Economic Growth and Productivity Change in Brazil [1]

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1. Introduction. The analysis of productivity change and its relationship to economic growth has been subject to only limited quantitative investigation in Brazil until recently.[3] The nearly-established consensus on this issue favors the interpretation that the 1990s have witnessed the resurgence of productivity growth, after a period of more than a decade in which negative productivity growth rates (both labor and multifactor) were not uncommon.[4] Two issues have been the subject of close scrutiny in recent work: the importance of physical capital accumulation and the role of productivity growth. Some studies devoted attention to human capital accumulation as well. In general, but with exceptions, economy-wide studies on the role of total factor productivity (TFP) change attributed a not too great importance to this component as compared to physical investment, which has been a critical one most of the time. But TFP growth made important contributions in specific time periods.[5] Indeed, Brazil's macroeconomic performance since the early 1990s suggests that TFP had a major say in explaining economic growth.

Studies conducted since the mid-1990s indicate that gross investment was the major factor behind GDP growth in the long run (for instance: Abreu and Verner [1997], Ferreira and Malliagros [1998], Bonelli and Fonseca [1998], Pinheiro, Gill, Servén and Thomas [2001], Gomes, Pessôa and Veloso [2003], Bacha and Bonelli [2004])[6], with qualifications depending on the choice of period. What the Brazilian experience in the 1990s suggests, in turn, is precisely the prevalence of low investment in physical capital concomitant with slow GDP growth—but recovery of productivity gains. The object of this paper is to investigate these issues. We begin with a primer on Brazil's macro performance since the 1960s (section 2) followed by a brief presentation of relevant pieces of investigation on growth, capital accumulation and productivity change (section 3). Next we focus on factor use and performance (section 4) and policies behind productivity change (sections 5 and 6) with a view to assessing the impact of recent TFP growth on GDP (section 7) and prospects for the future (section 8). Section 9 concludes.

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[1] Document prepared for the World Bank's Brazil Investment Climate Assessment (ICA), June 2005. Sections 2 to 6 are based on Bonelli (2005).

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[3] In part, this is due to the non availability of good capital stock estimates until recently, each analyst having to construct his or her own series. Our capital stock series are based on Morandi and Reis (forthcoming), the results of which are available on the site www.ipeadata.gov.br. Ms Morandi updated the series from 2000 to 2004 at our request.

[4] See Bonelli and Fonseca (1998), Pinheiro, Gill, Servén and Thomas (2001), Bonelli (2002), Gomes, Pessôa and Veloso (2003) and Bacha and Bonelli (2004) for analyses and references.

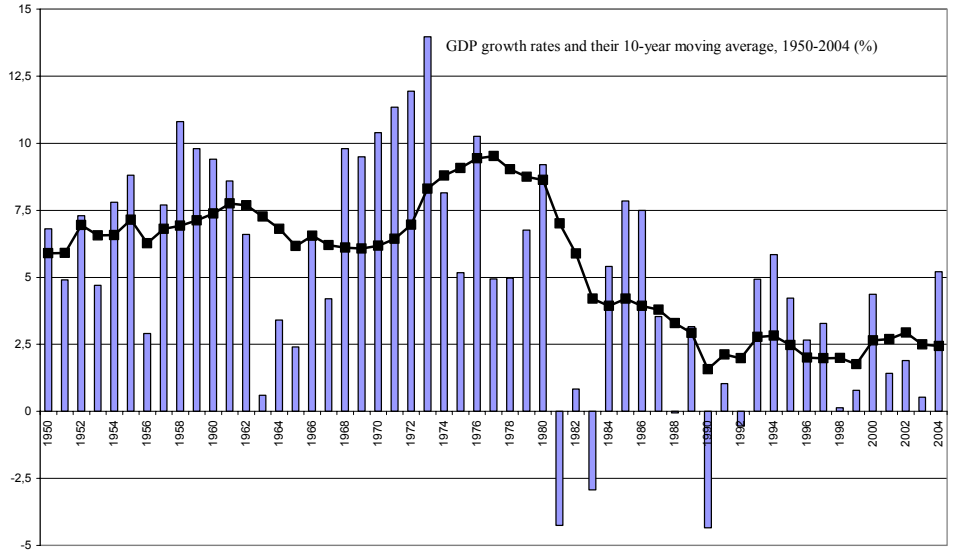
[5] Many, but not all studies on the performance of the manufacturing industries, on the other hand, found out that labor and TFP change experienced substantial growth in some phases. This was particularly the case in the 1960s and 1970s. See Bonelli (1975), Pinheiro (1989) and Bonelli and Fonseca (1998).

[6] Note that the international experience reviewed by cross section studies such as Easterly and Levine's (2001), among others, suggests that inter-country TFP was the major factor behind observed growth performance in the long term: "factor accumulation does not account for the bulk of cross country differences in the level or growth rate of GDP per capita; something else – TFP – does."(p. 179).

2. Background: A Primer on Brazil's Macroeconomic Performance since the 1960s.

One of the most striking aspects of Brazil's long term growth experience is the loss of dynamism observed since the beginning of the 1980s (Figure 1). Indeed, GDP average decade growth rates have plunged from figures of almost 10% p.a. in 1968-77 to 1.6% p.a. in 1981-90. In the late XX—early XXI century the country experienced only limited recovery, as witnessed by a 10-year GDP growth average of 2.5% p.a. in 1995-2004.

Figure 1: GDP growth rates and their 10-year moving average, 1950-2004 (%)



Source: IBGE, National Accounts

Behind the poor performance since 1980 lie a number of issues such as failed stabilization attempts, often associated with recessions (1981-83, 1987-88, 1990-92), and a succession of mostly exogenous shocks: external crises (1995, 1997, 1998); the blow-up of the NASDAQ bubble; a domestic energy crisis (2001); the effects of September 11; Argentina's default in 2001; and fears about economic policy changes associated with prospects of a left-wing Lula presidency. This generated a confidence crisis in 2002 that required bitter medicine (in the form of reinforced fiscal rectitude and high interest rates) and, consequently, resulted in nearly no GDP growth in 2003 (only 0.53%). But as a result of the measures taken, GDP growth resumed in 2004 (4.9%) and is likely to continue in 2005 (not as fast as in 2004, though).

Important economic reforms were implemented since the early 1990s, all of which were growth-enhancing in the medium to long terms. But it is fair to say that these reforms have not so far been able to raise the country's growth performance and potential. In part, this was due to the succession of shocks just mentioned. In particular, it will be shown that changes in investment and savings rates cannot be blamed, by themselves, for Brazil's reduced dynamism. And also that, as expected, productivity change has a say in this poor economic growth record, especially in the 1980s.

Our appraisal of long term Brazilian growth starts during the strong growth acceleration in the second half of the 1950s under President Kubitschek. The years 1956 to 1960 constitute a period in which intense industrially based structural transformation took place. The establishment of many of Brazil's modern manufacturing plants producing consumer durables (especially cars and electrical-electronic goods and equipment), intermediate goods and capital goods dates from this period. But a loose monetary policy associated with the construction of the new capital, Brasilia, led to severe inflationary pressures.

Attempts to reconcile growth and inflation under severe exchange rate constraints led to tensions that were to be felt in the early 1960s. As inflation accelerated and investment faltered, growth rates began to fall as well. A political crisis partly associated with President Quadros resigning from office (August, 1961) also indicated that major economic reforms were called for. Instead, the populist regime of 1962-63, unable to cope with conflicting economic proposals as inflation rates soared, failed in enforcing the necessary economic policies. Political instability, the inability (or unwillingness) to curb inflation and the difficulty to deal with balance of payments (BOP) disequilibria provoked a severe worsening of macroeconomic conditions. This state of affairs ultimately resulted in a military intervention in early 1964 that would last for 21 years, until 1985.

Growth under the initial years of the military regime was modest, as inflation was painfully and only partially controlled via monetary contraction and wage squeezes. But successful attempts at economic reform took place in 1964-67, including a major tax reform. The so-far unresolved issue of government financing was ingeniously dealt with by indexing government revenues and the issuing of new public debt indexed to past inflation. The foreign debt was rescheduled thanks to recourse to the FMI and support from the international financial community. The BOP disequilibrium was handled, in part due to the recession that followed. This also helped to solve the external crisis because of new foreign capital inflows, export growth and import repression during the recession then experienced.

Institutional rupture, however, did not mean change of growth patterns. This included a continued recourse to FDI and technologies similar to those in the developed world, as before, and, especially, the adoption of protectionist measures[7] in the context of a typical import substitution industrialization (ISI) model. In the late 1960s Brazilian economic policy would also benefit from the new wave of international financing associated with the market for petrodollars—phenomenon which is at the root of the foreign debt crisis the country would experience from the late 1970s on, which led to the foreign debt default of 1982. Growth under the military resumed at a very fast pace after 1967, as Brazil embarked on a phase of strong external borrowing and financing.

Any characterization of the period 1968-1980 should distinguish two sub-periods. The first one, to 1973-74, was an epoch in which GDP grew on average at very high rates: a little more than 10% yearly. This sub-period has been christened as the 'Brazilian

[7] Except for brief episodes, such as the timid attempts at trade liberalization in 1967-68.

Economic Miracle'.[8] The second one, to 1980, was characterized by slower growth and high variability of growth rates. This relatively good performance could only be achieved, however, due to a steeply increasing foreign debt, which complemented domestic savings in financing strong capital formation acceleration. Foreign indebtedness was pursued especially after the first oil shock in 1973, as the government refused to adjust the economy to the prevailing new, and much less favorable international conditions. In a period marked by international recession, as the mid-1970s, Brazil continued to grow at fast rates—although not as fast as before (see Figure 1)—due to increasing foreign indebtedness.

This represented an effort to postpone the cost of adjustment throughout the 1974-80 period, therefore keeping high both consumption and investment levels. This phase has been coined 'the forced march' period. The vulnerability to shocks, however, did not decrease. Dependence on imported oil, for instance, continued to exist, although disguised under the stability of nominal prices—and fall of real prices, given world inflation in 1973-78.[9] The need to adjust became crucial after the country was hit by the second shock wave in the late 1970s, represented by the second oil shock, sharp increase in international interest rates due to monetary policy changes in the USA, topped with international recession in 1980-82. This meant a severe blow after a period marked by strong external indebtedness unaccompanied by accumulation of foreign exchange reserves, which left the country vulnerable to adverse external conditions.

The course of economic policy would be swiftly modified in late 1980, when the government opted for reducing the level of economic activity in an attempt to reverse the trade deficit and generate exportable surpluses. The ensuing industrial recession represented a fundamental economic policy change adopted to deal with the external crisis, the effects of which would tarnish the remaining of the 1980s. The growth-cum-debt model had finally found its ending, after a long phase of increasing external and domestic disequilibria. One of the victims of the recession that followed would be productivity growth.

