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GROWTH**

ELIANA CARDOSO
VLADIMIR KUHL TELES



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A BRIEF HISTORY OF BRAZIL'S GROWTH*

Eliana Cardoso and Vladimir Kuhl Teles¹

Abstract

The paper studies Brazil's economic growth and begins with a brief overview of events that marked the country's development from her discovery to the 19th century. It then divides the years between 1900 and 2008 into four periods. The breaks in regime occur in 1918, 1967 and 1980, according to the methodology created by Bai and Perron (1998, 2003). The use of the accounting methodology serves the analysis of the behavior of productivity in the previously identified different phases of the post-World War II period. High inflation might have been a reason for the decline in productivity observed between 1980 and mid-1990s. The paper shows that terms of trade have a significant effect on economic growth and output fluctuations. Other factors (such as fiscal stimulus or easy access to foreign finance) also matter for output accelerations in the short run. From 2004 to 2008, terms of trade improvement and debt reduction brought economic progress. The emergence of a new era in this millennium will depend on wiser fiscal policies than those of the past.

KEY WORDS: *Economic Growth, Growth Accounting, Brazil.*

JEL CODES: O54, O47, O11.

¹ Eliana Cardoso is Chief-Economist for the Asia Region at the World Bank, on leave from EESP-FGV, where she is Professor of Economics. Vladimir Kuhl Teles is Associate Professor of Economics at EESP-FGV.

INTRODUCTION

The most significant part of the economic divergence between wealthy and poor nations took place between 1750 and 1900.² Countries with good institutions (such as the United States) were able to take advantage of the Industrial Revolution and grew rapidly, whilst the inheritors of exploitative institutions from their colonial past (such as Brazil) were left behind.

The United States entered the 20th century with a Gross Domestic Product per capita ten times larger than Brazil's. The economic distance between Brazilians and Americans was reduced between then and 1980. It increased again after 1981, but thanks to rapid growth between 1918 and 1980, Brazil finished the 20th century with an average income per capita (measured on a par with purchasing power) that was approximately one fifth of the U.S. equivalent. Thus, the country started the 21st century in a better position than that at which it entered the 20th century. From 2004 to 2008, terms of trade improvement and debt reduction brought further progress. Will it last?

The present paper leaves this question for the concluding Section, after examining Brazil's economic growth in three steps. Section A begins with a brief overview of events that marked Brazil's development from her discovery to the 19th century and made her an agricultural country at the beginning of the 20th century. It then divides the years between 1900 and 2008 into four periods. The breaks in regime occur in 1918, 1967 and 1980, according to the methodology created by Bai and Perron (1998, 2003).

Section B turns to sustained growth and uses accounting methodology to analyze the behavior of productivity in the previously identified different phases of the post-World War II period.

Section C discusses output fluctuations and shows that terms of trade have a significant effect on economic growth and output fluctuations. Other factors (such as fiscal stimulus or easy access to foreign finance) also matter for output accelerations in the short run. The importance of factors beyond terms of trade is evident in the recessions of 1942-45, 1956-57 and 1964-65 which coincided with an improvement in the terms of trade. Section C explores the importance of the abundance of liquidity in international financial markets for both the economic miracle of 1967-79 and its debacle. Finally, it looks at oscillations from 1980 to 2008, when the country moved from severe instability until mid-1994 to prosperity in more recent years. High inflation might have been a reason for the decline in productivity observed between 1980 and mid-1990s.

Section D offers conclusions and policy recommendations. The emergence of a new era in this millennium will depend on wiser fiscal policies than those of the past.

A: BREAKS IN ECONOMIC GROWTH

This Section begins the story of Brazil's economic growth by presenting a stylized picture of the country before the 20th century.

² See, for instance, Acemoglu (2001).

A.I. Before the 20th Century: “Yes, we do have bananas!”

“The seas are plentiful, infinite. And the earth, likewise, is so bountiful that, should one just care to use it, it can provide everything.” Pero Vaz Caminha wrote this description of the land (where Portuguese caravels arrived in April, 1500) to the king of Portugal, D. Manuel. In his letter, Caminha addressed the owner of the new findings as the “The Lucky One”, since the curse of natural resources was unknown at the time.

For centuries, Brazilian exports reflected cycles of boom and bust for different commodities. Sugar exports from Brazil peaked in the 1650s. Competition from growing output in the Caribbean and lower prices reduced sugar prices. As a consequence, the Northeast lapsed into subsistence agriculture. In the 1690s, the discovery of gold and, in 1720s, diamonds in Minas Gerais, created new opportunities. The gold industry peaked around 1750, with gold production at around 15 tons a year. As the richest deposits were exhausted, exports declined. When gold production collapsed, Brazil turned back to agricultural exports. At its independence, in 1822, the main three exports were cotton, sugar and coffee.

At the end of the 19th century the country experienced a boom from rubber exports, to which the Manaus Opera House still testifies. The Amazon region lived a fleeting dream of wealth. Between 1840 and 1911, when industrial uses for rubber multiplied, the price for a ton of rubber went from £45 to £512 – an annual increase of almost 15 percent. The tons of rubber exported increased five-fold between 1870 and 1911. Manaus drowned itself in luxuries. It was the first city in South America to feature a tram. Its residents would send their laundry to be done in Lisbon. Architects, contractors, painters and sculptors came from all over Europe to build the Manaus Opera House, the central point of Werner Herzog’s film, *Fitzcarraldo*, set in 1896. The film helped to spread the myth that Enrico Caruso performed there. A quick check on the website “www.visitamazonas.com.br” (which lists the musical companies that performed in the theater) denies the fantasy created by Herzog with the help of Bellini’s opera *I Puritani*. But, even without Bellini’s music, at the beginning of the 20th century “*lucevano le stele*” in Manaus, at least until the collapse of rubber prices ended the party, emptied the theater and extinguished the stars.

Exporting commodities – and, in particular, semi-manufactured goods that add value to primary goods – does not seal a country’s fate. Notwithstanding the unhappy ending of the rubber boom, a positive shock of the terms of trade could leave behind a more solid legacy and does not necessarily turn the country into a Venezuela or Nigeria, where, despite the abundant oil, economic policy errors, despotism and corruption leave the majority of the population behind and in poverty.

In 1876, Sir Henry Wickham harvested 70,000 seeds from Brazil’s rubber trees and sent them to Asia. Malaysia, Indonesia and Thailand are currently responsible for 90 percent of the world’s production of natural rubber. Although this production has lost its importance to the three countries, which are now specialized in the exporting of electronics, they still sell 42 different natural rubber products, ranging from surgical latex gloves to sofas.

There is no shortage of examples of countries who knew how to make good use of their natural resources and survive the turnabouts of the terms of trade. Australia (with a per capita GDP more than three times larger than Brazil) exports agricultural and mineral

goods. The mineral goods make up 45 percent of their exports and 40 percent of the total exports from New Zealand (also wealthier than Brazil) are made up of meat, dairy and forestry products. Chile got rich by exporting copper and agricultural products. It transformed its grapes into wine and stuck labels on its tomatoes, in the same way that New Zealand transformed the milk from its cows into the best butter in the world.

The successes demonstrated by Australia, New Zealand and Chile did not depend on magic formulas. They resulted from sensible economic policy, use of tax revenues to invest in education and research and determination to not inhibit the growth of more dynamic sectors through trade protection for the less efficient. For the opening of the economy invites investment into new technologies with positive consequences for productivity. It increases competition, provides incentives for efficiency and reduces inflationary pressures.

The paper returns to this discussion in Section C, which studies the importance of terms of trade oscillations for Brazil's output fluctuation during the 20th century. But before getting there, this section turns once again to the last decade of the 19th century, when Brazil was still an agricultural economy. The abolition of slavery, in 1888, and the mass influx of immigrants meant the money supply was insufficient to deal with the new reality of salaried labor. Thus, in 1889, after the proclamation of the Republic, the government gave the banks incentives to print money and promote credit. As a result, business and financial speculation took over the Republic's first year. Companies were founded: some real, others fictitious. Stock exchange speculation increased and so did inflation.

In 1890, when people thought money grew on trees, inflation ceased being a mystery. Machado de Assis notes, in *A Semana* (12/16/1894): "At the time, whoever placed a basket, bowl, barrel or receptacle of any kind out in the moon- or starlight, and awakened to find himself with five, ten or twenty thousand coins, soon understood that the only way to make money down here is through forgery". For Machado, any money not based on gold was false and, therefore, created inflation. But, even if that was not quite the case, there is little doubt that inflation during the first years of the Republic resulted from an excess of credit at a time in which there was no central bank and its accompanying regulation.

The period referred to by Machado is known as *Encilhamento* and ended with the crash of stock prices and the bankruptcy of banking establishments and companies in 1891, whilst British capital fled from Brazil, soon after the Argentine crisis. Consequently, the Campos Sales administration agreed to a punishing funding loan in 1898. It then contracted external loans, secured on the income from Rio de Janeiro's Customs and Excise. Furthermore, it committed itself to a program of deflation, incinerating part of the currency in circulation.

At the time, the State of São Paulo had already moved ahead of other regions, launching the kind of development characterized by agricultural diversification, urbanization and the industrial surge. Between 1890 and 1900, the population of the city of São Paulo grew at a rate of 14 percent per year, going from 64,000 inhabitants in 1890 to 239,000 in 1900. The coffee businesses set the stage for the first industrial surge by stimulating the increase in incomes, creating a market for the manufacturers and

promoting investment in railways and immigration. Approximately 3.8 million foreigners entered Brazil between 1887 and 1930.

