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Preface

This paper is part of the project "Explaining Economic Growth Performance" launched by the Global Development Network (GDN). The purpose of this project is to explain economic growth performances across seven regions - East Asia, South Asia, Latin America, Eastern Europe, Former Soviet Union, Middle East and North Africa, and Sub-Saharan Africa. Project support was provided by the GDN. Eduardo Fernández-Arias coordinated the preparation of the country papers for the Latin American region on behalf of the Latin American and Caribbean Economic Association (LACEA).

Introduction

Brazil's growth pattern during the 20th century is unique in more than one way. Until 1980, Brazil was among the fastest-growing economies in the world (Maddison, 1995). Yet this growth was achieved with a mix of policies frowned upon by today's economic consensus: low regard for price stability, high protection against imports, and widespread state intervention in the economy. The same policy set was in place for most of the 1981–93 period, when Brazilian GDP growth was not only much lower, falling behind world and Latin American averages, but also more irregular than in the previous 50 years.

The economy underwent significant structural changes during the 1990s, changes that transformed Brazil from inward-oriented, inflation-prone, and crisis-vulnerable to open, price-stable, and economically well managed. But Brazil's recent efforts to integrate itself into the world economy, establish macroeconomic stability, and rely on private enterprise rather than state planning as the engine of economic growth have met with limited success as measured by GDP growth.

Whether these reforms will be sufficient to generate GDP growth rates in the longer term comparable to those that Brazil enjoyed before 1980 is still an open question. Our hypothesis is that such growth will require further improvements, which are now possible given Brazil's new, more stable environment. Indeed some of these improvements — higher capital productivity associated with longer-term, more-transaction-specific investments and greater innovation; greater investment in skills and training; and the reform of institutions governing business activity — have only been imaginable under the clearer ground rules engendered by macro stabilization. To achieve these improvements, further reforms are necessary in government, policies, and institutions. Naim (1995) calls this second stage of reform *consolidation* and notes that, in contrast to the first stage, technical and political complexities are higher when reforms are launched, depending on a larger and more diverse set of actors. This underlines the need for political consensus about the necessity and content of these reforms, which has clearly been lacking in Brazil recently.

Thus a better understanding of Brazil's paradoxical growth pattern during the 20th century may not only improve policy formulation but also help generate political support for its implementation. Any proposal for deepening the reform process in Brazil will not win wide acceptance if it is not perceived to respond to a credible account of how policies that are "wrong" in 2001 appeared "right," and indeed seemed to work so well, for half of the last century.

With this context in mind, this paper addresses three overarching questions. First, how did Brazil manage to grow so rapidly from 1930 to 1980 while following so many "wrong" policies? Second, why did Brazil then perform so poorly in the final two decades of the century? And third, considering developments in both the domestic and international arenas, how should current public policy priorities be set to maximize Brazil's potential sustainable growth rate?

Analysis will proceed in four stages. First, we will look at the aggregate performance of the Brazilian economy in 1930–2000, estimating its supply-side sources of growth and relating the results to the policy framework adopted in each period. The next two sections will examine micro evidence from firms and households, respectively, and determine whether these patterns are consistent with the macroeconomic observations noted in our initial analysis. A final section sums up the main findings and details the policy and political-economy implications.

A Long-Term View from Aggregate Indicators

Overview

Despite the slowdown in its last two decades, the 20th century was a period of rapid change and exceptionally high growth in Brazil. As Table 1 indicates, both population and GDP growth accelerated after inauguration of the Republic in 1889. In particular, per capita GDP growth trebled during the Oligarchic or Old Republic when compared with the Empire period, and showed a six-fold increase when compared to the 320 years of colonial rule.

Yet this favorable record would only be a prelude to the remarkable growth of the following 50 years, starting with the 1930 Revolution and ending with the second oil shock and the debt crisis of the early 1980s. In this period, population, GDP, and per-capita GDP growth rates were higher than in any other phase of Brazilian development. The period was also unique in that Brazilian per-capita GDP increased as a proportion of the U.S.'s. Brazil's GDP growth performance also was remarkable compared with other Latin American countries and the world, and even with other 20th century high-achievers such as Japan and Korea (Table 2.2).

Table 1. GDP, Population, and Per-Capita GDP Growth in Brazil (1500–2000)

		Growth Rates (%)		Per Capita GDP*	
Period	**Characterization**	Population	GDP	Growth rate (%)	% of U.S. per capita GDP (end of period)**
1500–1820	Colony	0.47	0.62	0.15	51.4
1821–90	Empire	1.65	1.95	0.30	23.4
1891–1929	Oligarchic Republic	2.18	3.13	0.92	16.5
1930–80	*Desenvolvimentista* Era	2.62	5.72	3.03	28.0
1981–93	Very High Inflation Period	1.87	1.48	–0.39	20.8
1994–2000	Low Inflation/Adjustment Era	1.38	3.05	1.65	19.3
1500–2000		1.04	1.57	0.53	

Sources: Maddison (2001), IBGE, and IMF.
* Measured in 1990 international (PPP) dollars.
** Maddison (2001) estimates that Brazil and the U.S. had the same per capita GDP ($400) in 1500.

This bright performance ended in the early 1980s, and the luster did not return in the following 20 years. In 1981–2000, Brazil performed poorly not only vis-à-vis its past, but also compared with the world and Latin America. Its GDP per capita fell to a fifth of the U.S. level (in PPP terms), from a ratio of 28 percent in 1980. This deterioration is usually attributed to the poor macroeconomic and microeconomic management that characterized Brazil until the early 1990s. High inflation was accompanied by large trade barriers and by widespread state intervention through ownership of commercial enterprises, public monopolies, entry restrictions in a number of sectors, and a myriad of norms, regulations, and incentives aimed at directing private investment and activities. Yet this description also applies to the 1930–80 boom, suggesting it only partly accounts for the slowdown. Furthermore, since 1994 Brazil has experienced low inflation, trade liberalization, substantial privatization, and an end to much of the regulation of private activity, without restoring rapid growth (Tables 2.1 and 2.2).

Table 2. Comparison of Annual GDP Growth Rates (1930–2000)

Country	1931–50*	1951–80	1981–93	1994–2000
Brazil	4.6	6.8	1.4	3.1
Argentina	2.9	3.4	1.0	2.6
Mexico	4.1	6.4	1.7	3.1
Chile	2.7	3.4	3.5	5.6
Colombia	3.9	5.2	3.2	2.2
Korea	0.6	7.5	7.2	5.3
Japan	1.6	7.9	3.3	1.1
U.S.	3.2	3.6	2.2	3.9
Latin America	3.6	5.2	1.7	3.1
World	1.8	4.5	2.6	3.4

Source: Maddison (1995, 2001) and IMF.
*Years 1930–50 for Latin America and the world.

This apparent paradox will be examined in two ways. First, a one-sector, supply-side decomposition of GDP growth is used to scrutinize expansionary sources in a number of largely homogeneous periods of the 20th century. Then we analyze the characteristics of growth and economic policy in those different periods, introducing increasing detail as the end of the century nears and using a conditional convergence model to test for possible causes of (1) the slowdown in growth in the last two decades and (2) the seemingly small impact of recent reforms. The analysis is carried out separately for the following periods:

- *1901–30*. High period of the First (Old or Oligarchic) Republic, featuring mostly orthodox policies, a primary export economy, and relatively significant integration into the world economy;
- *1930–50*. Unstructured import substitution (IS) in traditional manufactures, with low participation by state-owned enterprises (SOEs) and high dependence on coffee exports;
- *1951–63*. Structured IS in consumer durables, with increasing participation by SOEs and foreign direct investment (FDI) and ongoing dependence on coffee exports;
- *1964–80*. Expansion of IS into intermediate and capital goods, rapid growth of manufactured exports, high FDI, and continuing growth of SOEs;
- *1981–93*. An increase and then a decline in import protection and export subsidies, first steps toward privatization, low FDI inflows, and high macroeconomic instability;
- *1994–2000*. Improved macroeconomic conditions, substantial increases in import penetration, deepening privatization, and expanding FDI.

Growth Accounting

Tables 3 and 4 show GDP growth accelerating from an average of 4.3 percent yearly in 1900–30 to 7.8 percent in 1964–80, paralleling the rise in growth rates of employment and, at least since the 1930s, of physical and human capital.[1] The stock of machinery and equipment rose especially fast, partly to offset its higher rate of depreciation. Table 3 illustrates again the significant deceleration in GDP growth in the last two decades of the 20th century. It also shows that lower GDP growth was accompanied by equally substantial declines in the growth rate of employment and physical and human capital. The contrast before and after the Real Plan is also evident: GDP growth was lower and factor accumulation was faster beforehand,

[1] Rates of investment (constant prices) were similar in 1900–30 and 1930–50.

while the opposite was true afterward except for machinery and equipment, which actually declined in 1981–93 and boomed after price stabilization.

Table 3. Annual Growth of GDP, Capital Stock, Employment, and Human Capital (%)

Period	GDP	Capital Stock				Employment	Human Capital (Years of Schooling)		
		Total	Const.	Man. & Equip.	Imported M.&Eq.		1981 PNAD	1998–9 PNADs	Combination[c]
1901–30	4.33					1.51			
1931–50	5.14	5.30	5.87	3.74	8.29[a]	1.84	1.67		1.67
1951–63	6.88	8.67	9.08	7.14	3.64	2.81	1.75	2.49	2.11
1964–80	7.79	8.96	8.83	9.49	4.00	3.25	2.14	2.69	2.62
1981–93	1.64	2.60	3.55	–2.58	–4.59	2.17		0.52	0.52
1994–2000[b]	3.05	2.30	1.60	7.33	20.77	–0.35		0.41	0.41

Sources: See Appendix 1; Pesquisa Nacional por Amostra de Domicílios (PNAD).
[a] Years 1934–50.
[b] Years 1994–9 for years of schooling.
[c] Combination of 1981 and 1998-99 PNADs.

Table 4. Illiteracy Rates, Secondary School Enrollment Rates, and Life Expectancy (1900–98)

Year	Illiteracy (%)	Gross Enrollment in Secondary Schools (%)	Life Expectancy
1900	65.3		
1920	69.9	2.1	
1940	56.2	3.8	42.74
1950	50.0	5.8	45.90
1960	39.5	10.8	52.37
1970	33.1	26.0	52.67
1980	25.5	33.5	61.76
1981		33.2	62.76
1991	20,1	40.5	66.03
1993		42.8	66.63
1998[a]	13.8	45.0	68.55

Sources: Romanelli (1982), IBGE, and GDN database (www.worldbank.org/research/growth).
Notes: Illiteracy rates are for age 15 or over.
[a] Year 2000 for life expectancy.

The reflection of those trends in output growth and factor accumulation on factor productivity is shown in Table 2.5. Substantial capital accumulation in 1931–80 caused a decline in capital productivity, but helped to foster a substantial rise in labor productivity, building on the already substantial increase recorded in 1901–30. The growth rate of human capital productivity also accelerated in 1931–80.

Table 5. Annual Factor Productivity Growth (%)

Period	Physical Capital			Labor	Human Capital		
	Total	Const.	Mach. & Equip.		1981 PNAD	1998–99 PNADs	Combination
1901–30				2.8			
1931–50	–0.2	–0.7	1.4	3.3	3.5		3.5
1951–63	–1.8	–2.2	–0.3	4.1	5.1	4.4	4.8
1964-80	–1.2	–1.0	–1.7	4.5	5.7	5.1	5.2
1981–93	–1.0	–1.9	4.2	–0.5		1.1	1.1
1994–2000	0.8	1.5	–4.3	3.4		2.6[a]	2.6[a]

Source: Table 3.
[a] Years 1994–99 for human capital.

In 1981–93, capital productivity continued to decline, while growth of labor productivity dropped 5 percent and human capital fell 4.1 percent. This was the only decline in labor productivity registered among the periods considered here. Partial factor productivity

of labor and physical and human capital all rose significantly in 1994–2000. Thus total factor productivity (TFP) growth was not only positive during this time, but at least 1.5 percent higher than in 1981–93, a larger increment than for output growth. On the other hand this means that factor accumulation in 1994–2000 was necessarily negative.

In Table 6 a Solow-style decomposition of output growth into factor accumulation and TFP growth (or the Solow residual) are derived. Leaving aside for now the growth in human capital, a Cobb-Douglas production function is used with physical capital (*K)* and labor (*L)* of the form

$$Y = AK^{\alpha}L^{1-\alpha}. \qquad (1)$$

To solve for the growth rate of productivity, logs and time derivatives are taken:

$$TFP = \text{GDPGrowth} - \alpha * \text{CapGrowth} - (1-\alpha) * \text{LaborForceGrowth}. \qquad (2)$$

The key parameter for the growth decomposition exercise, then, is the capital elasticity α, for which the literature presents varying estimates. Typical cross-country exercises, including some with Brazil as part of the sample, use values of α between 0.3 and 0.4.[2] Estimates from time series regressions with Brazilian data point to a value of α close to 0.7.[3] The national accounts, in turn, suggest a value of α between 0.48 and 0.55, depending on how self-employment income, which includes a return to both labor and capital, is allocated (IBGE, 2000). Based on this, some of the previous growth decomposition exercises for Brazil have assumed equal shares of capital and labor (i.e., $\alpha = 0.5$).[4]

Regardless of the value of α, it is clear from Table 6 that the decline in GDP growth after 1980 was due both to a lower rate of capital accumulation and a drop in TFP growth, with the lower growth rate in employment playing a secondary role. As the value of α grows, the contribution of capital in explaining the high GDP growth in 1930–80 and its subsequent decline increases, while the contribution of TFP growth decreases. For $\alpha = 0.7$, growth in capital stock explains 80 percent of GDP expansion in 1930–80 and 72.4 percent of the decline in output growth from 1964–80 to 1981–93, while TFP accounts for 8.1 percent and 22.3 percent, respectively. For $\alpha = 0.3$, capital accumulation accounts for 34.3 percent of GDP growth in 1930–50 and 31.1 percent of the decline in output growth between 1964–80 and 1981–93, while TFP growth contributes plus 38 percent and minus 31.1 percent, respectively.

Table 6 confirms that accelerated GDP growth after price stability in 1994 was entirely due to higher TFP growth. In fact, except for low values of α, TFP growth was higher in 1994–2000 than for any previous period in the table. Indeed, low inflation and the 1990s market reforms failed to restore output growth to pre-1980 levels because those reforms failed to generate factor accumulation, with the contributions of both labor and capital to output growth actually declining in comparison to 1981–93.

[2] See, for instance, Mankiw (1995), McKinsey (1998), and De Gregorio and Lee (1999).
[3] See Abreu and Verner (1997) and our estimates in Appendix 2.
[4] See, for instance, Bonelli and Fonseca (1998) and Bacha and Bonelli (2003).

Table 6. Growth Decomposition Using Solow's Model with Capital and Labor

		Brazilian Elasticities (α = 0.7)			Cross-Country Elasticities (α = 0.3)		
Period	GDP	Capital	Labor	TFP	Capital	Labor	TFP
1931–50	5.14	3.71	0.55	0.88	1.59	1.29	2.26
1951–63	6.88	6.07	0.84	–0.03	2.60	1.97	2.31
1964–80	7.79	6.27	0.98	0.54	2.69	2.28	2.83
1981–93	1.64	1.82	0.65	–0.83	0.78	1.52	–0.66
1994–2000	3.05	1.61	–0.11	1.55	0.69	–0.25	2.61

Following Mankiw, Romer, and Weil (1992), our second TFP measure builds on a production function augmented to include human capital (*H*) in addition to physical capital (*K)* and labor (*L*):

$$Y = AK^{\alpha}H^{\gamma}L^{1-\alpha-\gamma}. \quad (3)$$

We use the average years of schooling of 20-year-olds as a proxy for the human capital stock in the economy. As above, estimates of TFP and of the contributions of factor accumulation to growth depend on the values of α and γ. Our Brazil time series data revealed collinearity between physical and human capital growth. Controlling for the contribution of physical capital to labor productivity growth, we find no additional statistically significant contribution from human capital growth (i.e., the hypothesis that $\gamma = 0$ cannot be rejected).[5] This contrasts with the parameter values used in Mankiw (1995), namely $\alpha = 0.3$ and $\gamma = 0.5$, which assume that about two-thirds of labor income can be considered as return to human capital. Using Mankiw's parameter values and taking logs and time derivatives gives us the following:

$$\text{TFP} = \text{GDPGrowth} - 0.3 * \text{CapGrowth} - 0.5 * \text{SchoolGrowth} - 0.2 * \text{LaborForceGrowth} \quad (4)$$

which, when applied to the values in Table 3, gives the growth decomposition in Table 7.

Table 7. Growth Decomposition with Human Capital Using Elasticities from Mankiw (1995)

Period	GDP	Physical Capital	Labor	Human Capital	TFP
1931–50	5.14	1.59	0.37	0.84	2.35
1951–63	6.88	2.60	0.56	1.06	2.66
1964–80	7.79	2.69	0.65	1.31	3.14
1981–93	1.64	0.78	0.43	0.26	0.17
1994–2000	3.05	0.69	–0.07	0.21	2.23

The results are not qualitatively different from earlier, reflecting the fact that even with Mankiw's high elasticity for human capital,[6] its contribution to GDP growth in 1930–2000 is small. The decline in the growth rate of schooling accounts for a notable share of the post-1980 drop in GDP growth, but its role is again less important than that of TFP and capital accumulation. And the jump in TFP growth still explains the entire rise in GDP growth after 1994. The small contributions from labor and physical and human capital reflect, by construction, the low growth in their respective stocks during this period. Indeed this second decomposition confirms that the failed occurrence of factor accumulation, including human capital, has prevented Brazil from resuming pre-1980 GDP growth rates after the Real Plan.

[5] The same result is obtained by Abreu and Verner (1997) with a different measure of schooling: average years of primary, secondary, and tertiary education per person over 10.

[6] Mankiw, Romer, and Weil (1992) actually estimate $\alpha = 0.59$ for middle-income countries when only labor and capital are included in the model, as earlier, and $\alpha = 0.29$ and $\gamma = 0.30$ when human capital is also considered. With the figures in Table 3, these values would imply a higher contribution of capital to output growth than estimated with Mankiw's (1995) elasticities.

Physical capital accumulation and TFP growth explain most of the growth dynamics of the Brazilian economy since 1930. The higher the value of the capital elasticity of output used for decomposing growth, the higher the contribution of capital and the lower that of TFP. Note, though, that the two need not be dissociated. TFP growth seems to have been systematically associated with the growth in the stock of machinery and equipment, as can be seen comparing results in Table 5 and 6. It may therefore be that some TFP growth was gained through capital-embodied technological progress.[7]

Characterizing Growth and Policies in the 20th Century[8]

This section examines how the economy and policy evolved during the last century, focusing on variables that might explain the dynamics of Brazilian output growth. A cursory description of the 1900–30 period sets the stage for a gradually more detailed analysis of the periods that follow.

Oligarchic Orthodoxy, 1901–30.[9] In the first three decades of the 20th century — the acme of the so-called First Republic — Brazilian GDP expanded an average of 4.3 percent per annum, or 2 percent per capita, a substantial improvement on earlier growth rates. The period began with a cyclical recovery from the difficult latter years of the 19th century, sparked by a boom in rubber export prices. Aggregate investment reacted with a lag to the output performance — partly because almost all capital goods had to be imported — increasing continuously as a ratio of GDP from 4.9 percent in 1901 to 17.8 percent in 1908, dipping slightly in 1909, and rising again from 1910 to 1913, when it peaked at 29.1 percent of GDP (in constant 1980 prices). A substantial part of this investment went to industry and infrastructure: In 1901–14 the rail network expanded 4 percent annually, while total power generation capacity increased 30 times, largely through FDI.

Improvement in the trade and capital accounts led to substantial currency appreciation, with the mil-réis rising in value from 14.5 cents of a U.S. dollar in 1899 to 25 cents in 1905. To curb further appreciation, a currency board was established in 1906, fixing the exchange rate at 32.3 cents per mil-réis. Although a brief financial crisis in international markets in 1907 caused a recession in 1907–8, the economy boomed in 1909–12, helped by favorable terms of trade and easy access to external credit, with a particularly good performance by the industrial sector. This rapid industrial growth was facilitated by monetary expansion from the currency board's procyclical incentives, which used monetary policy to reinforce the stimulus provided by the trade account.

The 1913 decline in export prices, together with a surge in imports, caused liquidity to fall, leading to a major deflation and initiating a credit crunch that would last until the beginning of World War I, when the currency board was discontinued. Abandonment of the gold standard was followed by large fiscal imbalances and accelerated inflation, which averaged 17.1 percent annually in 1915–6. However the government successfully stabilized the economy with the assistance of a loan from foreign creditors, which also helped sustain the exchange rate around US$0.25 per mil-réis in 1915–8.

GDP remained essentially stagnant during the war, but the industrial sector picked up in 1915–7, after contracting 8.7 percent in 1914. With output capacity enhanced by the capital

[7] See De Long and Summers (1991) and Eaton and Kortum (2001) for a discussion of the importance of machinery and equipment investment to growth, particularly when using machinery imported from capital-goods-R&D-intensive countries such as the U.S., Germany, and Japan.

[8] The following overviews are not intended to provide a full historical account of the Brazilian economy in the 20th century. For that, see, among others, Furtado (1971); Fishlow (1972); Prado Jr. (1970); Suzigan (1986); Abreu (1990); Lamounier, Carneiro, and Abreu (1994); and Giambiagi and Moreira (1999).

[9] For a description of economic events and policies in this period see Fritsch (1990), on which we partly draw.

accumulation in the years preceding the war, firms were able to engage in import substitution, particularly of processed foodstuffs, and to increase nontraditional exports (Fishlow, 1972). The decline in imports cut fiscal revenues and forced the government to expand the basket of products subject to the consumption tax. Combined with low growth in public expenditures, this reduced the public deficit during the war.

Investment levels collapsed with the credit crunch initiated in 1913, falling to 11.7 percent of GDP, and were constrained by the ensuing war, which made importation of capital goods and access to FDI much harder. In 1915–8 the rate of investment averaged a mere 5.7 percent of GDP, with a substantial decline in construction and especially in machinery and capital equipment accumulation, which in this period fell on average to just a seventh of its peak value in 1913. Electric generating capacity and the rail network expanded less than 7.9 percent and 6.3 percent, respectively, from 1914 to 1918.

Brazil's terms of trade dramatically declined during the war, averaging in 1915–8 just 41 percent of their 1914 high. Yet loss of much of the 1918 coffee crop from cold weather and a robust postwar recovery in world economic growth caused Brazilian exports to double from 1918 to 1919, with a 66.5 percent improvement in its terms of trade. Adoption of restrictive monetary policies in the U.S. and England in 1920 produced a major drop in terms of trade, and a decline in exports in 1921, although imports by then had doubled with respect to 1918, reflecting high GDP growth and the partial recovery of investment levels. The impact was severe, as reflected in the 15.3 percent decline in the GDP deflator in 1921, and had an important influence on policy, but this shock proved to be short-lived. Both exports and terms of trade rose in the following years, thanks to a recovery of the world economy and a successful move by Brazil to reduce the supply of coffee in international markets.

After appreciating slightly in 1919, the mil-réis experienced a major devaluation in 1920–1 and again in 1923, when the exchange rate declined to a U.S. dime per mil réis. This depreciation and loose monetary policy stoked inflation to a peak of 30.1 percent in 1923. Currency weakness, high inflation, and the military upheaval of mid-1924 would then convince President Bernardes to adopt an orthodox stabilization program with restrictive monetary *and* fiscal policies, which caused growth to decline to 1.4 percent that year and zero in 1925, down from an average 8.2 percent in 1922–3. Industrial output, which had expanded at an average of 16 percent per annum in 1922–3, showed zero growth in 1924–5.

Despite its high costs with respect to lost output, the stabilization program successfully brought inflation down. As measured by consumer prices in Rio de Janeiro, inflation fell from 16.9 percent in 1924 to 2.7 percent in 1926, and the currency strengthened to $0.14 per mil-réis. Contributing to this appreciation was the recovery in Brazil's balance of payments, with the rise in exports and terms of trade referred to earlier and renewed expansion in FDI. Concerned once more with the negative impact of a strong currency on the income of coffee growers and entrepreneurs, the government resorted to a currency board, with the exchange rate fixed at $0.12 per mil-réis.

The events that followed resembled those of the prewar period. Expansionist monetary and fiscal policies lasted while the balance of payments was favorable but became suddenly contractionary when exports fell, at a time when imports were still growing, thus greatly reducing the trade balance and consequently the money supply. In 1926–8, when the government successfully kept coffee prices high, GDP expanded an average 9.2 percent annually. In 1928 the trade surplus fell to $85 million from $118 million in 1926, just as the supply of foreign credit declined, reducing domestic liquidity. Concerned with the balance of payments, the national government reduced domestic credit, constraining the ability of the government of the São Paulo State to finance its coffee price support scheme, particularly in light of the record crops of 1927 and 1929. Coffee prices began to fall in late 1929 and plunged during 1930, further tightening Brazil's monetary policy.

Despite the recessionary effects of the currency board in this unfavorable climate, a decline in industrial GDP, virtual stagnation in the rest of the economy, and a 3.6 percent deflation, the government stuck to the gold standard, hoping the external environment would change. Instead the situation deteriorated further, with a 2.1 percent drop in GDP (–6.7 percent for industrial GDP) and a 12.4 percent decline in the GDP deflator.

The late 1920s illustrate well the volatility during the first third of the century in growth, terms of trade, and exchange rates that could be expected in a primary export economy subject to the vicissitudes of weather and to external shocks, particularly of the magnitude of those registered in 1914–30. These shocks would eventually lead to a shift in economic models and Brazil's form of integration into the world economy, and to the evolution of new urban-based political alliances that overcame the decades-old dominance of agricultural interests, coffee growers in particular.