The two last decades of the XX century share a common feature: very low GDP growth rates, when compared with the previous decades. But this is their only common feature. As the 1980s have been labeled 'the lost decade', a more proper epithet to the 1990s would be 'the decade of incomplete reform'. And this is so because, following more than ten years of macroeconomic instability—and resistant, high, and rising inflation—the 1990s were marked by economic reform and stabilization.

As in many other countries in Latin America, the issues of foreign debt, external crisis, and their implications dominated economic policy in Brazil during the 1980s. Among these it is important to stress the strong inflation acceleration, despite unsuccessful stabilization attempts and domestic recession (1981-83). The strategy of contracting

[8] The 'miracle' was also possible due to a favorable conjunction of: existing idle capacity, generated during the 1963-67 recession; loose monetary and fiscal policies, including a host of fiscal incentives to investment and exports; public investment, including that of old and newly created state-owned enterprises.

[9] In 1978 Brazil imported 80% of the oil it consumed. Oil imports represented nearly one third of total imports, despite huge investments in oil exploration, which would mature only in the early to mid 1980s.

domestic absorption to service the debt was adopted throughout most of the first half of the decade, but it was relaxed afterwards.[10] Growth resumed briefly in 1984-86. But at the end of this short period, following another unsuccessful stabilization plan based on an overall but short-lived price freeze, inflation picked up again. An overvalued exchange rate in 1986 made things worse, because the economy was overheated. Its consequence was another BOP crisis that led to a painful (for its consequences) default on foreign debt in early 1987.

The last three years of the 1980s represent a phase of disequilibria and maladjustments, as inflation rates reach near hyperinflation levels in the context of increasing indexation.[11] Short-term economic cycles succeed each other until 1990, when a bold stabilization attempt was attempted—only to fail again. Productivity, in particular, continued to falter, as will be shown later on.

The recession of 1990-92 was provoked in the context of another attempt to curb inflation. But it was rendered useless, in the sense that inflation continued at very high rates afterwards. After the ousting of President Collor for corruption charges (late 1992) and the end of a severe institutional crisis, a new economic team took office and advantaged of the predominantly positive expectations generated from the coming to power of a new government. The level of activity began to grow soon afterwards as firms reacted to expansionary measures in the presence of idle capacity. This was concomitant with import liberalization, which, together with privatization and other state reform, resulted in faster than ever rates of productivity change in manufacturing and other sectors.

Growth picked up in earnest after the Real Plan, an ingenious—and successful—stabilization plan was implemented in mid-1994. The fast increase in real incomes made possible by sudden inflation deceleration boosted demand and GDP growth. This was followed by an only temporary output deceleration during the Mexican crisis (late 1994-early 1995). But the effects of the Asian and Russian crises were strongly felt in the context of a foreign exchange rate regime based on a slowly adjusting exchange rate, in good measure made possible by strong productivity growth in sectors producing tradable goods. As shown in Figure 1, GDP growth rates fell in 1996-97 and nearly zeroed in 1998. Following a foreign exchange rate regime change in early 1999, when Brazil embarked on a free-float regime, growth seemed to pick up—only to be aborted again during the events of the early 2000s mentioned above. Growth resumption in 2004 was mainly based on the recovery of trade and, to a smaller extent, investment. The existence of idle capacity generated in the preceding years made for a relatively costless (in terms of investment expenditures) but fast recovery: GDP grew by at 4.9% in 2004, the highest rate in ten years.

Productivity change has been part and parcel of Brazil's growth record, as expected. Indeed, as it will be seen, an important ingredient of post 1992 growth, modest as it was, is productivity-based.

[10] See Malan and Bonelli (1987) for an economic analysis from the late 1960s to the early 1980s.
[11] Increasing indexation apparently made high inflation less painful than otherwise; but it also turned anti-inflation policies more difficult.

3. Previous work. Studies on trends in aggregate capital accumulation in Brazil have long highlighted the fact that the pace of accumulation was very fast from the 1950s to the 1970s[12], in tandem with GDP growth. Hofman's (1992) work, for instance, was based on carefully constructed series of gross and net capital stock based on the perpetual inventory method for six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico and Venezuela). Among its conclusions with respect to Brazil we find that the total gross capital stock in Brazil grew at very high rates during most of the period analyzed: 8.76% p.a. from 1950 to 1973, a rate that increased to 10.40% p.a. in 1973-80 to fall to 5.51% p.a. in 1980-89. Another interesting conclusion is that all countries analyzed by him, except Chile and Colombia, experienced sharp increases in capital-output ratios, which indicates decreases in capital productivity. Brazil was the worst case. This implies that the country's position with respect to the main Latin American economies deteriorated more than the average.[13] But Hofman stopped short of explaining the observed trends in capital accumulation.

Still looking at inter-country comparisons, Elias (1978) was one of the first analysts to calculate TFP change in Brazil (as well as in other six Latin American countries)[14]. He found out that in the 1950s TFP growth accounted for more than half of total GDP growth, a share that fell in some phases later on (such as 1960-65, when it represented only 4% of GDP growth). In particular, TFP growth rates reached substantial rates in selected periods: 2.5% p.a. in 1965-70 and 2.1% p.a. in 1970-74. In spite of that, Elias concluded that, in general, growth of factor inputs, rather than productivity, explained GDP growth fairly well in a long term perspective.

In a later work, Elias (1992) found out that TFP explained 51% of GDP growth in Brazil in the period 1940-80 as a whole, therefore contradicting his previous results. But he also found out that in the 1960s the contribution was 24% and in the 1970s it was smaller than that: only 13% (=1.1/8.2). The result was mainly due to vigorous growth of capital inputs, a little above 10% per year. In 1980-85, in turn, TFP growth was, according to his estimates, negative (– 1.0% p.a.). Both labor and capital inputs grew at rates faster than GDP during this particular period.[15]

The importance of human capital accumulation has been documented in studies such as Langoni's (1974) pioneering attempt at a comprehensive growth accounting exercise for Brazil. Some of Langoni's results are worth spelling out in more detail because of the author's careful construction of estimates and importance of conclusions.[16] As to

[12] Goldsmith's (1986) is one example. His capital stock estimates are based on Langoni's (1974); see below.
[13] Indeed, the average for all countries studied by Hofman went from 1.9 to 2.8 between 1950 and 1989. Brazil's total gross fixed capital-output ratio, in turn, went from 1.2 to 3.0 in the same period. All figures in Hofman's study are based on 1980 international dollars.
[14] But, with respect to Brazil, his work was preceded by Langoni's (1974). See below.
[15] Labor is adjusted for quality, comprising education, gender, age, occupation, economic sector and region components. Capital is also adjusted for quality, the quality component being dependent on its composition (and reflected in rates of return, depreciation, capital gains, taxes on capital income and tax deduction allowances) under the assumption that differences in the gross rate of return on diverse kinds of capital (actually, five sectors) should reflect the differences in the services provided by each unit of them.
[16] *En passant*, we note that Langoni also estimated the social returns to education in Brazil at 28% in 1969, approximately twice the profitability of investment in physical capital.

GDP growth, the study notes that average rates of increase reached 6.64% p.a. in 1950-60 and 5.78% p.a. in 1960-70. But the contribution of fixed capital to GDP growth reached on average approximately 1.83% to 1.92% in 1950-60 and between 1.85% and 2.15% in 1960-70, only. The contributions of raw labor (employment levels) were 1.55% and 1.41% yearly in 1950-60 and in 1960-70, respectively. The net contributions of education were 0.31% (1950-60) and 0.91% per year (1960-70). The contributions of sector reallocation of labor (reallocation of workers from less productive to more productive sectors) were, respectively, 0.27% and 0.42%. And the contributions of changes in the age-sex composition of the labor force reached, respectively, 0.06% p.a. and – 0.16% p. a. Therefore, total labor contributions (termed 'human capital') were 2.19% p.a. (33% of GDP) and 2.72% p.a. (47% of GDP), respectively, in 1950-60 and 1960-70. Residual growth, or TFP, was 2.62% p.a. in 1950-60 (40% of GDP growth) and 1.21% p.a. in 1960-70 (21% of GDP growth). Again, TFP change represented, on average, a substantial share of output growth, albeit decreasing between the 1950s and 1960s (and less than human capital in 1960-70).[17]

A more recent growth accounting exercise, by Pinheiro, Gill, Servén e Thomas (2001) reached the result that human capital[18] represented a lower, but still substantial share of Brazil's long term GDP growth than found by Langoni in the 1950s and 1960s: in the 24-25% range in 1931-50, 1951-63 and 1964-80; and 42% in the 'long lost decade' of 1981-93. Its contribution, as shown in Table 1, is small especially during 1994-2000, at only 5% of GDP growth. TFP, in turn, explains a substantial share of GDP growth in all periods except 1981-93, when it accounted for 10% of GDP growth. It is important to note that TFP accounted for 73% of GDP growth in 1994-2000.

Table 1: Sources of Growth — Physical Capital, Labor, Human Capital and TFP, 1931-2000 (% p.a.)

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
1994-00	3.05	0.69	-0.07	0.21	2.23

Source: Pinheiro et alii (2001), Table 2.7: "Growth Decomposition with Human Capital Using Mankiw's (1995) Elasticities". The elasticity of capital adopted by the authors was 0.35.

Gomes, Pessôa and Veloso (2003), in turn, found out that human capital accumulation in Brazil was low in 1950-67 and mediocre in the period 1967-76. Even so, in the long term (1950-2000) human capital accumulation accounted for 19% of the growth of GDP per worker, while TFP represented a much larger share: 29%. But capital stock per worker contributed with the bulk of per capita GDP growth: 53%. These shares varied

[17] A comparison of the results by Bonelli (1975) and Pinheiro (1989) also shows a TFP growth deceleration in manufacturing—but from the 1960s to the 1970s.

[18] To compare with Langoni's (1974) results we added the raw labor (employment) and the human capital estimate in the table to add up to 'human capital' in the text.

considerably over time: TFP represented 45% of GDP per worker in 1950-67, 67% in 1967-76 and 46% in 1992-2000. In 1976-92 TFP change was negative.

Other long term studies on the importance of aggregate factor accumulation and TFP change produce a less consensual frame on their relative importance of TFP in explaining aggregate output growth. Abreu and Verner (1997), for instance, examined the period 1930-1993 and concluded that:

(i) The contribution of capital accumulation to a 6.1% average GDP growth was 5.11%. Labor force contributed with 0.84% and the residual, TFP, the remaining 0.16%. Capital accumulation was, therefore, crucial in explaining long term GDP[19] [20];
(ii) There was no significant impact of human capital on GDP growth – but this does not imply that education is not important. From their time-series regression equation (Abreu and Verner, Table 5.9, p. 105) the authors conclude that "The estimated coefficients—on average years of primary, secondary and tertiary education—cannot be rejected as statistically different from zero. Human capital stocks do not seem to have an impact on economic growth in either the short or long run."

