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THE 1990s**

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Abstract

Changes in economic policy induced marked changes in Brazil in the 1990s. Trade and financial liberalisation, begun in the late 1980s, continued and were followed by privatisation, other measures of State reform and the beginnings of economic stabilisation with the implementation of the Real Plan from 1994. Although Gross Domestic Product (GDP) growth rates for the decade as a whole were below long-term averages, several indicators of macroeconomic performance improved during the first half of the 1990s. Productivity change, both at the aggregate and at the sector level, was one of the most successful.

This paper explores the general issue of productivity change in Brazil in the 1990s following a series of steps: first, adopting a longer term view, it examines to what extent overall labour productivity in the 1990s progressed at rates different from those previously attained; second, it investigates productivity growth in manufacturing industry in the long term; third, it concentrates the analysis on the 1990s to cover all sectors in the economy, not just manufacturing industry; fourth, it explores the issue of who benefited from productivity growth; fifth, it evaluates the role of trade liberalisation and rising import penetration in increasing productivity.

In interpreting the data assembled for the research, I found that empirical research did not fully confirm certain theoretical ideas and hypotheses.

* This paper contains material as yet unpublished from preliminary research carried out since mid-2001, with substantial additions and revisions from previous work by the author. It also uses results from an on-going research project with Prof. Edmar Bacha in section 1. I am grateful to the staff of the Centre for Brazilian Studies, and particularly to its Director, Prof. Leslie Bethell, for the warm reception during my stay in Oxford, as well as continuous support. An earlier version of the paper benefited from comments made by Dr. Edmar Bacha, Dr. Mahrukh Doctor and Dr. Alberto Farre.

Sumário

A década de 90 foi um período caracterizado por fortes mudanças na economia brasileira, muitas das quais induzidas pela política econômica governamental. À liberalização comercial e financeira iniciadas ao final da década de 80 seguiram-se medidas visando a reforma do Estado, como a privatização de ativos, e a bem sucedida tentativa de estabilização econômica com o Plano Real. O conjunto de medidas adotadas teve importantes implicações em relação a diversos aspectos do desempenho macroeconômico. Mas poucos foram tão bem sucedidos quanto o aumento da produtividade.

Esse estudo analisa precisamente esse tema, a partir do exame de diversas fontes de dados. Entre seus resultados destacam-se: (i) na década de 90 rompeu-se a trajetória de taxas decrescentes de aumento da produtividade; o ganho de produtividade chegou, inclusive, a ser negativo na década de 80; (ii) o crescimento da produtividade agregada representou uma elevada proporção do crescimento do PIB real, invertendo tendência anterior; (iii) o sacrifício em termos de emprego foi aparentemente menor do que se supunha até a recente divulgação de resultados do Censo Demográfico; (iv) quanto à incidência setorial dos ganhos de produtividade, a Indústria destacou-se dos demais setores -- mas taxas muito elevadas de crescimento da produtividade caracterizaram também os setores de Comunicações e Serviços Industriais de Utilidade Pública; (v) nesses casos, como também em setores industriais como a produção de aço e petroquímicos, o desempenho esteve fortemente associado com o processo de privatização; (vi) os setores retardatários foram os de Serviços, Transporte e Comércio, caracterizados também por elevadas proporções do emprego total; (vii) isso explica porque o Brasil não pode beneficiar-se, na década, do clássico fator de aumento de produtividade agregada representado pelas mudanças relativas na estrutura de emprego em favor dos setores de alta produtividade; (viii) mas coloca também coloca um problema para a melhoria da produtividade no futuro, caso não se consiga elevar a produtividade desses setores de elevado volume de emprego e baixa produtividade; (ix) o estudo explorou, ainda que preliminarmente, a questão de quem se beneficiou dos ganhos de produtividade setorialmente diferenciados; não foi possível obter respostas únicas, mas procurou-se qualificar diversas possibilidades teóricas; (x) finalmente, procurou-se examinar a relação entre liberalização comercial e aumento da produtividade de um ponto de vista empírico. Como no item anterior, não há uma resposta única para a associação esperada: diversos padrões setoriais foram identificados a partir de uma base de dados especialmente construída para essa pesquisa.

Introduction

Since the mid-1980s, most studies on productivity growth in Brazil have concentrated on gains taking place within the manufacturing sector ¹. Although no overall agreement has been arrived at so far (and perhaps never will) on the magnitude of such gains — due to difficulties associated with the data sets such as changes in (and nature of) sample coverage, definition of variables, and other methodological issues — there is a perception, confirmed by individual industry case studies, that productivity growth rates in many manufacturing and non-manufacturing industries were very high during the 1990s ². In this sense, they represent a discontinuity with respect to previous experience. Beyond the controversy associated with manufacturing sector data, very little is known about what happened in non-manufacturing activities.