Although the degree of orthodoxy among Brazilian policymakers in this period is debatable, particularly regarding fiscal and monetary matters, a relative consensus exists that economic policy was predominantly liberal and that state intervention in foreign trade and private activities was minimized except for policies supporting international coffee prices. Governments endeavored to keep inflation low and, indeed, succeeded in doing so by the standards Brazil would set for the rest of the century. Moreover, although import tariffs — measured as the ratio of import taxes to import value — were also at the high-water mark for the century, their purpose was less to promote industrialization than to generate public revenues.[10] The Brazilian economy remained highly concentrated on agriculture, and the industrial share of total output only rose from 13.2 percent in 1900 to 17 percent in 1930 (Table 8).

Table 8. Sector Composition of GDP and Employment (%)

	Agriculture		Industry		Services	
	GDP	Labor	GDP	Labor	GDP	Labor
1900[a]	45.0	66.9	13.2	4.2	41.8	28.9
1930[a]	36.3	66.3	17.0	13.6	46.7	20.2
1950	23.2	59.9	25.9	17.6	50.9	22.5
1963	16.2	51.0	34.9	18.8	48.9	30.2
1980	10.1	29.4	40.9	29.1	49.0	41.5
1993[b]	12.5	26.1	39.5	20.8	48.0	53.0
2000[b, c]	12.9	23.6	38.4	19.2	48.7	57.2

Note: GDP composition is based on factor cost, 1980 prices.
[a] Workers in arts and crafts (artes e ofícios) and with unidentified occupations are allocated in services.
[b] Uses labor force figures from the New National Accounts System.
[c] Labor figures refer to 1999.

Economic policy would change substantially in the following decades. Fritsch (1990) argues convincingly that this change resulted less from the new political alliances that triumphed in the 1930 revolution than from the shift in the international order and external environment caused by the Great Depression:

> [I]n explaining the profound change in the style of economic policy that takes place from the thirties onwards, in the sense of greater government intervention in international transactions, a more prominent role must be ascribed to the restrictions imposed by the changes in the external environment that prevented the maintenance of the traditional stance. This amounts to minimizing the validity of the notion that, in this change of styles, there was any a priori intention towards increasing incentives to

[10] Indeed, the fact that those revenues were for a long time the main source of public funds also made fiscal policy procyclical, accentuating the volatility in growth.

industry, as not rarely is inferred from the assumptions regarding the loss of power of exporters after the collapse of the First Republic.

The dramatic external disequilibria experienced by Brazil since the late twenties, as a consequence of the collapse in international capital markets, the brutal contraction in international trade and the problems generated by large coffee crops, completely changed the viability of the forms of interaction to the world economy consolidated in the First Republic. Ironically, this created the conditions for overcoming the old problem of how to sustain domestic stability when faced with external shocks without any of the structural or institutional reforms that would have been necessary with the world economy under normal conditions.

Unstructured Import Substitution, 1931–50. This era was a time of relatively high growth marked by a substantial rise in the industry share of output, which rose from 17 percent in 1930 to 25.9 percent in 1950 (Table 8). Most of this period was characterized by low import volumes, which were limited either by the attempt to reduce balance-of-payments disequilibria or by World War II supply restrictions. In 1948 imports finally surpassed their real level in 1930, only to dip again in the following year as the government reacted to the trade account by reinstating several controls on foreign exchange expenditures. Overall, imports increased 0.5 percent on average in these two decades, versus 5.1 percent annual GDP growth and 7.3 percent industrial output growth.

Table 9. Trade and Current Account Indicators

	Real Annual Growth of Trade (%)		Trade Balance	Current Account	Terms of Trade	Parity Rate	
	Exports	Imports	GDP	Bal./GDP		Mean	SD
1901–30**	2.5	3.0			160.6	42.7	10.1
1931–50	1.5	0.4			118.2	77.1	17.7
1951–63	–1.2	1.7	–0.4	–1.4	164.0	65.8	13.0
1964–80	8.0	5.6	–0.7	–2.4	143.3	86.9	6.0
1981–93	6.5	1.9	3.6	–1.1	94.7	92.6	16.8
1994–2000	4.3	13.5	–0.2	–3.3	124.1	68.4	9.6

Note: Terms of trade are based on 1980 = 100; the parity rate is measured against the U.S. dollar using wholesale price indices.
[a] Years 1908–30 for parity rate.

The process of import substitution in this period was usually a side effect of policies dealing with reduced trade and capital flows during the Depression and World War II, and the foreign exchange constraints stemming from Brazil's high foreign debt. Only in the late 1940s did government realize the potential of fostering industrialization through selective protection of specific sectors and a targeted expansion of public credit (Vianna, 1990). As output growth became less closely linked to agriculture and the world market, growth also became more stable, particularly in industry (Table 10). As the investment recovery from the rather low rates of the 1930s suggests, this helped foster capital accumulation, with a substantial rise after World War II when trade liberalization and a grossly overvalued exchange rate boosted capital goods imports. A remarkable increase in capital goods investment ensued, more than three times higher in 1946–50 than in 1930–45.

Table 10. Average Growth and Annual Variation of GDP, Population, and GDP Per Capita

			Period					
			1901–30	1931–50	1951–63	1964–80	1981–93	1994–2000
GDP	Total	Mean	4.3	5.1	6.9	7.8	1.6	3.1
		Std. dev.	5.1	4.4	2.9	3.3	4.1	2.0
	Agriculture	Mean	3.6	2.7	4.1	4.5	2.4	3.4
		Std. dev.	7.5	5.1	4.0	4.5	5.9	2.6
	Industry	Mean	5.2	7.3	9.5	8.5	0.4	2.6
		Std. dev.	7.0	5.6	4.9	5.3	6.5	3.2
	Services	Mean	4.7	5.5	6.7	7.5	0.5	3.2
		Std. dev.	7.0	5.9	3.9	4.0	5.0	5.0
Population			2.4	2.0	3.0	2.6	1.9	1.4
Per capita GDP			2.0	3.1	3.9	5.1	–0.2	1.7

Following the difficult years of 1930–1, when GDP declined 2.7 percent annually, the economy recovered robustly in 1932–9, with GDP growing 6.1 percent annually. Compared with the first decades of the century, growth became more inward-oriented and was fueled by expansionist fiscal policies, mainly deficits from massive purchases of coffee that was then burned in order to sustain the international crop price.[11] Monetary policy, which had been clearly contractionary in 1931–2 when prices declined a total of 32.8 percent, also became more expansionary, with inflation averaging 3.4 percent in 1932–9.

The combination of expansionist fiscal, monetary, and credit policies, severe quantitative controls on imports (particularly until 1937, when servicing the foreign debt was a central objective of foreign exchange controls),[12] and the existence of substantial idle capacity from the late 1920s rise in investment provided great stimulus to industry. In 1932–9, industrial output expanded 9 percent yearly, allowing for a decline in the share of imports in domestic supply, in 1939 prices, from 45 percent in 1928 to 25 percent in 1931 and 20 percent in 1939 (Abreu, 1990). Yet because this industrial growth was accomplished essentially by a rise in capacity utilization, the structure of output changed little, with the share of traditional industries (e.g., foodstuffs and textiles) declining a mere 10 percent in 20 years, from 80 percent in 1919 to 70 percent in 1939 (Fishlow, 1972).[13]

The 1930s were marked by controls on foreign exchange purchases, with the severity varying over time. Faced with a 49 percent decline in terms of trade in 1930–2, and with no access to international capital markets, the government suspended foreign debt service and created a foreign exchange monopoly through Banco do Brasil, which received all export

[11] As noted by Fishlow (1972), though countercyclical fiscal policy might have been unintended, from 1933 onward the deficits were foreseen in the budget. According to Abreu (1990), this willingness to accommodate fiscal shocks with an increase in the fiscal deficit, so different from the usual policy orientation of the First Republic, allows us to "state that the Provisional Government's economic policy was pre-Keynesian."

[12] An interesting development in the late 1930s was the decision to prioritize foreign exchange expenditures with imports, allowing the economy to expand at a reasonable rate at the expense of servicing the foreign debt (Abreu, 1990). Another was the creation in 1940 of the National Steel Plan Commission and the concomitant decision to establish under state ownership Brazil's first large integrated steel producer, Companhia Siderúrgica Nacional, which would begin operations in 1946.

[13] In 1939, domestic output already accounted for the largest part of intermediate goods and consumer nondurables, but this was not true for capital goods and consumer durables (Fishlow, 1972).

revenues. Imports and other foreign exchange expenditures were then allowed according to a list of priorities defined by the government. As in other episodes in 1931–50, devaluation was not deemed worthwhile because of its negative impacts on the international coffee price, inflation, and the fiscal accounts, through government foreign exchange expenditures (in domestic currency). In this sense, the overvalued exchange rate, coupled with the obligation to sell to the government, worked as a tax on coffee and other traditional exports that was passed on to and paid by foreign consumers.

As terms of trade improved in 1934, foreign exchange controls were relaxed some, enabling nontraditional exporters to sell more in the "free" market by mitigating the negative impact on competitiveness of an overvalued exchange rate, and allowing importers and foreign investors to buy hard currency. Later, controls would be retightened when liberalization and a decline in terms of trade caused the current account to widen. In different forms the foreign exchange market would remain segmented for many years, with the coexistence of two, three, five, or even ten exchange rates, each applying to a different client, product, purpose, or end of the market. For domestic producers, the virtual ban on competing imports and the access to inputs and capital goods at an overvalued exchange rate provided extreme protection, regardless of the actual nominal import tariffs, which actually declined compared with 1901–30 (Table 11). Moreover the moderate trade opening of the mid-1930s and the privileges ascribed to "essential imports" fueled an increase in the stock of imported capital goods, which increased 27.5 percent between 1934 and 1939.

Table 11. Average Import Tariffs

	All Goods	Non-Oil
1901–30	30.4	
1931–50	22.3	25.7
1951–63	9.2	10.9
1964–80	10.8	13.9
1981–93	7.6	11.4
1994–2000	8.7	8.7

When World War II began, the economy again suffered a loss of export markets and access to foreign capital, particularly in 1940–2 when GDP grew slowly. In 1942, however, growth resumed as a consequence of expansionary fiscal, monetary, and credit policies and of the stimulus provided by an import substitution drive and an expansion in nontraditional exports made competitive by war conditions. In 1943–5, GDP expanded 6.4 percent annually, with industrial output rising 9.8 percent annually.

However inflation also rose, not only because of rapid GDP growth but also from lower imports caused by the war. An expansion in the money supply, attributable to monetization of the public deficit (which until 1942 had been financed mainly by increases in public debt) and an increase in the trade surplus (which caused current account surpluses and rising foreign reserves) were contributing factors.

When the war ended and a new government took office in 1946, foreign exchange controls were loosened and the focus of economic policy turned to fighting inflation, which had risen to 20.6 percent in 1944 before falling to 14.9 percent in 1945. The combination of three factors — rising output, an overvalued exchange rate (which had stayed constant in nominal terms since 1939 against an accumulated inflation of 150 percent), and repressed import demand — caused a boom in imports, which almost doubled in real terms from 1946 to 1948. Meanwhile exports — no longer benefiting from wartime conditions but penalized by the exchange rate overvaluation — stagnated. Consequently the trade account went from a US$391 million surplus in 1946 to a US$59 million deficit in 1948.

Trouble signs had already appeared in 1947, however, when the substantial deterioration in terms of trade caused Brazil to record a US$182 million balance-of-payments deficit, which was financed by losses in convertible reserves (US$59 million), accumulation of commercial arrears (US$72 million), and a loan from the Federal Reserve Bank in New York (US$80 million) as noted by Malan, Bonelli, et al. (1980). Therefore foreign exchange controls were reinstated in mid-1947.[14] A new import-licensing system soon brought the trade account back into surplus, abetted by a decline in import prices and a rise in coffee prices.

Industry experienced another boom in the post–WW II years, with average annual growth of 8.1 percent in the late 1940s raising the decade average rate to 7.5 percent annually. Moreover the industrial structure continued to change, with a 7.5 percent rise in the intermediate goods share of manufacturing output from 1939 to 1949 (Fishlow, 1972) that was offset by a similar decline in the share of traditional industries (consumer nondurables). Yet, just as 10 years earlier, the capital- and technology-intensive sectors (capital and durable consumer goods) still accounted for less than 8 percent of total manufacturing output.

Government-Led Import Substitution, 1951–63. The import-licensing schemes and foreign exchange controls implemented in 1931–50 were aimed largely at curbing foreign exchange expenditures, usually to overcome balance-of-payments disequilibria. It was not until the late 1940s, therefore, that its potential as an incentive for industrialization was realized and exploited (Malan, Bonelli, et al., 1980; and Vianna, 1990). Beginning then, the government began to rely more intensively on tariffs and the sector distribution of import licenses to encourage industrialization through import substitution. Other instruments to foster industrialization that were adopted in the late 1940s included a rise in public credit to manufacturers, access to imports of capital goods and inputs at an overvalued exchange rate, incentives to FDI in manufacturing, and a rise in SOE investment, all of which would intensify in the 1950s.

Although formally in place throughout this period, import-licensing schemes were relaxed in 1951–3, however, when the Korean War began. Contributing to that stance were an increase in export prices, which produced a major gain in terms of trade and a trade surplus in 1950; concern that the war would cause another shortage of raw materials and capital goods; and expectation that import liberalization would help curb inflation, which in 1951 had jumped to 18.1 percent from 9.2 percent the previous year (Malan, Bonelli, et al., 1980). Not only would imports raise the supply of goods, but a declining trade surplus would reduce upward pressure on the money supply.

The setup echoed that of the trade opening in 1946: high output growth, a grossly overvalued exchange rate (in 1951 the parity rate versus the U.S. dollar was 52 percent of the level recorded 10 years earlier, further appreciating to 40 percent in 1953), and repressed import demand. Unsurprisingly, the result was also the same: an import boom (52 percent real growth in 1951–2) and a substantial worsening of the trade account. In 1952 the current account deficit rose to US$624 million (2.9 percent of GDP), mostly financed through commercial arrears.

Eventually the government changed courses, tightening import-licensing schemes and introducing a five-tier exchange rate system that penalized traditional exporters (coffee, cotton, and cocoa), nonessential imports, and most profit remittances. This system would later be simplified somewhat, determining the "free" rate in foreign exchange auctions but retaining the underlying principles of the multiple exchange rate system.

[14] Once more the option was not to devalue fully, although there was a small 13 percent depreciation of the (official) exchange rate until 1952.

A remarkable consequence of the trade opening in 1951–2 was an increase in the rate of investment from 18 percent of GDP in 1949 to 22.1 percent in 1952, when imports of capital goods peaked at twice the average level in 1948–50. The private sector accounted for the entire increase, with its share of total investment rising from 66 percent in 1950 to 78 percent in 1952. This investment boom (boosted by a highly expansionist public credit policy), a 9.1 percent rise in agricultural output in 1952, and an increase in imports (services) largely explain why GDP growth averaged 6.1 percent in 1951–2 despite the priority ascribed by fiscal and monetary policy to price stabilization.

These policy inconsistencies accelerated inflation, which escalated from 9.3 percent in 1952 to 27.1 percent in 1954, the highest level since 1923. A decline in imports that reduced domestic supply and the 216 percent and 100 percent nominal increases in the minimum wage in 1952 and 1954, respectively (Vianna 1990), were also contributing factors. The economic turbulence was aggravated by power shortages in 1953 caused by a severe drought and the relatively slow expansion of power generation capacity, which had risen by 4.7 percent yearly in 1944–53 while industrial output had grown by 7.9 percent yearly.

The crisis building around President Vargas, culminating with his suicide in August 1954, created a year and a half of political instability. The new government taking office faced not only a politically tense situation but a foreign exchange crisis, sparked by the 49 percent decline in Brazil's 1954 terms of trade, and serious domestic imbalances with a large public deficit and rising inflation. Short-term constraints were eased by new loans from the Federal Reserve Bank in Washington and a syndicate of private banks led by Citibank and Chase Manhattan, while new measures were established to attract FDI (Pinho Neto, 1990).

On the domestic front, the government cut public spending, largely capital expenditures, and tightened monetary and credit policies by raising reserve requirements and curbing lending by Banco do Brasil. The result was a decline in the rate of investment in 1955, and a slowdown in GDP growth from an average 8.3 percent in 1954–5 to 2.9 percent in 1956. A change of finance ministers six months into the new government led, however, to a reversal of several of these measures, including a reduction in reserve requirements and a more expansionary stance by Banco do Brasil. Inflation, which had fallen in 1955, climbed back to 24.5 percent in 1956.

The new government's first year was affected by an agricultural output decline and by stagnation in services, causing GDP to grow a "mere" 2.9 percent despite an 8.6 percent rise in industrial output. Growth would, however, accelerate in following years, as the government embarked on President Kubitscheck's Plano de Metas, or Targets Plan, which, launched in late 1956, proposed ambitious and detailed initiatives to foster industrialization and greatly expand infrastructure. It foresaw that by 1960 Brazil would, among other things, expand electricity generation from 3 to 5 million kilowatts; raise oil production from almost zero to 100,000 barrels a day, and oil refining capacity from 100,000 to 300,000 barrels a day; pave 5,000 kilometers of roads and build 12,000 kilometers of first-rate highways; double steel output; increase the cement production from 2.7 to 5 million tons; raise the output of barilla, nonferrous metals, pulp and paper, rubber, and iron ore for export; and establish a car industry able to produce 170,000 vehicles per year, with a high national content ratio (Abreu, 1994).

The plan was largely successful in attaining its targets. The extension of paved roads more than trebled in 1957–60, while power generation capacity increased by 35 percent, contributing to the major expansion in electricity and transportation infrastructure that marked the 1951–63 period (Table 12).[15] Industrialization through import substitution also progressed quickly. Industrial output expanded an average 10.8 percent in 1957–61, pushing its share of GDP to 25 percent in 1961, up from 21.4 percent in 1948. Equally remarkable, by 1959 the

[15] See Table 7.2 in Orenstein and Sochaczewski (1990) for a more complete quantitative assessment of the government's success in implementing the Plano de Metas.

share of consumer nondurable goods in value-added manufacturing had declined to 46.6 percent, down from 61.9 percent in 1949, whereas shares of consumer durables and intermediate and capital goods rose from 2.5 percent, 30.4 percent, and 5.2 percent to 5 percent, 37.3 percent, and 11.1 percent, respectively (Fishlow, 1972).

Table 12. Infrastructure Expansion (%)

	Railways	Electricity	Roads	Paved Roads	Telecom
1901–30	2.6	15.6			
1931–50[a]	0.6	4.5	4.6	5.1	
1951–63[b]	–0.3	9.8	5.4	23.9	6.8
1964–80	–1.6	9.8	5.6	16.0	11.2
1981–93	1.0	4.1	0.8	4.9	6.9
1994–2000[c]	–1.5	3.6	0.7	1.7	24.8

[a] Years 1930–52 for roads and 1930–55 for paved roads.
[b] Years 1953–63 for roads and 1956–63 for paved roads.
[c] Years 1994–98 for railways and 1994–99 for roads and paved roads.

In addition to tariff and nontariff barriers and expanded domestic credit, the main policy instruments used in the Plano de Metas were increased public and SOE investment in infrastructure and basic inputs, and the attraction of FDI into manufacturing just as its weight in the utilities sector was declining. Overall investment averaged 20 percent of GDP, up from 18.3 percent in 1955–6, with the share of public investment rising from 21.6 percent of total capital accumulation in 1950–5 to 25 percent in 1956–60 (the share of SOEs rose from 2.7 percent to 7.4 percent in the same span). The government also successfully attracted FDI, particularly to the auto industry (see Shapiro, 1994). The main instrument, in this case, was Instruction 113, which allowed foreign investment to be made directly through imports of capital goods. This eliminated the need to bring capital into the country at the overvalued exchange rate and then import capital goods at the "free" market rate. Malan (1984, cited in Abreu, 1994) estimates that 75 percent of FDI and 70 percent of all capital good imports in 1956–60 entered Brazil under the aegis of Instruction 113.

Meanwhile the exchange rate regime continued to operate through a system of multiple rates, some of which were still determined at foreign-exchange auctions. The overvalued exchange rate and the much higher return from inward-oriented investment discouraged exports, which stagnated in this period (and indeed would surpass, in real terms, their 1947 peak only in 1970).[16] In 1957, when ad valorem tariffs were introduced, tariffs were set to produce high effective rates of protection for target sectors, but quantitative restrictions continued to play a central role. One such vehicle was the Law of National Substitution (Lei do Similar Nacional), which had been approved in 1911 but was seldom used until it was dusted off in this period to block imports that competed with "similar" domestically produced goods.

The construction of a new capital city, Brasília, combined with expenditures to shore up coffee prices, rising public and SOE investment, and incentives for industrialization to balloon government spending, generating a deficit that was then largely monetized. In 1957–63, the monetary base rose an average 38.8 percent annually, more than doubling its growth in 1951–6 (18 percent) and triggering higher inflation. From a moderate 7 percent rise in 1957, prices jumped 39.4 percent in 1959, 47.8 percent in 1961, and 79.9 percent in 1963. The worsening macroeconomic climate led to negotiations for an IMF adjustment loan, but talks broke off in 1959 when the Kubitscheck government refused to comply with IMF conditions. Negotiations resumed and agreement was reached during the Quadros administration in 1961,

[16] Even in current dollars the 1951 peak in exports would not be surpassed until 1968.

but when the president resigned just eight months into his term, new negotiations began that were not successfully concluded until the end of the Goulart administration in March 1964.

In sum, 1951–63 witnessed the first concerted policy effort promoting industrialization and infrastructure development. GDP growth accelerated, particularly in industry but also in agriculture and services. Growth was inward-oriented, with imports rising 1.7 percent yearly on average, versus a GDP rate four times larger and an annual export drop of 1.2 percent. A considerable rise in investment contributed to this bright performance, increasing to 19.1 percent of GDP in this period from 11.8 percent in 1931–50 (Table 13). About half of this investment rate rise was financed by increased savings, while the other half was covered by a decline in the relative price of investment goods due largely to the relatively open stance toward capital good imports and the overvalued exchange rate (Table 9).

Table 13. Investment Prices and Decomposition

Period	Gross Fixed Capital Formation/GDP		Invest. Prices/ GDP Deflator	Investment		Savings			
	Current prices	1980 prices		Public	Private	Foreign	National		
							Total	Public	Private
1901–30		12.9							
1931–50	11.6	11.8	103.4						
1951–63	15.4	19.1	81.3	3.7	11.7	1.4	14.1	2.5	11.5
1964–80	19.8	21.7	91.2	3.9	15.9	2.4	17.5	3.6	13.9
1981–93	21.2	17.0	125.3	2.9	18.3	1.1	20.0	–7.0	27.0
1994–2000[a]	19.7	16.5	119.3	2.5	17.4	3.3	16.4	–5.4	21.8

[a] For public savings and investment breakdown, averages refer to 1994–9.

Favorable trade terms and low import growth prevented major deterioration of the external accounts, despite the decline in exports. Domestic economic fundamentals, however, worsened substantially. The large jump in the public deficit and its financing through monetary mechanisms boosted inflation to a new threshold. On average, the GDP deflator rose 27.1 percent yearly in 1951–63, almost four times higher than 1931–50 and more than fives times higher than 1909–30 (Table 14). Inflation became a trait of Brazilian culture.

Table 14. Indicators of Macroeconomic Stability

	Inflation			Black Market Premium	Cur. Acct. Balance/ Exports (%)	Foreign Debt/ Exports
	GDP deflator	IGP-DI	SD of monthly inflation (IGP-DI)			
1901–30[a]	5.1					2.2
1931–50	7.4				10.3	2.8
1951–63	27.1	29.9	1.4	64.3	–17.6	1.9
1964–80	40.3	40.1	1.0	14.4	–35.0	2.5
1981–93	695.7	768.4	6.4	46.5	–13.7	3.9
1994–2000[b]	20.1	10.5	0.7	5.4	–44.5	4.1

[a] Years 1909–30 for GDP deflator.
[b] Years 1995–2000 for inflation indicators.

The Brazilian Miracle, 1964–80. In 1963 GDP stagnated, private investment declined, the public deficit reached 50 percent of fiscal revenues, inflation accelerated, and the import substitution process began to show signs of exhaustion. Political instability increased, and in

March 1964 a military coup — a looming threat since the early 1950s — overthrew the Goulart government. High inflation rates in the previous two years were partially responsible for the coup's initial popular support.

In power, the military adopted a stabilization program to lower inflation, reduce the public deficit, and correct relative prices. The exchange rate was devalued and a tax reform implemented, greatly reducing tax distortions and raising revenues from 16.3 percent to 22.4 percent of GDP, helping to bring down the public deficit. The stabilization program improved the current account from a deficit of 0.5 percent of GDP in 1963 to a surplus of 1.6 percent of GDP in 1965. Inflation was reigned in from 87 percent in 1964 to 24 percent in 1967, aided by a dramatic salary squeeze in which the real minimum wage in Rio de Janeiro, for instance, fell 34 percent between February 1964 and March 1967 (Bacha, 1977).

The new government also implemented significant monetary and capital market reforms, including establishment of a monetary correction (indexation) mechanism that protected investors from "inflation surprises" and was key to restoring confidence in long-term contracts in capital and credit markets. In particular, indexation renewed government's ability to finance its deficit in a noninflationary way (through the sale of public debt securities). Moreover it allowed the development of mortgage financing, which in coming years would provide a major boost to housing construction. All private and public savings also became protected by indexation.

The government also introduced an indexation mechanism in the foreign exchange market to protect exporters from inflation surprises, establishing a crawling-peg regime with small devaluations at random intervals. This greatly enhanced the stability of real exchange rates, which had fluctuated widely in previous years. Furthermore, in the late 1960s the real exchange rate depreciated further, which combined with a new system of tax exemptions and other incentives to significantly boost manufactured exports.