Concerning the first conclusion Bonelli and Fonseca (1998), adopting a traditional Solow growth-accounting framework, reached conclusions that differ from the results just cited, but for a shorter time period: in 1970-97, both for the economy as a whole, for the manufacturing sector and for agriculture (in this case, 1975-1996) the contribution of capital was high. But TFP change was also very important to explain output growth in particular sub-periods. This is especially true, both for manufacturing and for the total economy, in the 1990s. The authors note that their results suggest the existence of complementarity of factors of production.

In a recent study Bacha and Bonelli (2004) found results similar to Bonelli and Fonseca's. The next table documents their findings in the context of a Solow-type growth accounting decomposition applied to typical growth epochs.[21] In the table (1/v)' stands for capital deepening (i.e., the difference between the capital-stock-in-use growth rate and that of effective labor.)

The decomposition equation shows that capital deepening shares with effective labor (A.L) the explanation for GDP growth. The last column shows the proportion of GDP growth explained by TFP change. The authors conclude by stressing the role of capital deepening in explaining GDP growth in 1975-84: "… GDP growth in the last decade of the military regime could only be maintained on the basis of very high doses of capital

[19] The elasticity of capital in the Solow model adopted by the authors was 0.69. The labor share was, therefore, 0.31. The stock of capital grew at 7.4% p.a. and the labor force grew at 2.7% p.a.
[20] Hofman and Mulder (1997) reach a similar conclusion in their comparative work on Brazil and Mexico, based on data for 1950-1994.
[21] Elasticities of capital and labor are 0.5 each. TFP (A) is assumed to be labor-augmenting and capital is adjusted for utilization (u). The production function takes the form $Y = (u.K)^{0.5} (A.L)^{0.5}$, which can be transformed to $Y = (1/v)^{\alpha/1-\alpha}(A.L)$, used in the decomposition above, and where capital deepening $1/v = u.K/Y = (u.K/A.L)^{1-\alpha}$

deepening financed by external debt accumulation… In both 1965-74 and 1994-02 (on the other hand) the contributions of capital deepening were very small or nil"

Table 2: Brazil, Decomposition of GDP Growth Rates — Solow model, 1942-2002

Periods	Y'	(1/v)'	L'	A'	A' / Y' (%)
1942-52	0.069	0.011	0.021	0.035	51
1953-64	0.067	0.008	0.025	0.032	48
1965-74	0.088	0.002	0.032	0.052	59
1975-84	0.039	0.026	0.031	-0.017	-43
1985-93	0.025	0.008	0.025	-0.008	-32
1994-02	0.027	-0.001	0.016	0.012	44

Source: Bacha and Bonelli (2004)

TFP change reached negative values both during the external shocks period (1975-84) and in the hyperinflation years (1985-93), according to these authors. In the remaining periods, it represented a substantial share of GDP growth, with a high of 59% in the 'miracle' years. In 1994-2002 it accounted for 44% of GDP growth. In accordance with the evidence presented in Bonelli and Fonseca (1998), Pinheiro, Gill, Servén and Thomas (2001), Gomes, Pessôa and Veloso (2003), these authors identify in the 1990s a discontinuity with respect to the record of the 1980s and early 1990s in the form of a recovery of productivity growth.

Therefore, not only capital accumulation responded for a substantial share of GDP growth in some periods (thanks in part to technical change embodied in machinery and equipment), but productivity growth explained a sizeable part of the observed performance, with the exception of the period from the mid-1970s to the early 1990s.

4. Major Determinants of Productivity: Factor Supply and Allocation. As shown, factor accumulation explained a substantial share of past Brazilian growth in a long term perspective. In a broader sense, factor supply includes not only physical and human capital, but physical infrastructure as well. Factor allocation also deserves mentioning in our explanation of productivity determinants, besides factor accumulation. In what follows we highlight the importance of structural change and the role that the financial system played in the allocation of resources. We next deal with each of these issues.

Factor supply: Physical Capital

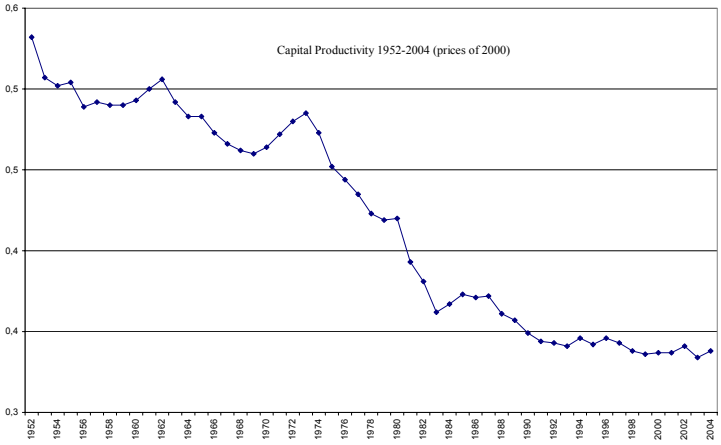
Growth of physical capital proceeded at very fast rates up to the early 1980s, concomitantly with output growth in much of past experience. Capital equipment—and, especially, imported machinery and equipment—have been important sources of embodied technical change especially in periods such the late-1960s to mid-1970s and more recently, from the early 1990s on, following import liberalization. However, capital accumulation fell since the early-1980s as macroeconomic unbalances and uncertainty increased, concomitantly with the debt crisis and strong inflation acceleration.

The reasons behind the observed reduction of capital accumulation and mediocre macro performance after 1980 have been explored in Bacha and Bonelli (2004). Their explanation is only partially based on reduced savings. Savings fell after the 1980s, but not in amounts sufficient to explain the observed fall in capital stock growth rates. Indeed, total savings fell from 22.2% of GDP in 1974-84 to 21.0% of GDP in 1984-93 and to 19.6% of GDP in 1993-2002. Instead, their explanation emphasizes the role of two additional factors, besides savings and decreases in capacity utilization: increases in the prices of investment goods and diminished capital productivity. As it will be shortly shown, capital productivity fell almost continuously from the mid-1970s to the early 1990s. Henceforth, it remained approximately stable. The relative investment price (defined as the ratio between the price deflator of gross fixed investment and the GDP deflator), in turn, increased almost continuously from the mid-1970s to 1989. The reasons for the increase in the relative price of investment have been put forward by Bacha and Bonelli (2004) in the following terms:

"The increase in the relative price of investment is a Brazilian anomaly in a worldwide perspective.... Possible explanations include: (i) increased oligopoly power in industries producing both final and intermediate investment goods…; (ii) inefficiencies in the capital goods production process, as more and more of previously imported goods are produced domestically; (iii) higher demand for durable goods, including housing, as a shelter against hyperinflation and financial default risks, with reflexes on the relative price of such goods if the supply curve is upward sloping…; (iv) oligopolistic price-makers' defensive pricing behavior in face of government procurement payment delays, in a context of accelerating inflation; (v) price-index measurement error….". (p. 13)

To make things worse, capital productivity[22] decreased substantially from the early 1970s to the early 1990s, as shown in Figure 2, in a trend that is broadly consistent with changes observed worldwide, at least since the 1970s in the OECD countries.

Figure 2: Capital productivity, 1952-2004 (Based on series at 2000 prices)



Source: Author's calculations. See Bacha and Bonelli for additional analysis (2004)

[22] Defined as the ratio of real GDP to average utilized capital (average of end-of-year stocks).

What is unique to Brazil is the magnitude of the observed productivity decrease.[23] The growth accounting exercise (see below) will spell out the major consequences of such a reduction.

Factor supply: Labor and Human Capital

From a purely quantitative standpoint, the supply of labor has not been a hindrance to Brazil's growth, as an elastic supply of manpower has characterized past performance.[24] But the fact that employment, and especially formal employment, has been growing slower than long term rates points to one of the main obstacles to productivity increases arising from labor markets: the very high degree of informal labor relations in Brazil. We will turn to this issue in a while.

The educational system, in turn, has gone through pronounced changes in contemporary Brazil, as shown in the next table. The increased enrollment in all education levels can be gauged from the table, which shows deep changes and an acceleration after the 1970s. Indeed, in 1970 illiterates still represented almost one third of the work force. Emphasis on college education began in the 1960s and proceeded at fast rates after since then. The proportion of the labor force possessing (incomplete + complete) college education went from 1.2% in 1950 and, again, in 1960, to 2.2% in 1970 and reached at least 4% in 2000.

Table 3: Distribution of the Labor Force According to Education Level, 1950 to 2000
(Selected Years, %)

Education groups	1950	1960	1970	2000*
Illiterate	48.3	41.4	31.1	13.2
Lower basic (0-4)	43.9	50.5	54.6	21.4 (0-3)
Upper basic (5-9)	4.8	4.5	7.4	32.1 (4-7)
Intermediate (10-12)	1.8	2.3	4.7	14.3 (8-10)
College (13-17)	1.18	1.25	2.21	18.3 (11- +)**

Sources: Langoni (1974), p. 67; www.ibge.gov.br Notes: * refers to population aged 7+; **group 15+ years of study (complete college) represented 4%; group 11-14 the remaining 14.3%

Recent estimates covering the period 1992-2002 are available in a study by Paes de Barros, Carvalho, Franco and Mendonça (2004), which highlight the importance of labor force education and qualification in explaining growth. First, the authors performed a detailed decomposition of family per capita income change between 1992 and 2002 based on a new methodology, to find out that labor productivity accounted for 50% of the observed per capita income increase observed in the period.[25] Change in average labor productivity is, in turn, explained by two variables, with the following weights: changes in

[23] As mentioned, Hofman's (1992) estimates pointed out to the same phenomenon.
[24] The working age population (WAP) grew at 2.17% p.a. in the 1990s (1991-2000), while the economically active population (EAP) grew at 1.74% p.a. in the same period. The long term growth rate of the Economically Active Population, based on Demographic Census data, was 3.06% p.a. between 1960 and 2000, period in which the country's total population growth reached 2.26% p.a.
[25] Changes in demographic variables explained 30% of the total per capita income increases while 35% were originated from transfers received by families. Negative components added to 15%.

labor force qualification (87%) and changes in the quality of jobs (13%). Therefore, changes in labor force qualification accounted for approximately 44% of the total income per capita increase between 1992 and 2002.[26] Note that per capita income grew, according to the household surveys, 30% between 1992 and 2002. Therefore, labor force qualification, reflected in the increased educational content of workers, played a major part in explaining GDP growth and productivity.[27]

As a result of improvements in the educational system the number of graduates (master and doctor degrees) has also increased steadily since the 1980s. A recent study (Viotti, 2005, our translation) summarizes the main trends as follows: "the accelerated expansion of scientific production in Brazil has been in good measure due to the increase in the stock of graduates (master's and doctor's degrees). Between 1987 and 2002 the number of these graduates increased, respectively, 510% and 634%. In 2002, no less than 23,421 Brazilians got master's degrees and 6,843 completed their doctoral programs. In addition to that, rates of enrollment expansion in doctoral programs in the last few years, as well as scholarships, will make it possible to graduate 10 thousand PhDs in 2006. Just for comparison: in the USA the yearly number of graduates has been hovering around 41 thousand PhDs per annum in the last 10 years… Scientific production has grown accordingly. There are indications that the contribution of this production towards increasing world scientific knowledge is becoming significant… this growing supply of human resources of high qualification and capacity to produce scientific advances represents an important base upon which one can build a national innovation and technological learning system " (Viotti, 2005, *passim*, our translation).