Over the course of the first Republic, the majority of loans and investments continued to originate in England. The US represented the main market for the most important Brazilian export of the time: coffee. And coffee remained king until 1930. The next section divides the 20th century into four periods.

A.2. Finding the Breaks in 20th Century Growth Rates

Jones and Olken (2008) investigate extremes of growth experiences within countries and examine the changes that occur when growth starts and stops. Their growth accounting reveals that physical capital accumulation plays a negligible role in growth take-offs and a larger, albeit still modest, role in growth collapses. Collapses typically feature reduced manufacturing and investment amidst increasing price instability, whereas growth takeoffs are primarily associated with large and steady expansions in international trade.

Jones and Olken use the methodology developed by Bai and Perron (1998, 2003) to identify changes in growth regimes and study the anatomy of these periods using growth accounting. The Bai and Perron (1998, 2003) methodology considers a multiple structural break model, with m breaks ($m+1$ regimes). The null hypothesis of no structural breaks is tested against the alternative of an unknown number of breaks. The tests are used to determine if at least one structural break is present. In addition, a maximum number of breaks is chosen. If the tests show evidence of at least one structural break, then the number of breaks can be determined and chosen by the Schwartz Bayesian Information Criteria (SBC).

This section applies the Bai and Perron methodology to the growth rate of GDP per capita in Brazil between 1900 and 2008. The maximum number of breaks is 9 as the authors choose a minimum period of 10 years. Table 1 shows the values of the SBC statistics, the number of breaks and the corresponding years. The lowest SBC value is 808.75 and identifies the number of breaks as three, corresponding to four periods: 1900-1917; 1918-1966; 1967-1979 and 1980-2008. The next section turns to growth accounting to analyze these four periods.

B: GROWTH ACCOUNTING

This section uses growth accounting methods to analyze the different periods as set out in the previous section. A variety of ways of carrying out the same exercise, undertaken by several authors, generally demonstrates that total factor productivity (TFP) grows until the end of the 1970s before dropping sharply over the following decades.³

B.1. Method and Data

The theoretical framework of this Section is basically the same as that used by the pioneering calculation found in Gomes, Pessoa and Veloso (2003). The first equation specifies a Cobb-Douglas production function with human capital:

³ See, for instance, de Mello (2008).

$$y_t = A_t k_t^\alpha H_t^{1-\alpha} \quad (1)$$

Where y_t is the output per worker at time t , k_t is the capital stock per worker at t , H_t is human capital (education) per worker at t , and A_t is total factor productivity at t (or TFP). Estimation of human capital follows the mincerian approach as in Bils and Klenow (2000):

$$H_t = e^{\phi(h_t)} \quad (2)$$

Where h corresponds to the average years of study of workers:

$$\phi = \frac{\theta}{1-\psi} h^{1-\psi} \quad (3)$$

Where $\theta > 0$ and $0 < \psi < 1$.

Log-differentiation of equation (1) implies:

$$\frac{\dot{A}}{A} = \frac{\dot{y}}{y} - \alpha \frac{\dot{k}}{k} - (1-\alpha) \frac{\dot{H}}{H} \quad (4)$$

Data

For the physical capital stock, the Section uses the series calculated by Morandi and Reis (2004), available at www.ipea.gov.br, IPEADATA. For human capital, it uses the series of five-yearly averages by Barro and Lee (2001), interpolated to provide the missing observations. As in Gomes, Pessoa and Veloso (2003), the values of θ and ψ used here are 0.32 and 0.58, respectively. In Gomes, Pessoa and Veloso (2003), the series of physical capital were yet to have been made available, thus they constructed the series using the perpetual inventory method.⁴ However, the work by Morandi and Reis (2004) is more precise as the authors were in possession of more reliable depreciation information for each point in time and assessed the accumulation of capital by sector, instead of on aggregate, taking into account differences in the quality of the capital. Furthermore, separate series for construction and machinery and equipment capital have been made available, avoiding a bias in the capital prices for the 1980s, as well as separating public capital from private. With this in mind, the Section has calculated three TFP series. One uses the total net stock of capital (TFP), one uses the total net stock of machinery and

⁴ Data used in Gomes, Pessoa and Veloso (2003), are available on the site: www.victorgomes.com.br.

equipment capital (TFP1) and, finally, the last uses the net stock of private sector machinery and equipment capital (TFP2).

This section uses α equal to 0.4, in accordance with the same parameter in Gomes, Pessoa and Veloso (2003) and very similar to the estimate by Ferreira, Issler and Pessoa (2004).

The data for number of workers used to calculate y and k are obtained by building a series of the population aged over 25 for Brazil, using the data from the 1950, 1960, 1970, 1980, 1991 and 2000 censuses, and performing a polynomial interpolation to fill in the missing years. Calculating k and y with these labor force figures and performing the calculations with the TFP indices, this section obtained the results presented in figure 1 (lines TFP, TFP1, and TFP2).

If the data for number of workers used to calculate y and k are that of the economically active urban population (urban EAP) obtained from IPEADATA, the results are those shown in line TFP-GPV in figure 1, which practically replicates the results in Gomes, Pessoa and Veloso (2003). There is however a problem with these estimates. It seems inappropriate to use the urban EAP to calculate k and y as the average for the years in focus used to calculate H , obtained from Barro and Lee, does not use the same base. The fact is that Barro and Lee provide data for average years in the study for the country's total population aged over 25. This figure would only be similar to the human capital stock of the urban EAP, for example, if the human capital stock were the same for rural as for urban areas. In addition, the rate of growth for the urban EAP is drastically different to the rate of growth for the population aged over 25, given the migratory movements observed from the countryside to the cities for the period of study. Finally, a significant part of the economic growth is strongly linked to advances in agricultural productivity, such that the exclusive use of the urban EAP could significantly change the Brazilian TFP measurement. In addition to the reasons mentioned for using a different series for the number of workers, there is an important methodological question to take into account. The exercise calculates the TFP using figures for product and capital divided by the EAP and years of study, divided by the population aged over 25. The measurements have to be compatible in order to make sense.

Thus, we have a strong preference for the results shown in the upper three lines (TFP, TFP1 and TFP2). These results show that, when the number of workers is consistent with other measures, although our estimations show similar directions for the oscillations of productivity in previous studies, the drastic drop in productivity seen after the 1970s is significantly lessened. The next section investigates the contribution of each factor to the growth in each period listed in A.2.

B.2. Capital and Productivity in three Post-War Periods

Before showing the decomposition of the growth rate of output per worker, year by year, the Section first looks at the average during each period of the growth rates for: output, population, workers, output per capita and per worker, physical capital per worker, human capital per worker and productivity per worker in Table 2.

Observe that, on average, the growth rate of output per capita is positive in all periods (the growth rate of output is higher than the growth rate of the population in all

periods). But, in the last period the growth rate of output per worker is negative, because the growth rate of workers is higher than the growth rate of output. Although the growth rate of output per worker is declining in the last period, total output is growing at rate that is still enough for output divided among the population (that is growing much more slowly than before) to grow at positive rates.

Also observe that the growth rate of human capital is very high in the last period compared to the two previous periods. The growth rate of capital per capita is both positive and high in the first two periods and negative in the third. Productivity growth is exceptionally high in the second period and negative in the third.

It is possible to separate the contribution to growth for productivity and for each factor, for each point in time, as the rate of growth of the product per worker is simply the sum of the aforementioned contributions. Undertaking this exercise for each year, using the population aged over 25 as labor and the total net capital stock for the capital measurement, produces the results presented in Figure 2.

The rates of product growth per worker are presented by the dark blue line in Figure 2, which is equivalent to the sum of the contributions of each factor. Vertical lines indicate the divisions of the periods listed in Table 2.

Beginning with an evaluation of the change from the first regime (1951-1967) to the second (1968-1980), note that the significant increase in the rates of growth was exclusively a result of the growth in the rates of TFP growth. This stems from the fact that the rates of growth for the stocks of physical and human capital do not change much. The contribution of these variables to growth of output per worker remains at approximately 2% per year in both periods. This result makes it clear that the main reason behind the economic growth of the period was not a result of policies aimed at increasing investment. It also rejects the recommendation made by those who prescribe a forced increase in savings and investment to stimulate growth.

However, the change to the third regime (1981-2008) is marked by a fall in both the growth in productivity and the rate of accumulation of capital by worker, which contribution reaches less than 1% for all the years in question. This could mean, for example, that miraculous periods encounter different growth foundations than those for periods of collapse, as suggested by Jones and Olken (2008). Within this logic, the increase in risk, both political and economic, experienced by the Brazilian economy for the majority of the period starting after 1980 would have inhibited investment, braking economic growth.

This asymmetry, however, could also be explained in another way. A fall in productivity naturally implies in a fall in the marginal product of capital and, consequently, of investment. Thus, the fall in the accumulation of capital could be seen as a consequence of the fall in productivity, as could the fall in economic growth. This point of view seems to be a better fit for the case of Brazil as the TFP's contribution to growth continues to dominate over the other factors for this period.