The list of factors deemed responsible for the favourable results attained in the 1990s includes trade liberalisation and privatisation, as well as other comprehensive State reform and deregulation processes adopted in Brazil over the last decade. But one should not expect them to influence all industries and activities in similar ways.

This paper will address these issues according to the following sequence: first, it presents results for the total economy in the long term, and focuses on overall labour productivity (section 1); second, it analyses labour productivity change in the manufacturing sector focusing on the developments since the mid-1980s (section 2); third, it investigates 42 sectors covering the whole economy in the period 1990-2000 relying on data from the new Brazilian System of National Accounts (section 3); fourth, the same data set is then used to examine who benefited from productivity growth (section 4) and to evaluate the role of trade liberalization and rising import penetration in inducing productivity increases (section 5). A section summarizing the main results closes the paper.

¹ See, for instance, Considera and Silva (1993), Feijó e Carvalho (1994), Bonelli (1996), Salm, Sabóia and Carvalho (1997) and Rossi and Ferreira (1999). Recent exceptions are Bonelli and Fonseca (1998), Bonelli (2000), Castelar et alii (2001), Muendler (2001) and Bacha and Bonelli (2002).

² See, for instance, McKinsey (1997). The case studies analysed by Mc Kinsey suggest that there is still considerable room for productivity increases in all sectors analysed.

1. GDP and Labour productivity growth in the long run ³

The investigation of productivity change in the long run adds perspective to the analysis of the 1990s. Table 1, below, documents the long-term evolution of GDP, population, per capita GDP and aggregate labour productivity in Brazil in terms of average annual growth rates for approximately decadal periods since 1940 ⁴. From this table, one cannot see the high variability within each selected period. This aspect can be seen from the Appendix ⁵. But these results allow us to discern periods of high growth from periods of low growth in a straightforward way. The four decades covering the period from 1940 to 1980 were clearly characterized by very high growth of all variables in the table – including population ⁶. In contrast, after 1980 there follows a period of slow – and not infrequently negative – growth. As a result, average per capita GDP growth was negative between 1980 and 1991 (– 0.4%). This applied to productivity change as well (– 0.92% yearly between 1980 and 1991).

Table 1: GDP, POPULATION, PER CAPITA GDP and LABOUR PRODUCTIVITY Brazil 1940-2000 (growth rates, % per year)				
Decades	GDP	Population	GDP/capita	Productivity
1940-1950	5.90	2.35	3.46	4.3
1950-1960	7.38	3.06	4.20	4.4
1960-1970	6.17	2.87	3.21	3.0
1970-1980	8.63	2.48	6.00	4.7
1980-1991	1.52	1.93	– 0.40	– 0.92
1991-2000	2.81	1.63	1.16	1.8
1940-2000	5.35	2.39	2.89	2.9

Sources: GDP – before 1947, Haddad (1975); after 1947, National Accounts (IBGE [1990] and IBGE [2002]); Population and Employment up to 1991 (to estimate labour productivity) - IBGE, Demographic Censuses, various dates. Population in 2000: IBGE, Demographic Census. Employment for comparing 1991 and 2000: National Accounts, IBGE (1995, 2002).

After 1991 (and, especially, after 1992) growth resumed, albeit at a slower pace than in all previous decades in the 20th century except for the

³ Labour productivity is the ratio of the output of goods and services to the labour time devoted to the production of that output. Advances in productivity - that is, the ability to produce more with the same or less input - are a significant source of increased potential national income. In the long run, increases in real hourly earnings are tied to productivity gains.

⁴ The choice of periods is in good measure dictated by the availability of population data from the Demographic Censuses. This explains why the year 1991 was adopted as a dividing year between the 1980s and 1990s.

⁵ Appendix 1 presents information on yearly GDP growth rates for the years here analysed. The variability of GDP growth rates can be clearly seen from the graph in that Appendix.

⁶ Information for previous time periods, collected and organized by Maddison (2001), informs us that during the years from 1930 to 1980 Brazilian GDP grew at 5.72% annually, on average (3.03 per capita), while from 1891 to 1929 it had grown 3.13% per year (0.92% per capita). The corresponding figure for 1821-1890 is 1.95% per year (0.30% per capita) and, for 1500-1820, only 0.62% yearly (0.15% per capita).

1980s. Even so, labour productivity grew at reasonably good rates (1.8%), taking into account a GDP average growth rate of 2.81% yearly from 1991 to 2000.

The average GDP growth for the whole 1940-2000 period, shown in the last line of the table above, was very high (5.35% p.a.), notwithstanding slow growth in the 1980s and 1990s. Since the population grew at 2.39% yearly, per capita GDP grew at 2.89% in the 60-year period 1940-2000. It can also be observed from the table that productivity growth tends to accompany per capita GDP growth over time. The fact that for the whole period productivity and per capita GDP grew at approximately the same rate indicates that, on average for the 60-year period 1940-2000, employment – or, rather, occupation – and population grew at approximately the same rates in the long term.