Despite recent advances, the still low labor average quality is a powerful impediment to innovation. Viotti (2005) calls attention to the result of a recent study conducted by IPEA — Institute of Applied Economic Research, that found out that among the four variables most closely associated to the probability to innovate, two are directly associated to characteristics of the labor force: training and school attainment. Firms that engaged more decisively in searching and succeeding in performing innovation with a view to external activities deploy more educated workers. Schooling levels of the labor force have a positive effect on the innovative capacity of firms, besides other advantages as the ability to learn new techniques.

Two other aspects deserve closer inspection: the first is the widespread existence of informal labor relations, which poses powerful barriers to economic growth and productivity change. The second is the strict set of rules and regulations that govern the labor market. We turn to these themes next.

One of the main issues related to the development of a productive labor supply is the existence of a large part of the labor force that is employed in informal activities,

[26] The authors also note that the degree of average labor productivity inequality in Brazil is substantially larger than in other countries of Latin America, thereby contributing to per capita income inequality. Higher than average labor productivity inequality in Brazil is explained mainly by 'quality of jobs' inequality, rather than by the degree of inequality in 'labor qualification', the weights being approximately 4.5:1.

[27] About 75% of family income in Brazil is derived from labor income. Therefore, income inequality reflects labor market differences. Better job posts imply higher productivity and higher per capita family income.

making for the occurrence of a sizeable shadow economy in Brazil. A recent study argues forcefully that informal labor is also a powerful obstacle to productivity growth in Brazil (McKinsey&Company, 2004).[28] The McKinsey study defines informality as the performance of licit activities in irregular forms, through the non-compliance of regulations (concerning evasion of taxes and duties and falsifications of instruments of fiscal control; non-payment of social security, inexistence of wage legislation and undeclared employment in labor markets; evasion of requirements on product quality, property rights, environment, etc. in product markets regulations) that imply substantial hidden costs to the economy. The costs associated with compliance of existing law are an inducement to less competitive firms to turn to informality as a strategy for survival.

The productivity gap between informal and formal firms in Brazil is estimated at about 50%. This is due to the difficulty to access financial market mechanisms, reduced access to judiciary in order to enforce contracts, disincentive to grow due to fears of being caught by government agencies in charge of enforcing tax and other legal norms and procedures, and insertion in productive chains formed by informal firms as well.

Once turned informal, there is little incentive for firms to invest in physical and in human capital. Access to credit markets is made more difficult. Informal operations have no incentive to grow because they would become more visible if they did. Relationships tend to concentrate in other informal firms as well. The study by McKinsey (2004) concluded that increasing the formal economy relatively to the informal, or shadow economy will have an important impact on Brazil's GDP and productivity. Thus, for instance, the lower than otherwise use of capital relative to labor—a typical feature of informal activities, and one often associated with lower productivity levels—follows from the tax evasion of labor costs. These and other barriers to the formal economic activities are barriers to productivity growth.[29]

From the McKinsey (2004) report we also learn that informal labor activities have been approximately constant in 1992-2002 (56.6% of the employed population in 1992 and 55.0% in 2002). Informality has been nearly stable only because agriculture's share in total employment has decreased. In fact, from the Brazilian household surveys (PNAD) we learn that the share of informal labor in agriculture is estimated at 90% (91.5% in 2002 and 89.9% in 2002). Figures for the remaining sectors are: manufacturing industries, 26.9% and 37.1 %, in 1992 and 2002, respectively; construction, 61.3% and 71.1%; commerce, 43.9% and 53.3%; transportation and communications, 28.5% and 42.0%; public administration and social services, 20.8% and 17.7%; and other services, 58.8% and 56.0%. Therefore, in the non-farm sector, as a whole, informal labor increased from 42.9% of the employed population in 1992 to 46.0% in 2002. This reflects migration from rural to urban areas, as will be further explored below. As to the within-manufacturing sector composition of informal labor activities, the report states that it is concentrated in sectors such as clothing

[28] Informal labor relations are tolerated because of the social implications of high unemployment: it is better for the poor to have some income, even if earned in the shadow economy, than to have none. Therefore, there is a cultural perception that a certain degree of informality is tolerable and, indeed, acceptable. But the implication for productivity advances should not be overlooked.

[29] A recent document from the World Bank (**Doing Business in Brazil**, 2004) estimates that the shadow economy accounts for 40% of Brazil's gross national income and for 50% of non-rural labor force.

and accessories (where 62% of employment is informal[30]), textiles (56%), food products and beverages (40%), metal products (38%).

'Informality' has several causes in Brazil. The most important are: (i) high costs implied by formalization: can be divided into those arising from rigid rules such as the ones for creating and closing down businesses[31], rules governing labor relations[32] (see below); excessive tax burden on formal firms and contributions to social security[33]; and (ii) low enforcement capacity from the authorities, often associated with a slow judiciary and a disproportionate judiciary burden[34].

McKinsey (2004) also presents estimates of output and productivity gains that could be achieved through decreasing informality[35]. Labor productivity would increase from the observed 1.4% p.a. to 2.8% or 4.6% per year, depending on the reduction of informality achieved. The study also suggests that for the economy as a whole the additional productivity increase would be on the order of 1.5% p.a., which is a rather powerful effect.

Labor market strict regulations are also a hindrance to productivity advances in Brazil, and have not been dealt with during the modernizing reforms of the 1990s. Regulations remain essentially the same as when they were first formulated and implemented in the 1940s. Indeed, Brazilian regulations are among the most rigid in the world and represent a focus of inefficiency: they do nor protect the workers and are an obstacle to more efficient allocation of labor resources. This translates itself into increasing informal employment (as mentioned, nearly 60% of labor is not formally employed).

Rigid labor laws imply lower hiring, slower output and productivity growth. Soaring labor costs have been imposed by the existing legal frame: hiring costs under the form of compulsory and non-negotiable charges amount to more than 100% the direct wages (CNI, 2005, *passim*). Therefore, they increase labor costs in a substantial way.

Government intervention is theoretically justified when market failures such as information asymmetries and unbalanced bargaining power exist. Information problems are usually dealt with via intermediation systems that facilitate supply and demand market equilibrium. Bargaining power problems have been dealt with in other parts of the world

[30] Defined as non-contributing to social security.
[31] The World Bank (2004) document states that it takes on average 152 days to establish a business in Brazil. The average closing down period is 10 years.
[32] From the World Bank (2004) document we learned that Brazil has the third less flexible labor legislation in the world.
[33] Of the tax rate of 34.1% of GDP collected in 2001, 11.0% came from employer social security contribution and 12.1% were from indirect taxes. Mc Kinsey (p. 28, 2004).
[34] Anecdotal evidence: while in Brazil the Supreme Court examines more than 100,000 processes each year, the Supreme Court in the USA issues sentences on approximately 100 cases per annum.
[35] The method consists in fitting an equation to data on productivity growth rates and informality rates data of 26 manufacturing industries. A significant and strong negative association was found. The equation results were then used to predict productivity growth in 1996-2001 under two assumptions on informality reduction (20% and 40%) in all sectors, simultaneously. Manufacturing output would then increase by an additional percentage between 1.5% and 3.0%.

via stimulus to association and *a priori* guarantees of rights. But none of these has happened in Brazil.

Factor supply: Infrastructure

Physical infrastructure has apparently not been especially productivity-enhancing in the last decade.[36] Prior to that, physical infrastructure did not hamper growth and productivity in a noticeable way. Indeed, Brazilian industrialization was characterized by high publicly funded investment rates in infrastructure, especially in the generation, transmission and distribution of electricity and road construction. This has been the case up to the early 1980, when the fiscal conditions began to worsen. Departing from ratios over 4% in the early to mid-1970s, public investment (mostly infrastructure investment) to GDP rates fell to 2% p.a. in the early 1980s and in the late 1990s, early 2000s. In 2003 it fell to 1.7% of GDP, and in 2004 it was even less than that.

The situation got worse as the issue fiscal crisis became deeper from the mid-1990s on, because most infrastructure investment was (and still is) publicly funded.[37] Privatization was adopted in the 1990s as a way out of the problem (see analysis in the next section). Public-private partnerships (PPP) are presently seen as a (partial) way out of the severe infrastructure financing problems.

Roads and ports have not contributed much to efficiency improvements in the recent past as well, as the corresponding infrastructure has reached levels of nearly complete utilization due to lack of (budget-constrained) public investment. Institutional change and reform since the early 1990s have not been able so far to attract private investment to physical infrastructure of this kind.

The long term impact of infrastructure investment on growth and productivity of private inputs in Brazil has been studied by Ferreira and Malliagros (1998). In their study infrastructure capital is composed of electrical energy, telecommunications, roads, railways, ports and airports. The authors' objective was to investigate which infrastructure sectors had the closest impact on GDP growth in the long term.[38] The issue of causality (i.e., between infrastructure capital and GDP or productivity) was also examined. Their main conclusions were as follows: (i) there is a strong association between infrastructure investment and GDP in the long run; (ii) the income elasticity is situated between 0.55 and 0.61; (iii) there is also a meaningful relationship between infrastructure and TFP change.[39]

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[36] Telecommunications are a notable exception, though, mainly due to privatization. See also Ferreira and Malliagros(1998). Expansion of the internet and information technologies has been very fast.

[37] In fact, a shortage of electrical energy in 2001 due to low investment levels in public utilities was held responsible for the abortion of a growth recovery phase that had begun in 1999.

[38] This issue had already been investigated by Ferreira (1996), who found out that a 1% expansion of federal infrastructure capital (telecommunications, electrical energy, ports, railroads) generated a positive impact on GDP of between 0.35% and 1.12%, depending on the depreciation rates utilized. Considering total public capital (includes state firms and regional and local administrations) the impact varied between 0.71% and 1.05%. This implies a strong relationship between infrastructure investment and GDP in the long run.

[39] According to the authors, their endogenous model suggests that a 1% change in infrastructure capital has a 0.53% impact on TFP; a 1% change in infrastructure investment has a 0.23% impact on TFP. Using the

The use of disaggregated series suggested that electrical energy, transportation and telecommunications were the segments that most closely influenced GDP. The fall in public investment in electrical energy and transportation since the 1980s had a significant negative impact on output and productivity in the Brazilian economy.

Factor Allocation: Structural Change

Structural change has also had a positive contribution towards increasing productivity, but the importance has varied vary with time. There have been periods in which production shifted (relatively) to activities characterized by higher than average (labor) productivity. In other cases the opposite has occurred, as in the 1990s (Bonelli, 2002, *passim*). Broadly speaking, the changing nature of structural change reflects the macroeconomic environment and performance.