The explanation for the Brazilian economy's long term growth depends on the explanation for the variations in productivity growth. Mussolini and Teles (2009) find the explanation for this fact in the behavior of public infrastructure investment. Using various measures for TFP and public capital, they obtain a highly robust result. The stock of infrastructure capital co integrates with the TFP. The infrastructure capital Granger-causes the TFP, whilst the inverse does not hold true. One of the explanations for the increase in

productivity during the second regime was the increase in public infrastructure spending. The fall in productivity over the third regime could be partly explained by the fall in this expenditure. The following Section will explore other possible explanations.

C: OUTPUT FLUCTUATIONS

During the 19th and 20th centuries, external turbulence amplified the domestic policy mistakes made within the Brazilian economy. In the 1930s and 1940s, the Great Depression, with its protectionist policies, and World War II isolated the country from the rest of the globe and Import Substituting Industrialization (ISI) responded to the lack of external financing. The 1950s, not only in Brazil but also in Latin America in general, was transformed into the spitting image of voluntarism, which believed that an intervening State was better than the market. The ideology of the period revisited the theoretical model of imperialism and functioned around representations of the center and its periphery, portrayed in the theory of dependence (developed at the United Nations' ECLA – Economic Commission for Latin America, in Chile).

The growth of trade during the 1960s and 1970s opened the doors for the debates on agrarian and tax reforms. The Alliance for Progress and the Inter-American Development Bank participated in reforms during this period. With the availability of cheap credit from petrodollars in the 1970s, government and the private sector borrowed heavily generating high but unsustainable economic growth. When oil prices increased, both in 1974 and in 1979, and interest rates rose in 1980, the high accumulated debts proved unsustainable, inducing a debt crisis. The result was almost 15 years of low growth and hyperinflation. The defeat of the heterodox programs for stabilization led to the Washington Consensus and praise for the Asian model. This takes us to the 1990s, which saw the beginning of the privatizations and trade liberalization. The accumulation of problems from high levels of debt and inefficient state-owned industries led Brazil to rethink its strategy to a more market-driven and trade oriented approach.

Figure 3 shows GDP per capita between 1900 and 2008. Between 1900 and 1917, it oscillates around its trend, according to which GDP per capita was growing at 0.8 percent per year. After negative growth in 1918, a new growth regime starts with an “up-break” (representing output acceleration) and GDP per capita moves upwards, peaking in 1928. The sharp decline in activity in 1929 is followed by two years of recession. Recovery starts in 1933 and culminates with a boom in the late 1950s which comes to an end in 1962. The rhythm of activity then falls once more and the gap becomes negative between 1964 and 1967. A new “up-break” occurs in 1967, with renewed acceleration in GDP from 1968 on. Observed GDP exceeds its trend by 1974 and acceleration continues until 1980, the year of a “down-break” (representing a collapse of trend growth). A sharp contraction in 1982-83 is followed by a recovery in the mid-1980s and another severe contraction in 1991-93. The most recent recovery starts in 2004, with a marked improvement in terms of trade. This last event brought back old stories that link the behavior of output in Brazil to movements in commodity prices.

C.1. Trend, Cycles and Terms of Trade

Oral tradition has attributed the weak performance of South American countries relative to countries in Asia to the instability of the prices of their major exports. Commodity prices are very volatile and this price volatility implies very volatile income sources. As a consequence, it generates uncertainty and, thus, reduces investment. Furthermore, pro-cyclical international capital flows amplify the fluctuations in income. The results are “boom-bust cycles”.

Intuition agrees with the perception that natural resource booms cripple non-resource export sectors, create incentives for rent seeking, inhibit other forms of productive activity and foster corruption.⁵ Nonetheless, despite the important share of commodities in Brazil’s exports, Cardoso and Holland (2009) find a small and statistically non-significant correlation between the price of commodities and economic growth in Brazil after 1980.

One can also reject the hypothesis that the price of commodities is a good explanation for growth in Brazil between 1900 and 2007. The correlation between the growth rate of GDP per capita and metal prices (or with food prices or with non-food commodities) are also small, negative, and statistically non-significant.

Yet, one should consider that what matters are the terms of trade and Brazil’s terms of trade do not reflect swings in commodity prices one for one. Commodities are not only an important part of Brazil’s exports, they also respond for an important share of the country’s imports. In 2007, primary products and natural resources based manufactures respond for 54 and 37 percent of Brazil’s total exports and imports, respectively. Thus, it is preferable to verify the impact of terms of trade, rather than the impact of different prices of commodities, on growth.⁶

⁵ Humphreys, Sachs and Stiglitz (2007) argue that natural resources are different from other sources of wealth, because they do not need to be produced. Their case for a negative impact of natural resources on growth also includes arguments such as the “Dutch disease”, insufficient investment in education, weak unaccountable states. One can also hypothesize that unearned riches are a curse because governments get fat on revenue from primary activities and do not have to tackle the far more difficult task of creating a framework of laws and institutions that generate sustained growth and stable tax revenues (See Sal-i-Martin and Subramanian, 2003). A massive inflow of natural resource revenues produces perverse political effects such as corruption and clientelism. Manzano and Rigobon (2007) find that the curse operates through debt-overhang and their finding supports the perverse voracity effect of natural resources on economic performance. However, development is subject to the wise, or foolish, decisions on which society embarks. Different results can come from the same situations, because unexpected factors are inherent to progress, such as chance or psychological variables. Thus, the empirical evidence on the curse of natural resources remains elusive.

⁶ Loyaza et al. (2005) find that negative terms-of-trade shocks have the effect of slowing down the growth rate of Latin America and Caribbean economies and Astorga (2009), intrigued by the negative association between trade openness and growth on his estimation of determinants of long term growth in the six largest economies of Latin America over the period 1900-2004, tests if high openness in the context of specialization in primary products can be harmful to growth. Adjusting the openness variable by changes in export composition over the century, he finds that the export diversification index has mixed results: in some regressions it is not significant and its inclusion does not affect the strength of the openness coefficient; in others he obtains some evidence that the degree of export diversification influences the growth impact of openness.

As a first approximation, the Section observes a positive and statistically significant correlation between Brazil's growth rate of GDP per capita and terms of trade (0.24 between 1900 and 2007 and 0.40 between 1973 and 2007). Has the effect of terms of trade on growth changed during this century?

To answer this question, the Section uses a linear state space model, i.e., a linear regression model with time-varying coefficients. The model provides a way to estimate a vector auto regression (the transition equation) with coefficients that change over time. These coefficients are called unobservable variables (known as the state variables) and are incorporated into and estimated along with the observable model (or the measurement equation).⁷

The first model used in this section describes a linear relationship between growth and terms of trade. The measurement equation is:

$$g_t = \mu + \beta_t TOT_t + \varepsilon_t, \quad \varepsilon_t \sim NID(0, \sigma_\varepsilon^2) \quad (5)$$

Where g is the growth rate of GDP per capita, TOT is the log of terms of trade and β is the state variable.

The transition equation is:

$$\beta_{t+1} = \beta_t + \epsilon_t, \quad \epsilon_t \sim NID(0, \sigma_\epsilon^2) \quad (6)$$

The result of the estimation of the space model is presented in Figure 4, which shows how β moves between 1910 and 2008. The blue line shows the point estimate and the red line the interval of confidence. Observe that the effect is positive for the whole period and increases from 1910 until 1940. After 1940, the relationship continues to be positive, statistically significant and becomes relatively more stable.

The next step is to introduce control variables into the previous model. To complete this step, the Section introduces the proportional changes in physical capital and human capital in the estimation of the relationship between the growth rate of output per worker and terms of trade. The data covers the period from 1950 to 2008 and is the same used in Section B: Growth Accounting.

The measurement equation is now:

$$\gamma_t = \eta + \lambda_t TOT + \alpha_1 dK_t + \alpha_2 dH_t + \xi_t, \quad \xi_t \sim NID(0, \sigma_\xi^2) \quad (7)$$

Where γ is the growth rate of output per worker, dK is the proportional change in the capital stock and dH is the proportional change in human capital.

The transition equation is:

$$\lambda_{t+1} = \lambda_t + \nu_t, \quad \nu_t \sim NID(0, \sigma_\nu^2) \quad (8)$$

⁷ For details, see Harvey (1989), Hamilton (1994, Chapter 13; 1994b), and especially the excellent treatment by Koopman, Shephard and Doornik (1999).

Results of the estimation of λ are presented in figure 5. Even after the introduction of control variables, the relationship between the growth rate of output per worker and terms of trade is positive and statistically significant. For comparison, we also looked at the results for the relationship between the growth rate of GDP per worker and terms of trade without the control variables. The difference in results shows that the introduction of control variables reduces the effect of the terms of trade on growth. The reason is that only part of the effect of terms of trade on growth is through its impact on productivity.

But if the argument that explains the link between growth and terms of trade relies on the fact that instability of terms of trade generates cycles of boom and bust with consequent uncertainty and adverse consequences for investment, then one must be able to observe a positive correlation between the terms of trade and the gap of observed GDP in relation to trend GDP.

Output Gap and Terms of Trade

The correlation between terms of trade and the output gap is indeed positive and statistically significant. And using the same methodology of the previous section one can verify that the effect of terms of trade on the GDP Gap remains positive during the 20th century. The linear state space model used here defines the measurement equation as:

$$gap_t = \delta + \pi_t TOT_t + \zeta_t, \quad \zeta_t \sim NID(0, \sigma_\zeta^2) \quad (9)$$

Where gap is the percentage difference between observed GDP per capita and potential GDP per capita. The Hodrick-Prescott filter was used to obtain the potential GDP per capita.