Note, besides, that one can achieve the same per capita growth in the 2000s (projected 1.3% p.a. population growth in 2000-2010) with a 1.5 percentage points lower GDP growth rate than in the 1950s to 1970s, when population growth was 2.80% p.a.

We next propose an identity-based exercise to explore how productivity affects GDP.

Consider a decomposition exercise of the following kind, based on the identity:

$$\text{GDP} = (\text{GDP}/\text{occupation}) * (\text{occupation}/\text{Economically Active Population}) * (\text{EAP}/\text{population}) * \text{population}$$

or

$$\text{GDP} = \text{labour productivity} * \text{occupation rate} * \text{activity rate} * \text{population} \quad (1)$$

A minor digression is in order at this point, to stress the influence of labour productivity on economic growth. Both the employment (occupation) rate ⁷ and the activity rate depend on economic and demographic factors as well as on expectations of the population about the future. The employment

⁷ Note that, conceptually, the occupation rate is similar to the employment rate: its complement is the unemployment rate.

rate increases if the economy is growing and decreases when it does not. The activity rate's behaviour is more difficult to predict, since it changes in response to changes in a variety of economic and social conditions as well. But in a steady state we can assume that they remain constant. Under these conditions, per capita GDP (GDP/population) depends entirely on productivity, which is sometimes assumed to be exogenous ⁸.

Table 2 presents data on the variables shown in identity (1) for the past 6 decades ⁹. Per capita GDP is shown in the last line and labour productivity in the line before last. Note that labour productivity in 2000 returned approximately to 1980 levels, after having fallen between 1980 and 1991.

Table 2: Real GDP, employment, economically active population (EAP), labour productivity and population (POP)

Absolute values	1940	1950	1960	1970	1980	1991	2000
GDP (1999 prices; R\$ billion)	43.9	77.8	158.6	288.6	660.1	779.7	1,001
Employment (E); 1000	14,759	17,117	22,750	29,339	42,272	55,293	64,704
EAP (L);1000	14,759	17,117	22,750	29,557	43,236	65,229	76,158
Population (POP); 1000	41,165	51,944	70,191	93,139	118,970	146,825	169,799
Productivity (1999 R\$)	2,972	4,544	6,970	9,836	15,616	14,101	15,470
GDP/POP (R\$)	1,066	1,497	2,259	3,098	5,549	5,310	5,895

Sources: Same as Table 1, except for demographic figures in 2000, which come from the Advanced Tables of the 2000 Demographic Census.

Taking logs of GDP, GDP/E (labour productivity), E/L (occupation rate), L/POP (activity rate) and POP and subtracting the log values from two consecutive periods allows for a decomposition of GDP growth into the factors on the right hand side of identity (1). The decomposition results are shown below ¹⁰.

Table 3: Decomposition of GDP growth (%)

Factors	1940-50	1950-60	1960-70	1970-80	1980-91	1991-2000	1940-2000
%Labour							
Productivity	74.1	60.1	57.5	55.9	-61.3	37.1	52.7
% Occupation rate	0.0	0.0	-1.2	-1.8	-85.7	0.9	-5.2

⁸ This is a simplification. But it has been adopted in many growth models, following Solow's seminal paper (Solow [1957]). One alternative view is that productivity fluctuates over the cycle – a view associated, among other approaches, with Kaldor and Verdoorn's laws. See also Basu and Fernald (2000).

⁹ The Demographic Censuses of 1940, 1950 and 1960 didn't investigate occupation levels. We implicitly assume that occupation equalled the economically active population on these dates.

¹⁰ This approach was borrowed from Bacha and Bonelli (2002). The present results are a revision of theirs.

% Participation rate	-14.7	-2.3	-3.5	16.4	120.6	3.8	7.2
% Population	40.6	42.3	47.3	29.6	126.3	58.2	45.3
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Same as Table 2

Table 3 shows that productivity change has always been a major source of GDP growth, in all periods analysed. But: (i) its importance decreased over time; (ii) the 1980s were representative of a sudden discontinuity in the long-term trend, as productivity change was actually negative in this time period, while GDP grew by a meagre 18% over a 11-year period (1.52% yearly, on average); (iii) this trend was reversed in the 1990s when, despite slow GDP growth (2.81% from 1991 to 2000, on average), productivity accounted for 37% of the observed GDP increase.

The occupation rate (which is equal to zero by definition up to 1960) decreased in the 1960s, 1970s and especially in the 1980s, when unemployment soared. The finding that it represented a positive growth factor in the 1990s – although a relatively unimportant one – should be interpreted with some caution as the new Demographic Census Advanced Tabulations for 2000 imply occupational growth higher than the Economically Active Population growth between 1991 and 2000 – which is very surprising, indeed¹¹.

The participation rate, on the other hand, increased during the 1970s, 1980s and 1990s, especially during the so-called “lost decade” of the 1980s, as female participation rates increased markedly in Brazil.