In the 1980s, as shown, capital accumulation, although still continuing to occur, was slower than before. But labor productivity change was negative in the decade as a whole. Thus, the Brazilian economy operated less efficiently in 1980s. In the 1990s, on the other hand, both labor and TFP recovered, despite slow growth. GDP growth was based on new technology and on economic reforms implemented over the decade—among them, trade and financial liberalization, state reform (privatization) and stabilization. Productivity gains were not evenly distributed through time among sectors. Next we focus on the issue of structural change and its relationship with productivity growth, particularly the changing composition of employment and output.[40]

The next table shows sector average labor productivity (ALP) levels and growth rates in selected years in the interval 1950-2000 (original figures are in constant 2000 R$). Labor productivity was measured as output per employee at market prices.[41] Gains were typically smaller in the 1980s (between 1980 and 1991) than in remaining decades.[42]

Transport and Communication was the leading sector in the long run. It was characterized by large productivity gains in all periods, which yield a compounded 5.66% p.a. growth rate over a period of half a century. On closer analysis one finds that gains were more concentrated in the Communications sub-sector than in Transportation. Gains in the former sub-sector were on the order of 11.4% p.a. between 1991 and 2000, 14.4% p.a. between 1980 and 1991, and, amazingly, 21.0% p.a. between 1970 and 1980.[43] The second highest productivity growth rate is observed in Agriculture (farming and animal production), in which an average growth rate of productivity change of 3.51% p.a. was observed over 50 years. As a result, agriculture's productivity levels increased from 26% to

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exogenous model the elasticity estimates would be between 0.48 and 0.49 and between 0.34 and 0.38, respectively.

[40] We borrow the following approach from Bacha and Bonelli's (2002) unpublished manuscript

[41] Sector output was estimated by sector shares in value added at factor cost (1950-1991) and value added at basic prices (2000).

[42] Care should be taken when analyzing the data in the table, especially data on Public Administration and Other Services sectors because of likely changes in registered employment in the Demographic Census. This is particularly true of the 1991 results.

[43] Before 1970 Communications and Transportation data were lumped together.

43% of the national average between the years analyzed. Public administration occupies the third place in decreasing order of productivity growth rates, but this result will not be emphasized due to the peculiar way public sector output was measured in the past: on a par with population growth. Next in line comes manufacturing (plus mineral extraction and public utilities), displaying a 2.76% long term average, followed by the financial (2.1% p.a. rate) and construction (1.0% p.a.) sectors.

Table 4: Productivity levels and growth rates, 1950-2000 (R$ and %)

	1950	1960	1970	1980	1991	2000
PIB per worker (at market prices)	4,995	7,657	10,808	17,158	15,494	17,020
(Average growth rate %)		4.36	3.51	4.73	-0.92	1.05
Agriculture	1,306	1,677	2,294	3,743	4,916	7,316
(Average growth rate %)		2.53	3.18	5.02	2.51	4.52
Industry (except Construction)	8,052	14,426	19,463	24,128	26,209	31,440
(Average growth rate %)		6.00	3.04	2.17	0.75	2.04
Construction	13,275	22,972	20,713	29,578	21,991	21,700
(Average growth rate %)		5.64	-1.03	3.63	-2.66	-0.15
Retail and wholesale trade	7,656	10,011	11,583	13,960	8,472	6,908
(Average growth rate %)		2.72	1.47	1.88	-4.44	-2.24
Transport and Communications	1,361	2,041	3,496	8,028	15,117	21,344
(Average growth rate %)		4.14	5.53	8.67	5.92	3.91
Financial activities	25,169	21,317	39,454	52,082	64,828	71,079
(Average growth rate %)		-1.65	6.35	2.82	2.01	1.03
Public Administration	6,262	7,850	11,000	10,260	20,287	25,872
(Average growth rate %)		2.29	3.43	-0.69	6.39	2.74
Other services (residual)	22,858	23,673	24,832	33,533	14,247	14,263
(Average growth rate %)		0.35	0.48	3.05	-7.49	0.01

Source: Author's calculations based on Demographic Censuses and National Accounts data

The remaining two sectors (trade/commerce and other services) show negative long-term average labor productivity growth, mainly due to the performance after 1980. These sectors are the ones in which informal labor has concentrated, especially since the 1980s. This explains their poor productivity performance.

Agriculture, in turn, also employs a substantial number of informal labor[44]. But the process of labor migration to urban areas has been so intense that the net result was positive. The next table shows the sector structure of employment in 1950 and 2000. It can be confirmed that even as late as 1950 the labor force in Brazil was largely concentrated in the primary sector: nearly 60% of total employment (down from 66% in 1940).

Fifty years later the share of agricultural employment had fallen to 17%. Trade and other services (the residual sector, in the table), on the other hand, were responsible for the major part of employment increase during the half century analyzed: from a little less than 13% of the total in 1950 to almost 46% in 2000, more than trebling their share on total employment—but at the cost of diminishing labor productivity. Note that public administration, construction and financial activities doubled their relative stock of workers,

[44] Other sectors also have considerable stocks of informal labor, including manufacturing.

while manufacturing (and related activities) and transport and communications maintained their relative proportions in total employment.

Table 5: Sector Structure of Employment, 1950 and 2000 (%)

Agriculture	59.91	17.18
Industry (except Construction)	14.17	14.77
Construction	3.42	6.87
Retail and wholesale trade	5.65	17.14
Transportation and Communications	4.03	4.76
Financial Sector	0.67	1.27
Public Administration	4.93	9.54
Other services (residual)	7.23	28.48
Total	100.00	100.00

Source: Demographic Census

As to the levels, most sectors had above mean ALP, lead by the financial sector, manufacturing plus mineral extraction and public utilities, construction and public administration sectors. There was some long term convergence towards the average over time. In 1950 the range of relative productivities was from 0.26 (in agriculture) to 5.0 (financial services). Fifty years later the range was from 0.41 (trade/commerce) to 4.18 (financial services).

We may now turn to the main issue raised above: to what extent did factor allocation contribute to overall productivity change? To answer this question we suggest the following simple decomposition exercise. Let Y[T]/N[T] – Y[0]/N[0] be total productivity change between two periods of time, (0 and T), where N is aggregate employment and Y is aggregate output. A simple algebraic manipulation of the above expression yields

$$Y[T]/N[T] - Y[0]/N[0] = \Sigma\, a[i,T].P[i,T] - \Sigma\, a[i,0].P[i,0]$$

where a[i,0] and a[i,T] are employment shares for each sector i in the initial and final years considered and P[i,0] and P[i,T] are the labor productivities of the ith sector in the initial and final year, respectively. It is easy to show that the above expression can be written as the sum of two components:

$$\Sigma\, P[i,T].(a[i,T] - a[i,0]) \qquad (1) \quad \text{and}$$

$$\Sigma\, a[i,0].(P[i,T] - P[i,0]) \qquad (2)$$

We label (1) a structural, or allocation component. It measures the contributions of structure, or allocation shifts through time (weighted by end-year sector ALP (P[i,T]). Expression (2) denotes a pure productivity component, which is given by productivity change between 0 and T (weighted by base-year employment shares). From these expressions we note that productivity may change even if ALP in all sectors is stagnant: it is only necessary that labor shifts to higher ALP sectors. In this case, all change would be due to the allocation component. Conversely, aggregate productivity may increase without

employment shares change: it is only necessary that ALP increase in some sectors, at least. In this case all change will be due to pure productivity (i.e., without structural change) growth. The results of the decomposition exercise applied to decade data from 1950 to 2000 are shown next.

Table 6: Decomposition of Average Labor Productivity Change, 1950-2000 (%)

	1950-60	1960-70	1970-80	1980-91	1991-2000
Pure productivity effect	65	51	54	76	142
Labor allocation effect	35	49	46	24	-42

Source: Author's calculations; see text

The decomposition results point to the important impacts of allocation effects in the Brazilian economy, especially from 1950 to 1980. The effect of employment changes represented from 35% (in the 1950s) to 49% (in the 1960s) of the total absolute increase in aggregate ALP in the economy. Their complement is given by pure productivity increases, the technological effect. This effect of structural change ceased to exist after 1980. In 1980-91, aggregate ALP on average decreased. Therefore, both effects in the table were negative—their ratio to total ALP change resulting positive. The major part of (diminished) ALP change was caused by reduced sector ALP. In 1991-2000 a negative allocation effect meant that labor shifted (in relative terms) to sectors of lower than average ALP, as in the previous decade. The positive ALP growth achieved, modest as it was (1.05% p.a.), was entirely due to sector ALP growth effect. Note that if the employment structure had remained unchanged in 1991-2000 ALP would have grown by 14%, instead of by 10%.

One of the implications for future productivity growth is that it is not enough to improve sector productivity performance. It is also necessary that the employment structure shifts away from sectors with low (and sometimes decreasing) productivity, especially Commerce and Other Services, towards sectors with higher than average ALP. Turning formal at least part of the informal labor force in the service sectors would contribute to improve overall productivity, as suggested above.

Factor Allocation: Role of the Financial System

The effectiveness of the financial system as a source of productivity growth is also a matter of concern in Brazil. Lacking a system of long term financing, resources available to firms have been very much constrained. Foreign loans and foreign direct investment (FDI) share with loans from the Brazilian National Development Bank (BNDES) the role of supplying (external to the firm) long term finance to manufacturing and other sectors. It is acknowledged that funds internally generated have been by far the main source of finance to firms. By and large, the financial system has not had its expected role in the allocation of resources in the Brazilian economy.

The country's financial system has undergone significant transformation since the mid-1990s, in good measure adapting itself to low inflation levels after the Real stabilization plan (1994). But despite all changes, the ratio of credit to GDP continues to be

extremely low, on the order of 25%, only[45]. Low financial intermediation reflects a host of factors, but especially the very high basic interest rate in the economy. But this is only part of the story. High domestic interest rates are also a consequence of high spreads and jurisdictional uncertainty[46]. High spreads, in turn reflect four main factors: precaution against non payment of debts, fiscal expenditures associated with loans, judicial difficulties to recover bad loans, and little competition among banks[47].

Securities markets such as bond and stock markets play only a limited role in financing new investment and the expansion of activities. Therefore, firms rely mainly on funds internally raised. External finance is exploited mainly by large firms, who can issue bonds abroad at rates considerably lower than those available (if available at all) in Brazil. In the 1960s and, especially, in the 1970s there were mechanisms for even medium and small firms to access foreign financing via commercial banks. But this became impossible as the debt crisis of the 1980s hit the country and the 1982 debt default took place.

Besides present difficulties, available commercial bank credit is of short term maturity, only. There is virtually no long term financing by private banks. Private agents display a clear preference for government liquid assets (given prevailing interest rates and the way public debts are rolled). In addition, fears of default on public debt — a consequence of high inflation years and the not infrequent debt defaults that took place from 1979 to 1990 — also pushes lenders to short term loans. Solutions in this regard are complex and require regulation and institutional changes.