The transition equation is:

$$\pi_{t+1} = \pi_t + \vartheta_t, \quad \vartheta_t \sim NID(0, \sigma_\vartheta^2) \quad (10)$$

Figure 6 shows the results for estimated π between 1910 and 2008. It shows a positive and significant effect of terms of trade on GDP Gap. The effect oscillates markedly from 1910 to the 1940s and thereafter becoming more stable.

For illustration, we plot the terms of trade and the GDP Gap in Figure 7. It shows a clear correlation between the boom of 2004-08 and the improvement in the terms of trade during those years. The effect of terms of trade in previous booms of the post World War II period is less obvious. Inflationary finance and import substituting industrialization (ISI) lie behind the output acceleration during the Juscelino Kubistchek years (mid-1950s to early 1960s) and left the economy in poor shape to face the political crisis of 1963-64. Exceptionally favorable international liquidity contributed markedly to the “economic miracle” period between 1968 and 1980.

Figure 7 also illustrates the effort at maintaining high growth rates after 1978 when terms of trade were declining. As a consequence, when the external crisis hit in 1981-82, the economy, with its large current account deficits, was poorly prepared to face the scarcity of capital. By contrast, at the end of 2008, the external financial crisis, scarcity of credit and decline in the terms of trade were all faced by an economy with large

international reserves. More on that later on. Let us first get back to history and other reasons beyond the oscillations in terms of trade for observed GDP fluctuations.

C.2. 1918 - 1966: Import Substituting Industrialization

During World War I, the interruption to the competition provided by imported goods became an incentive to manufacturing. In the 1920s, with government incentives, two large companies were founded: Siderúrgica Belgo-Mineira and Companhia de Cimento Portland. And, based on their experiences and the profits achieved throughout the war, small workshops were transformed into factories producing machinery and equipment.

According to the 1920 census, of a working population of 9.1 million people, 6.2 million (70 percent) did so in agriculture, 1.2 million (14 percent) were in the industrial sector and 1.5 million (16 percent) were in services. The proportion of people employed in the industrial sector doubled in relation to the 1872 census, when the figure failed to reach 7 percent of the working population. However, many “factories” were no more than small workshops. The majority of the few “real” factories were dedicated to producing low quality cotton textiles.

Brazil came to enjoy a monopoly in the market for coffee in the first half of the 20th century. During the 1920s, the government artificially maintained coffee prices by buying national production through the use of external loans. The crash of 1929 dried up the sources of foreign financing and forced both the central government and the State of São Paulo to interrupt the scheme. Between 1928 and 1930, the price of coffee dropped almost 40 percent and caused the falls in export revenues and GDP. In 1931, the National Coffee Council began buying and destroying stocks.

It is estimated that Brazil's GDP per capita fell 3.4 percent in 1930 and another 4.6 percent in 1931; but, in 1932 it was growing again and, in 1933 had already overtaken the figure for 1929. Despite the fact that the recession was serious, it only lasted two years. The price fixing policy for coffee, by guaranteeing the income levels of the plantation owners, allowed for the expansion of the manufacturing sector.⁸ However, the impact to the government budget was severe, with a suspension of the servicing of external debt between 1931 and 1932, followed by a readjustment plan in 1934, culminating in a default being declared by Getúlio Vargas, in 1937.

The crisis of 1929 reinforced import substituting industrialization and industrialization brought with it increased productivity. Kuznets (1953) was among the first economists to argue that labor migration from agriculture into manufacturing produces growth because manufacturing is more productive. Krugman (1987) also argues that this movement provides learning-by-doing spillovers.

After the 1940s, coffee also began to lose its supremacy among exports. Currently, Brazil's main commodity exports are iron ores, soy beans, oils, and oilcake. But Brazil's exports today are highly diversified, as is reflected in a very low Export Concentration Index of 9.1, which is typical of OECD countries (OECD, 2008).

From the JK years to the military coup

In the 1950s, Juscelino Kubistchek invented inflation to finance 50 years in 5 year period, with the creation of the automobile industry and the construction of Brasília. As

⁸ See Cardoso (1981).

discussed in Section C.1., an improvement in terms of trade was not behind the boom that lasted until 1962.

In the 1950s, inflationary finance was the government's response to its growing budget deficits. The beginning of an inflationary process takes people by surprise. The resulting revenue falls in the measure that inflation becomes endemic and the population learns to hold onto money for the shortest time possible. However, before people learn to anticipate purchases at the supermarket or to deposit their money at banks that pay the overnight daily rate, the government has time to enjoy inflationary revenues. This is why the government was able to create revenue with the creation of currency and why Juscelino Kubistchek could finance the government investment program by getting cash directly from the *Banco do Brasil*, during a period when the country did not have a Central Bank and government bonds were almost non-existent.

Figure 8 shows the tight correlation of the GDP gap and the percent variation of the monetary base between 1948 and 1964 (the correlation between the two variables is 0.32). This correlation was bound to disappear and did so after mid-1960s, with the introduction of a Central Bank and indexed government debt. Even during the mega-inflation years, the government was unable to finance itself through increased seignorage, which remained at around 2 percent of GDP during the 1970s until mid-1990s.⁹

However, it was not the capital flight that interrupted the escalation of the inflationary financing in the beginning of the 1960s. It was the military coup and its new policies. After introducing a program that is discussed in Section C.3., the military leaders then invented painless inflation. They created salary pegging, indexation and mini-devaluations.

From anti-export bias to export subsidies

The strong anti-export bias of ISI policies, in vogue until the mid-1960s, derived in good measure from real exchange rate overvaluation. Foreign exchange controls introduced in 1947 were an important tool in the promotion of the industrial park. Throughout the period of 1947 until 1953, the domestic currency became increasingly overvalued. A system of licensing kept the demand for imports under control. At the beginning of 1953, Law 1807 created a limited free exchange market in which the inflow and outflow of capital and its earnings were allowed, as well as the buying and selling of foreign exchange for tourism. Later that year, SUMOC Instruction 70 established a multiple exchange rate system, which eliminated direct quantitative controls and created an auction for obtaining foreign exchange. In 1957, the exchange control system underwent further changes. Ad valorem tariffs were introduced, rising to 150 percent. The exchange rate categories were reduced from five to two. Political crises dominated the years from 1962 to 1964; the official rate lagged substantially behind inflation, thus creating a disincentive to exports.

After 1964, the military government acted to increase the rate of growth and diversification of exports by undertaking a series of measures. It abolished state export taxes, simplified administrative procedures for exporters, and introduced a program of tax incentives and subsidized credits for exporters. Fiscal subsidies for exports introduced after 1964 included: exemption from tax on industrialized products (November, 1964);

⁹ See Cardoso (1998).

exemption from income tax on profits from exports (June, 1965); drawback of taxes on imported raw materials and components used in exported products (November, 1966) and VAT exemption for manufactured product exports (Constitution of 1967).

Changes introduced after 1964, such as a more stable real exchange rate than in previous periods and export subsidies, may have contributed to export diversification. The share of manufactured exports in total exports increased from less than 30 percent in 1974 to more than 50 percent in 1981.¹⁰

Export diversification and the growth of exports of manufactured goods may have contributed to increased productivity and the “up-break” in 1967. This hypothesis is reinforced by Pablo Fajnzylber (2005). He studies Brazilian exporting firms at the beginning of the 21st century and shows that exporting firms are more competitive and productive than non-exporting firms.¹¹

C.3. 1967 – 1979: The Economic Miracle

After the military coup, the government introduced the “Programa de Ação Econômica do Governo” (PAEG) which promoted important structural reforms, such as: a deep fiscal adjustment with a reduction of budget deficits with cut in expenditures and a tax reform, including the introduction of value added taxes; and a reform of financial markets, including the creation of a Central Bank. Veloso, Villela and Giambiagi (2008) claim that the growth acceleration episode associated with the Brazilian economic “miracle” was due to a large extent to the delayed effect of the reforms associated with the PAEG.

Everything was going fine until the oil shock in 1974. Between 1973 and 1976, the GDP continued to grow quickly, on a par with a faster potential growth than for other periods. From the end of the 1970s, however, aggregate demand challenges the laws of gravity and the limits imposed by the second oil shock. The government adapted to the shock and avoided a recession, letting inflation rise and financing the current account with external debt.

Figure 9 shows how tightly correlated the GDP gap in Brazil and the real U.S. interest rates are. The correlation is -0.62. As long as foreign loans sustained the current account, the boom could persist. A new oil shock in 1979 and increased foreign interest rate hikes came at a bad time. In 1980, the GDP reached a peak well above the potential product. Disaster was soon to follow.

The 1981 crisis put an end to the spectacular Brazilian growth, which turned negative in 1982 as the economy entered a recession. The oil shock, acting like a production tax paid to the exterior, also reduced the potential growth rate.

¹⁰ Since the 1980s, the share of manufactured exports in total exports has oscillated between 50 and 60 percent depending on how high the prices of commodities are.

¹¹ Fajnzylber studies 1,636 firms across 13 Brazilian States and 9 industrial sectors. Exporting firms sell 2.7 times more per worker and have 94% more capital and 50% higher total productivity than non-exporting firms. The share of workers with secondary education is 30% higher and wages are 90% higher in exporting firms than in non-exporting firms.

