lies on the importance of the labor shock. While it was shown not to be important to explain the economy during the 1980s, it is the shock that best explains the Brazilian economy in the 1990s. The correlation and U-Theil coefficients show that, not only introducing the labor wedge yields a very good fit of consumption, but also it is able to explain the drop in hours worked and part of the drop in output.

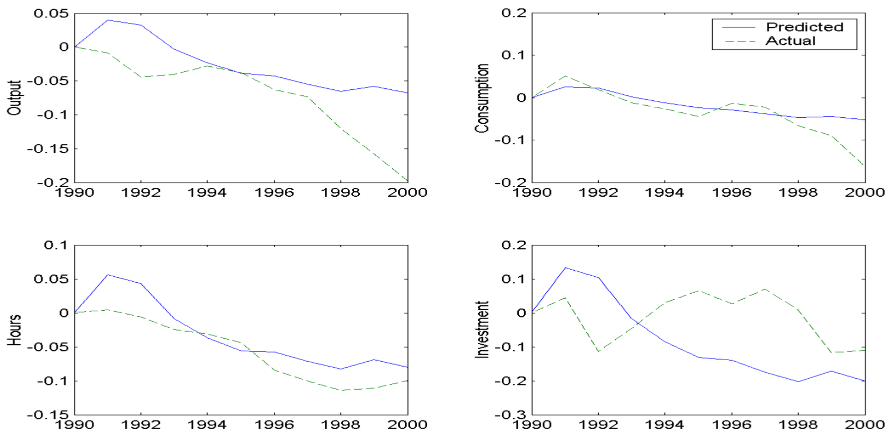
Therefore, we conclude that different shocks were responsible for the behavior of the economy during the so-called Brazilian "lost decades". During the 1980s, the decrease in productivity was the main responsible for the fall in output, consumption, and investment. The income accounting gap is able to explain part of the behavior of hours worked during the period. On the other hand, after 1990, the labor wedge is able to explain the behavior of output,

Figure 4.1: Simulated model with efficiency gap: 1990–2000



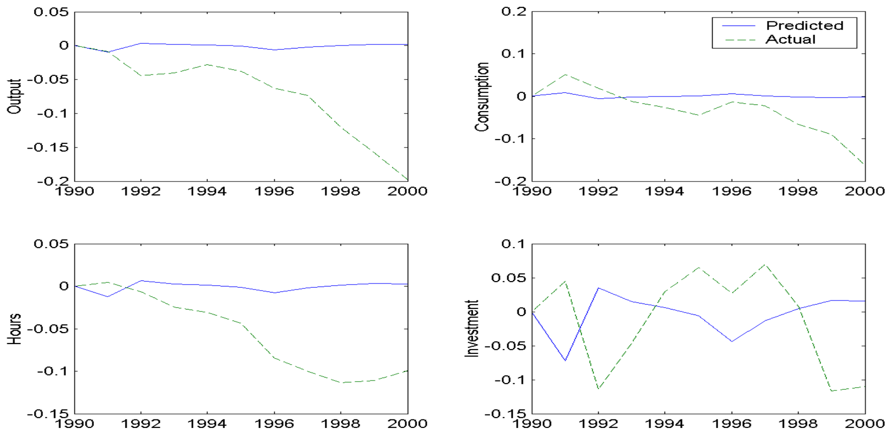
	correlation coefficient	U-Theil
output	0.0665	0.7651
consumption	-0.2628	0.8471
hours	-0.2618	0.8979
investment	0.8484	0.4148

Figure 4.2: Simulated model with labor gap: 1990–2000



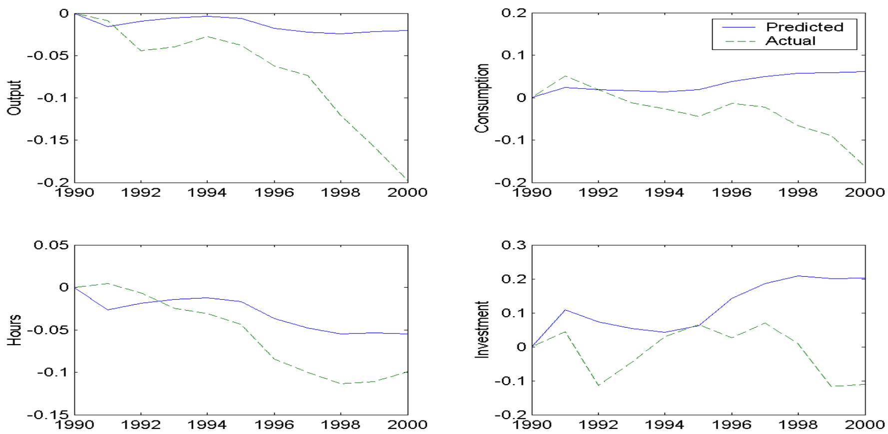
	correlation coefficient	U-Theil
output	0.7184	0.4212
consumption	0.8824	0.2889
hours	0.8893	0.2554
investment	-0.2222	0.7942