On the other hand, in part due to low financial intermediation, and in part due to improved Central Bank supervision, the financial sector has proven to be reasonably solid, with very few cases of bankruptcy, as witnessed by the resilience with regard to macroeconomic shocks in the last decade. But its role as economic growth agent is still incipient. Most credit to firms, whether to expansion or to initiate new business comes either from retained earnings or from the Brazilian National Development Bank (BNDES), the sole institution to grant long term loans (except for housing).

BNDES represented a very important source of finance to infrastructure and to manufacturing industries ever since its creation in the early 1950s. Its role as a development agency was reinforced in the late 1960s and in the 1970s. In the late-1980s, however, its sources of funds were reduced, in good measure because previous loans had been granted on very favorable terms, sometimes at negative real interest rates. This resulted in low returns from previous loans granted. It is also likely that non-performing loans had an impact on the available funds.

The weak financial sector performance in the past, therefore, can be blamed on the country's structural imbalances, which inhibited private savings and were responsible for

[45] In addition, almost half of this share is targeted to specific ends, such as housing and agriculture.
[46] Jurisdictional uncertainty as an explanation for the inexistence of a local long-term domestic credit market and high interest rates is a theme that has been recently explored by Arida, Bacha and Rezende (2005).
[47] See Reis and Valadares (2004), passim.

increases in the tax burden on financial intermediation. Public banks are still present, but much less than before: privatization of the banking sector took place in the 1990s.

5. Additional Determinants: Trade Liberalization and FDI

A closely related issue is: how does trade liberalization affect productivity, directly and indirectly? Liberalization makes it more difficult for domestic firms to shelter themselves from competition in their home markets and to guarantee secure sources of profits. Fast labor and TFP growth, cost reductions per unit of output, successful product innovation, enlarged market share and increased comparative advantage in foreign trade (as revealed by increased exports) are typical competitiveness-related variables associated with the presence of TNC in Brazil. FDI has had a strong influence in shaping the output structure and technological base of Brazil's manufacturing sector, as well as Brazil's trade structure and performance. In the case of the service sector, the role of TNCs in Brazil was important before WW II. In the 1990s FDI flows went primarily to services (non-tradables).

The export orientation of foreign-owned firms is, on average, higher than the export propensities of domestic firms. This is in part due to the role and extent of intra-firm trade. In addition, host countries provide export incentives which are taken up by TNCs more quickly than by domestic firms, reflecting competitive advantages in international markets due, for instance, to superior marketing channels and/or superior managerial flexibility. Also, one of the main aspects of export-oriented TNCs is their size: the competitive advantage of TNC often comes from the possession of some unique asset which, in turn, is often associated with firm size.

Trade and financial liberalization clearly facilitated FDI growth. Changes included the opening up of industries previously closed to foreign investment, the establishment of liberalization schemes and the enhanced role of intra-firm trade—an essential feature of all international production through FDI.

A conspicuous result of recent Brazilian economic performance is the productivity growth record in the manufacturing industries, which occurred with little new investment. This change has been related to trade liberalization, stabilization and the adoption/diffusion of new technological and managerial techniques in the context of a new production paradigm. All these processes have strong linkages with the enlarged presence of TNCs in Brazil. A recent report emphasizes the two-way dimension of the competitiveness-FDI link from a different perspective[48]. From its concluding remarks we extracted the following illustrative passages:

> "The efficiency-seeking dimension of present TNC investments tends to reinforce the competitiveness of local production, deepening advances obtained during the recessive years (of 1990-92) and consolidating consumers' gains.... Paradoxically, these welfare and competitiveness gains may not be sustainable if the cost in terms of foreign exchange be considered too high....Results from our TNC survey show that these firms have been very quick in reducing competitive disadvantages relative

[48] Laplane and Sarti (1997), op. cit. Our translation.

to the rest of the world. Present investments are directed to the same objective. The interviews allowed us to identify (many) TNCs modernization initiatives which contributed to the dissemination of product and process innovations in their supplying firms...emphasis on efficiency-seeking through standardization of products, processes and organizational and managerial techniques leads to specialization and rationalization in the development of innovations as well... (but) the spillovers of learning processes are low..." (p. 82-83)

The results from the research just cited strongly suggest that TNC modernization initiatives increase productivity and competitiveness very quickly, once adopted. But the authors are skeptical concerning the linkage effects that might be obtained from such initiatives.

Brazil's growth strategy changed substantially since 1990. For nearly six decades before that date economic policy had been characterized by low integration into the world economy, pervasive discretionary state intervention, and the prevalence of command over market competition. Since the early 1990s the economy was opened to foreign trade and to both direct and portfolio investment. In addition, a number of large state-owned enterprises (SOE) were sold off and a host of price and output regulations were discontinued. At the same time, and gradually, a new regulatory framework was erected within the context of overall market reforms. Institutional change occurred at a much faster pace than before. Needless to say, trade liberalization had a strong impact on manufacturing sector performance as well as on the economy: import liberalization was one of the driving forces behind the acceleration of productivity growth in the 1990s as firms, faced with the threat of increasing imports, reacted by adopting practices entailing more efficient use of resources. Trade liberalization also spurred productivity growth by allowing access to better (imported) raw materials, parts and components and forcing the least productive firms out of business. The exit of low productivity firms raises average productivity not only by eliminating those on the bottom, but also by increasing the productivity of the remaining firms.[49]

Different studies have confirmed empirically that trade liberalization in Brazil had a positive effect on productivity growth. However, issues of timing (how long does it take for the effects of liberalization to be felt on individual industries?), degree of data aggregation (either at the firm or at the sector level), availability (and type) of data, and how to represent empirically the liberalization process make it very difficult to perform direct tests of the hypotheses.

Productivity growth has been the answer to increased import competition in only a limited number of sectors. The Brazilian experience in this respect has been one of extremely varied responses. To some extent this reflects the fact that it is difficult to separate out effects of trade liberalization, privatization and other reforms on performance. Nevertheless, it is tempting to attribute the improved productivity results of many sectors in selected periods to the reforms of the 1990s. Against this frame, the high volatility in output growth, exchange and interest rates that characterized the 1990s may have affected

[49] See Pinheiro, Bonelli and Schneider (2004), passim.

individual sectors in very different ways. The mid-1990s, especially, were marked by intense labor productivity growth. A group of manufacturing industries was primarily responsible for this improved performance, helped by public utilities and, especially, telecommunications. Privatization, import competition and an improved macroeconomic performance in specific sub-periods were the main factors responsible for this record.

The 1990s also witnessed the introduction of new and modern management and organizational techniques, especially in manufacturing. The timing of the two phenomena (liberalization and adoption of modern management and organizational techniques) coincided, leading firms in nearly all sectors to restructure, further contributing to raise productivity — albeit at the cost of a substantial reduction in manufacturing employment (Bonelli, 1999). By focusing on defending market shares, rather than seeking an expansion of activities, the restructuring led to a concentration of investment in modernization. Investment in expanding productive capacity was in good measure postponed because activity levels were low until very recently.

Another important issue is the effect of change of the exchange rate system in early 1999, towards a free-float regime, on productivity. At that point, imports of capital equipment — one of the sources of productivity growth in the preceding years — were drastically curtailed both as a result of increased prices in domestic currency and as an outcome of output deceleration following exchange rate devaluation in 1999 and other years since then (notably 2001 and 2003). As we have shown, labor productivity continued to grow in 1999 and 2000, but faltered in 2001-2003. Growth resumption in 2004 as well as good prospects for 2005 suggests that this trend may have changed.

6. Other Determinants of Productivity: Competition, Social Dimension, Environment, Institutions, Integration, Investment Composition and Invariants

The competitive environment has been changing markedly in Brazil since trade liberalization, privatization and other state reform. As a result, it can be said that the economy has become much more competitive than before. But output in some industries within the manufacturing sector is still very concentrated in a small number of producers. This is especially the case in segments such as steel, certain construction materials, beverages (e.g., beer and soft drinks), chemicals and petrochemicals, not to speak of non-manufacturing activities such as mineral (oil and non-oil) extraction.

The same can be said of the asset and income inequality issue. Brazil is well known for its unequal distribution of income and high incidence of poverty. Both have changed in the 1990s, largely as a result of the Real stabilization plan. When inflation rates were suddenly reduced in 1994, real incomes abruptly increased. The gains were proportionately larger for the poorest segments in the population than for the richest ones, which had been better equipped to protect their earnings against inflation thanks to indexation. Poverty incidence decreased simultaneously, but the impact on inequality was not as pronounced as the impact on poverty incidence. To the extent that reducing inflation is considered part of the package of market reforms, it had a dramatic impact on poverty. But one disturbing aspect of this process was that poverty reduction seems to have been a short-lived, once-and-for-all phenomenon.

Thus, overall the impact of reforms on poverty was rather small, with the exception of changes just after the implementation of the Real plan. There are two main channels through which reforms might affect poverty: (i) income growth; and (ii) via income distribution changes. In both cases the results of the reforms were relatively unimportant in Brazil. The effect of these aspects (inequality and poverty) on productivity change is not easy to evaluate. Large income inequality makes for small markets for many goods and services. Therefore, scale economies cannot be achieved and productivity is, likewise, limited. For this reason, large income and asset inequality hampered productivity growth.[50]

Environmental concerns have not had so far the importance they deserve in Brazil. But except in few cases, usually related to the generation of electric energy (when environmental licenses are not necessarily granted according to the original project's needs, thereby generating construction delays and cancellations)[51], environmental regulations have had no great impact on productivity growth, or have not been an impediment to productivity growth. But this may well change in the near future.

Integration: Brazil has traditionally been a much closed economy, due to typical ISI policies and the protectionist practices they entailed. Thus, for six decades from the Great Depression through the 1990s economic policy had been marked by low integration into the world economy. But the country has recently become more and more integrated in both trade and finance. Exports have become a relevant source of demand growth. This has been the case particularly in 2003 and 2004, when they were responsible for the recovery in the level of economic activity. The flow of trade (exports plus imports of goods and non-factor services) to GDP ratio was nearly 29% in 2003, to be compared with only 18% in 1994. In the mid-1980s this ratio had been even smaller than that: approximately 15%.

Recent trends in export growth, after exchange rate devaluation in 1999 and the adoption of a free-float exchange rate regime, have added stimuli to exports. Brazil is competitive in a broad range of goods, from aeronautical equipment to steel and soy and related products. But the natural endowment base indicates that activities closer to natural resources (such as mining and agribusiness), have developed export capacity faster than most others. This has resulted in productivity gains in these sectors. ALP growth in 2004 and 2005 indicates that manufacturing as a whole is also benefiting from productivity change.[52]

Increased imports have also been an avenue to improved productivity performance. It has been suggested that part of the successful productivity growth story in the 1990s can be attributed to import liberalization (see next section). Growth has benefited from the use

[50] A recent survey on growth and productivity change concludes with the following remarks on the influence of inequality on growth: "My tentative conclusion is that inequality slowers growth… Although we can argue with limited confidence that inequality within a country slows its growth, we cannot say much about the channels through which this influence plays out" (Helpman, 2004, p.94).