C.4. 1980 – 2008: From the Lost Decade to a New Era

An important fact behind the low growth rates seen over the last hundred years in Brazil is its rollercoaster economy, largely due to external financial shocks. Each period of growth (not induced by an improvement in terms of trade) is followed by an external crisis that wipes out any advances gained. Phases of abundant external capital coincide with periods of spending. When the capital becomes scarce, growth disappears.

In the 1980s, with the potential growth reduced by the increase in oil prices, all it took was the growth of 1985 and 1986 to see the GDP once again above the potential product. With no external financing and the aggregate costs above the potential product, the heterodox plans for stabilization were doomed to failure.

During the 1980s, the debt remained unsolvable, despite the 1987 moratorium, which was only to be resolved in 1993. Domestically, the Brazilian government tried to finance fiscal imbalances through inflation. Not that the inflation produced any significant revenues. The Brazilians had already learned about capital flight. However, inflation did allow the tax imbalances to be hidden through a process in which the increase in prices converted nominal expenditure (which could not be financed by the budgeted tax revenues) into real expenditure (which are compatible with the real tax revenues).¹²

The very high inflation rates of the 1980s may well be a reason for the “down-break” of trend growth observed after 1980. Jones and Olken (2008) show that “down-breaks” are associated with substantial increases in inflation. Of the 39 down-breaks in their sample, 33 show increases in inflation.

During the 1980s Brazil’s government hid the problem of external debt inherited from the previous administration, and the maladjustments it provoked, under the soft carpet of mega-inflation. However, in the measure that inflation rose, the government became ever less popular. On one side, lower salaries failed to accompany inflation. On the other, the inflation transferred middle class savings to the upper class, which had better access to diversified information and investments.

The problems that had been accumulating since 1980 were taking a significant toll. After frustrated attempts at controlling inflation through price freezing and heterodox plans, the government declared the 1987 moratorium. President Collor then tried even more radical measures by freezing bank deposits and transformed the 1990-1992 recession into a traumatic period.

Inflation, however, continued to be so uncomfortable that, in the second half of the 1990s, the government indexed the debt to interest rates that followed the dollar. From the middle of 1994 onwards, President Fernando Henrique Cardoso used the exchange rate as an anchor that maintained inflation under control. With abundant amounts of foreign capital, it was possible to finance a deficit in the current account that reached, on average, three percent of the GDP during the eight years of his administration. Government spending increased year on year.

But, after 1993, the GDP began to grow again. It carried on, near the potential product, now reduced due to the lack of investments into infrastructure. 2003 was a year that saw GDP fall, although an approximately five percent increase in 2004 left it close to its potential level once more. The level of use of the installed manufacturing capacity

¹² See Cardoso (1998).

reached a peak in the middle of 2004. The Central Bank remembered that the last politician to speak of flexibility of the full capacity with an expansion of hours and overtime was Alan Garcia, the king of populism and sponsor of Peru's inflation explosion between 1985 and 1990. Its reaction was to raise the Selic rate and put the brakes on growth, which fell in 2005.

A New Era?

Between 2002 and 2008, Brazil benefited from global growth in general and China's growth in particular, with its demand for commodities, the production of which Brazil has an undeniable comparative advantage. Between August of 2002 and August of 2005, the price of Brazil's semi-manufactured exports rose by 43 percent and the price of its basic products by 59 percent. The benefits wrought by the positive shock of the terms of trade to the economy were visible. The exchange rate appreciation allowed for a reduction in the external debt and the increase in the prices of exports on investment for the production of raw materials was remarkable. Such prosperity came under threat in the second half of 2008 as a result of the global financial crisis.

But this time the Brazilian economy responded to the international crisis differently than it had in the past. Until 2002, net public sector debt would leap in response to the impact of exchange rate devaluations – both on the external debt, as well as on the national debt indexed to the dollar. This time, a dollar indexed debt was absent and the government had accumulated international reserves during the boom induced by the improvement in terms of trade.

Brazilian credit and external accounts suffered a significant impact from the international crisis during the final months of 2008, but since then the country has been able to partially contain its effects. The good news is that the 2008-2009 crisis was also different from those in the past.

In the past, exchange rate devaluation resulting from external shocks would cause at least two serious problems: an inflationary impact and an increase in the public debt/GDP ratio (because part of the debt was indexed to the dollar). The Central Bank would be forced to increase the interest rate in order to control the inflationary effect of the currency devaluation. In turn, this measure contributed to a new rise in public debt. To maintain confidence in the solvency of the public sector, the government would have to increase the primary surplus. Both the monetary and the tax policies multiplied the external shock's contracting impact, aggravating the recession induced by the external shock.

As opposed to what has occurred in the past, the devaluation of the real did not translate into an increase of the public debt during the crisis at the end of 2008 – in fact, there was a profit that created a margin for emergency financial aid actions. The high international reserves served to soften part of the devaluation shock, which brought losses for companies that speculated in the exchange rate derivatives market, but there was no capital flight. And the Central Bank was also able to reduce interest rates.

Even so, the damage caused by the turbulence in the Brazilian economy appeared in October, 2008. Companies promoted collective vacations, postponed investments and held off from undertakings. For the first six months of the crisis, from October, 2008, to March, 2009, the manufacturing industry retracted by more than 10%. The figure for just

the first quarter of 2009 showed a fall of more than 14%. However, in June, 2009, a gradual recovery seemed to be in place, with the manufacturing industry accumulating positive growth compared to December, 2008, despite the negative rates for the remaining bases of comparison.

Brazil was one of the countries that, even though affected by the crisis, reacted more effectively than others because it had less financial vulnerability and counted on decent regulation and supervision of its financial market.

D: CONCLUSIONS

This paper applied the Bai and Perron methodology to the growth rate of GDP per capita in Brazil between 1900 and 2008 and identified the number of breaks as three, corresponding to four periods: 1900-1917; 1918-1966; 1967-1979; and 1980-2008. The growth accounting analysis of these periods attributed the acceleration after 1968 to an increase in productivity, possibly due to lagged effects of structural reforms introduced in 1965-68 and to increased investment in infrastructure. The “down-break” in 1981 is marked by a fall in both the growth in productivity and the rate of accumulation of capital by worker. The fall in productivity over the third regime could be partly explained by the fall in infrastructure investment and by severe inflation until mid-1994. Finally, the country moved from severe instability until mid-1994 to prosperity in more recent years.

Using linear state space models, the present paper also found a positive and significant effect of terms of trade on economic growth and on output oscillations around potential output. It argued that periods during which the government tried to increase growth by increasing expenditures in the presence of deteriorating terms of trade (as in the late 1970s) ended in disaster when external finance dried up.

An *Ideal Husband*, the play by Oscar Wilde, tells a story of unrealistic expectations. Lady Chiltern, a woman of strict principles, idolizes her husband, a rising star in politics. Their life is filled with nectar and ambrosia, until the appearance of Mrs. Cheveley. She comes with a letter – one that proves Sir Chiltern’s fortunes were made on the back of privileged information during the construction of the Suez Canal. In exchange for this letter, she seeks support for the construction of a new canal in Argentina. Having previously denounced the Argentine project as a fraud, Sir Chiltern is faced with a dilemma. Should he alter his stance or allow the contents of the letter to come to light? Either course will result in the demolition of his spotless character and bring an end to his marriage. Although loathe to disabuse his wife of her unrealistic expectations, no amount of money can buy back one’s past.

The same principle holds for governments. Every administration is hostage to the actions undertaken by the previous one, and Brazil’s history is littered with mistakes made when trying to correct previous errors. To deal with the fiscal disequilibria and low tax incomes, the Juscelino Kubistchek administration used inflationary finance. To live with inflation, the military government adopted generalized indexing. To resolve the absence of long term credit in the volatile economy, the government offered subsidized loans through the National Development Bank.

After stabilization in the mid-1990s, the country seems to be mending its way to judge from the economy's response to the last international crisis. Yet, Brazil's fiscal strategy remains questionable. The government has relied on a steadily rising tax burden to finance steadily rising fiscal spending. In 2008, tax collection amounted to 36 percent of GDP, nearly 14 percentage points higher than levels between 1991 and 1993.

During the second semester of 2009, Brazil's short term fiscal picture still looked under control despite some deterioration. However, both the primary surplus and the budget deficit had weakened. The ratio of the primary surplus relative to GDP had declined to just 1 percent of GDP during the 12 months through October 2009, down from 4.3 percent of GDP in the 12 months through October 2008. Despite the decline of the burden of fiscal interest payments, the budget deficit had worsened to 4.6 percent of GDP from 1.3 percent of GDP a year earlier.

Brazil's fiscal deterioration appears mild by recent international standards. Counter-cyclical policies, however, have to be temporary. It is true that recent tax breaks fit this description, but the rise in spending inspires caution. Federal expenditures have risen in areas such as public sector wages and hiring, which seem hard to unwind quickly if necessary and fiscal policy is unlikely to tighten ahead of the elections in 2010. There is also reason for concern in the potential quasi-fiscal costs associated with the current aggressive expansion of credit by public sector banks.