Figure 4.3: Simulated model with capital gap: 1990–2000



	correlation coefficient	U-Theil
output	-0.2681	0.9482
consumption	0.4521	0.8876
hours	-0.0967	0.9276
investment	-0.6424	0.9135

Figure 4.4: Simulated model with income accounting gap: 1990–2000



	correlation coefficient	U-Theil
output	0.7633	0.6785
consumption	-0.6059	0.9199
hours	0.8865	0.3707
investment	-0.0434	0.7648

Table 4.1: Simulated model: 1980–1989

	correlation coefficient	U-Theil
With the efficiency gap:		
output	0.9858	0.1981
consumption	0.8437	0.1582
hours	0.5415	0.8576
investment	0.9441	0.2371
With the labor gap:	correlation coefficient	U-Theil
output	0.1094	0.9121
consumption	0.5294	0.9049
hours	0.0765	0.4856
investment	0.1048	0.9378
With the capital gap:	correlation coefficient	U-Theil
output	0.1643	0.7455
consumption	-0.0321	0.9400
hours	0.0322	0.8968
investment	0.0555	0.6877
With the income accounting gap:	correlation coefficient	U-Theil
output	-0.8963	0.9964
consumption	0.9309	0.7216
hours	0.7402	0.2161
investment	-0.8249	0.9965

consumption, and hours worked, while the efficiency gap can only account for the behavior of investment.

In the next section, I discuss possible reasons for the productivity fall in the eighties, and for the increased importance of the labor wedge in the nineties.

5 Discussion

As Chari et al. (2006) argue, there is a variety of models that match our prototype model with efficiency, labor, capital, and income accounting wedges. While this experiment is not a closed guide for any one specific configuration, it helps in identifying which "class of models" would be the most effective in the explaining the behavior of the economy. In this section I discuss possible avenues, and their relation with Brazilian economic history and policy in the eighties and the nineties.

5.1 The Eighties

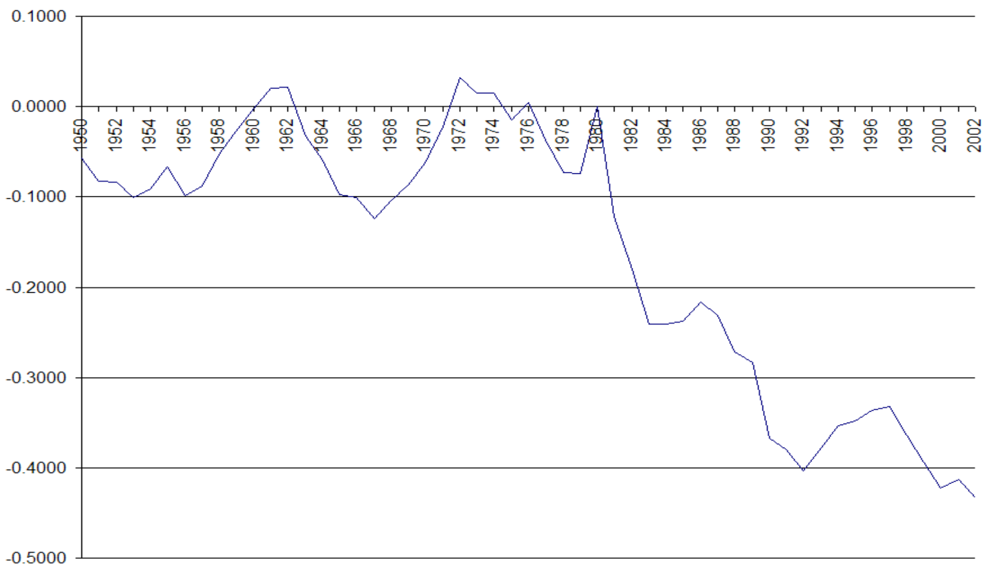
The simple growth accounting exercise of section 2 and the wedge decomposition of sections 3 and 4 show that the main reason for the fall in detrended output during the 1980s was a drop in productivity.