[51] This is, incidentally, a very hotly debated issue in contemporary Brazil, as firms complain from excessive environment regulation.

[52] De Negri and Freitas (2004) have shown that TFP change in Brazil has been positively associated with the export performance of manufacturing firms.

of improved (imported) raw materials and machinery and equipment. This has coincided with economic integration within MERCOSUR, which provided for enlarged imports and exports from and to neighboring Argentina, Uruguay and Paraguay.

Role of Institutions and Regulations that can affect productivity[53]. The market reform process that Brazil began in the late 1980s-early 1990s has remained incomplete, in the sense that it lacks complementary institutional reforms in areas such as sector and overall regulation, property rights, judicial reform, and administrative reform. The following excerpts summarize the issue of excesses and deficiencies of regulation in infrastructure as follows:

"Although macro stabilization dominated the economic scene in the 1980s, this period also recorded a number of market-oriented reforms, essentially geared at eliminating some of the excesses introduced in the post-1974 period (*as a reaction to the first oil crisis*). (*However*), reforms … counted with very little political support. Indeed, the 1988 Constitution had clear nationalist and 'statist' provisions in establishing, for example, public monopolies in telecommunications, … oil and… distribution of gas, and in setting up barriers to foreign ownership in mining and electricity. Yet, less than two years after … (*that*), Brazil launched major market-oriented reforms, … enlarging the trade liberalization, privatization and deregulation programs (*in a substantial way*).

Changes in the regulation of privatized sectors … provide a testimony of the difficulties in this arena. (*This is*) shown by the difficulties in resolving conflicts of interest and overlapping responsibilities (as in ports) and extending the network operated by private investors (as in the case of highways) ... Moreover, in the railway sector the break up of SOEs and the restrictions imposed on cross-ownership seem to have led to an excessively fragmented industrial structure.

Another aspect of excessive regulation is its effect on increasing informality, because it induces companies to operate at sub-optimal scales and capital intensity, causing both labor and total factor productivity to be lower than otherwise. Indeed, the only way these companies are able to compete is by not spending with their tax obligations ….. By not paying taxes informal firms gain a substantial cost advantage vis-à-vis formal competitors. This spurious competitiveness brings negative consequences for the economy. In particular, it hinders more productive and efficient companies from expanding their output, while keeping human, management and capital resources locked into inefficient methods of production, causing an important opportunity cost…

The high tax burden is the main component of the cost of being formal. But it is not the only relevant factor. Another important factor is the heavy regulatory burden that falls on formal firms. There is evidence that the share of the informal sector in GDP is in general: (i) higher in countries in which there is a heavier corporate regulation and in which regulators have greater discretion in its application; (ii) larger in countries with a heavier tax burden, with the application of tax norms being as important as the tax rates proper; and (iii) correlated with the quality of public services (more informality corresponds to lower

[53] It is fair to note that institutions are not only cause but also consequence of growth processes.

quality services), with the latter measured by the degree of corruption and how the rule of law is applied, especially regarding the legal protection to private commercial investment.

Among the measures of corporate regulation that have been used one finds three indicators: the number of procedures necessary to start up the firm, the official number of working days necessary for completing those procedures, assuming that there are no delays, and the financial cost of doing so. The start up of a firm in the formal sector is a rather complicated process, which demands lots of time and is rather expensive in most countries. More specifically: (i) the number of procedures that need to be followed to start a firm ranges from a minimum of 2 in Canada to a maximum of 20 in Bolivia, with a world mean around 10. In Brazil, there are 15 procedures; (ii) the minimum required time to complete those procedures ranges from 2 working days (several countries) to 174 working days (in Mozambique), with a world average of 63 working days. In Brazil, it is necessary 67 working days; (iii) the cost of following these legal procedures ranges between 0.4% of per capita income (New Zealand) to 2.6 times per capita income (Bolivia), with a world average of 34% of per capita income. In Brazil, the cost amounts to 67.4% of per capita income" (Excerpts from Pinheiro, Bonelli and Schneider, 2004).

Thus, although its overall effect is difficult to gauge, institutional change in Brazil has proceeded in the right direction since the late 1980s-early 1990s. But there are still tough issues on which substantial voicing has been raised in the recent past: rules governing the protection of intellectual property rights, regulatory structures, lack of bureaucratic capacity in state agencies, and special institutional arrangements supporting business.

The composition of investment expenditures exemplifies another impediment to productivity growth, given the strong concentration of Construction activities in total capital accumulation. Since productivity is more closely associated to machinery and equipment absorption than to expenditures on construction (especially residential construction), recent trends in investment structure are suggestive of impediments to productivity growth.[54]

Another aspect concerns the role of imported machinery and equipment in productivity enhancing. These imports have represented a not very high (and variable) proportion of total machinery and equipment use because of the autarkic industrial policies Brazil adopted for a long time. If we accept that imported machinery and equipment is 'more productive' than the domestic substitute, recent results show that following trade liberalization the structure of capital equipment became more geared to productivity growth. But after a record 48% share of imported equipment on total machinery and equipment expenditures in 1999, the proportion began to decrease. In 2003 it reached only 28%.

[54] A very high share of Construction in total gross investment characterizes contemporary Brazil: it reached a high of 70% of fixed investment in 1998. Machinery and Equipment were, typically, around 30% of fixed investment in the 1990s and early 2000s. In addition, in the late 1990s-early 2000s imports of capital goods represented only approximately 20% of total imports.

Evidence from the 1960s and 1970s reveals that sectors that relied more heavily, in relative terms, on imports of materials inputs, machinery and equipment, and technology were the ones with the highest TFP growth.[55] The vintage composition of the capital stock had the same positive effect on TFP: lower mean ages of firms, or higher proportions of output accruing to newer firms characterized higher TFP gains in both decades.[56]

As to the invariants: (i) Brazil has clearly benefited from its geographic location (including a very large maritime coast), natural-resource endowments and (potential) size of the market; (ii) political institutions have been increasingly responsive to the need to improve regulations and growth-enhancing instruments, despite frequent setbacks; (iii) natural-resource endowments are clearly a plus; land of good quality (in part made possible by improvements in farming due to indigenous R&D) and mineral resources abound, with the exception of coal; Brazil is also competitive in mining and is likely to become self-sufficient in crude oil due to deep-sea production under the aegis of a SOE.

7. Growth Accounting 1960-2004.

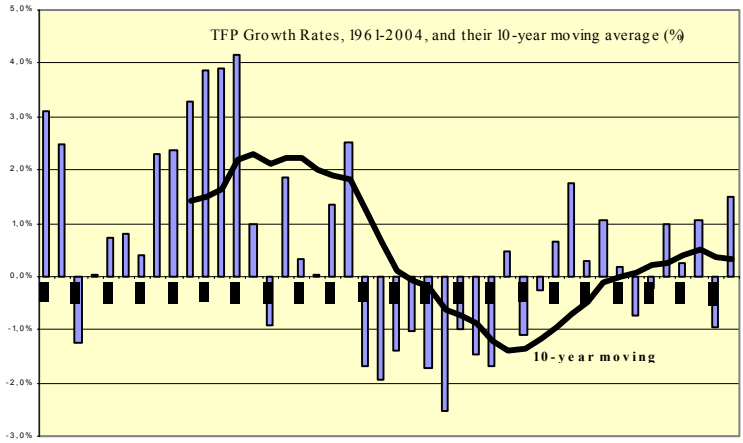
We depart from the standard Cobb-Douglas production function with constant returns to scale of the usual form

$$Y = c.A.(u.K)^{\alpha}.(L)^{1-\alpha}$$

where Y is real GDP (at constant prices of 2000), c is a scale constant, A is TFP, u is the degree of capacity utilization, K is capital stock (at constant prices of 2000; geometric average of year-end values), and L is employment[57]. TFP rate of change (A') is estimated as the residual in a log-linearization of the function, where we assumed technical change to be neutral and disembodied[58]. The elasticity of output with respect to capital was assumed to be 0.5[59]. The next graph shows the results in terms of TFP rates of change (A') from 1961 to 2004.

[55] Bonelli (1975) and Pinheiro (1989).
[56] Ibid.
[57] Capacity utilization figures follow the methodology shown in Bacha and Bonelli (2004). Capital stock figures, provided by Ms L. Morandi, are updates from Morandi and Reis (forthcoming). Employment estimates are based on Demographic Census results, adopted as benchmarks, assuming constant within-decades (Census years) labor-output elasticities in order to calculate yearly figures.
[58] In a previous work (Bacha and Bonelli, 2004) we assumed technical change to be labor-augmenting. In that case, the production function would be $Y = c.(u.K)^{\alpha} (A.L)^{1-\alpha}$. Given the parameters adopted, this results in TFP growth rates exactly twice the size found in the present text, given the hypothesis on $\alpha = 0.5$. Capital and labor contributions would be correspondingly reduced.
[59] We follow Bacha and Bonelli (2004) on this point: "This convenient value is consistent with the income share of capital in Brazil's national accounts. It is also in accordance with the country's very high income concentration" (p.32). Preliminary econometric results also suggests that 0.5 is the capital coefficient of a modified Solow-type Cobb-Douglas function (expressing overall labor productivity as a function of the capital-labor ratio) estimated in first differences with data for the period 1981-2004.

Figure 3: TFP growth rates, 1961-2004, and their 10-year moving averages



Source: Author's calculations (see text)

Three cycles of productivity change emerge from the picture, as suggested by the 10-year moving averages superimposed on the graph. The first one is characterized by positive and sometimes very high rates of TFP change that prevailed, with exceptions (usually associated with slow GDP growth: 1963, 1964, 1967, 1975, 1977, 1978), in the 1960s and 1970s. The second cycle covers the 1980s and early 1990s, when TFP change was negative (except in 1990). After 1992 a new cycle of generally positive TFP growth begins, albeit modest compared to the previous positive TFP growth cycle. The exceptions are, again, years of slow GDP growth (1998, 1999 and 2003). At the end of the decade 1995-2004 average TFP was growing at a little less than 0.5% per year.