The contractionary monetary and fiscal policies adopted in this period slowed GDP growth, which nonetheless averaged 3.6 percent in 1964–6, and industrial output, which stagnated in 1964–5. However, with a sharp drop in the relative price of investment goods, the rate of investment reacted positively to the more stable political and economic environment, rising from 16.3 percent of GDP in 1964 to 18.9 percent of GDP in 1966.[17] Also noteworthy was the particularly strong growth in capital goods investment, which more than doubled. Low GDP growth and rising investment combined to create large idle capacity: 17.5 percent for the entire economy and 25 percent in manufacturing in 1967.

Economic policy shifted dramatically in later years after a new administration took office, with fiscal, monetary, and particularly credit policies all becoming highly expansionary. A boom in consumer and mortgage credit helped boost the output of durable consumer goods and construction, which were also fueled by the rise in public investment, particularly in infrastructure. In 1968–73, annual investment growth rates in transportation, electricity, and telecommunications averaged 15.1 percent, 13.9 percent, and 44.7 percent, respectively (Ferreira and Malliagros, 1999). This period would also record a rise in overall capital accumulation, with investment rising from 18.6 percent of GDP in 1967 to 23.6 percent in 1973. Capital goods investment increased an average 17.8 percent per annum, with capital good imports rising 24.8 percent per annum

The concession of export incentives, a more stable and competitive exchange rate, and the improvement in the external environment (with high growth in international trade) caused exports to surge, growing by an average 9.7 percent yearly in real terms, with the strongest expansion in manufactured goods, whose share of total exports rose from 28.7 percent in 1967 to 40.6 percent in 1973. Brazil's external position also improved as a result of a 26.7 percent increase in its terms of trade between 1966–8 and 1972–3. Thus the 150 percent real increase

[17] Computed in 1980 prices.

in imports was accommodated with only a moderate increase in the current account deficit, which rose from 0.75 percent of GDP in 1967 to 2.01 percent in 1973.

Benefiting from the low initial rate of capacity utilization, and with easy access to European markets softening balance-of-payment constraints, the change in policy orientation accentuated the cyclical recovery of GDP, which expanded an average 11.5 percent annually in 1968–73. Industry led this boom, growing on average 13.2 percent per annum, with the output of durable consumer goods expanding 25.4 percent yearly This surge in growth did not, however, stoke inflation, which fell from 25.5 percent in 1968 to 15.5 percent in 1973 (IGP-DI). The unusual combination of high growth, industrialization, and declining inflation rates caused this period to be dubbed the "Brazilian Miracle."

Matters changed rather dramatically, however, when the first oil shock of the 1970s impacted. With the price of a barrel of oil jumping from US$2.80 in 1973 to US$11.10 in 1974 and imports of 705,000 barrels per day (as much as 81 percent of its consumption), Brazil was hit hard. The oil shock was not, however, the only problem inherited by the administration that took office in 1974. The final days of the Medici administration had been marked by strong inflationary pressures, stemming from the rapid nonsterilized expansion of foreign reserves (53 percent in 1973 alone) and the maintenance of expansionary policies when output was close to full-employment levels (as illustrated by the 35 percent real expansion in domestic credit in 1973).[18] Rising prices of raw material imports (e.g., wheat, copper, and coal) and of exports added pressure to domestic prices. Furthermore, inflation had been artificially controlled in the early 1970s through price freezes that left a number of key prices misaligned.

Full employment was also pressuring the trade account, which had shown a surplus of $7 million in 1973 after recording deficits of $341 and $244 million in 1971 and 1972, respectively. With the deficit in services also rising, the current account deficit doubled from 1969 to 1970, expanded 133 percent in 1971 and 13.5 percent per year in 1972–3. As noted by Malan and Bonelli (1977), Brazil had been living beyond its means for a number of years and had accumulated rising levels of foreign debt, which increased almost four-fold in 1968–73. That was not the full extent of Brazil's rising vulnerability: "Most important, currency loans, which accounted for only 20 percent of total debt in 1967, represented almost two-thirds (62.4 percent or US$7.85 billion) of total debt by 1973" (Malan and Bonelli, 1977: 24).

The deterioration in the external environment in 1974 went beyond the rise in oil prices. As noted above, other imports on which Brazil was highly dependent, including raw materials and capital goods, also posted substantial price increases. And the industrialized economies that were a primary export market and a source of capital for Brazil slid that year into recession. Repressed inflation and the need for a major structural adjustment in the foreign accounts were legacies of the "miracle" years:

> [T]he balance-of-payments situation during the 1968–73 upswing was not sound: even without the 1974 international oil crisis, Brazil would not have been able to maintain its potential growth rate of GDP because of balance-of-payments disequilibria; when domestic capacity limits and balance-of-payments constraints emerged after 1972, economic policy went into disarray — substituting optimistic propaganda for effective action, Brazilian policymakers let the external debt reach staggering proportions; during the next four years, a rigid import diet will have to be implemented to reduce the net external indebtedness of the country; as a consequence, economic growth will have to slow down during a period when significant political changes can be expected to occur (Bacha, 1977: 47).

[18] The volume of credit to the private sector rose from 15.4 percent of GDP in 1966 to 47.9 percent in 1973 and an average 59.8 percent in 1978–9, before declining in following years (Serra, 1980).

The government opted not to follow an "orthodox" stabilization program, choosing instead to sustain the pace of economic growth and make inflation control a secondary priority, leaving the external accounts as the adjustment variable. Indeed the basic features of the government economic program for 1974–9 stressed real GDP growth of 10 percent; a 150 percent increase in exports; accelerated import substitution of capital and intermediate goods; and a large expansion of domestic oil output and infrastructure capital by state enterprises.

This decision to outgrow external imbalances rather than trying to adjust through contractionary fiscal and monetary policies was motivated mainly by two factors. First, policymakers believed that the oil shock would be brief and the external environment would rapidly return to its previous state (Malan and Bonelli, 1977). Second, constraints were imposed by the decision to move ahead with the political transition to which Bacha (1977) alludes. That is, it would have been extremely difficult in a low-growth environment to overpower military hardliners who opposed the gradual political opening initiated in the mid-1970s, when the hard-line regime of 1968–73 could be touted for its high growth.

In a sense, therefore, economic growth was sought as a source of political legitimacy, not much differently than in the early 1970s. As Lamounier and Moura (1983) indicate, there was a "need to sustain optimism" during a time in which "euphoria with the rates of GDP growth, virtually deified in the Medici period, and even the rhetoric that we would be a great power" were still reverberant in people's minds. Finally, the constituency for growth also included the influential business community, which was not expected to support an orthodox stabilization attempt (as would become evident in the late 1970s when Finance Minister Simonsen attempted one only to be sacked from government). In turn, the substantial liquidity in international capital markets, created by the recycling of petrodollars, provided the means to sustain the previous policy course through the borrowing of large loans at negative (although floating) real rates of interest.

Therefore, unlike most other semi-industrialized countries that adjusted to the negative impact of the first oil shock by expanding exports and reducing output growth, Brazil reacted by expanding import substitution, borrowing more, modestly increasing exports, and accelerating growth (World Bank, 1981; and Fundação Getúlio Vargas, 1981).[19] As part of this heterodox response and in an attempt to prevent higher inflation, the government also decided not to let the exchange rate depreciate despite the 29 percent decline in terms of trade in 1974–5. This policy lacked credibility, however, and an import boom ensued as private agents feared either devaluation or an increase in import duties. Imports rose 20 percent in 1974, helping to bring the current account deficit to US$7 billion or 6.3 percent of GDP.

The government reacted by raising import barriers, reversing the modest trade liberalization begun in 1967 (Coes, 1988). Tariffs were raised; surcharges of 30 percent to 100 percent were levied on 40 percent of all goods; prior deposits became mandatory for import licenses; and several other nontariff barriers were used, including a negative import list known as "Annex C" and a more rigorous application of the Law of National Substitution (Pinheiro and Almeida, 1995).[20] These measures put all the burden of adjustment on imports, with real exports remaining virtually stagnant in 1974–7. However, a 55 percent rise in export prices and a 21 percent drop in import quantities were sufficient to generate a trade surplus of US$97 million in 1977, compared to a deficit of US$5 billion in 1974.

But this adjustment had clay feet. In 1978–80 Brazil's current account deficit widened again, reaching US$12.8 billion, or 5.4 percent of GDP in 1980. Contributing causes were a 36 percent decline in terms of trade; a rise in import quantities; and especially a mushrooming

[19] For a favorable assessment of this strategy see Cline (1981).

[20] Cline (1981) estimates that tariff protection, including prior deposit requirements, increased by 47.4 percent from 1973 to 1976.

external debt, largely contracted at floating interest rates, whose service costs ballooned as Paul Volcker tightened monetary policy in the U.S.

Until mid-1980 the government held out, not adjusting to the deterioration in the external environment, trusting that a combination of further import substitution, high growth, and a rollover of foreign debt would suffice to insulate it from external shocks until the situation returned to normal. Thus despite rising inflation and mounting external imbalances, monetary, fiscal, and credit policies remained expansionary, causing GDP to grow 9.3 percent in 1980.

Taken as a whole, 1964–80 was a period of exceptionally high growth. GDP increased an average 7.8 percent annually, with industry expanding 8.5 percent annually. The period also saw relative stability in key macro indicators such as GDP growth, the real exchange rate, and inflation, which was more or less constant despite being higher than in previous decades (Table 14). This stability provided an important stimulus to private investment, which in current prices increased from 11.3 percent of GDP in 1970 to 16.8 percent of GDP a decade later. Equally impressive was the investment drive of SOEs, which rose from an average 1.9 percent of GDP in 1961–5 to 7.7 percent of GDP in 1977, before declining to 4.5 percent of GDP in 1980. Consequently infrastructure capital expanded rapidly, sustaining the high growth rates of 1951–63.

The structure of the economy also changed substantially in this period. The share of industry in output and employment rose from 34.9 percent and 18.8 percent in 1963 to 40.9 percent and 29.1 percent in 1980, respectively. In manufacturing, the share of traditional sectors — foodstuffs, beverages, textiles, clothing, tobacco, and wood — declined in value added from 39.4 percent in 1959 to 27 percent in 1980, while the share of more capital and technology intensive sectors — machinery, electrical equipment, and transportation equipment — rose from 15 percent to 24.9 percent. Import substitution industrialization peaked during this period, culminating with perhaps the highest ratio of per capita income in Brazil versus the U.S. in the 20th century.

The Long Lost-Decade, 1981–93. In hindsight, it is clear that policymakers made the wrong choices in both 1974 and 1979–80, clinging to a strategy that had outlived its usefulness. Trying to *grow* out of its external problems, Brazil rapidly amassed large external liabilities, with net foreign debt increasing from US$6.2 billion in 1973 to US$58.4 billion in 1980 and the current account deficit going from US$1.7 billion to US$12.8 billion. Brazil entered the 1980s with its economic fundamentals seriously weakened: Inflation was high and rising while the external accounts were exploding. Unable to deal with these twin crises, Brazil entered in 1981–93 a "long decade" of stagnation. In these 13 years, GDP grew on average 1.6 percent yearly versus a yearly demographic expansion of 1.9 percent, resulting in an average annual decline of 0.2 percent in per capita income. Industry was particularly affected, growing a mere 0.4 percent per annum.

With the sharp deterioration of Brazil's external accounts in the late 1970s, the government allowed the cruzado to depreciate, and its parity rate against the dollar rose 15.2 percent from 1978 to 1980. When the subsequent rise in inflation caused the currency to appreciate in real terms again in 1981–2 and the current account deficit continued to swell, trade policy was entirely subordinated to macroeconomic objectives. The negative import list (Annex C) was greatly expanded, covering 40 percent of all tradable goods in 1983; while firm import programs and import financing became mandatory. Administrative procedures (e.g., delaying import license concessions) became the main instrument to control imports.[21] On the export side, credit and financial subsidies compensated the exchange rate appreciation in the early 1980s, and compounded the effect of a weaker currency in 1983–5. In 1981–2,

[21] For a discussion of these policies see Pinheiro and Almeida (1995) and the references therein.

firms received incentives worth 74 cents for every dollar of exported manufactured goods (Pinheiro et al., 1993). In 1983 the real exchange (parity) rate devalued 25 percent.

GDP declined a total 6.3 percent in 1981–3, which together with the large currency devaluation and the rising import barriers and export incentives produced a major turnaround in Brazil's current account, which averaged a small US$98.5 million deficit in 1984–5. But low growth, the devaluation, and the rise in export subsidies devastated the public accounts. For several reasons — ranging from large public loans contracted in the late 1970s and early 1980s to finance the current account, to fear that a devaluation would bankrupt a number of firms with foreign liabilities — much of the exchange rate risk on the foreign debt ended up on public-sector books in the early 1980s. This made the external crisis also a fiscal crisis, particularly after the 1983 devaluation, which caused the net public debt, as a ratio of GDP, to jump from 29.5 percent in 1982 to 49.5 percent in 1983 and 53.5 percent in 1984.[22]

With imperfectly indexed fiscal revenues, accelerating inflation caused tax collections to decline from an average 25.4 percent of GDP in the 1970s to 22 percent of GDP in 1985 (the Oliveira-Tanzi effect). Growing public indebtedness caused interest payments to increase just when subsidies were going up, rising from an average 1.7 percent of GDP in 1976–9 to 2.9 percent of GDP in 1980–3. The 1988 Constitution compounded the public finance problem, transferring a sizable share of tax revenues from the federal to state and municipal governments without doing much to redistribute expenditures. Since states and municipalities used the extra revenues to increase their payrolls, the deficit created at the federal level was not compensated by a surplus at the local levels. As a result, the public sector ran very large operational deficits throughout the 1980s, culminating at 7.4 percent of GDP in 1989. The bottom line was a dramatic decline in public savings, which plummeted from plus 4.7 percent of GDP in the 1970s to minus 5.8 percent of GDP in the 1980s.

Inflation, which had risen in the late 1970s, spun out of control in 1981–93, averaging an annual increase of 768 percent versus the average annual increase of 40 percent in 1964–80 (IGP-DI). In the 12 months of 1993 prices increased by a factor of 28. Taking the whole 1981–93 period, prices increased 7.7 billion times. In the early 1980s, inflation was fueled by the large public deficit and sparked by the need to achieve a substantial real devaluation. In an economy that for years had been developing sophisticated indexing mechanisms, it soon became clear that once triggered by a change in the exchange rate, inertia would set in and inflation rates would accelerate. The Cruzado Plan in 1986 attempted to counteract inflationary inertia through a price freeze, but the failure to eliminate the high public deficit, the excessive increase in money supply, and the 8 percent decline in crop output soon torpedoed the effort. Two other heterodox stabilization plans were attempted during the Sarney administration, in 1987 (Bresser Plan) and 1989 (Summer Plan), but both were short-lived.

Two more attempts took place during the Collor administration. The plan launched in March 1990 was certainly the most traumatic. After a bank holiday, a large share of the economy's financial assets was frozen in the Central Bank, where they would stay for 18 months before being returned in 12 monthly installments. This brutal contraction in money supply caused output to plummet. Policymakers reacted by freeing some assets held at the Central Bank, but again this was done beyond reasonable limits. By the beginning of 1991 inflation was picking up steam again, and another plan was launched, this time resorting to a price freeze. As with the other efforts before it, this too was short-lived.

All five heterodox stabilization plans implemented in 1986–91 included price freezes and changes in established contracts, and as each failed to contain inflation, it fueled uncertainty and further sapped government credibility. In this sense they contributed to another key feature of the 1981–93 period: the high volatility in growth, inflation, and the

[22] Obviously, part of this jump was merely the accounting effect of the devaluation on GDP measured in dollars.

exchange rate.[23] Finally a change of finance ministers in mid-1991 brought a more orthodox economic team into government that tightened monetary policy, thereby keeping monthly inflation rates at the 20 percent level for several months in a row. As a side effect of the high interest rates in this period, Brazil experienced a large inflow of foreign portfolio investment, causing foreign reserves to more than double from 1991 to 1992 and helping strengthen the currency and curb inflationary pressures.

The bitter cocktail of low and irregular growth, high and accelerating inflation, price freezes, contract breaches by policymakers, and high interest rates could only depress investment. Although in current prices the investment rate in 1981–93 was 1.4 percent of GDP higher than in 1964–80, in constant 1980 prices it was 4.7 percent of GDP lower. The difference stems from a 37.4 percent rise in the relative price of investment, dating back to 1974 when import barriers to capital goods began to rise, causing capital good imports to fall 81.2 percent between 1974 and 1984. Infrastructure investment also fell during this time, with the transportation network and electricity undergoing falls of 50 percent and 45 percent, respectively, between 1980 and 1993. Thus although growth in the stock of infrastructure capital stayed positive, it showed a remarkable drop-off compared to the prior three decades.

Yet this strategy was quite successful in producing trade surpluses, which in 1984 amounted to US$13.1 billion compared to a trade deficit of US$2.8 billion in 1980. But by the same token, fiscal and credit incentives were a major obstacle to fiscal austerity, which was becoming ever more necessary to curb soaring inflation rates. Concerns were also raised as to whether export competitiveness would outlive the end of government incentives. These policies were clearly unsustainable. Therefore as the foreign exchange constraint lessened, Brazil gradually moved toward a more open and neutral trade policy.

The bright side of the economic record in 1981–93 was Brazil's ability to overcome the external shocks of 1979–81, turning the large current account deficits experienced in 1980–2 into a small surplus in 1984. Adjustment was obtained through a substantial rise in exports, stagnant real import levels, and an improvement in trade terms, particularly after 1986 when oil prices declined considerably. In this period export quantities grew an average 6.5 percent yearly, four times more than output, partially reversing the economy's inward orientation. Imports, in turn, showed a mere 1.9 percent growth rate, slightly more than GDP. All this import growth occurred after 1988, and most after 1990. Indeed, the 1983–8 period recorded a major compression in import quantities, making Brazil a very closed economy.[24]

By the early 1990s, the state's role in the economy had changed dramatically. Trade liberalization, privatization, the end of price controls, a reduction in entry and exit barriers, enactment of legislation protecting competition, a more open attitude toward foreign investment, and a sharp reduction in red tape in the life of citizens significantly transformed the business environment.

Over a span of several years Brazil progressively reduced protection to domestic producers. Two reforms, in 1988 and 1989, cut the average import tariff from 54.9 percent in 1987 to 29.4 percent in 1989. Most nontariff barriers were eliminated in 1990, with the ban on computer product imports ending in October 1992. Starting in 1990, a preannounced schedule of tariff reductions gradually reduced the average nominal import tariff to 13.5 percent in 1993. In 1994 tariffs were further cut to 10.2 percent as part of the effort to consolidate the Real Plan, but were raised again to 13.4 percent in 1997–8 (Kume et al., 2000). On the export

[23] The five heterodox stabilization programs of 1986–91 did reduce the public debt as a result of rule changes and contract breaches that caused less-than-perfect indexation of public liabilities, or that imposed lower interest rates on the debt. Together with the currency appreciation in 1986–94, they brought the public debt down to 29.6 percent of GDP by the end of 1994. Creditors, however, sued the government, and since 1995 have been awarded some 5 percent of GDP in compensation known as "skeletons."

[24] In 1983–7, non-oil imports were equivalent to just 2.8 percent of GDP.

side, trade policy also became more neutral from the mid-1980s onward, especially after 1990. Several subsidies were discontinued in 1983–5, and all were essentially eliminated in 1990. Consequently the value of incentives fell from an average of 3.1 percent of GDP in 1981–4 to 1.3 percent in 1990–1 despite the significant expansion of exports in the meantime (Pinheiro et al., 1993).

In addition to trade liberalization, the government sponsored policies that fostered competition and reduced firms' regulatory burden. The competition law and the antitrust agency were both strengthened, while a number of laws and decrees were revoked, discontinuing public monopolies, entry barriers, and restrictions on certain activities. Regulations on FDI were also eased, which helped boost FDI inflows in the late 1990s.

Privatization also brought a major change in policy orientation in 1981–93. Brazil's first attempt to control expansion of state enterprises dates to 1979, but officially privatization did not begin until 1981 when a presidential decree created the Special Privatization Commission. Over the rest of the decade the government sold 38 companies, transferred 18 to state governments, merged 10 into other federal institutions, closed 4, and rented 1. Most of the sales were reprivatizations of small companies, and proceeds were minimal (US$723 million) and largely financed from within government. In 1990 the government launched the National Privatization Program, greatly expanding the scope to include large industrial SOEs. In 1991–3, large state holdings in steel, petrochemicals, fertilizers, and other manufacturing sectors were sold to private investors.

Adjustment under the Real Plan, 1994–2000. Notwithstanding the importance of the structural reforms of the early 1990, it was the Real Plan and its success in taming inflation that marked the most important turning point for the Brazilian economy in recent years. The plan evolved in three stages. Phase I was targeted at reducing the public deficit through creation of the Social Emergency Fund, approved by Congress in February 1994 to give the executive branch control over 20 percent of previously earmarked budget revenues and either spend or withhold them in 1994–5. Phase II was launched a month later, with creation of the so-called Real Value Unit (URV), a unit of account that was kept at one-to-one parity with the dollar. The URV allowed the alignment of most prices and wages, as well as inflationary expectations, thereby avoiding the carryover of residual inflation into Phase III that had plagued previous stabilization attempts. Finally, on July 1, as most prices and wages had been converted into URVs, currencies were changed, with prices in URVs being quoted in *reais*. The real became not only a unit of account but also a means of payment. In addition to the careful preparation, the large increase in agricultural output in 1994–6 (which helped to keep food prices down), the appreciation of the exchange rate, and tight monetary policy all contributed to the success of the new currency.

The sudden decline in inflation, from 46.6 percent in June 1994 to 0.6 percent in December, and the currency appreciation caused real incomes and credit supply to rise, leading to a consumption boom that reinforced the cyclical recovery begun in 1993 and spurring a GDP rise of 5.9 percent in 1994. In the first quarter of 1995 the economy was clearly overheated, with GDP expanding 10.7 percent compared to first-quarter 1994. Growth rates of that magnitude were incompatible with the stabilization effort, not least because the substantial increase in output, largely derived from increasing capacity utilization, did not keep pace with the growth of absorption, moving the trade account from a US$10.8 billion surplus in 1994 to a US$3.3 billion deficit in 1995. Other problems also loomed.

The Mexican crisis of December 1994 inaugurated a series of external shocks that forced Brazilian policymakers to adjust the Real Plan. In March 1995 the government raised interest rates, contracted domestic credit, and devalued the exchange rate, causing GDP to stagnate in the following six quarters. Other shocks in 1997 and 1998 were countered in the

same fashion, in particular by tightening monetary policy, which caused real interest rates to remain extremely high (an average 23.4 percent in 1994–8).

Fiscal policy, however, took the opposite direction, becoming highly expansionist after 1994. With the decline in inflation, real public spending rose, unveiling a fiscal deficit previously hidden by the acceleration of inflation. Real increases in pensions and civil servant salaries in 1995 and a broadly lax approach toward controlling discretionary spending in 1995–7 were also important. The net result was deterioration of the primary accounts, which went from a surplus of 2.65 percent of GDP in 1993 to a deficit of 0.98 percent of GDP in 1997, before a fiscal adjustment package was adopted after the Asian crisis. Combined with very high interest rates, this deterioration in the primary accounts raised the operational deficit from less than 1 percent of GDP in 1993 to almost 8 percent of GDP in 1998.

Reflecting the booming domestic economy, a strong currency, and the lagging impact of trade liberalization, import quantities soared after the Real Plan, rising 20.4 percent yearly in 1994–8. Export quantities, however, stagnated, increasing at a rate of just 2.3 percent. Thus even though terms of trade increased by 40.6 percent in 1994–6, declining only moderately in the following two years, the external accounts showed a continuous slide, culminating with a US$33.6 billion current account deficit (4.3 percent of GDP) in 1998.

The combination of an expansionary fiscal policy, a strong currency, and tight monetary policy resulted in the rapid accumulation of public and external liabilities, which threatened to gain a life of its own. With the decline in international liquidity that followed the Asian crisis, the government was forced to change the policy mix, introducing gradual measures aimed at weakening the real and reducing the public deficit. The Russian crisis and the continued rise in fiscal and current-account deficits forced a more dramatic reform in early 1999, however. In January the real was floated, depreciating significantly, buying time while a more substantial fiscal adjustment program was put in place that generated primary surpluses of 3.3 percent and 3.5 percent of GDP in 1999 and 2000, respectively.

In 1994–8 the government also implemented significant structural reforms, notably the extension of privatization to infrastructure through transfer to private investors of SOEs in telecommunications, electricity, rail transportation, and ports, in addition to highway concessions. A number of constitutional amendments were approved in 1995 to end public monopolies in oil, telecommunications, and gas distribution and reduce discrimination against foreign companies, including the opening of the mining and electricity sectors to foreign investors. With the boom in imports and FDI after 1994, the economy became more open than any time since the late 1950s.

Growth performance in this period was not particularly remarkable, as noted earlier. GDP growth accelerated only moderately when compared to 1981–93. Moreover, growth volatility, although declining, remained high compared to 1951–80. Output growth was pulled by agriculture, which benefited from trade liberalization, and services, with industry growing less than the rest of the economy. Capital accumulation showed an even weaker recovery than output, with the rate of investment declining in both current and 1980 prices. In this regard, one should note that although the relative price of investment goods declined vis-à-vis 1981–93, lower inflation, the trade opening, and a strong currency kept the decline below what might have been expected (Table 13). The low investment rate translated into a further deterioration of infrastructure, except for telecommunications, which boomed with privatization. Roads and highways remained virtually stagnant, with investment declining as a ratio of GDP, while electricity generation capacity grew only marginally above output. Last but not least, the growth in human capital continued to decelerate from the already low growth rates of 1981–93 (Table 3).