Two longer term fiscal challenges require attention. First, the composition of spending, because social security expenses have increased steadily over the years, while public sector investment remains extremely low at just 1 percent of GDP. Second the strategy based on a steadily rising tax burden to finance ever-increasing expenses does not seem sustainable and the complex tax system is a hurdle for doing business in the country. Out of 183 countries, Brazil ranks at place 167 in terms of the amount of taxes and mandatory contributions on labor paid by business as a percentage of commercial profits (69 percent in Brazil and 41 percent in median countries). When it comes to the time it takes to prepare, file and pay the corporate income tax, the value added tax and social security contributions, Brazil ranks at the very last position (standing ten standard deviations from the median).

From the point of view of stimulating Brazil's growth potential, it appears that important fiscal reforms and infrastructure investment will be needed for leading productivity to a higher and sustainable path. A hypothesis worth investigating in future work is whether high and complex taxation is one reason for the poor performance of GDP growth in Brazil relative to other emerging countries.

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Table 1
Identifying the Changes in Trend of Brazil's GDP per Capita Growth Rate

Number of Breaks	SBC Statistics	Year of Break
0	817.74	
1	815.00	1980
2	810.16	1918, 1980
3	808.75	1918, 1967, 1980
4	810.09	1918, 1967, 1980, 1992
5	811.36	1918, 1928, 1967, 1980, 1992
6	812.66	1918, 1928, 1942, 1967, 1980, 1992
7	813.89	1910, 1928, 1942, 1955, 1967, 1980, 1992
8	814.97	1918, 1928, 1942, 1955, 1967, 1977, 1987, 1998
9	816.66	1916, 1926, 1936, 1947, 1957, 1967, 1977, 1987, 1998

Source: Ipeadata. Authors' investigation.

Table 2
Annual Growth Rates of:
Output, Population, Workers, Output per Capita and per Worker,
Physical Capital, Human Capital and Productivity per Worker
Average during the Period, Percent
Brazil, 1951-2008

Period	Growth Rate of Output	Growth Rate of Population	Growth Rate of Workers	Growth Rate of Output per Capita	Growth Rate of Output per Worker	Growth Rate of Human Capital	Growth Rate of Physical Capital per Worker	Growth Rate of Total Factor Productivity
1951-1966	6.36	3.02	2.99	3.24	3.27	0.41	5.16	0.96
1967-1979	8.90	2.52	3.05	6.22	5.67	-0.02	6.51	3.08
1980-2008	2.47	1.69	2.86	0.77	-0.38	1.35	-0.14	-1.13

Source: Authors' calculations using data described in the text.

Figure 1
Total Factor Productivity, Second Set of Results
Brazil, 1950-2008

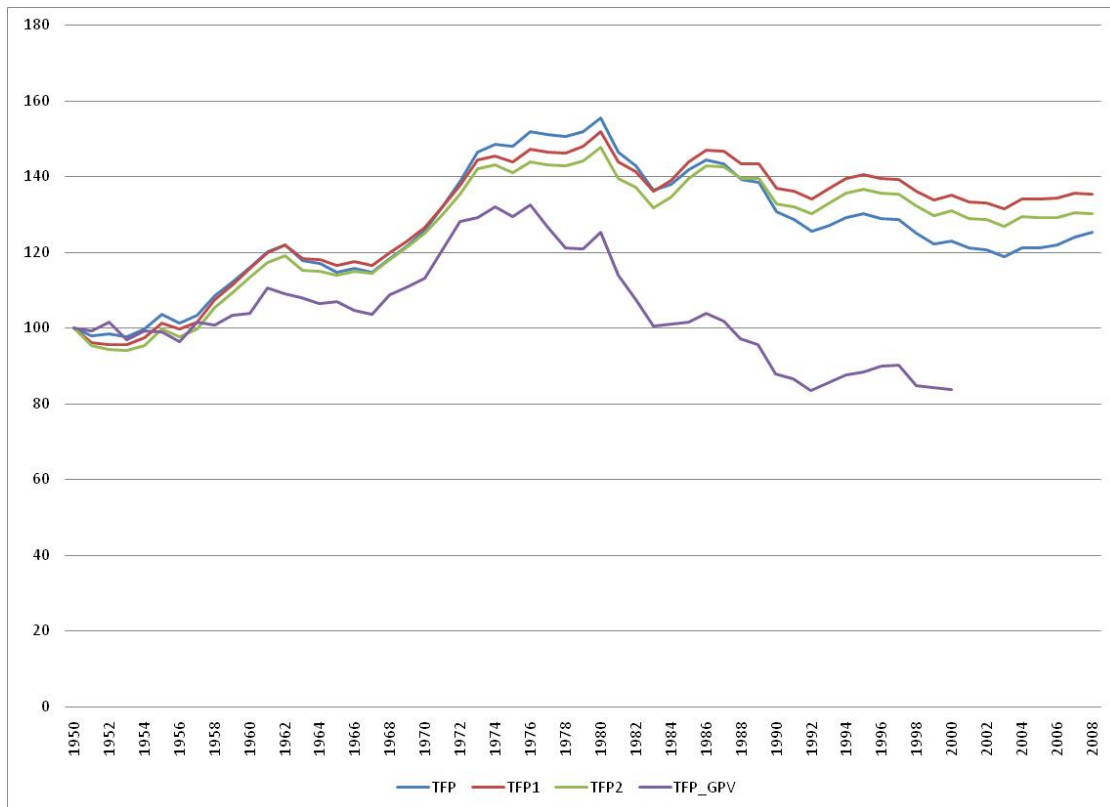


Figure 2
Decomposition of Growth of Output per Worker
Brazil, 1951-2008

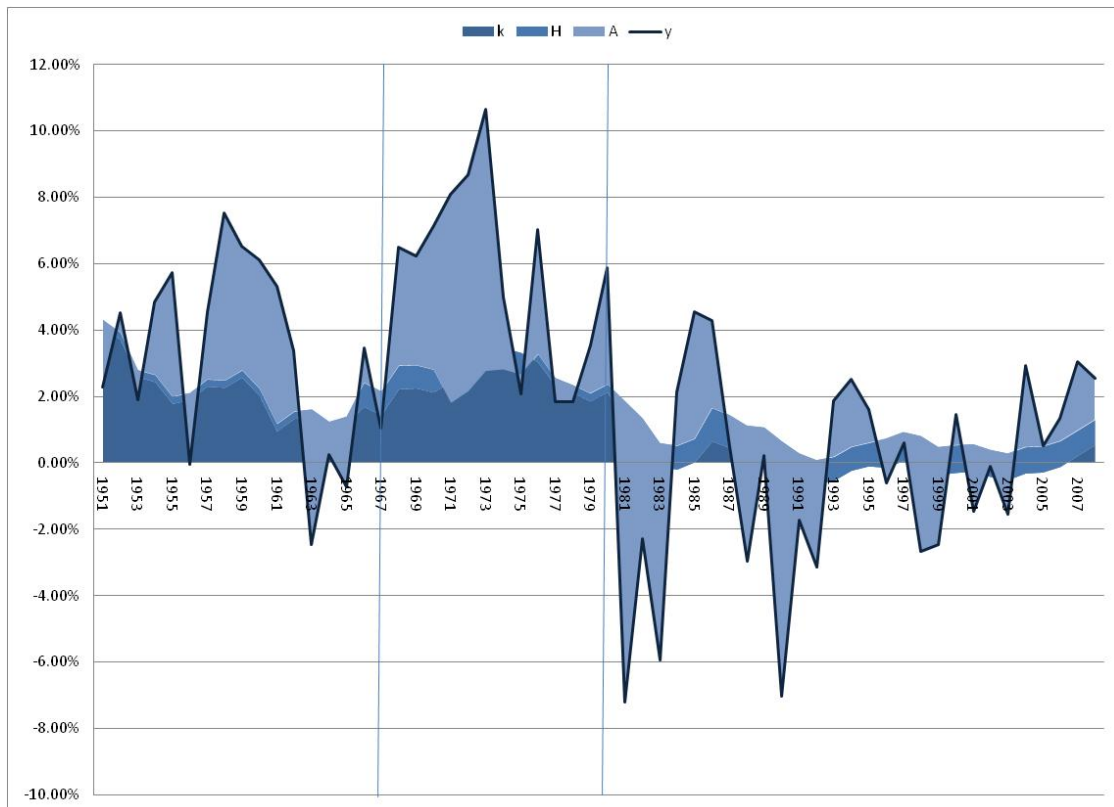
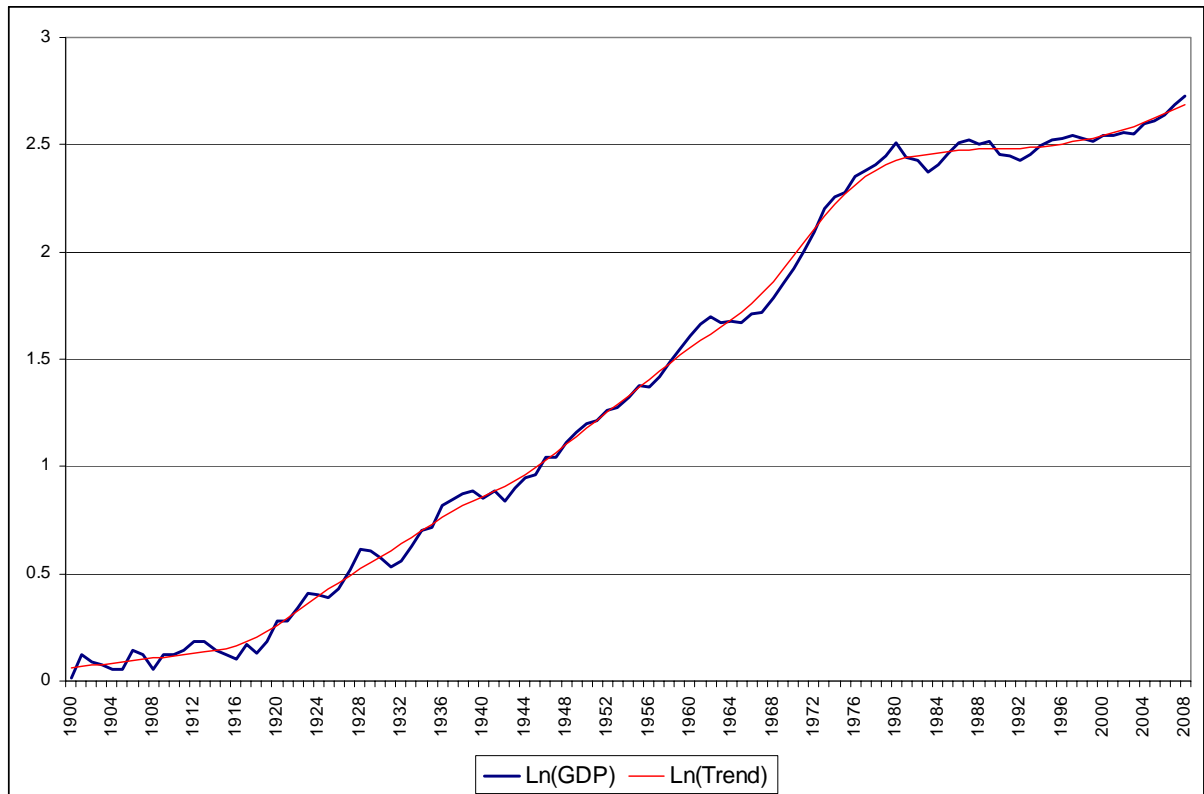