The last column summarises the decomposition of GDP growth for the whole 1940-2000 period: labour productivity accounted for a little over 50% of the total gain, while population growth responded for 45%. The activity rate increased a little when end-points are considered, raising overall GDP by 7%. In contrast, the occupation rate decreased between 1940 and 2000 and contributed to some (–) 5% of GDP change. The 1980s were solely responsible for this negative contribution.

We conclude that the 1990s experience was, despite slower GDP growth than historically observed, characterised by productivity gains that represented a complete reversal of the record of the 1980s. Taking into

account the economy's low growth performance due to external shocks during the second half of the 1990s, the productivity record can be considered very positive, especially considering that: (i) productivity growth resumed; and (ii) employment levels were not sacrificed to the extent believed so far.

2. Manufacturing labour productivity change: the long and medium terms

This section investigates the performance of labour productivity in the manufacturing sector, because data for the manufacturing industries are more easily available, frequent and have better quality than for the remaining sectors of the economy ¹². Moreover, it is a key indicator variable because the manufacturing industries are the main *loci* of productivity change ¹³. Table 4 introduces the subject by presenting average results for 5-year periods taken from the Economic Manufacturing Censuses since 1949 ¹⁴.

Table 4: Brazil – Productivity growth rates in the manufacturing industries, selected periods ¹⁵

(% per year)	
Periods	% per year
1949-1959	5.84
1959-1970	3.31
1970-1975	2.80
1975-1980	1.94
1980-1985	-2.83
1985-1990	-0.68
1990-1995	7.19
1995-2000	8.31
1949-2000	3.45

It is somewhat surprising to find out that labour productivity growth rates have decreased over all decades and 5-year time spans from the late

¹¹ One often cited feature of Brazilian labour market performance in the 1990s has been the rise in unemployment over the decade – albeit with fluctuations.

¹² Census figures for Agriculture also reveal the existence of substantial productivity gains in the Primary sector since 1970. See, for instance, Bonelli and Fonseca (1998).

¹³ This has been typically the case until the 1990s. From mid-1990s onwards the activities associated with Information Technology have received considerable attention due to the (presumably) very high productivity growth rates associated with their diffusion. See, for instance, Gordon (2000) and Oliner and Sichel (2000).

¹⁴ Information from the Economic Censuses differ from those of the Demographic Censuses in that the former investigate the establishments and plants, while the latter are based on questionnaires obtained from the households – i.e., the respondents are not the firms (administrative returns), but the head of each household.

1940s to 1990. Indeed, they even became negative in 1980-1985¹⁵. After 1985 the trend of (on average) negative labour productivity growth rates continued: productivity decreased by – 0.68% yearly between 1985 and 1990.

However, there is a marked change when we move into the 1990s, as Table 4 clearly shows. Note that the long-term average of 3.45% yearly was only exceeded in the 1950s and in the 1990s. It is worthwhile going into more detail to examine this most recent period.

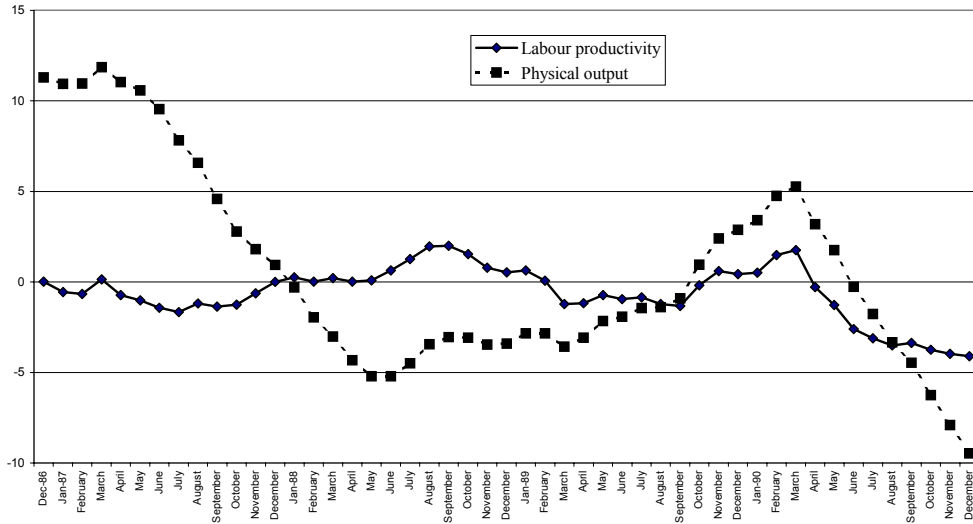
Graph 1, summarizes productivity trends in manufacturing on a year on year basis for the period December 1986 to December 1990. It can be clearly seen that, despite very high output growth in the mid-1980s, labour productivity growth was nearly nil: it actually fluctuated around zero during most of the 1986-90 period. Indeed, at the end of this particular period productivity was evolving at a negative rate of almost 5% per year as a result of a failed stabilization attempt in President Collor's inauguration year, when aggregate output contracted very sharply: – 10% for manufacturing in December 1990.