Boosted by depreciation of the real, and reflecting the fact that much of the public debt was either foreign or domestic debt indexed to the exchange rate, public liabilities jumped as

a proportion of GDP in 1999, closing 2000 at a ratio of 49.3 percent. Thus the public deficit stayed high despite the major effort to increase revenues and cut expenditures. With interest payments on the public debt of 8 percent of GDP, the fiscal deficit closed 2000 at 4.5 percent of GDP. Adjustment in the external accounts was also partial, with only a moderate drop in the current account deficit, which closed 2000 at 4.1 percent of GDP (US$24.6 billion). In this sense, the reforms implemented in the 1990s have been insufficient to overcome the problems inherited from the 1980s or generated in the 1990s. It is no surprise, therefore, that growth has yet to reignite the bright flame of 1951–80.

Explaining Differences in Growth Performance

Summarizing 100 years of economic developments in a paper is a daring proposition. Anyone familiar with Brazil who has read the previous pages would certainly identify relevant facts or interpretations missing from our summary account. One cannot hope in a handful of pages to do justice to the richness of policy initiatives, the interplay of politics and economics, or the influence foreign constraints on economic policy and growth. The usefulness of our breaking the century into clearly demarcated periods can also be challenged since outcomes in one period were often the result of policy initiatives or mistakes in previous periods. Different interpretations of the facts and decisions described above also exist. Although further summarizing these 100 years of economic growth in a few regression statistics would seem overtly sacrilegious, the possibilities are too tempting to resist.

This section looks at several variables that may account for differentials in growth rates across the six periods analyzed previously, using a cross-country conditional convergence regression estimated with data extracted from the GDN database (www.worldbank.org/research/growth) for 20 Latin American countries in 1960–99.

Table 15 contains the results of our growth regressions. In all cases the dependent variable is the rate of per capita income growth, in constant international prices for each decade (1960s, 1970s, 1980s, and 1990s). Right-column variables include per capita income, measured in PPP prices as a proportion of U.S. per capita GDP, at the beginning of each decade; inflation; the rate of investment; the black market premium; the gross secondary enrollment rate and life expectancy at the beginning of each decade; total trade ($X + M$) as a percentage of GDP; and average terms of trade in each period, as a ratio of the average terms of trade in 1960–99. The rates of investment in 1960 and the 1960s, 1970s, and 1980s were used as instruments for the rate of investment in the 1960s, 1970s, 1980s, and 1990s, respectively. To capture the effect of difference in the world environment across the four decades, we use the growth rate of world output (PPP prices) in each decade and decadal dummy variables. The regressions are estimated using ordinary least squares (OLS), three-stage least squares (TSLS), and generalized method of moments (GMM) estimators.

The regression results are similar to De Gregorio and Lee's (1999), with two noteworthy differences. First, trade openness has a negative influence on growth, contrary to their finding using an alternative definition of openness. Our coefficient suggests that Latin American countries were generally more open in the 1980s and 1990s than in previous decades, and that therefore lower growth did indeed coincide with greater openness. Alternatively greater openness may be picking up the effect of a lower degree of industrial development. Second, we omit institutional variables such as democracy and rule-of-law indices since these factors have varied over time in Latin America and this effect would not be picked up by the GDN databank's fixed country indicators.

Table 16 presents average values of the explanatory variables for each period, and Table 17 uses our GMM estimators to measure the contribution of each variable to growth performance in each period. The main insight from these results seems to be that while the

model predicts fairly accurately the differential in per capita GDP growth between 1931–50, 1950–63 and 1981–93 and 1964–80, it explains much less well the decline in per capita GDP growth in 1994–2000. A possible reason may involve the human capital variables, which suggest an improvement inconsistent with the growth in schooling of the labor force.

Table 15. Cross-Country Regressions for Sample Latin American Countries

Variable	OLS 1	OLS 2	TSLS	GMM
Initial income	–0.0406	–0.0349	–0.0206	–0.0349
	(–2.22)	(–1.92)	(–1.24)	(–6.56)
Inflation	–0.0092	–0.0072	–0.0064	–0.0072
	(–2.10)	(–1.73)	(–2.25)	(–7.20)
Investment rate	0.1421	0.0989	0.0558	0.0526
	(2.82)	(1.98)	(1.01)	(3.88)
Black-market premium	–0.0007	–0.0006	–0.0005	–0.0006
	(–1.93)	(–1.97)	(–2.62)	(–9.36)
Terms of trade	0.0131	0.0104	–0.0062	0.0118
	(0.98)	(0.82)	(–0.62)	(3.33)
Trade(X + M)/GDP	–0.0351	–0.0290	–0.0310	–0.0279
	(–3.15)	(–2.71)	(–3.17)	(–9.15)
Secondary enrollment	0.0207	0.0192	0.0243	0.0205
	(1.18)	(1.17)	(1.84)	(5.10)
Life expectancy	0.0513	0.0618	0.0635	0.0830
	(1.00)	(1.23)	(1.38)	(6.02)
World growth	1.1266			
	(3.47)			
Intercept 1960s to 1990s	–7.9798	–2.5877		
	(–2.21)	(–0.89)		
Dummy 1980s		–2.5702		
		(–4.69)		
Dummy 1990s		–2.0661		
		(–3.19)		
Intercept 1960s and 1970s			–0.5754	–3.1904
			(–0.23)	(–3.91)
Intercept 1980s			–3.3872	–5.8385
			(–1.28)	(–6.98)
Intercept 1990s			–2.7651	–5.4437
			(–0.99)	(–6.30)
R^2 (number of observations)				
All	0.52 (72)	0.58 (72)		
1960s			0.25 (14)	0.26 (14)
1970s			0.11 (19)	0.06 (19)
1980s			0.75 (20)	0.72 (20)
1990s			0.33 (19)	0.28 (19)

Note: Growth in per capita GDP is the explanatory variable in all four models.

Table 16. Average Value of Explanatory Variables

Variable	1901–30	1931–50	1951–63	1964–80	1981–93	1994–2000
Per capita income (% U.S., PPP)	17.2	17.1	16.8	19.4	25.7	21.2
Inflation (%)	5.1	7.4	29.9	40.1	768.4	10.5
Investment (% of GDP)	12.9	11.8	19.1	21.7	17.0	16.5
Black-market premium (%)	0		64.3	14.4	46.5	5.4
Terms of trade (1960–2000 = 100)	128.1	94.3	130.8	114.3	75.5	99.0
Trade [(X+M)/GDP]	19.9	7.5	18.5	13.9	15.6	15.1
Schooling (% secondary enrollment)		2.8	5.8	15.0	33.2	43.2
Life expectancy (years)		39.8	45.9	52.49	62.8	66.9
World growth (PPP)	2.2	1.8	4.5	4.5	2.6	3.4

Table 17. Explanatory Variables' Contribution to Growth Differentials (1964–80)

Variable	1901–30	1931–50	1951–63	1981–93	1994–2000
Per Capita Income	0.08	0.08	0.09	–0.22	–0.06
Inflation	0.25	0.24	0.07	–5.26	0.21
Investment	–0.46	–0.52	–0.14	–0.25	–0.27
Black-market premium	0.01	0.01	–0.03	–0.02	0.01
Terms of trade	0.16	–0.24	0.19	–0.46	–0.18
Trade	–0.17	0.18	–0.13	–0.05	–0.03
Schooling		–0.25	–0.19	0.37	0.58
Life expectancy		–1.05	–0.55	0.85	1.20
World growth	–2.6	–3.0	0.1	–2.1	–1.2
Estimated differential in per capita GDP growth		–1.56	–0.67	–5.03	1.45
Actual differential in per capita GDP growth	–3.46	–2.65	–0.91	–6.15	–4.74

Note: See Table 16 for values and definitions of explanatory variables.

Productivity Growth in Brazilian Industry

This section takes a fresh look at the evolution and determinants of total factor productivity (TFP) growth in Brazil's industrial sector during the 1980s and 1990s. The objective is to identify the factors that shaped observed TFP performance. The analysis focuses on four issues: the impact of trade liberalization, the contribution of knowledge embodied in input quality, the role of resource reallocation across firms and sectors, and the factors and constraints shaping investment decisions.

Unlike most previous empirical studies of TFP in Brazil, which use economy- or industry-wide aggregates, this is the first systematic exploration of a large firm-level dataset, the Pesquisa Industrial Annual (PIA). A priori, microeconomic data offer two important advantages over aggregate data for studying TFP. First, aggregate TFP patterns may conceal diverging trends among different subsectors and/or types of firms. For example TFP performance may vary systematically with firm-specific characteristics (e.g., size, composition of input mix, etc.), and these relations would be masked in aggregate data. Second, measures of TFP growth based on aggregate data mix firm-level TFP growth with the effects on TFP of reallocation of inputs and outputs across microeconomic units with different productivity levels (through channels such as changing market shares of incumbent firms or entry and exit of firms).[25] Disaggregated data allows one to disentangle the contribution of these two conceptually distinct forces to overall TFP performance.

For Brazil, however, the microeconomic data also pose major challenges concerning its coverage, consistency, and reliability. PIA contains methodological breaks that hamper comparability of data across different time periods; lacks information on the use of productive inputs — even on capital stocks after 1995; and much of its time coverage corresponds to years of extreme inflation, which complicates considerably the construction of variables. While we have made a major effort to correct some of these shortcomings, and believe that limiting the extent of measurement error embedded in our TFP estimates has been largely successful, the empirical results reported below should be taken with caution.

This section draws extensively from Muendler (2001a, b), and its analysis proceeds in four stages. First, an overview is provided of select earlier studies of Brazilian productivity growth. The methodological approach to estimation of TFP with firm-level data is then defined, and the main features and problems of the dataset are summarized. The patterns revealed by TFP estimates over time and across industrial sectors and geographical regions are then described. Finally the factors behind observed TFP performance are examined to shed light on the issues under investigation and draw conclusions.

Previous Studies

The evolution of productivity in Brazil has been the focus of a number of empirical studies. Some are concerned with productivity at the aggregate (GDP) level, while others focus on the industrial sector as a whole or on specific subsectors. Among the former group, several studies offer cross-country results, allowing for a comparative perspective on Brazil's productivity performance. Table 18 summarizes the results of some recent empirical analyses. Among aggregate-level studies, De Gregorio and Lee (1999) estimated a TFP growth rate for the period 1960–90 of 0.8 percent (below the average in Latin America). When considering the 1980s only, however, they found that the Brazilian economy experienced negative TFP growth of –1.4 percent. In turn, Bonelli and Fonseca (1998) found average TFP growth of 0.1

[25] See Jorgenson (1990) for why this reallocation effect may be particularly important for the short-run evolution of aggregate TFP.

percent in 1980–9, and 0.2 percent in 1990–7. Using data for a much longer period, Hoffman (2000) estimates a TFP growth rate of 2.6 percent for Brazil in 1950–89. This contrasts with earlier results in Elías (1990), who finds a much lower TFP growth rate (0.8 percent) over a similarly long period, 1940–90. For the 1990s, however, Hoffman finds that TFP growth slowed to 0.1 percent, similar to the results of Bonelli and Fonseca (1998), although with a considerable acceleration to 0.7 percent after 1992.

Finally, two of the most recent studies of aggregate TFP, by Teixeira da Silva (2001) and Gomes (2001), find a similar pattern of fall and recovery despite using different methodologies and data. According to Teixeira da Silva, TFP fell at an annual rate of 0.7 percent over 1980–92, and then rose at an average rate of 0.9 percent in 1993–2000. Moreover aggregate labor productivity displayed a very similar pattern. In turn Gomes finds a comparable turnaround in TFP growth — from 0.6 percent to 0.7 percent in 1985–9 to 4.7 percent to 5.7 percent in 1991–8 — with the exact figure depending on which method is used.

The studies of TFP in Brazilian industry vary considerably in terms of coverage. Among the earliest studies, Braga and Rossi (1988) used a translog production function to analyze factor productivity for 21 industrial sectors during 1970–83, finding that 10 of the sectors had experienced negative TFP growth.[26] Using a growth accounting method and data from the industrial censuses of 1970, 1975, and 1980, Bonelli (1992) estimated TFP growth in manufacturing in 1975–85 to average 0.8 percent yearly. Only leather, pharmaceuticals, and furniture had negative TFP growth rates in his findings.

The economic reforms of the 1990s renewed interest in TFP manufacturing estimates. Bonelli and Fonseca (1998) estimate TFP growth for aggregate manufacturing and 21 distinct sectors. At the aggregate level, they calculate a negative TFP growth rate of –0.73 percent in the 1980s. For the 1990s, however, they find positive annual TFP growth of 3.4 percent. Similarly Rossi and Ferreira (1999) calculate TFP and labor productivity for 16 industrial sectors in 1985–97, finding that both accelerated for virtually all sectors after 1991. On average, TFP grew at 2.2 percent in 1991–7, compared to an average yearly decline of –2.5 percent in 1985–90. Finally, the study by Gomes (2001) cited above also estimates aggregate industrial TFP accelerating similarly in recent years, with annual TFP growth rising from 0.4 percent in 1976–89 to 3.4–4.4 percent in 1991–8.

How does this performance compare with other countries? The development in recent years of several large international data sets has made it possible to compare the growth experience of a substantial number of countries by employing a transparent methodology. A review of these studies is presented in Table 18. Elías (1990) presents TFP growth for a group of seven Latin American countries in 1940–90, with Brazil ranking below the Latin America average and below Chile and Mexico. De Gregorio and Lee (1999) examine TFP growth for a larger sample of 21 Latin American countries during a shorter time span, 1960–90, finding that Brazil exceeds the Latin American average.

Latin American TFP grew 1.9 percent yearly in the 1960s and 0.7 percent in the 1970s, while declining 2 percent annually in the 1980s. Brazil's TFP growth rates in the 1960s, 1970s, and 1980s were 1.5, 2.5, and –1.4 percent respectively. In summary, Brazil's TFP growth (decline) was above (below) Latin America's TFP growth (decline) in the three decades covered by De Gregorio and Lee except for the 1960–9 period. Brazil's 1970s TFP growth was almost three times the Latin American average.

Finally, Nehru and Dhareshwar (1994), using a sample of 83 industrial and developing countries for the period 1960–87, obtain an annual average TFP growth for Brazil, Chile, and Mexico of 1.39, 0.37, and 0.68 percent, respectively. These figures are higher than the ones observed in Elías (1990) and De Gregorio and Lee with smaller samples of countries.

[26] Another early study is that of Pinheiro (1989), based on firm-level data from the 1970 and 1980 census.

Moreover Brazil's TFP growth is higher than the averages for the OECD countries and Latin America during the same period.

It is interesting to compare the performance of *industrial* TFP in Brazil with other countries. Jorgensen and Stiroh (2000) report TFP growth for 37 industries in the United States, using a growth accounting methodology for the period 1958–96. Industry-wide TFP grew 0.48 percent yearly, but individual growth rates ranged from 1.97 percent in electronics and electrical equipment to –0.44 percent in printing and publishing. Nine industries had negative productivity growth for nearly 40 years.

Table 18. Recent Studies of Productivity Growth in Brazil

Authors	Aggregation Level	Period	Yearly TFP Growth (%)	Yearly Labor Productivity Growth (%)
Bacha and Bonelli (2003)	GDP	1940–2000	0.32	
		1970–80	0.09	
		1980–91	–2.28	
		1991–2000	1.73	
	Industry (excluding construction)	1950–99		3.38
		1980–91		0.47
		1991–9		4.80
Bonelli and Fonseca (1998)	GDP	1980–9	0.10	
		1990–7	0.20	
	Transformation industries	1989–9	–0.73	
		1990–7	3.38	
	General industry	1992–7		9.59
	Textiles			6.20
	Nonmetallic mineral products			11.46
Castelar Pinheiro (1989)				
De Gregorio and Lee (1999)	GDP	1960–90	0.80	
		1980–9	–1.40	
Elías (1990)	GDP	1940–90	0.80	
Gomes (2001)	GDP	1975–98		0.21–0.30
		1975–89	0.56	0.12–0.14
	Industry	1990–8	3.20–4.07	0.39–0.46
Hoffman (2000)	GDP	1950–89	2.60	3.90
		1990–8	0.10	0.40
		1992–8	0.70	1.00
	Industry	1976–89	0.37	
		1986–98	0.78–1.37	
		1976–98		3.76
		1986–98		3.5–4.7

Table 19. International Studies of TFP Growth

Authors	Aggregation Level	Period	Yearly TFP Growth (%)
Collins and Bosworth (1996)	GDP		
	Latin America	1960–94	0.2
	East Asia		1.1
	Taiwan		2.0
	Korea		1.5
	United States		0.3
De Gregorio and Lee (1999)	GDP		
	Latin America	1960–90	0.1
	Argentina		–0.5
	Brazil		0.8
	Chile		0.9
	México		0.5
	Latin America	1960–9	1.9
	Argentina		0.7
	Brazil		1.5
	Chile		1.6
	México		2.3
	Latin America	1970–9	0.7
	Argentina		0.6
	Brazil		2..5
	Chile		0.5
	México		1.2
	Latin America	1980–9	–2.0
	Argentina		–2.6
	Brazil		–.1.4
	Chile		0.6
	México		–.1.8
Elías (1990)	GDP		
	Latin America	1940–90	1.2
	Argentina		0.5
	Chile		1.4
	Colombia		0.8
	Mexico		1.1
Nehru and Dhareshwar (1994)	GDP		
	Latin America	1960–87	0.13
	Brazil		1.39
	Chile		0.37
	Mexico		0.68
	OECD		0.76

Liang and Jorgenson (1999) use a translog production function to estimate industry TFP growth for Taiwan in 1961–93. TFP growth of the manufacturing sector rose from 0.2 percent yearly in 1961–82 to 0.55 percent in 1982–93, and 0.32 percent for the whole period. In 1961–82, the highest TFP growth was in electrical machinery and electronics (5.44 percent per annum) followed by textiles and food. The laggards were wood and furniture products with a rate of –12.35 percent and paper and printing with –8.66 percent.

In Latin America, the World Bank (1999) presents TFP growth for manufacturing in Mexico in 1993–7. Between 1993 and 1995 TFP growth accelerated from 0.6 percent to 13.8 percent annually. TFP growth rates subsequently fell to 1.3 percent in 1995–6 and to –3.9 percent in 1996–7. TFP growth estimated at the two-digit industry show two groups. The first group — food; textiles and apparel; wood products and furniture; and clay and cement products — has TFP growth below the industrial average. The second group — paper and printing, chemicals, metals, machinery and other industries—has above-average TFP growth rates.

On the whole, the international evidence suggests three things. First, Brazil in recent decades has lagged behind East Asian economies in productivity growth but was roughly on par with the rest of Latin America. Second, TFP in Brazil, as in other developing economies, accelerated in the 1990s after a disappointing performance during the 1980s. Finally, industrial TFP growth in Brazil, as in other countries, whether developed or developing, varies widely across sectors; and negative TFP growth rates at the sector level are often encountered in the literature.

Several Brazil studies offer hypotheses to explain this time path of TFP — and a few actually test some of them. We should note that one likely reason behind the 1990s recovery of TFP in Brazil (and other Latin American economies) is the procyclicality of productivity estimates, which tend to follow the regional pattern of recession in the 1980s and recovery in the 1990s.

This is particularly clear from the annual TFP growth figures underlying the period-average TFP growth rates in Brazil to which we have referred thus far. These figures display large swings from year to year, tracking closely the economy's annual growth performance. For example most estimates show abrupt TFP declines in the severe recessions of 1983 and especially 1990 (Teixeira da Silva, 2001; Gomes, 2001; and Bonelli and Fonseca, 1998).[27] Indeed, estimated TFP growth is strongly correlated with the growth rate of the corresponding value-added aggregate, whether at the economy-wide level (GDP) or the industrial level (industrial GDP). For example, Gomes (2001) reports that the correlation between his estimates of aggregate TFP growth and observed GDP growth is in the range 0.72–0.76, while for industrial TFP the correlation is even higher, 0.86–0.88. This procyclicality partly reflects measurement error regarding labor and capital utilization, for which no good proxies exist in the Brazilian case, as well as the methodological failure of existing studies to account for the possible impact of economies of scale when estimating TFP.

But other factors are also at play behind this dynamic pattern. First, the decline in macroeconomic instability in the 1990s relative to the preceding decade, particularly as reflected in the post-1994 containment of inflation, likely played a key role in TFP recovery by facilitating investment decisions and restoring the informational value of relative prices to guide resource allocation (Teixeira da Silva, 2001; and McKinsey, 1998). Second, several studies have credited the structural reforms of the 1990s, which strengthened the role of domestic and foreign competition, for their impact on TFP (Hay, 1997; McKinsey, 1998; Rossi and Ferreira, 1999; and Gomes 2001). The decline in public infrastructure investment as part of the fiscal crunch of the 1980s and the constraining action of labor regulations on

[27] For this reason, Gomes (2001) excludes the year 1990 when computing period averages of TFP growth.

firms' ability to shed labor (and hence their willingness to employ it) are also among the explanations that have been offered for the productivity slowdown of the 1980s. These are explored in some detail in McKinsey (1988), who concludes that they did not play a major role in the observed time path of TFP in Brazil. We revisit these issues below.

Estimation Technique

The analytical approach underlying our TFP estimations is described in detail in Muendler (2001a). The approach is based on the estimation of sector-specific Cobb-Douglas production functions relating output to capital, intermediate materials, and skilled and unskilled labor:

$$y_{it} = \beta_k k_{it} + \beta_{bl} l_{it}^{bl} + \beta_{wh} l_{it}^{wh} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it} . \quad (5)$$

Here y denotes real output, k is capital, m represents materials, and l is labor input, with the superindices bl and wh respectively denoting unskilled and skilled labor (or more precisely, blue- and white-collar labor). All variables are expressed in logs, and the subscripts i and t refer to the firm and period, respectively. (Log) TFP is measured by the composite error term, which consists of a serially corelated productivity index ω observed by the firm, and an unobservable random technology shock ε.

Estimation of (5) using firm-level data poses two well-known problems. First, firms choose their inputs on the basis of the observed productivity index ω; which renders the right-side variables endogenous and requires an instrumental variable procedure for consistent estimation of the βs. Second, since firms' entry and exit decisions will likewise depend on their productivity level, at any given time the available sample of firms suffers from selection bias due to the exit of the least productive firms and the entry or survival of the most productive ones. The estimation procedure adopted here follows Olley and Pakes (1996) and is designed to overcome the simultaneity and selection problems when estimating production functions.

In this manner, we can recover from estimation of (5) the firm-level values of TFP and hence its growth rate. To arrive at sector- or industry-wide TFP growth estimates, which often are of direct interest, it is important to note that aggregate TFP change between two periods can be decomposed into four ingredients:[28] the TFP growth of incumbent firms, given their size (i.e., given their respective shares in total output); the change in size of incumbent firms, given their respective TFP levels; the TFP level of new entrants; and the TFP level of exiting firms.

To assess the factors behind observed TFP performance, we rely mainly on a regression framework relating TFP, as estimated from (5), to a set of explanatory variables that summarize firm and sector characteristics. The basic specification is of the form

$$\omega_{it} = x_{it}\delta + \alpha_i + u_{it} , \quad (6)$$

where x is a vector of explanatory variables; δ represents the parameters to be estimated; α is a firm-specific, time-invariant effect; and u is a random disturbance. In the experiments reported below, parameter estimates for equation (6) were obtained using fixed-effects regressions since Hausman tests rejected the random effects specification.

In addition to (6), we also estimated specifications, with the dependent variable in first differences, to assess the effects of different factors on TFP growth. In these equations the explanatory variables were lagged one period since the objective was to examine the role of

[28] The decomposition we use follows along the lines of Baily, Hulten, and Campbell (1992).

firm and sector features on subsequent TFP growth performance. For both the level and difference regressions we checked for residual autocorrelation, using the technique Baltagi and Wu (1999) devised to control for time gaps in the sample (e.g., the unavailability of PIA in 1991) in unbalanced panels. In general we found no evidence of serial correlation.

Data

Our source of firm-level data is the Pesquisa Industrial Anual (PIA), an annual survey of manufacturing firms[29] administered by the Brazilian census bureau since 1986, and available until 1998 (with the exception of 1991, in which no survey was conducted). The survey is biased towards medium and large firms, and thus cannot be viewed as representative of the entire manufacturing sector, which includes numerous small firms. Muendler (2001b) has described the PIA in detail, so discussion here is limited to a few key issues.

First is the question of the sample. The sampling method, and thus the sample's correlation to the universe of larger industrial firms, has changed over time. When the survey was launched, it included all the largest manufacturing firms, plus a random sample of medium-sized ones and a nonrandom selection of (large) new entrants. Over the years, all surviving originally surveyed firms remained in the sample, while new entrants were not added after 1993. The exit of old firms and absence of new ones has reduced the sample's representativeness. Furthermore, in 1996 almost a third of the original sample was dropped from PIA records due to a change in sampling method. Consequently the data before and after 1995 are not strictly comparable.

Second is the question of measurement. PIA contains income-statement and balance-sheet data, plus information on a few economic variables, including number of workers and investment flows. These data pose measurement problems for TFP estimation.