Figure 3
GDP per Capita and Trend GDP
Brazil, 1900 – 2008



Source: Ipeadata.

Figure 4
The Effect of Terms of Trade on the Growth Rate of GDP per Capita
Brazil, 1910 - 2008

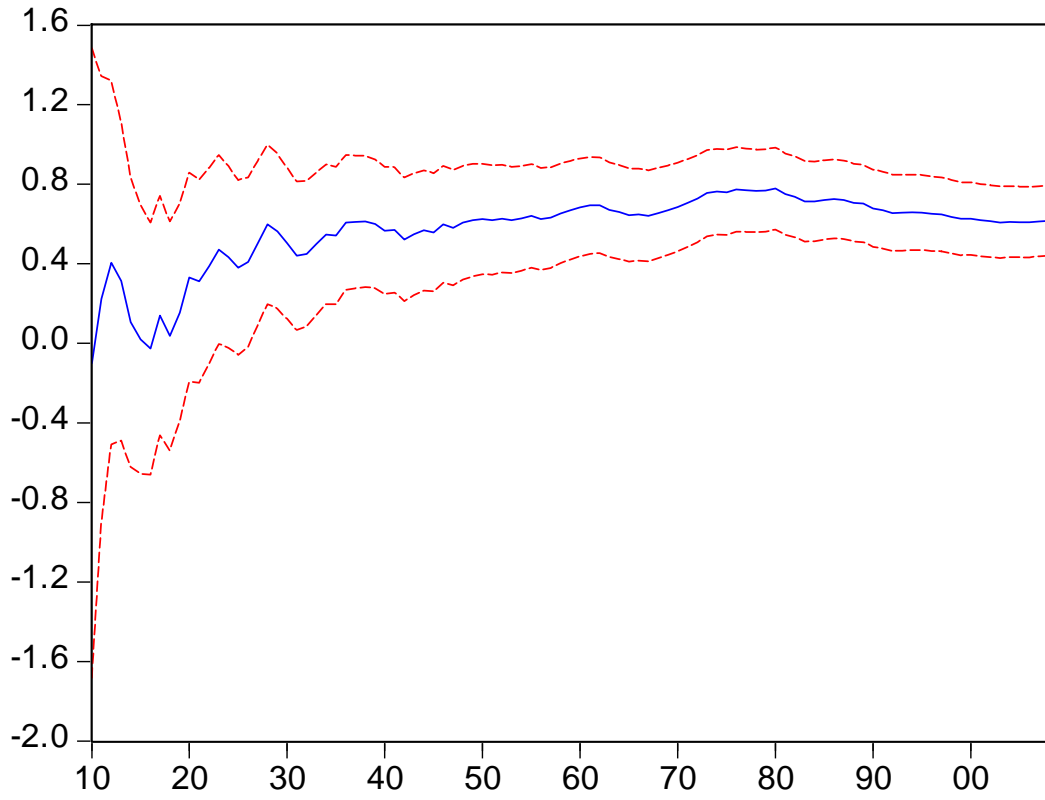


Figure 5
Effect of Terms of Trade on Output per Worker
(for a model including control variables)
Brazil, 1950-2008