Other years registering severe output contractions were: (i) mid to late 1992, as Collor's Plan II went into effect; (ii) and in the first half of 1995, as a result of measures taken to defend the new currency (the Real) in the wake of the Mexican crisis.

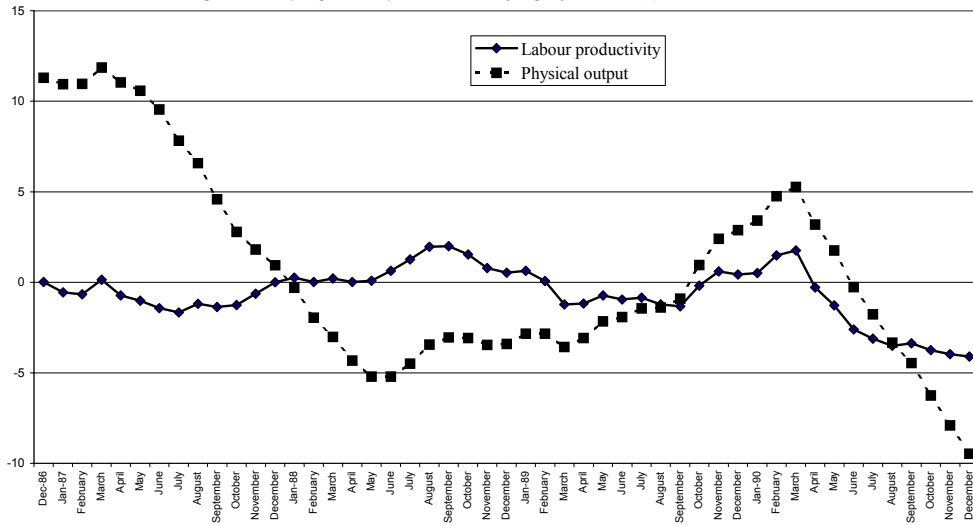
¹⁵ Sources for the table: IBGE. Up to 1985 – Economic Census; from 1985 to 2000 – Monthly Industrial Researches (PIM-PF and PIM-DG).

¹⁶ But this may be at least partly due to the fact that the 1985 Economic Census had a degree of coverage higher than the previous one (1980), in the sense that it included activities not investigated before.

Graph 1: Year on year productivity and manufacturing output growth rates (%), Dec. 1986 to Dec. 1990

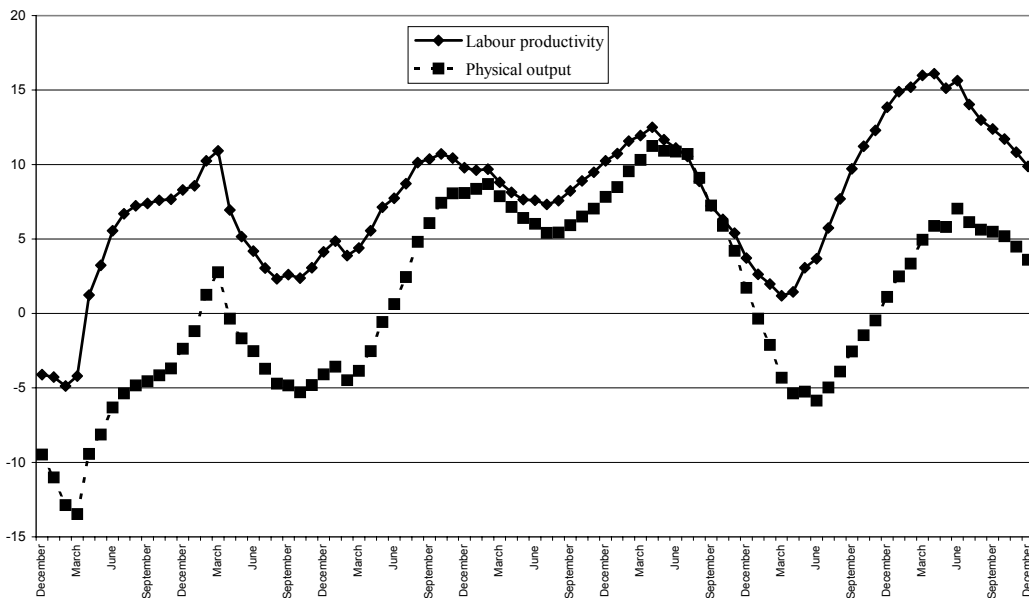


Graph 1: Year on year productivity and manufacturing output growth rates (%), Dec. 1986 to Dec. 1990