Only the number of workers (by white and blue collar) is available, not hours worked. No information is available on capital-stock utilization, a common problem with firm-level data. As a result, standard estimation procedures such as ours will incorrectly identify as TFP changes any output fluctuations derived from varying use of labor (and capital) inputs. Since hours worked are procyclical, our TFP estimates also will tend to behave procyclically, although this seems to be less problematic with our data than in earlier studies.[30]

Brazil's high inflation during the period of analysis introduces other difficulties for the calculation of real output and intermediate input series. These series must be constructed from income statements, which are reported in nominal terms. Hence the task requires price deflators for outputs and intermediate inputs. In the absence of firm-level price data, it is customary to use sector-level price indices. In our case, the measurement error generated by the use of approximate deflators is likely to be magnified by the relative price volatility that usually accompanies extreme inflation,[31] as well as by the fluctuation in output sales, input purchases, and inflation over the year. Considerable effort was devoted to the construction of adequate sector-specific price indices for input purchases, and a number of alternative deflators were considered for output.[32]

Construction of the capital stock poses similar difficulties. Up to 1994, our capital stock figures are based mainly on balance-sheet data (which typically include an adjustment for inflation based on government-mandated price indices that tended to understate actual

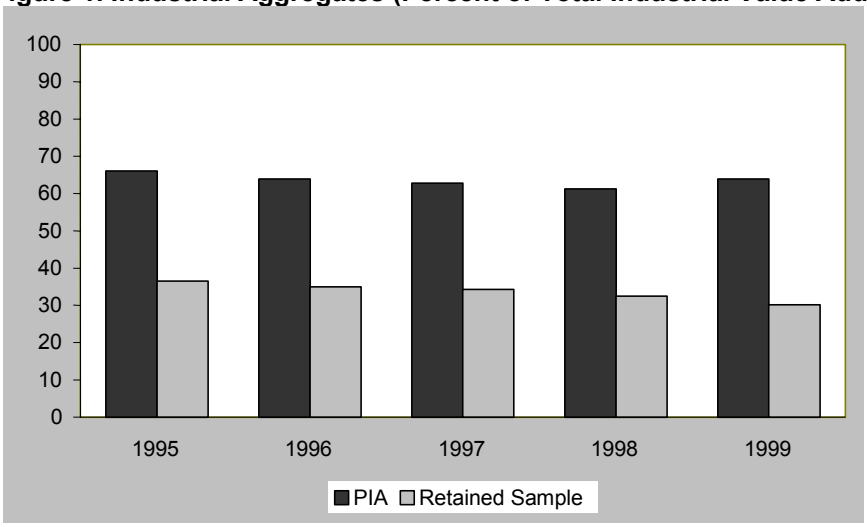
[29] PIA also contains plant-level data, although it is much less comprehensive than the firm-level data used here.
[30] There are reasons other than measurement error why productivity should be procyclical (Basu and Fernald, 2000). But in our data these are very likely of secondary importance.
[31] For the Brazilian case, see Fava and Cyrillo (1999).
[32] The results reported here make use of the sectoral WPI. See Muendler (2001b) for extensive details on the efforts made to construct appropriate deflators for output, intermediate inputs, and capital.

inflation). The situation is more complicated after 1995 because PIA ceases to include balance-sheet data, and capital-stock figures for later years must be constructed on the basis of investment flows. As with value added, considerable efforts were made to arrive at suitable deflators for investment and the capital stock, yet measurement error is still likely to remain in the constructed capital stock series.

In summary, these measurement problems[33] imply that the TFP estimates reported below should be interpreted with caution. Still it is also worth noting that in the context of regressions such as (6) much of the measurement problem error is likely to wash out. Measurement error in the dependent variable should not affect the consistency of parameter estimates when the measurement error is uncorrelated with the right-side variables. If this latter condition is met, the inferences drawn from estimation of equations like (6) about the determinants of TFP should remain valid even if TFP itself is measured with error.

Finally one must consider questions of sample selection and aggregation. Firms in the sample were grouped into sectors according to their two-digit-level industrial classification — the so-called Nível 50 classification — which comprises a total of 27 industrial sectors accounting for roughly two-thirds of total industrial value added in the late 1990s.[34] For most of the empirical analysis, however, only 13 sectors possessing the largest number of firm-year observations were retained. [35] In the late 1990s, these 13 sectors accounted for about half of the value added by Nível 50 industry, or about one-third of the value added in overall industry (Figure 1). Equation (5) was separately estimated for each of these 13 sectors.

Figure 1. Industrial Aggregates (Percent of Total Industrial Value Added)



Pattern of TFP Growth

Figure 2 plots the estimated log TFP series for all Nível 50 industry, as well as that corresponding to the 13 sectors under consideration. In addition, for comparison the figure presents the industry-wide log TFP series estimated by Gomes (2001) on the basis of data

[33] Like many other firm-level studies, we lack information on input quality — other than the crude distinction between blue- and white-collar workers. One should keep in mind that changing input quality has been shown to be a major factor behind TFP growth; see Jorgenson (1990) and Gu and Ho (2000) for some illustrative figures about the U.S. and Canada.

[34] The Nível 50 excludes five sectors included in overall industry: minerals, oil and gas, other industries, utilities, and construction. The latter is by far the largest, accounting for nearly 10 percent of GDP.

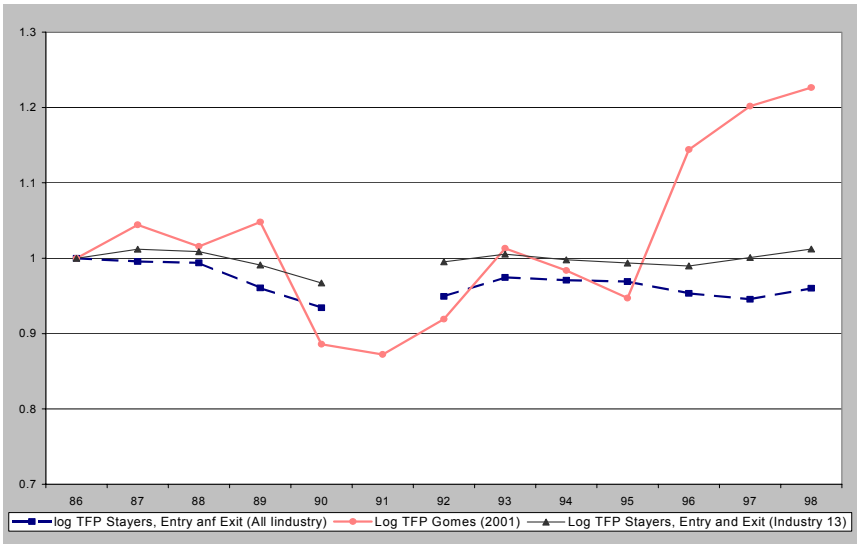
[35] The threshold for inclusion was at least 2,500 firms.

from the Pesquisa Industrial Mensal (PIM).[36] For comparability, all three series are rebased to equal 1 in 1986.

The time pattern of our firm-level data estimates of TFP is qualitatively similar to that found by most of the studies summarized in the previous section. TFP experiences a declining trend in the late 1980s and then recovers in the 1990s. However, the amplitude of this cycle is very small, and on the whole the figure suggests that Brazil's industry-wide TFP has shown little change over the period of analysis. This conclusion is further strengthened if 1990 is ignored as an anomaly in which the severe recession accompanying the Collor Plan produced a largely artificial collapse of measured TFP due to the sharp decline in labor and capital use.

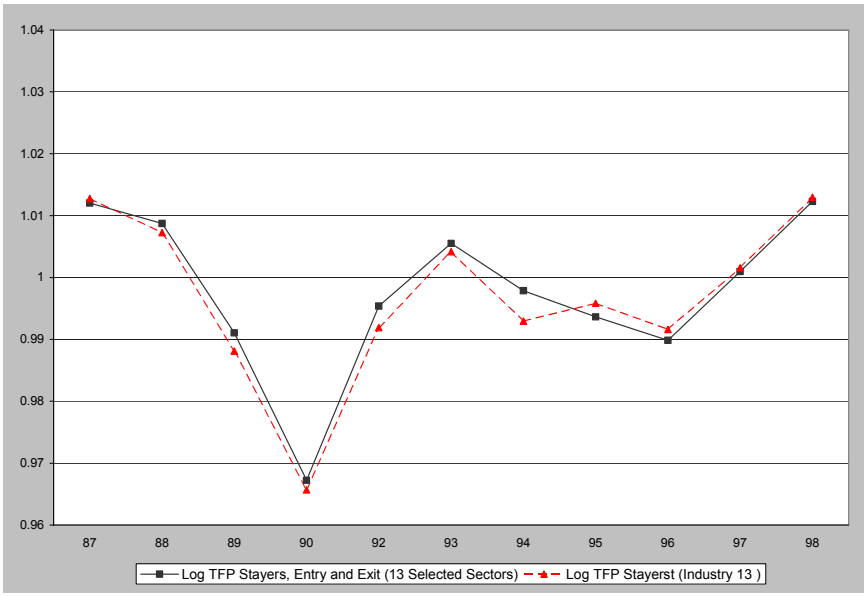
As Figure 2 also shows, until 1995 the PIA-based TFP estimates display a time pattern similar to that of Gomes's (2001) PIM-based estimates, but the volatility of the former is much smaller than the latter's. This suggests that the PIA-based estimates may be less subject to measurement error and hence display less procyclicality than the estimates obtained by Gomes. After 1995, however, the two sources yield divergent TFP estimates, with those of Gomes showing a steep rise absent from the estimates obtained here.

Figure 2 Industry-wide TFP (1986–98)



[36] Unlike PIA, whose unit of observation is the firm, PIM is based on production-line data. Gomes (2001), however, is based on aggregated PIM information rather than the raw data. While PIM's sample size is smaller than PIA's, it contains information on hours worked, allowing utilization to be considered in the analysis.

Figure 3. Industry-wide TFP, 13 Sectors, All Firms and Stayers (1986–98)



As noted earlier, aggregate TFP growth reflects resource reallocation across firms in the form of exit by old firms, entry by new ones, and productivity changes in the holdovers (with this latter component in turn including both productivity changes at the firm level and changes in the relative size of holdover firms).[37] Using PIA allows one to separate the effects of entry and exit from the change in the TFP of the holdover group. Decomposition results are displayed in Figure 3, which compares the time path of aggregate TFP for the 13 sectors of analysis with the path that results from ignoring entrants and exiters. The two series move closely in tandem; the biggest gap arises in 1994, but its magnitude is negligible. This is essentially a reflection of entry's limited role in the PIA sample.

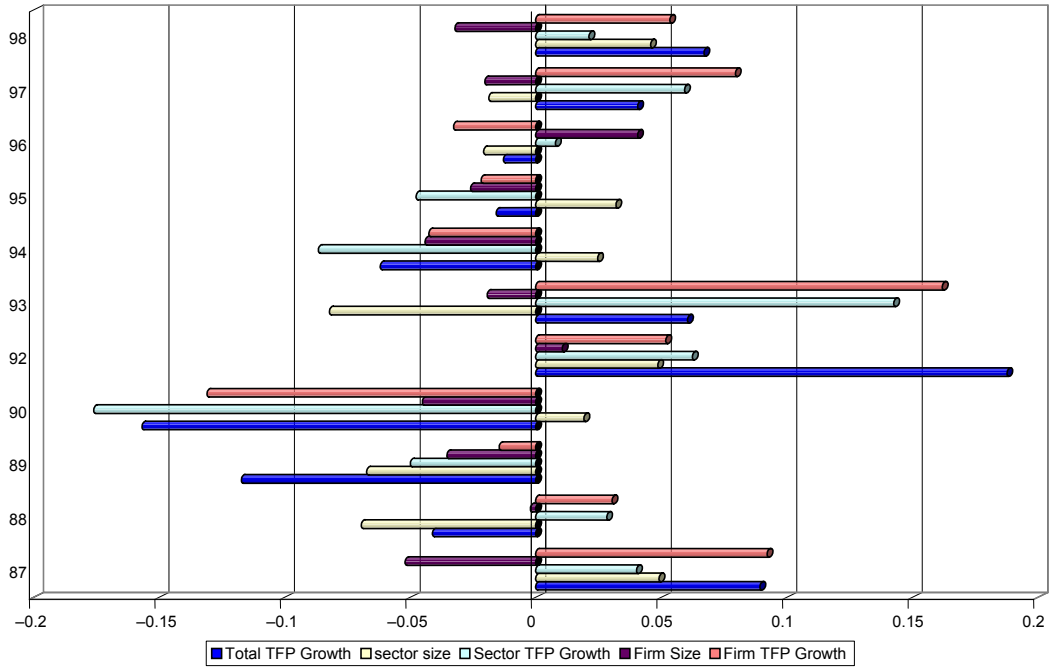
In sum, our estimates agree with previous results showing a TFP recovery in the 1990s, but disagree in showing much less TFP variation over time than earlier estimates. Table 20 condenses the information in Figure 3 into the average TFP growth rate over the 1980s and 1990s in the PIA data; for comparison the figures from Gomes (2001) are also presented. In the 1980s, TFP declined at an annual rate of 0.8 percent (0.3 if 1990 is ignored) for the 13 sectors of analysis, and 1.6 percent for overall industry (1.3 without 1990). In the 1990s, however, TFP grew at positive albeit modest rates, 0.3 percent per annum for the combined 13 industrial sectors on which we focus and 0.2 percent for overall industry.

Table 20. Industry-wide Annual TFP Growth Rates (1987–98)

	Thirteen Selected Sectors	All Industry (Nivel 50)	Gomes (2001)
1987–9	–0.29	–1.30	1.67
1987–90	–0.81	–1.62	–2.49
1991–8	0.29	0.19	5.99
1987–98	0.10	–0.33	2.12

[37] The importance of these reallocation effects for aggregate measures of TFP has been amply documented, for example, by Jorgenson (1990) at the macroeconomic level and by Olley and Pakes (1996) at the firm level.

Figure 4. 4. Decomposition of TFP Growth among Stayers (1987–98)



As mentioned earlier, the evolution of holdover firms' aggregate productivity reflects two forces: the time path of firm-level TFP and the changes in firms' relative size. It is useful to examine the contributions of both factors. Figure 4 shows the decomposition, delineating the contribution firm-level TFP and changing firm and sector size make to TFP growth each year. It is apparent that changes in firm size actually *detracted* from aggregate productivity in most years, with 1992 and 1996 being the lone exceptions, while changing sector size had a more mixed impact on observed TFP growth. This suggests that resource reallocation proceeded in a way harmful to aggregate productivity, an issue that will be more fully examined later in the paper.

The cross-sector patterns of TFP growth underlying these aggregate figures from PIA are summarized in Table 21. Only average TFP growth rates over the same subperiods as in the preceding table are reported, and the figures include only the group of holdover firms for the 13 sectors under consideration. The period to 1990 was characterized by a TFP slump in virtually all sectors except for other metallic products, which exhibited positive TFP growth during the late 1980s. The worst performances came in apparel and in wood and furniture, for which the estimated TFP decline is very large. Again, exclusion of 1990 would considerably reduce the size of some of these seeming declines, but would not reverse them. In the 1990s, by contrast, nine out of thirteen sectors experienced positive TFP growth, with especially high rates in electrical equipment and in vehicles and parts. Four sectors continued to experience a TFP slump in the 1990s: food, textiles, leather, and nonmetallic minerals.

This pattern is broadly similar to Rossi and Ferreira (1999), who used aggregate PIA data. They also report a uniform TFP decline in 1985–90, followed by a uniform increase in 1991–7. Furthermore, the vehicles and parts sector is also the recent performance leader in

their results, with electrical equipment among the top performers as well.[38] The rapid productivity gains by the vehicles and parts sector in the 1990s are also documented in McKinsey (1998), who traces them to the trade opening during the decade.

Finally we examine TFP growth patterns from a regional perspective. For this purpose, the country is divided into three geographical regions: São Paulo, the South plus the rest of the Southeast, and the North and Northeast. It is important to note from the outset that these regions differ considerably in the size of their industrial sectors. In 1997, São Paulo provided 44 percent of Brazil's industrial value-added. Including the South and the rest of the Southeast, the figure rises to 85 percent. The North and Northeast account for the remaining 15 percent. Furthermore, the three regions differ considerably in their industrial composition. Since not all sectors are significantly represented in every region, we focus on industry aggregates. Until 1990, the profile is fairly homogeneous across regions: All experience falling TFP. In the 1990s, however, a large gap opens between the Northeast, which witnesses a further abrupt decline in TFP in 1994–5, and the other two regions, which show rising TFP, especially rapid in the South and remaining Southeast. This contrasting regional performance likely reflects the Northeast's limited share of the industrial sectors that led TFP performance in the 1990s (such as cars and parts, and electrical equipment).[39]

Table 21. TFP Growth by Sector (%)

	1987–90	1991–8	1987–98
Nonmetallic mineral products	–7.77	–1.16	–3.56
Other metallic products	1.17	1.15	1.16
Manufacturing and maintenance of machinery	–5.42	3.06	–0.02
Electrical equipment	–3.32	12.07	6.48
Wood and furniture	–12.94	0.43	–4.43
Paper, pulp, and cardboard	–0.02	2.83	1.80
Plastics	–5.76	0.14	–2.01
Textiles	–1.25	–2.06	–1.77
Apparel	–16.73	6.05	–2.23
Leather products and footwear	–0.79	–2.34	–1.78
Processed and edible products	–7.31	0.03	–2.64
Food and beverages	–3.06	–4.10	–3.72
Vehicles and parts	–3.34	6.95	3.21

[38] They also found rapid TFP gains during 1991–7 in the chemical sector, which is not included in our analysis. We should note, however, that our sectoral TFP performance rankings are fairly different from those of Gomes (2001), who uses national accounts data on industrial value added by sector. He reports negative TFP growth in 1990–8 in 8 of our 13 sectors, perhaps because he includes 1990 in the period of analysis. In that year most sectors display a TFP decline, which, as mentioned earlier, basically reflects the deep recession that took place. Nevertheless Gomes also finds that the automobile sector was at the top in terms of TFP growth in the 1990s.

[39] Indeed, if we perform the same exercise but include all industrial sectors — rather than the 13 in the text — the estimated TFP performance of the Northeast compares much more favorably with other regions.

Policy, Structural Factors, and TFP Growth

We next study the policy and structural factors shaping TFP performance, using TFP estimates constructed above. The ultimate objective is to assess how selected aspects of the policy and regulatory framework have affected the evolution of Brazilian industrial firms over the last decade. Specifically, the focus is on four broad sets of questions:

- *Trade Barriers*. How has the changing exposure to foreign competition affected firm productivity? Did the decline in protection during the 1990s spur TFP improvements?
- *Knowledge*. What role has the knowledge that is embodied in physical and human capital played in promoting firm productivity? Has the latter been improved by the availability and use of foreign equipment (which may embody the latest technology available in world markets), by information technology, and by human capital?
- *Resource Allocation*. How do firm size and TFP interrelate? Do newer firms bring in higher-productivity techniques? Does greater capital intensity of production cause higher or lower TFP? Did the regulatory environment reallocate resources toward the most productive firms? How did the rules and regulations constraining labor adjustment affect firm performance? Did they pose a significant burden to firms seeking to downsize operations?
- *Physical Capital and Investment*. Was insufficient investment an obstacle to productivity improvement? What factors constrained firms' ability to expand their capital stocks?

To address these issues, we rely mainly on results from the multivariate regressions introduced earlier in the paper. To avoid omitted-variables bias, explanatory variables that attempt to capture the various factors affecting TFP are included. Thus to reflect the changing exposure of domestic producers to foreign competition, we include in the regressions the value-added weighted nominal tariff rates by sector constructed by Kume et al. (2000); the real exchange rate; the sector-specific degree of local market penetration by foreign exporters (defined as the ratio of imports over total final uses for each sector's goods, based on Ramos and Zonnenschain, 2000); and the firm-specific ratio of exports to total sales. Next, in regard to the impact of embodied knowledge, we examine how the composition of capital and labor inputs affects TFP. For capital we focus on the ratios of used machinery to all machinery and of imported machinery to all machinery. For labor we examine the effects of the white-/blue-collar composition of the workforce as a proxy for the prevalence of skilled/unskilled workers.[40] For resource allocation, the available regressors are the capital-labor ratio, the age of the firm, and its size. The latter is measured by both value added and output. For size and age we allow nonlinear effects by including quadratic terms.[41]

Not all regressors are available in every year. The composition of the capital stock (foreign and used machinery, as well as computers) is available in 1986–95. The ratio of exports to sales is unavailable prior to 1989. The only observations for which all candidate

[40] For 1996–8 PIA also includes information on the ratio of foreign materials to total materials used. However the composition of the capital stock is unavailable for these years. We nevertheless performed some additional regressions, using only 1996–8 data, to assess how the composition of intermediate goods affected TFP and its growth rate. The results were never significant, so we do not report them here.

[41] In addition, the regressions include regional dummies (invariably insignificant and hence not reported here) and the inflation rate (to control for cyclical factors) rather than the effect of inflation itself. Because its coefficient seems uninformative, it is ignored here. In addition, additional experiments were performed to assess the determinants of firm-size change, the impact of labor regulations, and the determinants of investment. These experiments are described in detail in Muendler (2001b).

regressors are simultaneously available are 1989–95.[42] For this reason we present two sets of results: for 1989–98 (excluding variables describing the composition of capital) and 1989–95 (including such variables). Descriptive statistics for the dependent and independent variables are shown in Table 22.

Parameter estimates from the regressions appear in Table 23. Note that generally the regressions possess satisfactory explanatory power given the huge sample sizes, especially in the equations with TFP level as the dependent variable. Nevertheless, the R-squared measures suggest that unobserved factors are responsible for much of the variation in TFP and its growth rate. The estimated parameters are in all cases significant jointly, as implied by the Wald statistics. Finally, these regression results should be interpreted with caution since we cannot exclude possible reverse causation from TFP to some regressors, e.g., high tariffs might stem from successful lobbying by low-productivity firms rather than vice versa.

Let us now take up the question sets, one by one.

Table 22. Descriptive Statistics for Alternative Samples

	TFP				TFP Growth			
	1989–98		1989–95		1989–98		1989–95	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Trade								
Tariffs	0.2288	0.1470	0.2125	0.1315	0.2110	0.1384	0.1978	0.1186
Real exchange rate	1.0006	0.1299	1.0444	0.1396	1.030	0.1362	1.0655	0.1366
Exports-to-sales ratio	0.5627	0.1370	0.0587	0.1361	0.058	0.1358	0.0590	0.1334
Foreign penetration	0.0651	0.0635	0.0611	0.0587	0.0644	0.0612	0.0621	0.0594
Knowledge								
Used machinery to total machinery			0.0586	0.1505			0.0579	0.1479
Imported machinery to total machinery			0.0467	0.1191			0.0489	0.1209
Computer equipment to total machinery			0.0070	0.0124			0.0071	0.0120
Skilled employees to total workers	0.2514	0.1748	0.2614	0.1767	0.2521	0.1739	0.2585	0.1744
Resource allocation								
Age	25.5432	16.7961	27.3608	16.54	27.0833	16.8392	27.8095	16.5874
Size (output)	5.49E+07	2.74E+08	6.33E+07	3.04E+08	6.06E+07	3.02E+08	6.73E+07	3.27E+08
Physical investment								
Capital-labor ratio	9841.54	25046.65	9232.446	24747.6	9529..551	24372.42	9080.968	24157.72
Total factor productivity								
TFP	5.944	2.0232	6.009	2.0440				
TFP growth					0.0438	0.3863	0.0514	0.3774

[42] Ignoring the information on the composition of intermediates, which are available for 1996–8 only.

Table 23. Regression Coefficients from TFP Level and Growth Equations

	TFP		TFP growth	
	1989–98	1989–95	1989–98	1989–95
Trade				
Tariffs	–0.1688**	–0.0543**	–0.1449**	–0.2299**
Real exchange rate	–0.0580**	–0.0106	–0.9248**	–0.9809
Exports-to-sales ratio	–0.0741**	–0.1477**	–0.1239*	–0.2057*
Foreign penetration	1.6274**	0.9048**	–0.7590**	–0.6825**
Knowledge				
Used machinery to total machinery		0.0023		–0.0010
Imported machinery to total machinery		0.0557		0.0268
Computer equipment to total machinery		2.0329**		1.3266**
Skilled employees to total workers	–0.0057	0.0317	0.0642**	0.1157**
Resource Allocation				
Age	–0.0301**	–0.0049	–0.0333**	–0.0519**
Age^2	–0.0001**	–0.0002**	0.0000	0.0001
Size (output)	2.19E-09**	2.41E-09**	1.47E-09**	1.70E-09**
$Size^2$	–1.95E-19**	–1.95E-19**	–1.25E-19**	–1.35E-19**
Physical Investment				
Capital-labor ratio	–8.05E-07**	1.92E-06**	7.97E-07**	3.25E-06**
R^2 within	0.1373	0.1018	0.0653	0.0838
No. of observations	30,913	15,739	20,679	12,164
Wald test of joint significance of all parameters (p value)	0.0000	0.0000	0.0000	0.0000

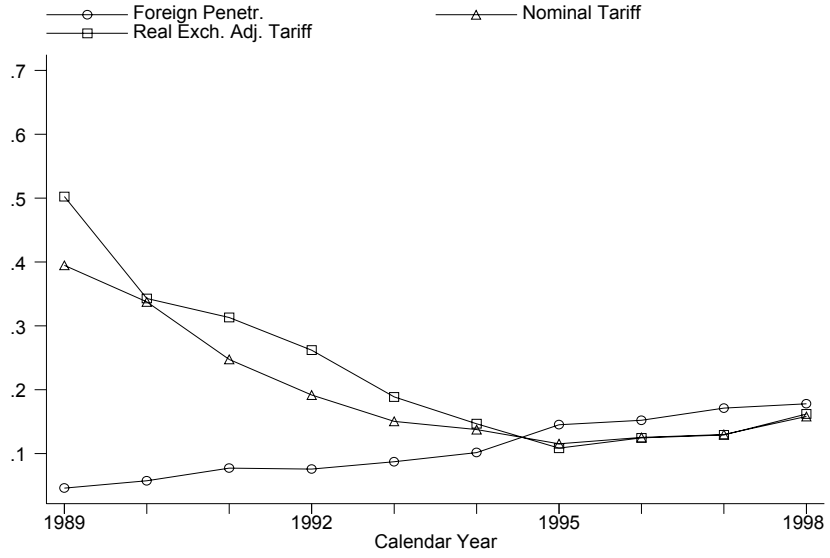
*Coefficients are statistically significant at the 10 percent level.
**Coefficients are statistically significant at the 5 percent level.

Trade Barriers. Liberalization proceeded in four stages (Kume et al., 2000). Reforms in 1987–9 primarily sought the removal of numerous redundant tariffs. The (value-weighted) average effective tariff declined from 68 to 39 percent. In the second stage (to 1993), nontariff barriers were lifted, leaving the real exchange rate and tariffs, which were reduced further until the average effective rate was 15 percent, as the main protective instruments. Tariff reduction picked up again with the advent of the Real Plan in 1994, bringing the average effective rate to 12 percent. Finally, in 1995–8, a partial reversal occurred. Certain rates (on automobiles, consumer durables, textiles) were raised first, and then a generalized 3 percent increase was imposed so that the effective rate climbed back to an average of 15 percent.