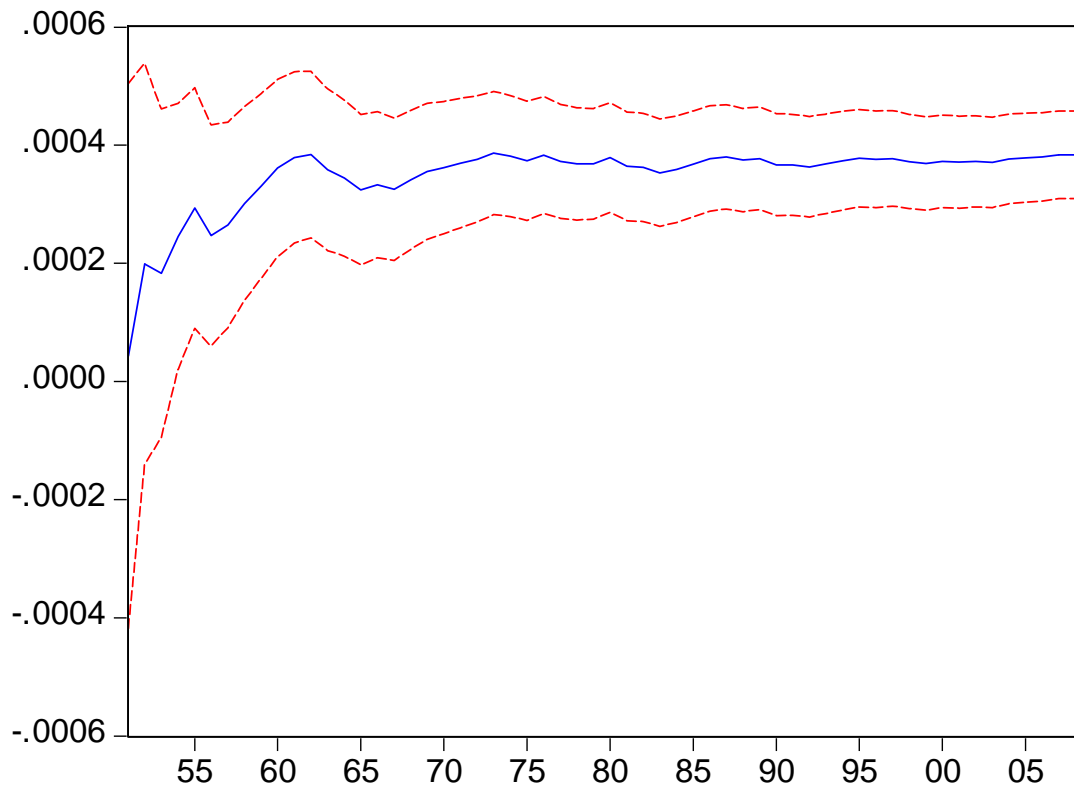


Figure 6:
The Effect of Terms of Trade on GDP Gap
Brazil, 1910 - 2008

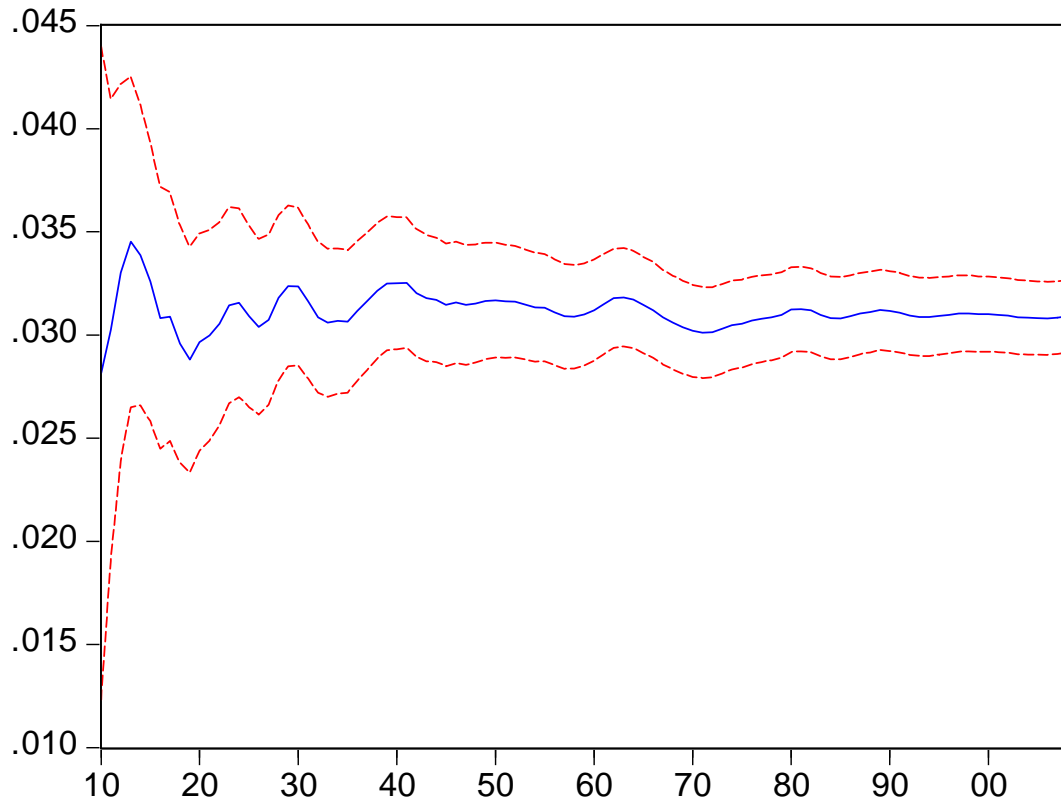
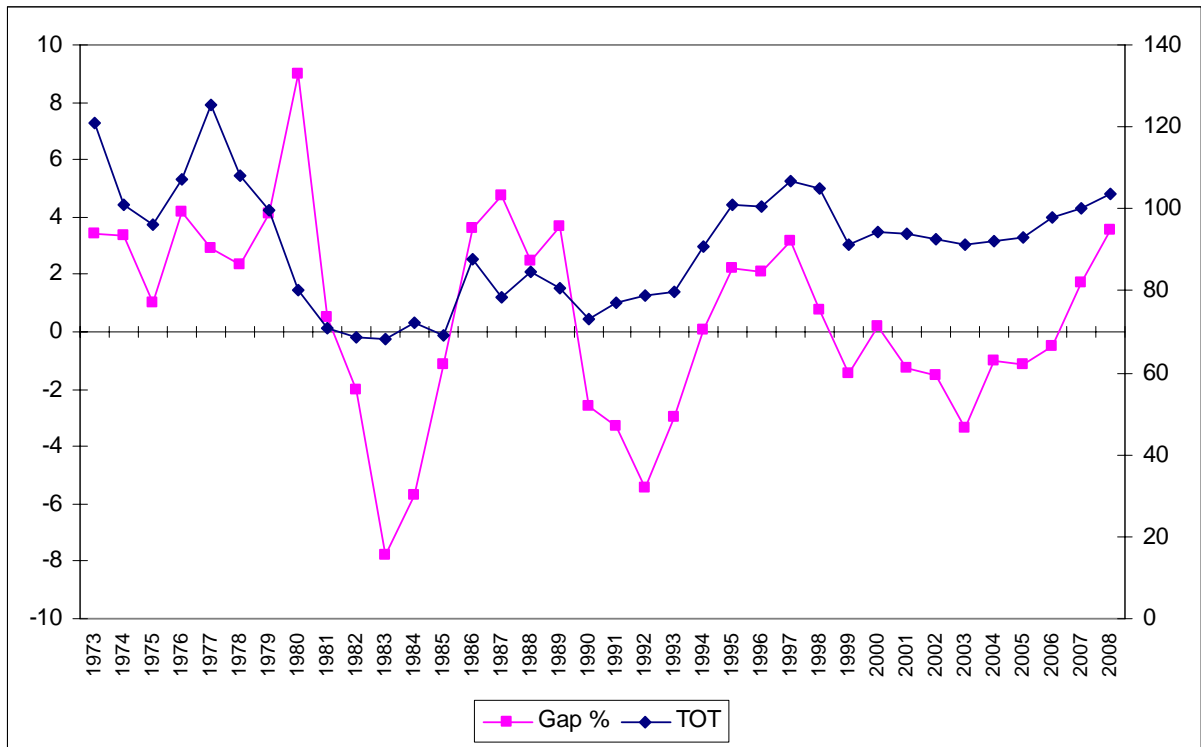
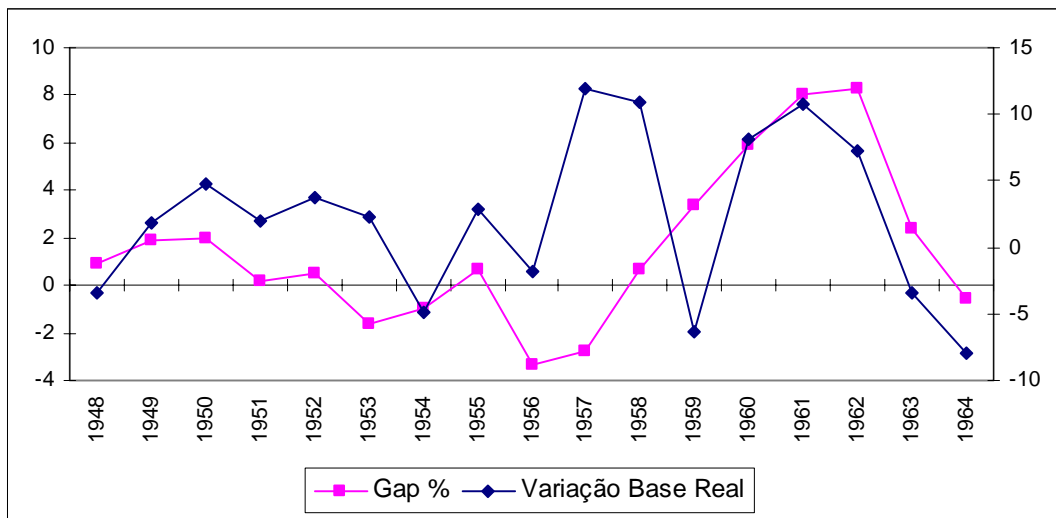


Figure 7
GDP Gap and Terms of Trade
Brazil, 1973-2008



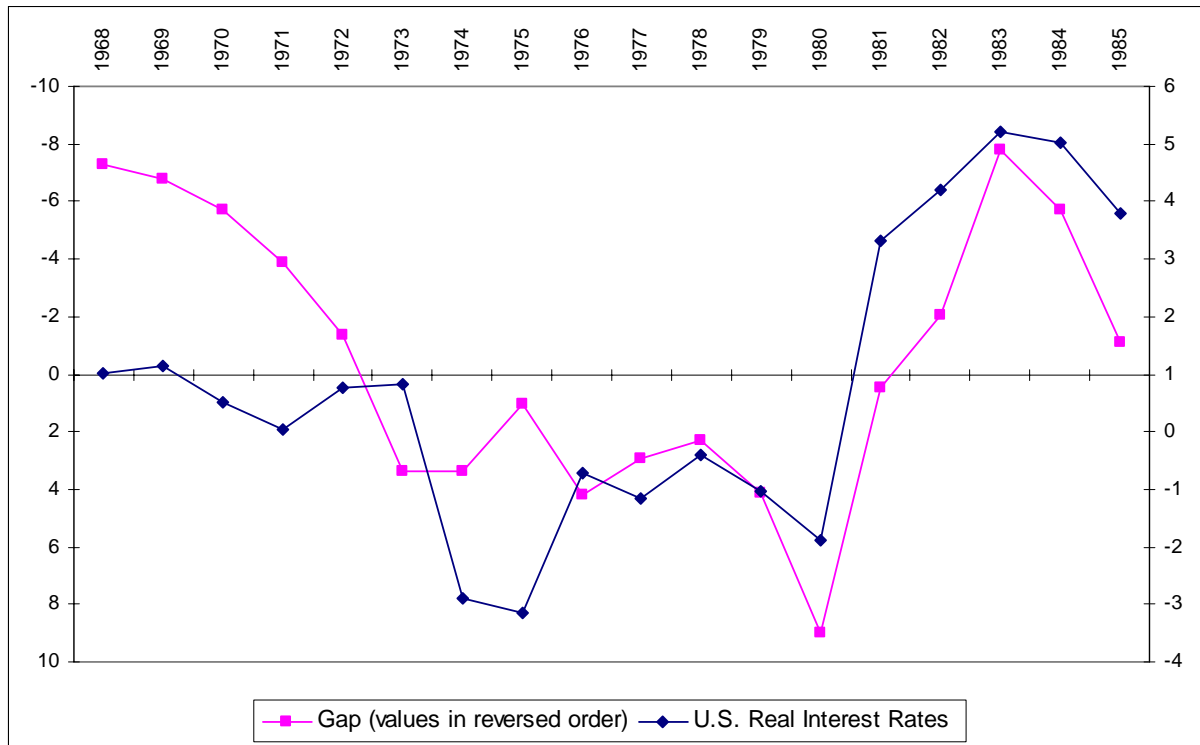
Source: Ipeadata, Oxford Latin American Economic History Database and Funcex.

Figure 8
GDP Gap and Percent Change of the Monetary Base
Brazil, 1948-1964



Source: Ipeadata

Figure 9
GDP Gap and U.S. Real Interest Rate
Brazil, 1968-1985



Sources: Ipeadata and US Bureau of Labor Statistics.