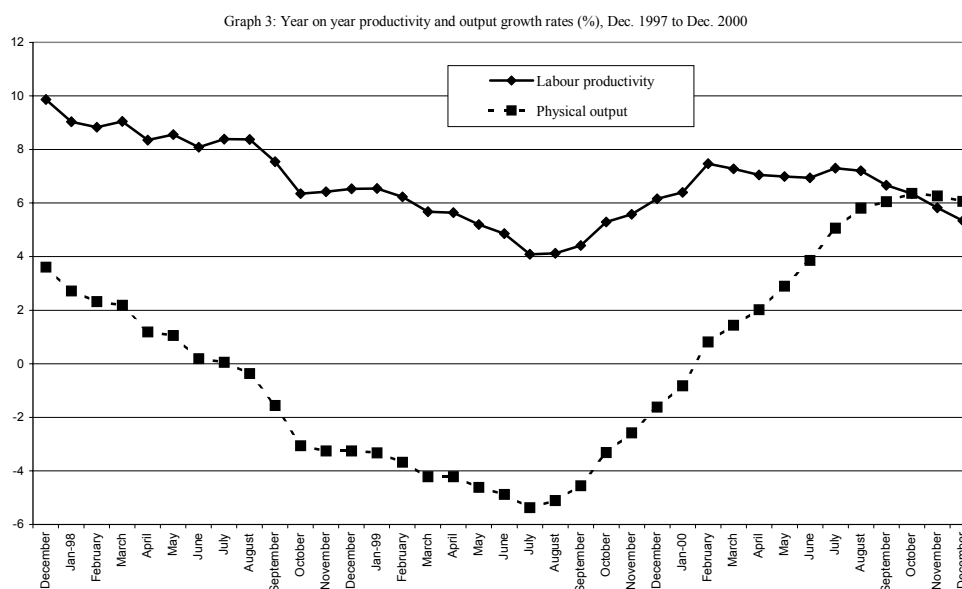
Graph 2 registers the same variables as Graph 1, but for the period December 1990 to December 1997.

Graph 2: Year on year % growth rates, productivity and manufacturing output - Dec. 1990, Dec. 1997



Labour productivity attained very high growth rates during most of the period shown in Graph 2, especially in mid 1997, when it grew at a little over 15% on a yearly basis. However, at this point, GDP and manufacturing activity started to fall as the effects of the Asian crisis hit Brazil and sharp interest rate increases became necessary to defend the Real with the expected negative impact on the aggregate level of economic activity ¹⁷.

Productivity continued to grow at very high rates after the Asian crisis, although the overall trend from that date onward has been a clearly decreasing one. Graph 3 documents this aspect from late 1997 to late 2000, showing a disturbing picture of slowing labour productivity gains in the latter part of the period. The severe output swing observed in the middle of this last period was one of the results of the exchange rate devaluation of early 1999, which initially caused a strong contraction in the level of economic activity followed by a very fast recovery from mid-1999 onwards, as manufacturing activity growth reached nearly 6% per year in late 2000, after having been of – 6% yearly only 18 months earlier ¹⁸.



Note also that after the turn of the decade productivity tends to move in line with output – something that clearly did not happen in the second half of

¹⁷ The pattern for individual industries is not the same as the sector total's, of course. We will not go into a detailed analysis here. The reader is referred to Appendix 3, where we show the information on patterns of productivity change from the mid-1980s to 2000 for all individual industries. It is apparent from the graphs shown in Appendix 2 that, except for a few industries, the growth patterns are similar.

the 1980s, as Graph 1 amply demonstrates. In particular, the results for the end of 2000 show that employment levels in manufacturing began to recover for the first time in a long time ¹⁹.

Figures on which the above results are based have been subject to criticism on many grounds, among them: (i) the surveys upon which they are based do not properly take into account increasing outsourcing (procurement of materials, parts and services from other firms – instead of intra-firm procurement – or de-virtualisation of production at the firm level) that took place during the first half of the 1990s and affected many manufacturing industries performance in a presumably strong way; (ii) the productivity data are obtained as the quotient of output and employment series which come from different samples ²⁰; (iii) a proper measure of labour inputs should be constructed in terms of the number of hours actually worked, and not on employment levels; (iv) the monthly survey samples investigate the productive performance of firms at the plant level by investigating physical output, or gross production, not value added. Therefore, if an increasing amount of raw materials, parts and components is imported, instead of being domestically produced, the “physical output productivity” measure will result in a (upward) biased measure of productivity growth ²¹. This is especially likely to happen during periods of import liberalization, as Brazil experienced in the first half of the 1990s ²².

These objections can be answered as follows:

(i) The “outsourcing” issue: it is certainly true, as many reports from the specialised press showed at the time, that substantial outsourcing (from domestic sources) occurred, especially during the first half of the 1990s. But: (a) most outsourcing occurred in services related to manufacturing activities (administration and accounting, security, catering, maintenance, cleaning,

¹⁸ Preliminary information for the period after December 2000 suggests that labour productivity growth rates in the Brazilian manufacturing sector continued to slow down in 2001.

¹⁹ Employment increases if the output growth curve is above the productivity growth curve, otherwise it decreases.