Figure 5.1 shows the efficiency wedge, computed from 1950–2002. From the graph we can see that, although the largest drop in productivity took place in the eighties, efficiency had been falling since the middle of the seventies. After 1974, the growth rate of GDP per working age population was sustained through an increasing investment share of GDP due to the increment in both public and private investment, stimulated by the government subsidies of the Brazilian II National Development Plan (Bugarin et al. (2003)). The economy was growing as long as new investment could be financed, and during this period they were being financed by loans in the international markets. But after 1980, with the debt crisis, both GDP per working age person and productivity decreased.

Gomes et al. (2003) observe that there was a generalized drop in productivity between 1977 and 1991, and argue that the drop in Brazilian productivity reflects the drop in efficiency in the United States, from 1974–82. However, table 2 shows that Brazilian productivity fell in both absolute and relative terms, compared to the United States. Moreover, the intensity and duration of the drop in efficiency in Brazil are only similar to other countries in Latin America.

One possibility is that all countries were affected by the same shocks, but countries in Latin America have had a stronger reaction to them. Rodrik (1999) argues that potentially conflicting societies are particularly vulnerable to external shocks, tending to transform transitory shocks into permanent drops in productivity.

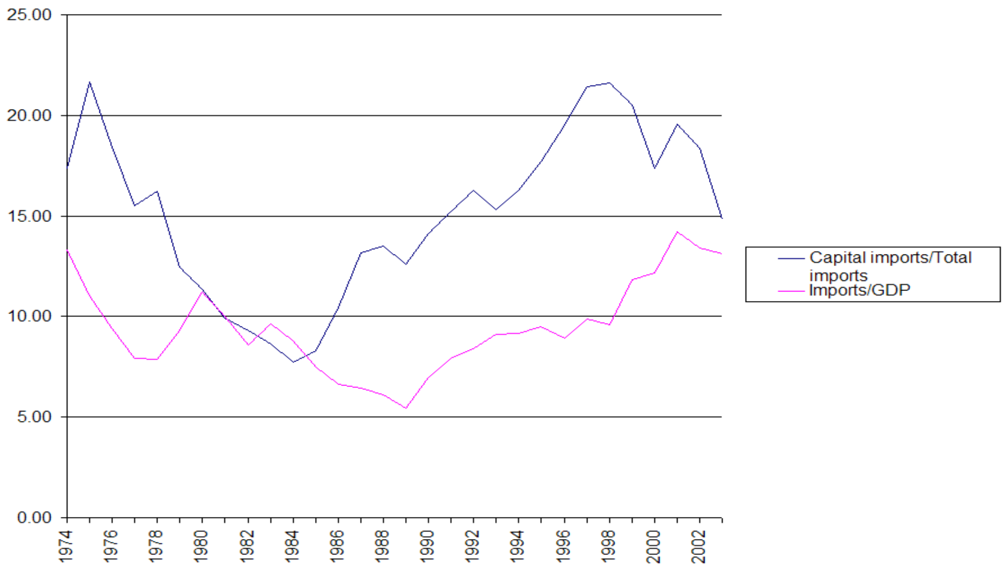
Figure 5.1: Efficiency wedge: 1950–2002



Bugarin et al. (2003) argue that productivity did not recover after the external shocks of the 1980s possibly because the government policy distorted the allocation of resources both within and across sectors. This is the same argument as Bergoeing et al. (2002a,b) for Chile and Mexico. Bugarin et al. (2004) suggest that the creation of public companies in the 1970s might have driven down the productivity of the whole economy. In a closed economy, this effect is increased, since inefficient firms are able to survive in business.

Ellery-Jr et al. (2005) provide some possible explanations for the productivity downfall, such as the third wave of import substitutions. After the World War II, Brazilian trade policies were characterized by a consistent anti-export bias, high tariffs, an extensive and discretionarily applied tariff reduction system, and widespread non-tariff barriers to imports. However, these policies favored imports of capital goods, which were much more productive than internally produced capital. After the 1974 oil shock, the government decided that Brazil should be "auto-sufficient", and promoted the import substitution of capital and intermediate goods. Since domestically produced capital was less productive, the overall productivity of the economy dropped. Figure 5.2 shows imports of capital goods over total imports, and total imports as a proportion to the GDP.

Figure 5.2: Imports of Capital Goods: 1974–2003



Source: IBGE, Ipeadata.