Figure 5 plots the time path of the average nominal tariff (with and without adjustment for the protection accorded by the level of the real exchange rate) as well as the degree of foreign market penetration (as defined above), with all variables corresponding to the overall industry average. The steep decline in protection after 1989 is apparent, as are the partial reversal of the reform after 1995 and the steady increase in foreign penetration. This general framework conceals significant variation across sectors. One interesting experience is that of the auto and auto-parts industry, which enjoyed one of the highest nominal protection rates prior to liberalization and the highest effective protection rate throughout the reform period

(Kume et al., 2000). In this case the pattern of abrupt tariff decline and reversal is particularly striking, as is the steady increase in foreign penetration despite the partial rollback in the late 1990s of prior tariff cuts.

Figure 5. Nominal Tariffs and Import Penetration, All Industry Average (1989–98)



A few studies have focused on the impact of this reduction in trade barriers on Brazil's TFP. Hay (1997) examines the impact of nominal and effective protection rates on the TFP of a group of large industrial firms. He finds negative effects of both variables, as well as from protection accorded by depreciated real exchange rates, and concludes that both the elimination of nontariff barriers at the end of the 1980s and the tariff reductions in the 1990s (along with domestic deregulation and privatization) had positive impacts on the level of TFP. Rossi and Ferreira (1999) likewise find a strong negative impact of nominal and effective tariffs on the growth rate of aggregate TFP, and conclude that the process of trade opening was a key factor behind the TFP recovery observed in the 1990s. Finally, McKinsey (1998) also spotlights tariff reductions as the main force behind the productivity improvements observed in the auto and auto-parts sectors, and underscores the obstacle that high tariffs on capital goods (particularly telecommunication equipment) posed to investment and plant modernization at the beginning of the reform period.

The first group of coefficients in Table 23 allows us to assess the impact on TFP of opening up the domestic market to *foreign competition*. A priori, we expect protection via tariffs or the real exchange rate to retard TFP, while market penetration by foreigners and contact with export markets should enhance it.

Starting with tariff levels, we find that higher tariffs are invariably associated with lower TFP levels and growth rates in both sample periods. In the case of TFP levels, however, the association is significant only in the longer sample. In the case of TFP growth rates, the coefficients are significant over both time periods. They suggest a positive effect on TFP growth of around 0.2 percent for each point decline in tariff rates. Thus a 30 percent drop in tariff rates (roughly the average rate decline over the reform period) would yield, other things being equal, a 6 percent acceleration in TFP growth.

In turn, the real exchange rate also carries a uniformly negative coefficient in regressions of both the TFP level and TFP growth rate, although as with tariffs the coefficient is insignificant in the level regression for the 1989–95 sample. More-depreciated real exchange rates provide domestic firms additional protection from foreign competition. They

also tend to raise the real cost of imported intermediates and machinery. On the whole, the regression results suggest a higher real exchange rate allows firms to get by with lower or more slowly growing TFP.[43]

Foreign penetration in local markets has a significant positive effect on the TFP level in both sample periods (columns 1-2). However, its negative impact on the subsequent growth rate of TFP (columns 3-4) is somewhat puzzling.

Finally, in the case of export orientation, a negative and significant association with TFP and its growth rate was found in both sample periods, contrary to expectations. We should note, however, that in this experiment a number of key variables are held constant — skill intensity, machinery use, and firm age and size — that other studies have found to be significantly associated with export orientation. Interpretation of this result is therefore unclear.[44]

Knowledge. To explore the second broad issue, the role of knowledge embodied in physical and human capital, we focus on variables describing the composition of the physical capital stock — the ratios of used machinery, imported machinery, and computer equipment to total machinery — and the white-/blue-collar composition of the labor force. It is worth noting that the foreign machinery ratio reflects access to foreign markets on the input side, rather than the output access discussed in the preceding subsection. A priori, one expects all these input-quality and embodied-knowledge measures to be positively related to TFP performance except for the used-machinery ratio, which should exert a negative effect.

Of all the variables just listed, only the skills ratio is available in both sample periods under study. The second group of coefficients in Table 23 shows that this ratio has a positive and significant effect on TFP growth in both periods but no significant effect on the TFP level in either period. Regarding composition of the capital stock (available for 1989–95 only), the ratio of computers to machinery is significantly associated with higher TFP and TFP growth, and its coefficient is of large magnitude.[45] In contrast, neither the used nor the foreign machinery ratios exhibit any significant effect on TFP or its growth rate. The latter result, in particular, suggests that quality differences between domestic and foreign machinery are inconsequential from the perspective of productivity.[46] Finally, the same conclusion applies to foreign intermediates: Their ratio to total intermediate inputs is not significantly associated with TFP level or TFP growth.

Firm Characteristics and Resource Allocation. Four questions arise concerning the role of resource allocation in the observed patterns of TFP: First, does productivity vary systematically with firm age and size, i.e., do newer or smaller companies bring in higher-productivity techniques? Second, does capital intensity bear any relationship to TFP? Third, did more productive firms tend to expand faster than less productive ones? And finally, do labor regulations pose a significant burden on business operations? To answer the first two questions we can look at the third group of estimates in Table 23.

In general, looking at *firm age*, older companies exhibit significantly lower TFP and TFP growth rates. For TFP levels, the effect is convex, becoming stronger as firms mature. Its magnitude seems considerable: Other things being equal, a one-year increase in age lowers TFP growth by 3–5 percent (note than mean age is around 25–30 years). In interpreting this

[43] Caution is necessary regarding this result since the real exchange rate measure included in the regressions lacks cross-sectional variation and only displays time variation. It may thus partly capture the effects of other aggregate shocks affecting Brazilian industry, in addition to the effects of the real exchange rate itself.

[44] Moreover, additional work in progress by Muendler (2002) using a different econometric approach finds that export orientation and TFP show a positive association among Brazilian manufacturers.

[45] The computer-to-machinery ratio is generally very small; its sample mean is 0.6 percent.

[46] As noted earlier, the same result was found for foreign intermediates over the shorter 1996–8 sample.

result, however, it is important to remember that other features which vary systematically with firm age — firm size, for instance — are being held constant.

Firm size is measured both by output and value added, and in both cases we find a strongly significant effect. In the case of value added, the impact is concave: Larger firms exhibit higher productivity and faster productivity growth, although beyond a certain size the relationship changes sign. Near the sample mean, a 10 percent increase in size as measured by value added is associated with an increase in TFP of about 0.5–0.8 percent and an increase in TFP growth of roughly the same magnitude. In turn, an increase in size as measured by output yields a more modest, but still positive impact on TFP.

Table 23 shows that *capital intensity* exerts a positive and significant effect on TFP growth in both sample periods. Its impact on the level of TFP, however, is less clear. It is positive in the 1989–95 sample when the variables describing the capital stock composition are available, and negative in 1989–98 when they are not.

Contrary to expectations, the contribution of *firm size changes* to aggregate TFP was negative in several years. Change in firm size acted as a drag on aggregate productivity. This result is worth closer inspection. Therefore we ran fixed-effects regressions with firm size change measured by value added as the dependent variable, and with the same explanatory variables (other than size) used in the TFP regressions summarized above, including the profit rate and the TFP level as additional regressors. On the whole, these regressions had a high explanatory power (with R-squared coefficients around 0.20). Their main result is that size change is strongly and positively affected by firm TFP levels. Thus, other things being equal, more-productive firms did tend to expand faster over the sample period. Other things, of course, did not remain equal, and must underlie the negative contribution of firm size change on aggregate TFP growth.[47]

In assessing the impact of *labor regulations*, we focused on the burden posed by dismissal rules on firms' ability to adjust to changing conditions, looking at the share of labor costs in total costs for those firms that were shrinking since the constraints on labor shedding should be reflected in rising shares of labor costs for those firms. The main finding from these experiments (see Muendler 2001a) is that shrinking output is indeed associated with higher labor cost shares, after controlling for other firm characteristics. Although this seems consistent with the reasoning posited earlier, it is difficult to establish the direction of causality underlying the association. Hence it cannot be viewed as conclusive.

Physical Capital and Investment. Given the earlier result that capital intensity encourages TFP growth, interest naturally turns to investigating the factors that shape firms' investment decisions. Our final set of empirical experiments involved the estimation of investment equations relating fixed capital formation to a set of real and financial variables. Among the real regressors, we added the firm's TFP level and its capital-to-output ratio to the variables used thus far. The financial variables included the ratios of profit and credit to output and a set of indicators for a firm's financial structure. This analysis yielded two key results. First, TFP affects investment negatively, which might be interpreted as a "catch-up" effect. That is, firms invest precisely to raise productivity, and they begin to slow their investment pace when productivity reaches a sufficient level.

Second, investment is systematically affected by financial variables such as the profit ratio, the ratio of credit to output, the ratio of long-term credit to the total, and the credit-to-equity ratio. The first three variables are positively associated with investment; the fourth is negatively related. It is tempting to conclude that this reflects the action of financial

[47] More precisely, while the *unconditional* correlation between size change and TFP level is negative in the sample, the *conditional* correlation (that is, controlling for the other factors mentioned in the text) is significantly positive.

constraints on firm investment. However, as in the earlier query about labor regulatory burdens, it is difficult to establish causality. Hence the empirical association of investment with these variables must be interpreted with considerable caution. Other work however has found evidence for the existence of credit constraints in Brazilian investment since the Real Plan, however, increasing our confidence in this interpretation of the results (Thomas, 2001).

Conclusions

On average at the firm level, Brazilian TFP growth was negative in the 1980s before modestly recovering in the 1990s. Performance differed widely by industry, with the auto and electrical equipment industries showing the strongest productivity growth in the 1990s. Less technological sectors — food, textiles, leather, and nonmetallic minerals — showed the worst performance and actually declined in productivity during the decade. The industrial composition of the manufacturing sector in the North and Northeast led to lower TFP growth in these regions relative to the South and Southeast.

TFP and TFP growth regressions across firms within industries suggest that trade opening may have helped raise average TFP by about 6 percent. Market penetration by foreign competitors raised the level of TFP but not its growth rate. On the other hand, export orientation does not raise TFP in the Brazilian data; indeed the relationship is negative. Other findings suggest the importance of technological innovation: Higher shares of information technology in physical capital raised both TFP and its growth rate. Complementing this result, firms employing more skilled labor, in the form of a higher white-to-blue-collar ratio, showed faster TFP growth, suggesting that Brazilian human capital investments contribute to TFP growth. Foreign machinery, on the other hand, had no significant effect, calling into question the role this played as a conduit for embodied technological change in recent Brazilian growth. Given evidence from firms elsewhere on the importance of international knowledge flows, this result heightens concern that Brazil's integration into international production is not generating all its potential benefits, perhaps due to a bias toward regional trade, perhaps owing to impediments to technology transfer. Finally, new firms possessed higher and faster-growing TFP, suggesting that measures to ease their entry may be a source of future productivity gains for Brazil.

Household Income Growth and Its Distribution

This section focuses in particular on how much economic growth accrues to the poor. Dollar and Kray (2000) have recently found that growth in per capita GDP across countries is more or less unrelated to changes in measures of their inequality. This finding can be interpreted in two ways. On one hand it refutes those who claim that growth is an irrelevant measure of welfare, that it is systematically regressive because it is generated and captured by elites; yet it also suggests that the distribution of growth might be an interesting second statistic to examine since it is essentially "orthogonal," i.e., unrelated to, the level of growth. We treat this as an open question for Brazil, and attempt to answer it by comparing aggregate income growth patterns with its distribution patterns. The analysis is then extended by examining the underlying causes of both growth and its distribution. We shall return to possible explanations of growth and the pattern it takes, later in this section.

Our analysis makes use of stacked household data from 1982–98,[48] contained in Brazil's annual national household survey, the Pesquisa Nacional por Amostra de Domicílios

[48] In the context of explaining historical patterns in Brazil, comparable data from the 1970s would have been desirable. Unfortunately such data are not available.

(PNAD). Our approach has two main advantages. First, PNAD has a stratified sample design that makes it representative at the state level. This is useful in itself since one can compare growth in household incomes across different states to assess aspects of state performance. But using household data to compile income growth measures also allows us to focus on income growth among the poor (as well as the general population) and then calculate partial correlation with factors that vary at the household or the local level.

PNAD also has some fairly well-documented shortcomings.[49] In particular, its income measures are rather partial since the questionnaire pays little heed to assessing home production and nonmarket income (important in rural areas). However for our present purposes it has one overriding advantage: its comparability across time. Furthermore the patterns obtained from PNAD are consistent with the regional accounts (see Azzoni et al., 2001), suggesting at least that the conclusions in their general form are robust to any design faults specific to the PNAD survey.

Our measure of income growth is change in log per capita household income.[50] For each year the survey was performed (1982–98, with 1994 missing), two such measures are constructed: change in mean income for the population and change in mean income of the poorest (as measured the previous year) 25 percent of the population. These two measures are then treated as the independent variable in the regression analysis.

The implicit analytic unit for most of the analysis is the state. The presentation of results contains two parts, first descriptive and then analytical. The descriptive overview presents state growth rates in four periods: 1981–5, 1985–9, 1989–93, and 1993–8. The analytical section uses an age cohort within a state as the unit of observation. This allows us to enrich the exercise by adding greater variation in important dimensions such as educational attainment, employment patterns, and access to infrastructure. We lack repeated observations of the same households over time (panel data), but by aggregating within state-cohort cells, we do have repeated observations of cohort means over time (quasi-panel data: see Deaton, 1980). The analysis then uses panel estimation techniques to derive consistent estimates of partial correlations between state cohort characteristics and state cohort income growth. Thus, the analysis tries to answer the question: What parts of Brazilian state-level characteristics or policies coincided with income growth within the periods studied?

Hypotheses

To frame the answer to this question, initial hypotheses about what determines or constrains household income growth in Brazil and its states are needed. Many such hypotheses exist, but many of these are untestable using the data and methods of this paper. The following hypotheses were selected, with notes amplifying the evidence that would support each:

First are *education constraints*. Brazil's low level of workforce education (ranking behind most of its South American neighbors in most statistics) is often cited by investing companies as an impediment to economic activity. So it is natural to posit this as an obstacle restraining growth. If this is so, one would expect to see states and cohorts with more education among the workforce showing significantly higher levels of income growth.

Second is *political and policy uncertainty*. Policy uncertainty has been cited by firms in many surveys as the number-one obstacle to investing in Brazil. It is sometimes difficult to ascertain exactly what comprises this uncertainty: Exchange rates, economic ambiguity,

[49] See Ferreira et al. (1998) for the most complete discussion of this topic.

[50] For changes of about 10 percent or less, this measure is approximately equal to the percentage change in income. Using log-differences has certain analytical advantages that make it preferable, however. Parts of the analysis were performed using percentage changes in income, without causing undue disparity. The main divergence between the two is that log-differences deflate large (greater than 10 percent, say) income growth figures. The results suggest that this distortion does not excessively harm the main conclusions of this analysis.

unpredictable legal rulings, among other factors, may all play a part. For present purposes, we focus on the educational level of public-sector employees in a state, the frequency of ideological shifts in government, and the volatility of voting patterns as measures of uncertainty that may impede economic growth.

Third are *infrastructure bottlenecks*. Brazil's infrastructure is not worse, overall, than its neighbors in many categories. There is, however, great infrastructural variation among the states (e.g., in electrification, water, paved roads, and public services such as garbage collection). If infrastructure were a constraining factor, one would expect to see the states best endowed in these dimensions growing faster, *ceteris paribus*.

Fourth are *labor rigidities*. Brazil's labor code is onerous by international standards. Again, the extent to which this impedes growth is unclear, but if it is an impediment, then under certain assumptions one would expect to find lower income growth rates in states and cohorts with higher levels of formal labor contracts. The proportion of contracts that are formal is of course endogenously determined as a function of their associated costs and benefits, so the line of analysis suggested in the previous paragraph can only be pursued with some skepticism. However, nearly all the explicit costs of formality are federally imposed and thus invariant across states and cohorts. Variation in the proportion of contracts that are formal must therefore be due to other factors, some of which will be controlled for in the analysis: education and employment composition by sector, for example. Thus one must assume that remaining variation in the extent of formal contracts is exogenous.

Fifth is c*limate*. A long strand of economic literature posits that some countries are geographically doomed to lower growth rates owing to climatic conditions that impede economic activity. The most common evidence cited is the negative coefficient on "tropical" dummy variables in cross-country growth regressions. We therefore investigate whether rainfall, latitude, or altitude are associated with differences in income growth rates.

Sixth are a*gglomeration and spatial factors*. A related hypothesis holds that poor areas remain poor due to low aggregate demand (so-called trading externalities, discussed theoretically in Diamond, 1982). These effects are therefore also "geographical,"[51] but would show up in data as low growth rates associated with low local measures of economic activity.

Seventh are *access to markets and trade volume*. Brazil's economy remains relatively closed despite lowered tariffs in the 1990s. There is also variation in the distance to major markets among the states. If integration were constraining growth, *ceteris paribus* we would expect to see states furthest from markets, and those trading least, growing more slowly. To attempt to test for these effects we use distance from the sea as a proxy for market access, and interstate trading volumes as a proxy for integration into the national economy.

Eighth is *migration*. Brazil's economic miracle included processes of urbanization, transformation of the productive base from traditional industries toward manufacturing, and migration, particularly from the Northeast to the Southeast regions (see Gordon, 2001). Recently these migratory flows have diminished and even reversed (Fiess and Verner, 2001). It is an interesting question, though hard to answer convincingly, to what extent this has caused Brazil's economic slowdown. Because opportunities for income growth cause and are caused by migration, most attempts to assess causality are doomed to ambiguity.

Descriptive Results

The main issues we are interested in describing before a discussion of underlying causes are:

- *Income Growth over Time*. How does income growth behave in different periods since 1982? What are the relative performances of the states and regions?

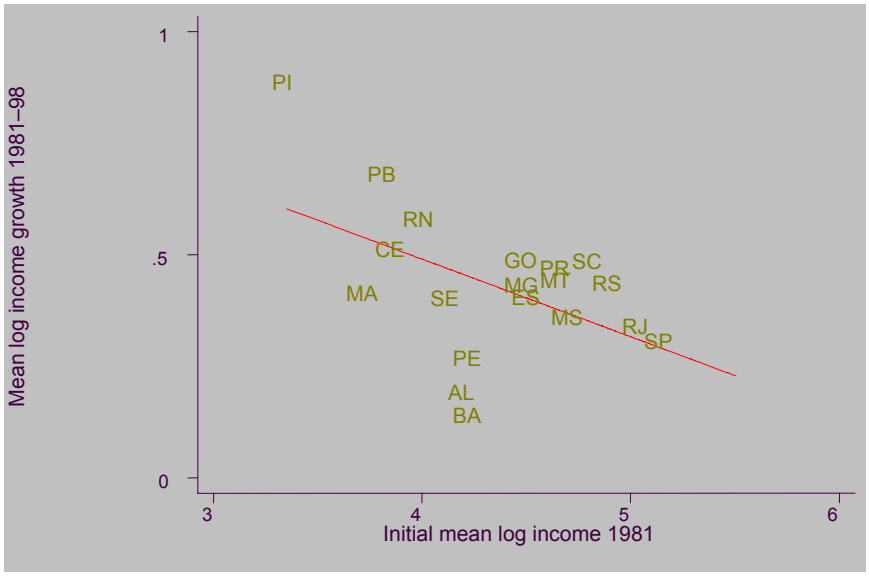
[51] See Jalan and Ravallion (2000) on China.

- *Convergence*. Is there a tendency for poor states to catch up with richer ones? If so, how fast?
- *Income Growth among the Poor*. To what extent does income growth accrue to the poor? How does this vary by state and region?
- *Changes in Inequality*. What are the effects of income growth, and its accrual to the poor, on inequality? Has inequality risen or fallen? Is there a "tradeoff" between income and inequality?

For convenience we divide the full period 1981–98 into four approximately five-year subperiods: the early 1980s including and following the debt crisis (1981–5); the late 1980s including and following the Cruzado Plan (1985–9); the early 1990s including and following the Collor plan (1989–93); and the late 1990s including and following the Real Plan and stabilization (1993–8).

Figure 6 plots state household-income growth (vertical axis) versus initial household per capita income (horizontal axis) for the whole period. One can see the high divergence in states' growth rates, although only 19 of Brazil's 27 federated units are shown in the diagram for various reasons. The Federal District comprising Brasília and neighboring towns is not a state. Also, the states of Brazil's Northern region[52] have been excluded since they are special cases, exhibiting "frontier" characteristics. They have extremely variable growth rates, mainly owing to waves of immigration and exploitation of natural resources (e.g., oil in Roraima), and their inclusion would obscure more than it would reveal.

Figure 6. Initial Income and Income Growth (1981–98)



There is some evidence of states falling into regional blocks.[53] Brazil's regions are to some extent economically homogeneous clusters. The Southeast (SP, RJ, MG, and ES) is richest and forms the industrial powerhouse of the country. The South (RS, SC, and PR) is also relatively wealthy but more agricultural and less industrial than the Southeast. The

[52] The states of Rondônia, Acre, Roraima, Amapá, Pará, and Amazonas. The state of Tocantins, which only separated from Goiás in 1991, has been merged with Goiás for the purpose of comparability across time.
[53] Brazil has standardized definitions of its regions. The Southeast comprises São Paulo (SP), Rio de Janeiro (RJ), Minas Gerais (MG), and Espírito Santo (ES). The South comprises Rio Grande do Sul (RS), Santa Catarina (SC), and Paraná (PR). The Center-West comprises Mato Grosso (MT), Mato Grosso do Sul (MS), Goiás (GO), and the Federal District (DF). The Northeast comprises Bahia (BA), Sergipe (SE), Alagoas (AL), Pernambuco (PE), Paraíba (PB), Rio Grande do Norte (RN), Ceará (CE), Piauí (PI), and Maranhão (MA).

Center-West (MT, MS, GO, and DF) is poorer than the first two and relies mainly on natural resources and agriculture. Its infrastructure is far less developed than that of the South and Southeast. The Northeast (PI, PB, RN, CE, MA, SE, PE, AL, and BA) is much poorer. The Northeast's 28 percent of the national population account for only 13 percent of GDP. Its interior includes a large semiarid expanse, the Sertão, which contains Brazil's most extreme problems of rural poverty. Infrastructure and social indicators are also much less advanced in the Northeast.

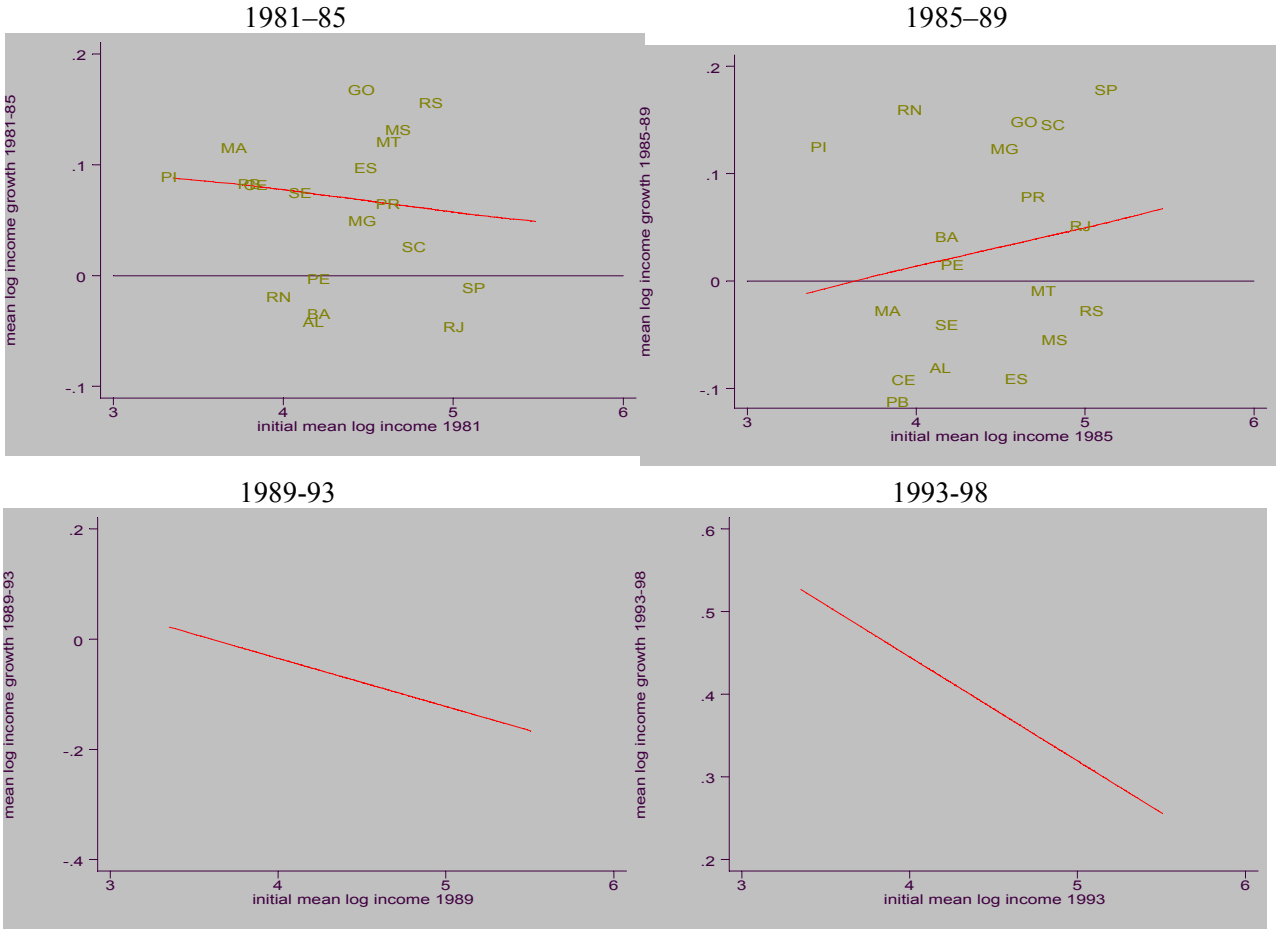
The states within each region differ to a greater extent in their public policies. Evidence of clustering into regional growth performance is therefore evidence that initial conditions or conditions that change only slowly (levels of industrialization, some social indicators such as adult literacy) are responsible for a large part of growth differentials. In this context, differences between seemingly similar states within the same region are notable, although a more analytical approach is needed to try to disentangle the causes. The South, Southeast, and Center-West all show less intraregional variation than does the Northeast in Figure 6. In the Southeast, for example, the states of Rio de Janeiro and São Paulo are neighbors on the graph. Paraná, Santa Catarina, and Rio Grande do Sul in the South all had near equal income in 1981 and showed similar growth rates over the period. This suggests that for these regions initial conditions and national considerations dominated state policies in determining economic growth.