²⁰ In particular, the output series come from “intentional samples” which investigate the largest producers in each manufacturing industry in a way such that the firms are chosen for inclusion in the samples so as to represent a sizeable proportion of total output in a base year. The employment series come from “stratified samples” that are constructed to represent the behaviour of plants of all sizes. These criteria are adopted to take into account the fact that output is much more concentrated in the large plants than employment. Therefore, a representative figure for employment in manufacturing should take into proper account the performance of large as well as medium and small firms.

²¹ This may be seen as a variant of (i): it is also due to outsourcing.

²² See, for instance, the pioneering figures and analysis of Moreira and Corrêa (1998). More on this below.

etc), and not in the industrial processes themselves; and (b) the industrial surveys explicitly investigate employment in production activities. Therefore, the available figures should, in principle, be representative of real labour inputs used in production.

(ii) The “conceptual sample bias” issue: little can be said on that. The output series have been accepted as being of better quality than the employment series because it is easier to keep track of the output of large firms than to investigate the performance of a large number of small and medium firms. Furthermore, it is a fact that small and medium size firms have exit rates well above large firms, and it is not clear if the former are properly replaced in the employment samples that originate the series²³. Therefore, it is likely that the resulting productivity growth rates are overstated.

(iii) The “head count *versus* hours worked” issue: our defence for using employment in production instead of hours worked is two-fold: first, the head count is less subject to reporting errors than the alternative concept; second, the measures make little difference when longer time spans are considered. Of course, in examining short term results the hours worked concept is clearly more precise and, thus, superior. But in the medium to long term the fluctuations in the duration of working time matter little.

(iv) The “physical output *versus* value added” issue: this is, clearly, one of the most serious objections for using the usual physical output (gross production) series, particularly in the first half of the 1990s. Unfortunately, there are no easily available long term value added (VA) and comparable employment data at the sector level.

Recent Brazilian National Accounts estimates investigate real VA per occupied person in 42 sectors that cover the whole economy. Most of these sectors belong to the manufacturing industries²⁴. Although the results have to be considered with caution, they provide a more complete picture of labour productivity trends in the 1990s than previously available²⁵. The following three sections explore this new set of data.

²³ An indirect indication that this has been the case is that IBGE has recently re-designed its short-term surveys on employment, wages and related data based on a new selection of firms.

²⁴ See IBGE (2000, 2002). The data presumably include both formal and informal occupation.

²⁵ Note that the results are still preliminary. A number of empirical inconsistencies appeared when we analysed yearly figures from these series, particularly in the mid to late 1990s. Therefore, we preferred to work only with

3. A broader picture of the economy in the 1990s

Table 5 presents data on labour productivity growth rates from 42 economic sectors between 1990 and 2000 in average percent per year ²⁶, divided into three groups of sectors: high, low and negative productivity growth, using the simple mean as a dividing line. A number of observations can be drawn from these results.

1. Total average labour productivity measured in VA per worker grew at 1.53% yearly from 1990 to 2000, a figure smaller than GDP per occupied person shown in Table 1 — which was 1.8% yearly from 1991 to 2000 ²⁷. But there was a sizeable variation of productivity growth rates across individual industrial sectors, around the average of 3.49% ²⁸.

Table 5: Labour productivity growth rates, 1990-2000

17 High productivity growth > 3.50% p.a.	% per year	19 Low productivity growth 0 < p < 3.0 % p.a.	% per year	6 negative productivity growth p < 0 % p.a.	% per year
Communications	10.62	Paper and printing & publishing	3.18	Commerce	-0.07
Steel	9.84	Real estate	3.12	Services to firms	-0.10
Public utilities	9.50	Agriculture	3.01	Services to families	-0.45
Oil refining & petrochemicals	9.23	Metal products	2.65	Clothing and accessories	-0.82
Electric equipment	8.62	Other food & beverages	2.52	Plastics (transformation)	-1.03
Cars, trucks, buses	8.31	Other ind vegetal & tobacco	2.39	Private non profit services	-1.81
Oil refining, domestic use	7.61	Coffee	2.07		
Rubber products	7.06	Financial institutions	2.03		
Non ferrous metals	6.82	Textiles	1.75		
Other vehicles	6.12	Pharmaceuticals, cleansing	1.72		
Mineral extraction (non-oil)	5.28	Public administration	1.57		
Chemicals, non petrochemicals	5.23	Miscellaneous	1.57		
Miscellaneous (chemicals)	4.80	Milk and dairy products	1.57		
Extract min: oil, gas, coal, fuels	4.75	Wood and furniture	1.31		
Machinery and tractors	4.67	Construction	1.26		
Electronic equipment	4.36	Sugar refining	1.18		
Non metallic minerals	3.85	Transportation	0.80		
		Prepared meats	0.34	Simple Average	3.49
		Footwear and leather	0.17	Weighted Average	1.53

2. Defining as high productivity growth sectors (HPGS) all those characterised by above average PG, we observe that of the 17 HPGS in Table 5, no less than 15 belong to manufacturing industries, although the

data for the series' initial year (1990) – when these inconsistencies did not seem to be great – to the last year available (2000) – when recent revisions imply better results than for the years in the middle of the decade.