Cole et al. (2005), when studying stagnant total factor productivity in Latin America, conclude that barriers to competition are at least part of the reason why Latin American producers are systematically and persistently less efficient than North American, European, and Asian producers. Indeed, Ferreira and Guillén (2002) observe jumps in productivity growth in the majority of the industrial sectors in Brazil, after the reduction of trade restrictions, in the beginning of the 1990s. However, they did not find evidence of a fall in the market power, which could point to the existence of other channels responsible for the productivity increase rather than actual competition from abroad – such as increased access to imported inputs and technologies, more efficient and of better technology/quality than domestically produced inputs.

Ferreira and Rossi (2003) confirm the large and widespread increase in productivity in the 1990s, and argue that it is not the result of other macroeconomic policies and/or institutional changes that occurred in the period.

They rule out privatization by arguing that it was restricted to a few industries, and that by the time it occurred, productivity had already increased in many industries. They argue that tariff liberalization increased productivity because foreign competition pressured firms to adopt more efficient production and business processes (Muendler (2002)), and because of the embodied technology in imported machinery.

5.2 The Nineties

In the nineties, productivity grew by almost the same proportion as in the seventies, led by the trade reform that took place in the beginning of the decade. As previous sections have shown, a model that included only shocks in productivity could not be able to explain the continued drop in output, consumption, and hours worked. On the other hand, a model that includes distortions in the labor markets is able to explain most of the fall in the variables of interest. This is an interesting point by itself, since most real business cycle models give much importance to productivity shocks, which in this period have shown to be important only if allied to labor shocks. I argue that the 1988 Constitution has played a determinant role in explaining the observed labor market distortions.

Gonzaga et al. (2003) mention the main changes in legislation which increased labor costs. The workweek was reduced from 48 to 44 hours, with a maximum of eight daily hours. The maximum number of daily extra hours worked cannot exceed two hours, and its premium must be at least of 50% in excess of the regular hourly wage. Smaller workweeks must be negotiated individually or with the labor union.

Social charges increased in about 9 percentage points and many benefits increased, such as maternity and paternity leaves, and a vacation bonus of 1/3 of the monthly wage. There was also an increase in the redundancy payment, from 10% to 40% of the accumulated balance of the Unemployment Compensation Fund.

Other factors may have contributed for the increase in the labor wedge, such as the hyperinflation of the end of the eighties, which eroded real wages. The opening of the economy, which increased productivity, may also have contributed for the drop in hours worked, due to the crescent adoption of labor saving, or capital intensive, technologies.

6 Conclusion

The main purpose of this paper was to diagnose what types of shocks might have accounted for the downturn of the Brazilian economy during the 1980's and 1990's, by computing deviations from the equilibrium equations in a neoclassical growth model ("wedges"). Then, each gap was inserted back into the model separately, in order to assess the quantitative importance of each of them in explaining the behavior of the economy.

According to the simulations of the model, productivity shocks seem to perform well in predicting output, consumption, and investment, in the eighties. Many factors may have contributed for this drop in productivity, such as the further closure of the economy, in response to the 1974 oil shock (the third wave of import substitutions). Two channels through which this may have affected the economy are the increased barriers to competition and the production of less efficient capital. The creation of public companies and other distortionary government policies may also have driven down the productivity of the whole economy, enabling less efficient firms to survive in business.

With the opening of the economy in the beginning of the nineties, there is evidence of an increase in productivity, similar to the one experienced in Brazil during the so-called "Miracle" of the seventies. However, the country never achieved the high rates of growth of the earlier period. According to my analysis in this paper, it is the labor wedge that accounts for most of the variability of the variables of interest, during the nineties. There was a large increase in the labor wedge after the 1988 Constitution, which introduced and/or increased many distortions in the labor markets, increasing labor costs.

This paper raises an interesting conclusion. In both decades the capital wedge was considered unimportant to explain the behavior of output, consumption, hours worked and investment. At least in principle, it contradicts the widespread idea that the high interest rates are the responsible for the Brazilian stagnation. On the other hand, it is possible that the high interest rates affect the economy through the *efficiency* wedge. As Chari et al. (2006) show, models with input financing frictions which vary over time are equivalent to a growth model with efficiency wedges. Therefore, one possible avenue to explore is the idea that the high interest rates in Brazil are not a problem for growth *per se*, and that decreasing rates would not have any substantial effect, unless the credit markets are improved and restructured to lessen financing costs.

Further research should explore these questions.

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