The Northeast is another story. The region contains Brazil's fastest-growing state over the period (within the 19 we are discussing) — Piauí — and the slowest — Bahia. Despite starting from similar initial incomes, the states of this region displayed widely divergent growth rates over the period. What can explain this? We will argue that at least part of the reason is state public policy.

Figure 7 illustrates growth versus initial income for states in each of the four periods separately. The periods do not very much resemble one another graphically, supporting the argument of the previous paragraph. The PNAD data confirm, at the microeconomic level, the macroeconomic observation that the 1980s were a "lost decade." For 1981–5, four states record negative or zero real per capita household income growth in the data. For 1985–9 the story is worse. The 19 states are split about in half between those that record negative or zero per capita income growth and those that record positive growth. And the recession of 1991–2 creates even worse effects in the third period, when only seven states show positive growth. Positive growth returns to the micro data just as it does to the macro data only after 1993. The dispersion among states is also slightly higher in 1989–93 than it is in 1993–8.

Some of the regional clustering that was apparent for the whole period is less so within subperiods. A closer look at the data reveals that the bulk of the growth over the whole period is accounted for by what occurs in the fourth period. Regional clustering also is most apparent during this period, even for the Northeast, though it still shows greater intraregional growth variation than the other three.

Figure 7. Initial Income and Economic Growth in Four Periods



Convergence among States

A now extensive literature discusses the concept of economic convergence between countries, that is, the notion that — for reasons of technological imitation, factor mobility, and higher returns to scarce factors such as capital (physical and human) — poor countries ought theoretically to be able to "catch up" with rich countries. The cross-country evidence is mixed, and there are many reasons why "theoretically" may accord with inappropriate theory. Nonetheless, the theories that imply convergence between countries ought to apply more readily to states within the same country. Obstacles to factor mobility and to technological imitation are fewer. Moreover many institutional parameters are fixed at the country level and, therefore, to a first approximation are fixed across states, bringing the implicit *ceteris paribus* assumption behind growth comparisons a little closer to reality.[54]

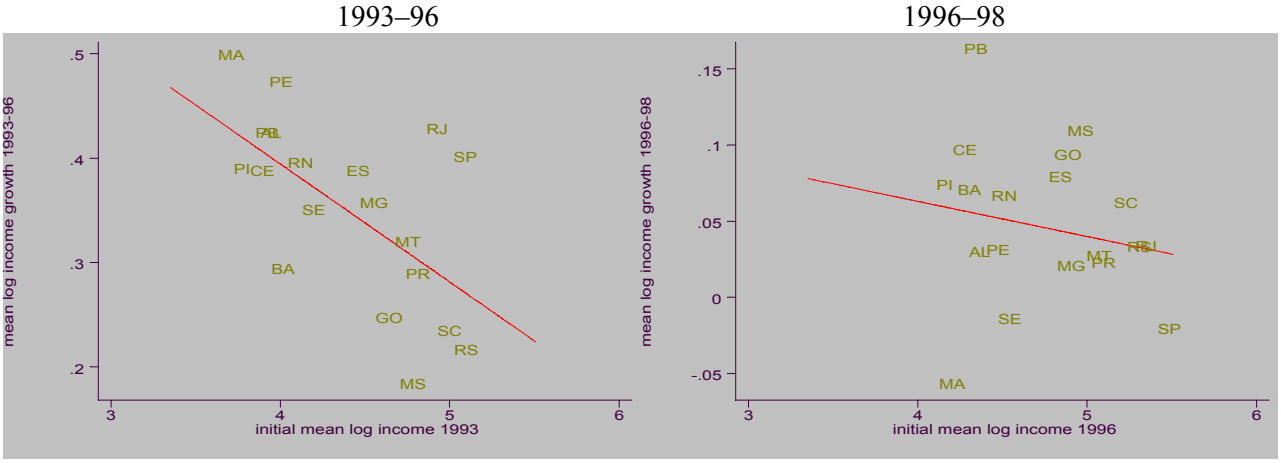
Figure 7 shows quite clearly that if convergence has occurred at all in Brazil since 1981, it has only been since 1993, or possibly, if one reads the third graph charitably, since

[54] See Barro and Sala-i-Martin (1991) for an analysis of convergence applied to states and regions in the U.S. and Europe over the long run.

1989.[55] In the three earlier periods there is simply no visual (let alone statistically significant) relationship between initial levels of income and subsequent income growth. Since the Real Plan, however, there is a striking relationship: Poorer states, particularly in the Northeast, have exhibited faster income growth. This is no doubt partly because greater macroeconomic stability allows longer-term planning and investment, clearly a necessary component of the convergence story. It is also partly because the costs of high inflation had been borne disproportionately by the poor, who could not protect themselves by asset switching as effectively as richer households. The elimination of inflation in 1993–5 therefore generated relative gains for the poor.

Which of these two explanations better fits the data can be suggested by dividing the post-1993 period in two: 1993–6 and 1996–8. Gains from eradication of inflation were concentrated in the first subperiod. Gains from greater stability and long-term investment only began to be felt in the second. Figure 8 shows what happened to convergence in these subperiods and illustrates that the early part of the Real Plan accounts for a large part of the convergence effect of the fourth period (1993–8) as a whole. It is likely that eradication of inflation had beneficial consequences that helped the poor. Earlier changes, such as the trade opening, may also have changed market structures during this period in ways that helped the poor. We therefore hypothesize that the speed of convergence between 1993 and 1996 may be difficult to recreate without explicit regional initiatives. A final note in this regard: The evidence from elsewhere does not suggest that one should expect "automatic" and rapid convergence of Brazil's poorer states with its richer ones. Barro and Sala-i-Martin's (1991) analysis of Europe and the U.S. suggests conditional convergence of around 2 percent annually. This corresponds to a catch-up "half-life" of about 35 years.

Figure 8. Results from Bifurcating the 1993–8 Period



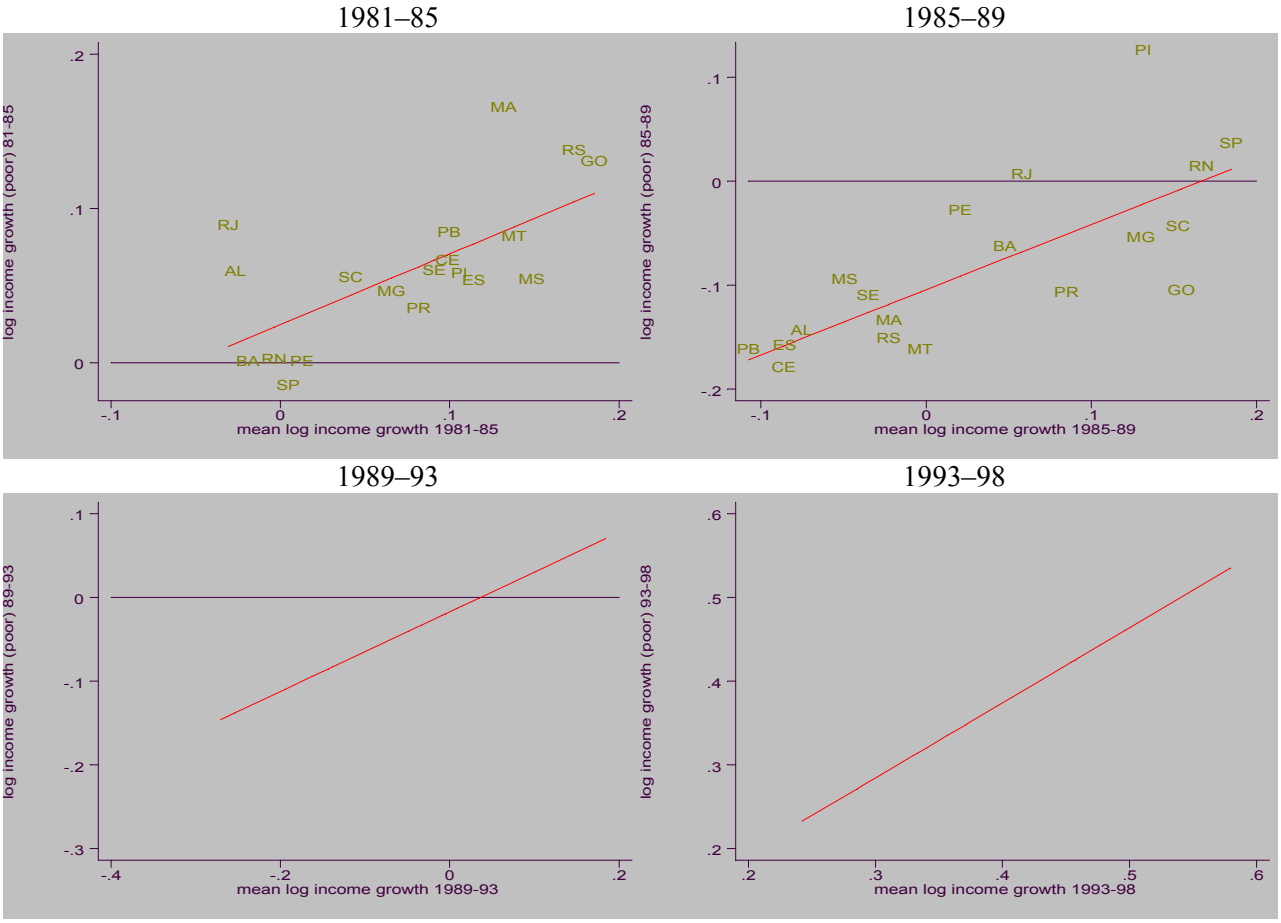
Income Growth among the Poor

Figure 9 plots the rates of income growth among the poor versus general income growth, for the whole period and each subperiod. Between 1981 and 1998 the income of the poor grew at a lower rate than the income of the whole population. Inequality thus increased. A related observation is that the slopes of the lines of best fit in the four quadrants of Figure 4 have

[55] The literature makes an important distinction between conditional and unconditional convergence. The former is understood to mean relative catch-up in residual income after controlling for many factors such as education and governance, which are at lower standards in poorer countries. Our discussion in this section limits itself to the simpler concept of unconditional convergence between states. Azzoni, Menezes-Filho, and Menezes (2001) use the same data to investigate conditional convergence among Brazilian states and find some supporting evidence.

slopes of less than one. In terms of a thought experiment in which a "less successful" state takes on the growth characteristics of a "more successful" state, this would mean that the poor would benefit less than the state's population as a whole. The situation does improve in the fourth period, however, as the respective slopes of the lines are 0.46, 0.63, 0.48, and 0.90.

Figure 9. Income Growth among the Poor in Four Periods

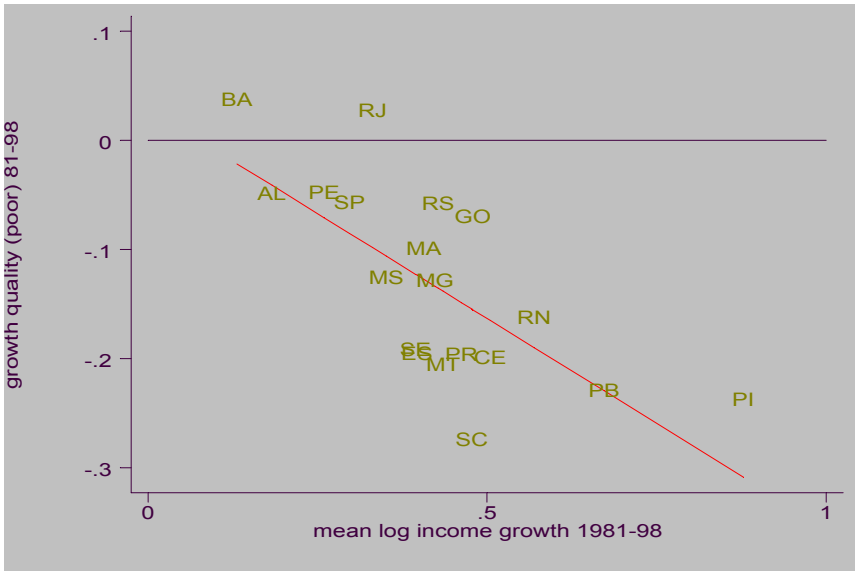


Perhaps unsurprisingly the order of states by economic growth over the period does not markedly change whether one considers the poor or the whole population. Indeed, in the fourth period the rank correlation in these data between average income growth and income growth among the poor is 0.83. Nonetheless Figure 9 shows variation between one measure and the other; so that even if the choice of measure makes little difference to the ordering of states, focusing on the difference between the two measures is of interest.

Figures 10 and 11 plot a measure of the "equality" of growth against the quantity of growth for the whole period and then each of the four subperiods. This definition of equality derives from the remainder in difference measures applied to log income: that is, income growth is calculated (as the difference in log income) for the whole population of a state and subtracted from the same measure restricted to the poor.[56] Thus if income among the poor grew faster than the average, then the equality measure is greater than zero, showing that inequality decreased. If inequality was constant or increased, the remainder is zero or negative, respectively.

[56] The ability to construct such a decomposition is an advantage of using the log-difference specification of growth.

Figure 10. Growth: Quantity and Equality (1981–98)



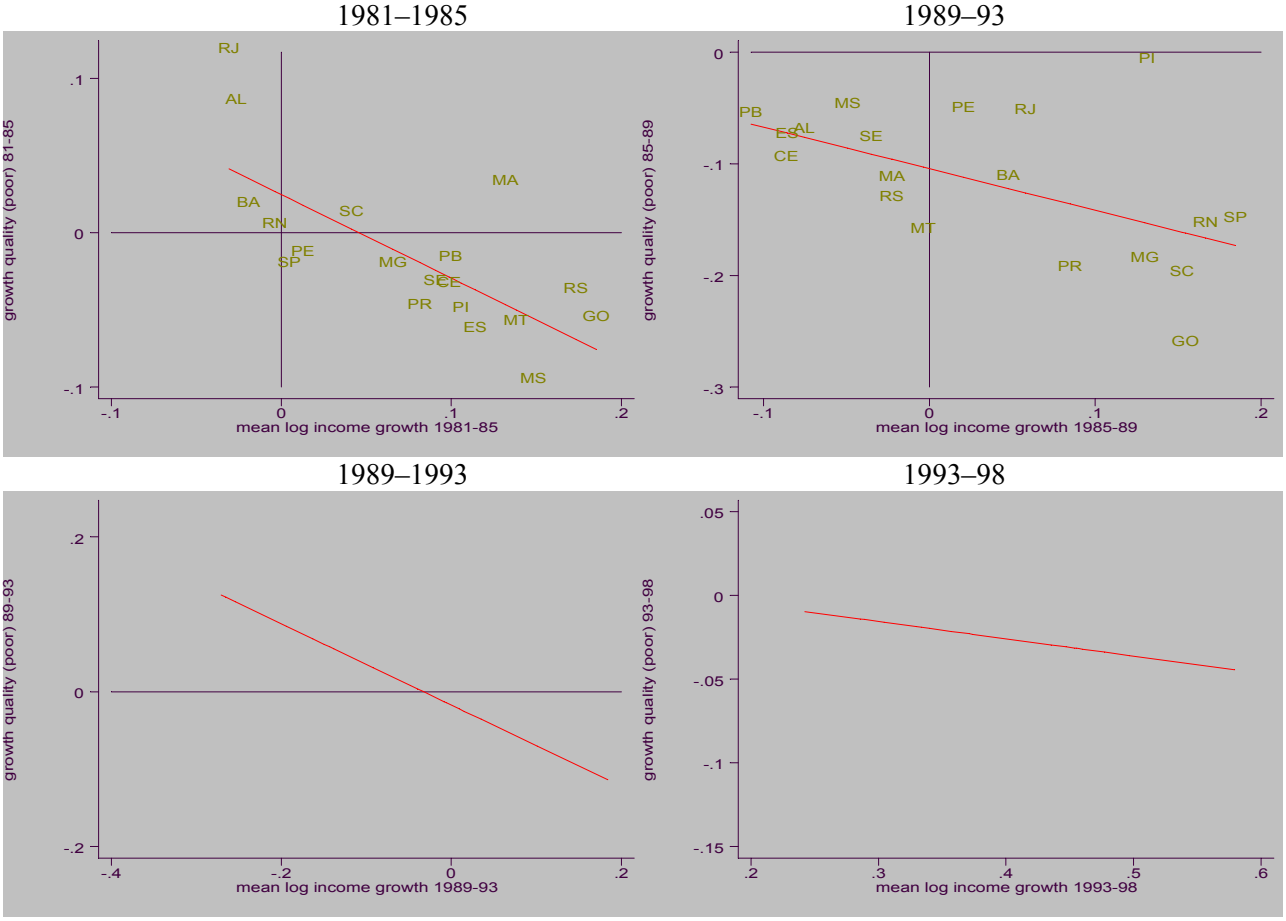
There has been a systematic relationship between growth and its distribution. Any tradeoff between growth and inequality — between quantity and equality of growth — would show up in these graphs as a downward line of best fit. For the period as a whole, the line of best fit is downward and has a statistically significant slope of –0.38. The slopes of the lines of best fit for the four subperiods are –0.54, –0.37, –0.52, and –0.10, with the first three statistically different from zero (at a 5 percent level of significance), and the last one not. It is to be hoped that the significant negative relationship between quantity and equality has disappeared entirely since the Real Plan, but this may be overoptimistic given the pro-poor effects of the one-time fall in inflation. It would therefore not be surprising were the "growth-inequality tradeoff" of the earlier periods to return in the near future.

If the income growth of the poor coincides with broader income growth, and if inequality changes are (recently) unrelated to income growth, then one would expect poverty reduction to occur in states where higher income growth occurred. This is indeed the case. The three states with the highest income growth in the period, the small Northeastern states of Piauí, Paraíba, and Rio Grande do Norte, also saw the largest drops in the poverty headcount rate.[57] São Paulo and Rio de Janeiro had the lowest declines in the poverty rate and were among the bottom five states with the lowest rates of economic growth during the period.

In summary, although there was an apparent tradeoff in Brazilian household data between economic growth and inequality until the Real Plan, this tradeoff diminished or disappeared in the data after 1993. Economic growth is highly correlated with the growth of the incomes of the poor and thus to poverty reduction. However, income growth has not accrued proportionately to the poor. For each 1 percent of general income growth over the whole period (1981–8), the income of the poor rose by a little over a half percent. This ratio has risen to about 0.9 since the Real Plan, but some of this improvement may not be sustained beyond the period of inflation eradication.

[57] The poverty headcount cited here uses a food-poverty line, and is often also known as the extreme poverty rate, or *taxa de indigência*.

Figure 11. Growth: Quantity and Equality in Four Periods



Almost all the significant growth in real household incomes in the period has occurred since 1993. Economic stability is clearly a sine qua non for improved household welfare, whether of the poor or of the population at large. Over the same period, there has been unconditional convergence in states' incomes. Moreover, "regional fixed effects" in growth are strongly evident, suggesting the importance of initial conditions, economic structure, and national policies in determining growth, seemingly dwarfing state policy parameters in their effects.

Econometric Results

We now turn to more structural explanations of the above patterns. First, growth observations are pooled for each year (1981–97 since first differences are used), state (19 in our sample), and age cohort (10 defined in our sample). The aim is to establish which state- and cohort-level variables are correlated with economic growth; pro-poor economic growth; and at a later stage, the difference between the two, which corresponds with our difference-in-differences equality measure described above. All reported estimates were calculated using first-difference or quasi-first-difference generalized method of moments (GMM) estimation. In first-difference specifications, variables that are not strictly exogenous are instrumented with lagged levels of right-side variables, following the methodology proposed by Arellano and Bond (1991). Similar results were generated from simpler but less econometrically defensible estimation techniques such as OLS with state-cohort fixed effects, although where there was

divergence in results we weaken our conclusions accordingly. Tables 24 and 25 describe the variables used in the analysis.

Table 24. Summary of Variables Used

Variable Name	Description	Mean	Standard Deviation
Dependent Variables	NB. "cell" refers to by-state, by-cohort groupings.		
Delta	Difference in mean log income in cell over the year	0.0317	0.231
Delta25	Difference in mean log income of the poorest quartile	0.0215	0.231
Quality	Difference in differences: Delta25-Delta	-0.0119	0.159
Weakly Exogenous Variables			
Education	Average completed years of schooling of household head	3.51	1.57
Primary	Fraction of cell with completed primary education	0.691	0.189
Middle school	Fraction of cell with completed lower secondary education	0.154	0.125
High school	Fraction of cell with completed high school education	0.103	0.076
College	Fraction of cell that attended college	0.052	0.042
Public admin.	Average years of education of state's public employees	7.14	2.62
Political	Sum of squares of changes in parties' vote shares	0.411	0.287
Policy	Indicator of change in political leaning of governor	0.529	0.499
Electric	Percentage of electrification in the state	0.773	0.169
Trash	Penetration rate of garbage collection in the state	0.500	0.200
Industry	Fraction of households in cell with industry employee	0.190	0.108
Agriculture	Fraction of households in cell with agricultural employee	0.326	0.136
Services	Fraction of households in cell with services employee	0.366	0.139
Urban	Fraction of cell that lives in an urban area	0.659	0.144
Formal	Fraction of households with head formally employed	0.216	0.150
Rain	Annual rainfall (cm)	103.1	24.6
Latitude	Average latitude of the state (degrees)	13.34	7.10
Altitude	Average altitude of the state (m)	328.6	164.9
Distance	Average distance from the sea (km)	226.1	204.2
Migration	Fraction of population that immigrated from out of state	0.146	0.109

Table 25. Evolution of Selected Variables

Variable	1981	1985	1989	1993	1998
Log income	4.41	4.48	4.52	4.50	4.91
Log poor income	3.51	3.56	3.48	3.44	3.84
Education	3.22	3.36	3.47	3.66	3.90
Primary	0.779	0.738	0.691	0.658	0.583
Middle school	0.106	0.125	0.152	0.176	0.212
High school	0.0640	0.0910	0.105	0.114	0.142
Tertiary education	0.0506	0.0454	0.0524	0.0525	0.063
Public administration	6.99	6.62	6.91	7.15	8.06
Electric	0.620	0.694	0.772	0.840	0.900
Trash	0.336	0.423	0.477	0.585	0.673
Industry	0.258	0.202	0.196	0.160	0.128
Agriculture	0.354	0.379	0.332	0.300	0.268
Services	0.376	0.403	0.428	0.309	0.287
Urban	0.615	0.627	0.640	0.703	0.709
Formal	0.294	0.273	0.258	0.161	0.117

Income Growth across States. The first column of Table 26 reports coefficients from the regression of observations on overall income growth, pooled over the whole period, on the right-side variables. The corresponding OLS specification in first-differences explained 67 percent of the variation in income growth, a high proportion for quasi-panel data. The significant effects are from average years of education, the political and policy variables, the penetration rate of garbage collection, and the level of employment in industry and services (that is, in relative terms agriculture fared poorly).

Many studies find positive relationships between the amount of education and income (whether analyzing households, countries, or other levels of aggregation). All of the literature on returns to education falls within this category, for instance. Yet for our education coefficient, this is not exactly the case. Rather we are reporting a significant positive relationship between the *initial level* of education (of an age cohort in a state) and the subsequent *rate of growth* of income (by that age cohort in that state). It is far from obvious that one would find such a robust effect in the Brazilian data (the coefficient is also large, approximately 0.1, implying an extra year of average completed education increases subsequent income growth by 10 percent). Similarly, it is worth noting that political and policy uncertainty both have the expected signs and are significant. States with uncertain political outcomes, or where the governorship moved between different points on the ideological spectrum, grew more slowly. The effect of the variable *trash* is interesting. This variable is a proxy for public provision of infrastructure. The interpretation of this effect equates to a direct impact by the infrastructure level on productivity growth. This effect could also be viewed as an indicator of geographic effects, i.e., the same people would have higher income growth if they lived in a richer location.

The second column of Table 26 reports the coefficients from the same estimation when restricted to the later two subperiods described earlier, covering 1989–98.[58] The education effect is almost identical, while the infrastructure effect (from *trash*) is still significant though smaller. There is also now a significant effect from the other infrastructure variable, the level of electrification in the state. Political uncertainty increases in importance, while policy uncertainty does not appear significant. This difference in the behavior of the sector variables across the two periods (1981–98 versus 1989–98) may reflect the true underlying differences in productivity growth across time. Finally, there is a significant positive effect from the proportion of workers in the formal sector.[59]

[58] For contemporary relevance one would prefer to restrict even further to, say, 1993–8, but this is unfeasible econometrically since the methodology being used requires sufficient variation in the regressors across time to identify effects.

[59] This effect was absent from the OLS specifications and also from the longer time period.