A growth decomposition exercise is performed next, in which we divided the whole period into five distinctive phases characterized by broadly similar economic policies and performance:

1961-1967 — Prelude and first act of the military regime
1968-1974 — 'Economic miracle'
1975-1980 — Growth *cum* debt
1981-1992 — (long) Lost decade
1993-2004 — Real era[60]

Table 7 summarizes the growth decomposition results and highlights the importance of capital accumulation. It explains nearly one half of GDP growth in all periods except the lost decade: in 1981-92 capital was used in a very inefficient way, the result being negative

[60] Implementation of the Real Plan took place in 1994. But the economic team who formulated and implemented the plan had been in charge since 1993. Since the PT government that began in 2003 kept intact the economic policy regime it inherited from the previous administration, we chose to label the whole 1993-2004 as the Real Era. A possible division would possibly be between the first half, up to 1998, and the second, after 1999, when the new exchange rate regime was adopted and fiscal adjustment began. For the record, TFP growth averaged 0.63 % p.a. in 1993-98 and 0.49% in 1999-2004. These results average a different figure from the one in the table due to the log-linearization adopted to calculate the TFP series.

rates of TFP change (– 1.3% per year) mainly due to decreased capital productivity. Prior to that decade, capital contributed with between 49 and 66% of GDP. In the Real Era a much slower path of capital accumulation (at 3% per year, which yields a contribution of 1.52%) accounted for 49% of GDP growth (2.92% p.a.).

Both labor and TFP made important contributions to growth in selected periods. Up to 1980 labor represented around 20% of GDP growth, a share that reached 83% in the lost decade and 31% in the Real Era. TFP, in turn, accounted for 30% of GDP growth during the Brazilian 'miracle'. But the share shrank in the latter part of the 1970s, when it accounted for only 13% of GDP growth. The situation deteriorated even further in the next period analyzed, when inefficiencies in factor use led to an annual rate of TFP decrease of – 1.31% per year. The recovery observed in the next period analyzed was remarkable: from – 1.3 to 0.5% per year between the two periods.

Changes between consecutive periods can best be evaluated from the results in the table's lower panel. Between the period 1961-67 and the "miracle" years average GDP growth increased an additional 6.1%. At the margin capital contributed with 41% of additional GDP growth. Increased labor input accounted for 21% and TFP for a sizeable 38%. Moving from the "miracle" years to the growth *cum* debt period (1975-80) implies an average GDP growth rate that is 3.9% smaller than before. The change was mostly due to diminished TFP growth, which at the margin represented no less than 61% of lower GDP growth. Capital and labor inputs growth accounted for 18 and 21%, respectively. The difference from the 1975-80 phase to the lost decade results in an additional subtraction of 5.5% in average GDP growth. The burden of this negative change falls mainly on capital input growth: 54% of total GDP decrease. Lower (actually negative) TFP growth contributed at the margin with 40%, leaving 6% to the labor input.

Table 7: Capital, Labor and TFP contributions to GDP growth, 1961-2004

		Contributions to growth			Relative contributions (%)		
Periods	Average GDP growth rate	Capital	Labor	TFP	Capital	Labor	TFP
1961-1967 (Early military)	0.0461	0.0273	0.0096	0.0092	59	21	20
1968-1974 (Economic miracle)	0.1072	0.0523	0.0228	0.0321	49	21	30
1975-1980 (Late 1970s)	0.0686	0.0452	0.0148	0.0086	66	22	13
1981-1992 (Long lost decade)	0.0135	0.0154	0.0112	-0.0131	114	83	-97
1993-2004 (Real era)	0.0292	0.0152	0.0091	0.0049	52	31	17
Change between:							
Early military & 'miracle'	0.061	0.025	0.013	0.023	41	21	38
'Miracle' & late 70s	-0.039	-0.007	-0.008	-0.024	18	21	61
Late 70s & 'lost decade'	-0.055	-0.029	-0.004	-0.022	54	6	40
'Lost decade' & Real Era	0.016	0.000	-0.002	0.018	0	−12	112

Source: Author's calculations. See text.

One of the most interesting aspects revealed by the results above is the change from the 'lost decade' to the Real era. Average GDP growth increased only a meager 1.6%. But all change is explained by TFP growth: 112% at the margin. Labor contributed with a negative 12% (meaning that employment grew less in the second period than in the first),

while the capital input grew at nearly the same rates in the two consecutive periods—therefore contributing close to nothing at the margin.

These results highlight the importance of productivity change in the most recent period, compared to the previous long decade of 1981-1992. The analysis in the text focused on the importance of the reforms that have taken place since the beginning of the 1990s in shaping the productivity recovery record.

8 Growth: Prospects for the Future

In order to speculate on future growth paths we need to add hypotheses and behavioral models—or, at least, useful identities—to project the relevant variables. The starting point is the production function presented above. Assuming technical change neutral and disembodied, we need, in addition to prospects for TFP, estimates of labor and capital inputs. Assuming constant unemployment and activity rates, labor input growth can be approximated by the working age population (WAP) growth rate. Estimating future capital paths is trickier.

To proceed we borrow an expression developed in Bacha and Bonelli (2004). It is an identity that expresses capital stock growth (K') as a function of five variables: the saving rate (s); the index of capacity utilization (u), presented above; the capital productivity (v), already introduced; the relative price of investment goods (p), defined as the ratio of the gross investment deflator to the GDP deflator; and the capital stock depreciation rate (d). The expression linking these variables is the following:

$$K' = s.u.v.(1/p) - d$$

We only need now to provide future paths for these variables. Present (i.e., 2004) values are the following

s = 0.1955 (saving rate)
u = 0.955 (capacity utilization)
v = 0.338 (capital productivity)
p = 1.088 (p = 1.0 in 2000)
d = 0.036 (depreciation)

Plugging these parameter values in the expression above results in a capital stock growth rate of 2.2% yearly. After a log-linearization of the production function and assuming TFP growth of 0.5% p.a. (average of last decade) and employment growth at 2.2 as well (growth rate of WAP), we get a GDP growth rate of 2.7% per year, only.

In the short run, of course, both K and L can grow more than assumed. Thus, if utilization increases, there is an increase in K' as well, as can be immediately inferred from the canonical expression. But it is a once and for all increase, as can be easily seen. In the same vein, given the still high unemployment rates in Brazil, L' can grow in the short run more than the hypothesized 2.2% per year. But not indefinitely. At some point employment will be limited by supply.

To grow more requires changes in the parameters in order to increase capital accumulation and productivity. Beginning with the former, the expression above suggests that K' can grow as a result of different combinations of the parameters (u, v, s, p and d). The next table highlights some of possible combinations, keeping capital utilization, the relative price of investment index and the depreciation rate at their 2004 values (respectively: 0.955, 0.338 and 0.0362). The table shows different combinations resulting from increases in the savings rate from 0.1955 to 0.235 and decreases in the relative price of investment goods from 1.0 (observed in 2000) to 0.8. The stock of capital would then increase at rates that range from 2.7% yearly (upper left corner) to 5.9% yearly (lower right hand corner).

Table 8: Capital Stock Growth Rates (alternate projections)

s \ p	**1**	**0,95**	**0,9**	**0,85**	**0,8**
0,1955	0,027	0,030	0,034	0,038	0,043
0,2150	0,033	0,037	0,041	0,045	0,051
0,2350	0,040	0,044	0,048	0,053	0,059

Plugging these lower bound and upper bound estimates in the Solow equation, keeping the values of the parameters as before, assuming labor input growth at 2.2% yearly (growth rate of the WAP), and assuming TFP to proceed at the rates observed in the beginning of the XXI century (0.5% per year) we arrive at projected GDP growth rates ranging from 3% in the case where there is no increase in the savings rate and the relative price of investment is kept at the levels observed in 2000, to 4.6% under the hypothesis that savings can be raised four additional percentage points of GDP and the prices of investment goods experiences a reduction of 20% relative to the GDP deflator. To go beyond that one needs to assume TFP growth higher than observed in the recent past. Assuming that productivity is pro-cyclical—as it appears from the past record; see above[61]—one could reasonably expect TFP growth rates in the range of 1.0 to 1.5% yearly in the future, provided GDP growth accelerates (which is the case, under the premises of the exercise). Therefore, under these more favorable hypotheses, GDP can possibly grow at rates of up to 5.1 to 5.6% per year. But, to repeat, these projections assume: (i) TFP growth at 1-1.5% per year; (ii) a 23.5% of GDP savings rate[62]; and (iii) a decrease of the relative price of investment goods on the order of 20% from the levels observed in 2000.

[61] A regression equation of GDP on TFP growth for the period 1960-2004 suggests a positive coefficient of 0.2 if the years 1981-92 are excluded from the sample, indicating that TFP growth is approximately 20% of GDP growth. A regression of factor use (i. e., GDP minus TFP) on TFP growth results in approximately the same coefficient.

[62] The period 1999-2004 has witnessed a substantial recovery of domestic savings (including inventory accumulation), from 15% to 23% of GDP. This occurred simultaneously to the 5% reduction of foreign savings to a current account surplus of 2% of GDP. The phenomenon is the counterpart of the reduced share of total consumption in GDP, from 81% in 1999 to 74% of GDP in 2004. See Giambiagi and Montero (2005). Seen from the magnitude of this recent adjustment, the assumed/projected 4% rise of domestic savings (excluding inventory accumulation) does not seem to be too large a change.

9. Conclusion

With few exceptions, many of the central conclusions from the economic growth literature on long term growth in Brazil emphasize the role of capital accumulation and TFP in explaining growth. Productivity change was of crucial importance in some periods, only. In particular, especially in periods characterized by high rates of economic growth—which is strongly suggestive of a Kaldor-Verdoornian, or pro-cyclical interpretation of productivity change.

As to the constraints to productivity growth, our analysis suggested the following:

a. *Low levels of capital accumulation*. Bacha and Bonelli (2004) have suggested that this has been caused by increased prices of investment goods (relative to the GDP deflator) and by diminished capital productivity until the early 1990s, probably associated to: (i) world trends since the mid-1970s; (ii) inefficiencies in the domestic production of capital goods; (ii) the increased share of Construction in total capital formation. The corollary is that economic efficiency and economic growth are associated;

b. *Institutional aspects*, such as regulation, have also been responsible for the not so favorable GDP growth and productivity record. A deficient infrastructure, particularly since the 1980s, can also be blamed for that record. Inefficient and/or incomplete regulation shares the responsibility for this outcome;

c. *The quality of the labor force* also shares responsibility, despite recent changes. Faster expansion of TFP in manufacturing was observed in the 1960s and 1970s in sectors characterized by a more skilled labor force;

d. *Technology transfer from abroad* has been mostly possible through FDI and TNC performance. Their role has changed substantially over time, with a clear improvement since the early 1990s. There is evidence that technology transfer, FDI and productivity change are closely intertwined;

e. Lastly, but not less importantly, the *sector composition of gross investment* evolved through time towards an increasing share of construction in total capital formation. This has represented a smaller contribution to productivity growth than before.

As to future GDP growth, assuming that productivity is pro-cyclical, one can expect TFP growth rates in the range of 1.0 to 1.5% yearly, under the assumption that GDP growth accelerates from recent average rates. Thus, under these hypotheses, GDP can possibly grow at rates of up to 5 to almost 6% per year. This assumes: (i) TFP growth at 1 to 1.5% per year; (ii) a 23.5% of GDP savings rate; and (iii) a decrease of the relative price of investment goods (on the order of 20% from the levels observed in 2000).

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