Table 26. Income Growth Equation Coefficients (Absolute Z-values)[a]

	I	II	III	IV
Period	1981–98	1989–98	1981–98	1989–98
Dependant Variable	Delta	Delta	Delta25	Delta25
Coefficients				
Education	0.103**	0.104**	–0.0076	–0.024
	(7.20)	(6.38)	(0.51)	(1.29)
Public administration	0.0068**	0.0034	–0.0002	–0.0020
	(3.37)	(1.36)	(0.10)	(0.82)
Political	–0.044**	–0.055**	–0.042**	–0.051**
	(2.27)	(2.93)	(2.23)	(2.63)
Policy	–0.013**	–0.0017	–0.0062	–0.0002
	(2.61)	(0.16)	(1.09)	(0.02)
Electric	0.126	0.343**	0.095	0.402**
	(1.44)	(3.12)	(1.10)	(3.68)
Trash	0.361**	0.605**	0.194*	0.264*
	(4.04)	(4.79)	(1.71)	(1.73)
Industry	0.177*	0.361**	0.106	0.183
	(1.95)	(1.98)	(1.09)	(0.93)
Agriculture	0.152	0.334**	–0.021	0.092
	(1.38)	(2.37)	(0.22)	(0.63)
Services	0.209**	0.591**	–0.080	0.074
	(1.97)	(4.00)	(0.75)	(0.51)
Urban	–0.038	–0.324**	–0.071	–0.223
	(0.32)	(2.06)	(0.59)	(1.39)
Formal	–0.083	0.085	–0.156	–0.144
	(0.74)	(0.54)	(1.28)	(0.79)
Lagged dep. variable	0.334**	0.327**	0.153**	0.233**
	(12.76)	(9.31)	(4.19)	(5.32)
R^2 from OLS	0.67	0.52	0.63	0.43
Number of observations	2,890	1,853	2,890	1,853
Number of groups	190	190	190	190
Mean number of periods	15.2	9.8	15.2	9.8

[a] All statistics are calculated from robust standard errors.
*Coefficients are statistically significant at the 10 percent level.
**Coefficients are statistically significant at the 5 percent level.

Income Growth among the Poor. Column III of Table 26 reports coefficient estimates using the sample from the whole period restricting to the poor.[60] The results are strikingly different from column I. First, education does not appear to be significantly correlated with income growth among the poor. We repeat here that education is undoubtedly correlated with income for this sample of households, but not necessarily with its subsequent rate of growth. Political uncertainty, however, appears with almost an identical negative coefficient to that in column I. Next, the infrastructure effects are attenuated, though similar in pattern to column I. Finally, there are no marked effects from the sector-composition of employment. All in all for 1981–98, income growth among the poor seems harder to explain than among the general population.

Column IV reports the same results for 1989–98. The education effect is again absent, while the effects of political uncertainty are heightened. The infrastructure variables seem to swap roles relative to column II, with electrification (electric) highly significant and trash less so. There is no significant effect among the sector variables, although the highest point estimate is for the industrial employment variable.

Taken together, these results suggest that there is far less systematic correlation between state-cohort characteristics and economic growth among the poor than there is in the

[60] The definition of *poor* for the purposes of calculating income growth in this section is the same as that used in the previous section, namely the bottom quartile of individuals in the data.

economy as a whole. This is in itself an interesting finding. One may now ask whether the differences between the coefficients for the two groups are significant. Since the *difference between income growth* among the poor and among the whole population is precisely our measure of the *equality of growth* from the previous section, this equates to regressing our equality measure on the same variables.

This recalls the notion discussed earlier, and commonly voiced in economic debates since Kuznets, that tradeoffs may exist between the pursuit of economic growth as an end in itself and the distribution, or equality, of that growth. To the extent that individual variables appear with a significantly smaller coefficient in regressions of income growth among the poor than in regressions of general income growth, these variables may be thought of as microlevel incidences of such tradeoffs.

The first column of Table 27 shows the results from regressing growth equality on the RHS variables. As expected given the results so far, educational attainment appears with a highly significant negative coefficient. For the period 1981–98, improvements in education across Brazilian states seem to have benefited the population as a whole more than they have the poor. On the other hand, industrial employment appears with a significantly "better" positive coefficient than employment in either agriculture or services. Over the whole period industrial employment was significantly correlated with income growth (Table 26), and moreover its differential effects relative to agriculture and services have been greater among the poor. Policy stability also has a small but significant effect on income distribution. Finally, the quality of public administration seems to have had a slightly inequitable impact on growth, though the point estimate of this effect is very small.

The corresponding results restricting to the later period of 1989–98 are reported in Table 27, column II. The results are similar, suggesting that the effects reported in the previous paragraph are not solely due to including 1980s data. In 1989–98, education again appears to have greater growth effects on average than among the poor. The main differences between the 1990s and the whole period lie in the sector and infrastructure effects. Services now appear with a significantly larger negative coefficient, i.e., it appears that service income growth has not benefited the poor relative to the whole population. Finally trash, the variable proxying for local infrastructure, now appears with a significant negative coefficient.

Table 27. Equality Equation Coefficients (Absolute Z-values)

	I	II	III	IV
Period	1981–98	1989–98	1981–98	1989–98
Dependant Variable	Equality	Equality	Relative Equality	Relative Equality
Coefficients				
Education	–0.114**	–0.135**	–0.113**	–0.144**
	(7.93)	(7.44)	(6.00)	(6.05)
Public Administration	–0.0052**	–0.0040	–0.0044*	–0.0051
	(2.62)	(1.59)	(1.86)	(1.60)
Political	0.0135	0.0136	–0.037	–0.0087
	(0.65)	(0.65)	(1.01)	(0.24)
Policy	0.0117**	0.0059	–0.015**	–0.0008
	(2.21)	(0.48)	(2.00)	(0.05)
Electric	–0.151	–0.131	–0.129	0.052
	(1.62)	(1.15)	(1.08)	(0.29)
Trash	–0.124	–0.281**	–0.271*	–0.590**
	(1.21)	(2.17)	(1.85)	(2.74)
Industry	–0.118	–0.358*	–0.145	–0.312
	(1.31)	(1.72)	(1.05)	(1.23)
Agriculture	–0.299**	–0.469**	–0.667**	–0.887**
	(3.46)	(3.35)	(4.25)	(3.44)
Services	–0.313**	–0.559**	–0.431**	–0.608**
	(2.78)	(3.71)	(3.09)	(3.04)
Urban	–0.068	0.093	–0.309*	–0.110
	(0.50)	(0.46)	(1.65)	(0.42)
Formal	–0.066	–0.059	–0.063	–0.129
	(0.58)	(0.34)	(0.38)	(0.52)
Lagged dep. variable	0.170**	0.168**	0.139**	0.214**
	(4.60)	(3.93)	(3.13)	(3.93)
R^2 from OLS	0.28	0.26	0.24	0.23
Number of observations	2,707	1,685	2,707	1,685
Number of groups	171	171	171	171
Mean no. periods	15.8	9.9	15.8	9.9

*Coefficients are statistically significant at the 10 percent level.
**Coefficients are statistically significant at the 5 percent level.

Columns III and IV of Table 27 explore a further concept of income distribution: equality of growth interpreted as its incidence among the poorest 25 percent *within each state*. This changes the emphasis from the income distribution at a national level to the distribution at the level of individual states. The person at the 25 percent point of the income distribution in São Paulo, for example, is above the extreme poverty line used for this and other studies.[61] On the other hand, much more than 25 percent of the population of, say, Ceará fall below this boundary (indeed more than half do). It is worthwhile to check whether the same broad results hold if one interprets poverty as "relative" rather than "absolute." Seemingly the results do not change very much, with two exceptions. As column III (Table 27) shows, for the whole period 1981–98, the policy uncertainty variable expresses a significant negative coefficient. Also, relative to column I, agricultural employment was significantly less pro-poor (in our newly relative terms) than was industry.

For 1989–98 the picture is similar, even if the coefficients alter somewhat. Education and infrastructure (through garbage collection rather than electrification as a proxy) again express negative coefficients. Agricultural employment again seems to be the precursor of inequitable growth, with an even higher negative coefficient than for the whole period.

[61] The poverty line is defined in absolute terms at R$65 (measured in São Paulo in 1997), and adjusted for regional price variations (Azzoni and Menezes, 2000). Since the poverty rate measured this way varies greatly across states, there is a significant difference between the concepts of absolute and relative poverty as defined in the text.

Distinguishing among Levels of Education. Since the analytic results regarding education are robust thus far and also important from a policy perspective, the next step is to assess differences by education level. Table 28 reports coefficients from equations that included measures of the development of different levels of schooling (primary, lower secondary, high school, and college). Since we are mainly interested in the *differential* effects of the various educational levels, the coefficients we report are the differences between the effects of secondary, high school, and college attendance measures and those related to no education or just some primary school attendance. Moreover, for digestibility we restrict to the period 1989–98 and omit mention of all other coefficients. The results for the other coefficients are very similar anyway to those reported in Tables 26 and 27, and would distract focus from analysis of education.

Column I reports the results of the general income equation estimation, while column II restricts to the (absolute) poor. Column III then reports the point estimates of the effects of the different levels of education on our measure of equality. Column IV (analogous to columns III and IV of Table 27) investigates the notion of relative equality defined above. Significant results are what one might expect. College enrollments, despite their positive (though statistically insignificant) effect on income growth, increase subsequent income inequality in these data. This may seem unsurprising, but taking the data at face value nonetheless reinforces the message that policymakers should be aware of the distributive consequences of investments in tertiary education. Beyond this, the results of splitting education by levels are quite clear. Upper primary education enrollments correlate with subsequent improvements in income distribution (the coefficients are relative to the omitted category of primary education enrollment). Secondary and tertiary enrollments correlate with subsequent deterioration in the income distribution, whether measured according to a national or a state-relative definition. There is a general descending pattern from positive toward negative distributive impacts as one ascends through the levels, as one would expect.

Table 28. Analyzing Levels of Education

	I	II	III	IV
Period	1989–98	1989–98	1989–98	1989–98
Dependant variable	Growth	Income growth of poo	Quality	"Relative" equality
Coefficients				
Secondary	–0.018	–0.031	0.241**	0.219
	(0.46)	(0.68)	(1.97)	(1.39)
High school	–0.023	–0.0059	–0.391**	–0.291**
	(0.36)	(0.08)	(3.49)	(2.39)
College	0.160	–0.143	–0.396*	–0.278
	(0.80)	(0.83)	(1.68)	(1.11)
…Other coefficients not reported				
R^2 (OLS-FD)	0.47	0.42	0.18	0.17
Number of observations.	1,845	1,845	1,685	1,685
Number of groups	190	190	171	171
Mean no. periods	9.7	9.8	9.9	9.9

*Coefficients are statistically significant at the 10 percent level.
**Coefficients are statistically significant at the 5 percent level.

Location and International Trade. Three of the hypotheses enumerated at the beginning of the section concern trade, migration, and geographical location (climate, latitude, and altitude). Since these variables are fixed in time, or have been for practical purposes since data is only available for certain years, the estimation strategy of the previous section, which relies on taking first differences of the data in consecutive years to control for all state-fixed effects (simultaneously ruling out identifying them), is inapplicable. However, following the approach of Holtz-Eakin et al. (1988), a workable alternative is at hand. The main element is allowing state-fixed effects to be nonstationary (time-variant) so that the model is generalized to encompass the state-fixed effects model as a testable restricted form. This more general specification is known as quasi-first-difference (QFD) estimation. If the restricted stationary fixed effects form is rejected (as it is in our data), this allows the effects of other time-invariant variables (such as geographical location) to be identified by the estimation.

Table 29 gives the coefficients from a QFD specification including location and trade variables. There is evidence of trade and climate effects in general income growth, but not among the poor. Most noticeable is distance-from-the-sea's negative effect on income growth, an effect that became more marked in the 1990s. We interpret this as possibly attributable to international trade, suggesting trade's growing importance for income growth in Brazil. The result is intuitive given the lowering of tariff barriers in the early 1990s. However, the incomes of the poor show no sensitivity to trade access, giving some succor to the view that the trade opening has not helped the poor. The result is confirmed in the inequality regressions (columns III and VI): The positive coefficient on distance in our interpretation implies that access to markets has increased inequality in Brazilian household income, with the effect larger and more significant in the 1990s. Of course distance from the sea may be capturing factors in Brazil other than access to foreign markets, given the proximity of all the main metropolitan centers to the coast.

Table 29. QFD Growth Equation Coefficients (Absolute t-statistics)

	I	II	III	IV	V	VI
Period	1984–98	1984–98	1984–98	1989–98	1989–98	1989–98
Dependent variable	Growth	Inc. growth of poor	Growth equality	Growth	Inc. growth of poor	Growth equality
Coefficients						
Temperature	0.116	0.0157	–0.0142	–0.0048	–0.0231	–0.0470
	(0.66)	(0.94)	(0.85)	(0.16)	(0.86)	(1.60)
Rain	–0.0017	0.0018	0.0080	0.0545*	0.0645*	0.0074
	(0.10)	(0.10)	(0.48)	(1.66)	(1.71)	(0.17)
Latitude	0.0133	0.0006	–0.0043	0.038	0.0455	0.0044
	(0.83)	(0.03)	(0.31)	(1.31)	(1.57)	(0.15)
Altitude	0.0005	0.0010	–0.0073	0.0057	–0.0033	–0.0165*
	(0.10)	(0.21)	(1.39)	(0.74)	(0.48)	(1.82)
Distance	–0.0072*	–0.0016	0.0103**	–0.0187**	0.0001	0.0281**
from the sea	(1.77)	(0.41)	(2.61)	(2.96)	(0.01)	(3.53)
Number of observations	2,550	2,550	2,550	1,695	1,695	1,695
Number of groups	171	171	171	171	171	171
Mean no. periods	14.9	14.9	14.9	9.9	9.9	9.9

*Coefficients are statistically significant at the 10 percent level.
**Coefficients are statistically significant at the 5 percent level.

Rainfall has a weak effect on income in the 1990s (column IV) in the direction one might expect (higher rainfall raises income growth). This effect is approximately equal for poor and nonpoor alike (columns IV and V), reflected in the absence of any relation between rainfall and inequality (column VI). Turning this around suggests that low rainfall hurts the poor proportionately (or even a bit more than average if one uses the point estimates, although the difference between them is not statistically significant), justifying public interventions in

times of drought in the interest of equity. We will not overemphasize this analysis since sophisticated econometrics are probably not required to reach this conclusion.

Migration. Estimating the effect of migration in these data suffers from two problems. First, migration figures have only been calculated for two years, so much of the time variation in this variable remains unobserved. Second, it is therefore impossible to structure a convincing specification that sorts out the very severe problems of endogeneity that this variable poses. Migration is clearly a choice made in response to incentives, including the relative expected economic opportunities offered by point of departure and destination. This induces correlation between future economic activity and inward migration, even in the absence of a causal effect running from migration to subsequent growth.

We nevertheless ran one specification of the regressions including the migration variable, and found that migration into a state is not correlated with subsequent growth in average household per capita income in the period.

Conclusions

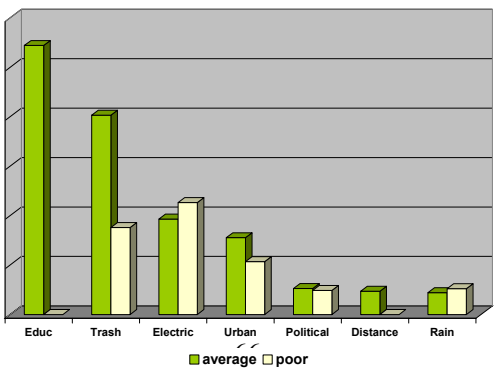
Household data reveal that, within 1980–2000, significant convergence has occurred between the poorer and richer Brazilian states only since the Real Plan stabilization, and that much of the convergence pattern is due to the pro-poor impact of eradicating inflation. International evidence suggests that any growth strategy that jeopardizes this central achievement is likely to fail. This section suggests, furthermore, that it would likely most hurt the poor.

Comparing the income growth of the average household with that of the average *poor* household reveals that the poor do benefit from economic growth, although their incomes do not rise proportionally with everyone else. That is, a general income rise of 1 percent corresponds to an income gain of less than 1 percent for the poor. Moreover, this effect tends to increase as growth increases, implying that higher growth has tended to raise income inequality among households. These effects were attenuated in the late 1990s, however.

Panel regression analysis of differences in household income growth by state and age cohort reveals the primacy of education as an influence on income growth in Brazil. However, the effect of *average* education on the income growth of the poor is nil; improvements in basic education among the poor have not (yet) significantly affected income growth. Further analysis suggests that investments in basic education and lower secondary education are central both to increasing income growth and attacking inequality.

Finally, other factors are important growth determinants for household income. Local infrastructure (e.g., electrification, trash collection) plays a significant role in subsequent income growth. And international trade and political stability also boost income growth. These factors vary in their importance to the poor relative to the average. Electrification seems to have been particularly important for the income growth of the poor.

Figure 12. Representation of Effects of RHS Variables
(Response of Income Growth to a One Standard Deviation Improvement in the Variable)



Policy Conclusions

Looking Back: Resolving the Paradox of the Economic Miracle

Brazil was one of the world's fastest growing economies in the 20th century despite a mix of policies frowned upon by orthodox modern economics. However a closer look at events and econometrics suggests that Brazil's achievements were less paradoxical than this broad statement initially suggests.

First, the stage for economic growth was primed in 1964 by a subset of policies that were in fact remarkably orthodox when set against the economic debates alive at the time. Despite benign external conditions — in particular favorable terms of trade and low import growth — that had benefited the centrally planned efforts of the 1950s (notably Kubitschek's Plano de Metas), domestic economic fundamentals deteriorated substantially with the large increase in the public deficit and its financing through monetary expansion, bringing inflation to a new historical threshold. By 1963 investment was stagnant, the public deficit totaled half of fiscal revenues, and inflation was accelerating. The new military government adopted a stabilization program to lower inflation, reduce the public deficit, and correct relative prices. The exchange rate was devalued and a tax reform implemented, greatly reducing tax distortions, raising revenues dramatically, and improving the current account. The government also implemented monetary and capital market reforms with establishment of an indexation mechanism. Despite its later shortcomings, this restored domestic and foreign confidence in long-term contracts in capital and credit markets. Lastly, the government established a crawling-peg exchange rate regime with small devaluations at randomly determined intervals.

After a time, investment reacted positively to the more stable environment, rising quickly. By 1967 the economy contained a large idle capacity, which was to prove key in the successful economic performance that ensued. Thus despite a high degree of central planning in the economy, the macroeconomic management that paved the way for Brazil's economic miracle of the late 1960s and early 1970s was in fact fairly orthodox.

The second half of the explanation is less optimistic but no less orthodox. Brazil's continued growth after the first oil shock of 1973 was simply unsustainable. Repressed inflation and the need for structural adjustment in the foreign accounts were legacies of the miracle years. Yet the government opted to sustain the pace of economic growth, making inflation a secondary priority and leaving the external accounts as an adjustment variable, partly from belief that the oil shock would be transitory. The substantial liquidity in international capital markets, created by the recycling of petrodollars, provided the means to sustain this course temporarily, although Brazil's external debt had already begun to rise. Again, in the mid 1970s, favorable shifts in terms of trade helped Brazil stick to its guns, but Brazilian export quantities remained virtually constant. In the late 1970s, Brazil's current account deficit widened again, and its rapidly growing external debt, largely contracted at floating interest rates, greased the slope for the lost decade of the 1980s.

As other studies have also shown, physical capital accumulation and TFP growth explain most of the growth dynamics of the Brazilian economy since 1930. The higher the value of the capital elasticity of output used for decomposing growth, the higher the contribution of capital and the lower the contribution of TFP. However, TFP growth seems to have been systematically associated with growth in the stock of machinery and equipment, suggesting that some TFP growth was gained through capital-embodied technological progress.

This suggests another reason for the eventual faltering of Brazil's high growth performance in the 1970s. Part of the government response to external imbalances early in the decade had been to increase import barriers on capital goods. The subsequent drop in capital-good imports created ripple negative effects by decreasing embodied technological progress.

A final legacy of the macroeconomic imbalances inherited from the 1980s has been the dramatic decline in Brazilian infrastructure investment, which had primarily been undertaken under the aegis of the state until the 1990s. Fiscal constraints have precluded a concerted campaign of public investment in the 1990s, while residual macroeconomic uncertainty, scarce credit, and a regulatory regime that has until recently still been in its formative stages (e.g., the energy sector) have limited willingness and the ability of the private sector to step into the breach.

Looking Forward: Policies for the Next Century

In contrast to the broad pattern since 1930, macroeconomic growth accounting exercises suggest that the acceleration of GDP expansion after price stability in 1994 was entirely due to higher TFP growth. Under most assumptions, TFP growth was higher in 1994–2000 than at any time since 1930. Indeed, the reason why low inflation and the 1990s market reforms have failed to bring output growth back to pre-1980 levels has been the failure of those reforms to generate factor accumulation, with the contributions of both labor and capital to output growth actually declining in comparison to 1981–93. This TFP recovery proves slightly elusive in firm-level data, where TFP growth in the 1990s seems somewhat anemic. The broad pattern of TFP decline through the 1980s and recovery in the 1990s is nonetheless present.

More helpful for policy formulation are the differential patterns of TFP growth observed across firms of differing characteristics. Less technological sectors — food, textiles, leather, and nonmetallic minerals — showed the worst performance and actually declined in productivity during the 1990s, while more-technological sectors — autos and auto parts, and electrical equipment — were more dynamic. And the industrial composition of the manufacturing sector in the North and Northeast led to lower TFP growth in these regions relative to the South and Southeast.

Trade opening has had a positive effect on industrial productivity and may have helped raise average TFP by about 6 percent. Market penetration by foreign competitors raised the level of TFP, though export orientation does not raise TFP in the Brazilian data; indeed this relationship is negative. Other findings suggest the importance of technological innovation: Higher shares of IT in physical capital raised both TFP and its growth rate. Complementing this result, firms employing more skilled labor (expressed as a higher white-to-blue-collar ratio) showed faster TFP growth, suggesting that Brazilian human capital investments contribute to TFP growth. Foreign machinery, on the other hand, had no significant effect, calling into question its role as a conduit of embodied technological change in recent Brazilian growth. Given evidence from firms in other countries about the importance of international knowledge flows, this result raises concern that Brazil's integration into international production is not generating its full potential benefits, perhaps because of a bias toward regional trade or owing to technology transfer impediments. Finally, new firms possessed higher and faster-growing TFP, suggesting that measures to ease their entry could spur future productivity gains for Brazil.

The future importance of knowledge flows and the vibrancy of new entrants must be seen in the context of Brazil's present business environment. The directed credit schemes that reflect the centrally planned approach of Brazil's past, a heavy regulatory burden involving three levels of government (e.g., rules for business licenses and site development), cascading

taxes, pervasive labor regulations, controls on foreign licensing and technology transfer, and a slow process of intellectual property protection are all candidates for public scrutiny and reform given the empirical evidence presented here.

Household evidence buttresses what has already been suggested by firm-level data about the need for human capital investments in Brazil. Macroeconomic analysis suggests that human capital accumulation has yet to become the driver of the country's economic growth. In fact Brazil's human capital levels, particularly education indicators, still lag behind the region's. Yet in the 1990s, education emerged in household data as the strongest determinant of income growth.

Indeed the expansion of basic education, in particular lower secondary schooling, is the single most powerful tool at the government's disposal for improving the distribution of gains from economic growth among the population. In this regard, the household data contains another important finding. It shines a spotlight on the fundamental role the Real Plan played in improving the incidence of income growth among the poor by ending inflation. This is a key policy conclusion: Any return to the inflationary environment of the past would above all hurt Brazil's poor. By continuing these two basic policies — expanding high-quality basic education and keeping inflation low — Brazil can avoid the pitfalls of the growth-inequality tradeoff that the data suggest it has faced in the past.

Clearly a return to the policies that Brazil pursued in the 1960s and 1970s is neither feasible nor desirable. Scrutiny of Brazil's most successful period of economic growth suggests that macroeconomic fundamentals were not ignored in laying the foundation for growth, and that when they eventually were, this was not without consequences. Attention to what the macroeconomic and microeconomic data are telling us today suggests that trade, enterprise, innovation, knowledge flows, and human capital will be the primary drivers of Brazil's growth in the next century.

APPENDIX A: Vector Error Correction Model

$$Y = AK^{\alpha}L^{1-\alpha}$$

Vector Error Correction Estimates

Sample(adjusted): 1933–1999
Included observations: 67 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LY(–1)	1.000000	
LKL(–1)	–0.709671	
	(0.01923)	
	[–36.8992]	
C	6.139549	
	(0.20220)	
	[30.3638]	
Error Correction:	D(LY)	D(LKL)
CointEq1	–0.230796	–0.019307
	(0.05925)	(0.02339)
	[–3.89541]	[–0.82529]
D(LY(–1))	0.267711	0.109657
	(0.11714)	(0.04625)
	[2.28537]	[2.37081]
D(LY(–2))	0.394475	0.106968
	(0.11707)	(0.04622)
	[3.36969]	[2.31418]
D(LKL(–1))	0.150799	0.866719
	(0.35487)	(0.14012)
	[0.42495]	[6.18568]
D(LKL(–2))	–0.048860	–0.057031
	(0.31686)	(0.12511)
	[–0.15420]	–0.45584]
D81	–0.090956	–0.015216
	(0.03246)	(0.01282)
	[–2.80200]	[–1.18719]
R^2	0.342000	0.835520
Adj. R^2	0.288065	0.822038
Sum sq. resids	0.062505	0.009745
S.E. equation	0.032011	0.012639
F-statistic	6.341031	61.97322
Log likelihood	138.6672	200.9276
Akaike AIC	–3.960214	–5.818736
Schwarz SC	–3.762779	–5.621301
Mean dependent	0.030122	0.038607
S.D. dependent	0.037938	0.029961
Determinant residual covariance		1.34E-07
Log likelihood		346.2347
Log likelihood (d.f. adjusted)		339.9488
Akaike information criteria		–9.699964
Schwarz criteria		–9.206377

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