²⁶ Unfortunately, it is not possible to breakdown the period into sub-periods with different economic policy characteristics: the revisions made so far cover only the years 1998 to 2000.

²⁷ The difference is due to the fact that Table 1 figures are based on GDP at market prices, while Table 5 is based on VA at “basic prices of the previous year”, a concept similar to VA at factor cost. Note that these results differ from those in Table 2, which, as noted, use the new occupation data from the Advanced Tables of the 2000 Demographic Census.

²⁸ The fact that the simple average (3.49%) is greater than the weighted average (1.53%) indicates that some of the slow productivity growth sectors are responsible for a sizeable proportion of total employment. These results will be fully explored below.

leading and third sectors are non-manufacturing: Communications and Public Utilities. The top few sectors were all characterized by substantial privatisation of assets in the 1990s (this includes, in addition to Communications and Public Utilities, Steel in second place and Petrochemicals in fourth).

Thus, it seems safe to conclude that HPG and privatisation were concomitant. Although it is tempting to conclude that privatisation “caused” HPG, one needs to exercise more caution: in at least two cases (Communications and Public Utilities), output growth had been occurring at very rapid rates for some time before privatisation began, but it is not clear if the same happened to productivity growth.

3. Table 5 shows that there were nineteen low – albeit positive – productivity growth sectors (LPGS) in the 1990s, among which it is worth mentioning that: (i) Real Estate is not a “productive” sector — its “output” are rents (paid and imputed) and the corresponding employment is given by the number of employees in real estate agencies and related activities; (ii) Agriculture saw very rapid productivity growth in the decade; this agrees with previous trends which show the primary sector as one characterised by still very low but rapidly increasing productivity levels ²⁹; (iii) the productivity of Public Administration is crudely estimated; (iv) eleven of the remaining fourteen LPGS, belong to the manufacturing sector — the other three are Financial Services, Construction and Transportation. Note that slow productivity change in Financial Services occurred despite privatisation of local (state) banks and the entry of foreign banks during the decade ³⁰. Privatisation of the railway system, in the same vein, was not enough to increase the productivity of the Transportation sector as a whole.

4. Negative productivity change occurred in six sectors, four of which relate to Services ³¹, creating an additional problem because sizeable proportions of total occupation are concentrated in these sectors. The following table presents the employment levels and employment structure in

²⁹ See, for instance, Bonelli and Fonseca (1998).

³⁰ One possible explanation for low average productivity growth in this case rests on the fact that after the implementation of the Real Stabilization Plan the banking sector could not rely on inflationary earnings and gains as it did before, despite the 30% reduction in employment (Table 6).

³¹ Actually, in Commerce and Services to Firms the average growth rate was nearly nil.

1990 and in 2000. Note that some of these sectors also possess low absolute productivity levels.

Table 6 shows that changes in the structure of employment were particularly unfavourable to manufacturing, public utilities, mining and financial institutions. The loss in agriculture was expected, given the sector's modernisation and implementation of technological advances in the course of the decade. Thus, table 6 amply demonstrates that almost all of the structural employment gains were accrued by the Services and Commerce sector.

Table 6: Levels and Structure of Employment

	1990	2000	1990	2000
Sectors	(1000s)	(1000s)	(%)	(%)
Agriculture and animal production	14,911.4	14,886.6	25.46	23.04
Mineral extraction	335.3	236.7	0.57	0.37
Manufacturing industries	9,079.5	7,978.4	15.50	12.35
Public utilities	324.0	204.7	0.55	0.32
Construction industry	3936.0	4,075.3	6.72	6.31
Commerce	7619.2	9,759.7	13.01	15.10
Transportation	2087.3	2,473.8	3.56	3.83
Communications	174.2	213.8	0.30	0.33
Financial institutions	1,005.9	711.3	1.72	1.10
Real estate	313.4	296.9	0.54	0.46
Public administration	5713.8	5,672.5	9.76	8.78
Services	13,070.8	18,107.6	22.32	28.02
Sum	58,570.8	64,617.3	100.00	100.00

Sources: Same as Table 5.

We next perform an exercise to decompose total labour productivity change into two factors to separate out the effect of changes in the structure of employment from changes due to pure productivity increases.

Let $Y[t]/N[t] - Y[0]/N[0]$ be the total productivity change between time periods 0 and t (1990 and 2000), where Y and N are output and employment.

Total productivity change can also be written as

$$\sum a[i,t].P[i,t] - \sum a[i,0].P[i,0] \quad (1)$$

Where

$a[i,0]$ and $a[i,t]$ are sector (i) employment shares in times 0 and t

$P[i,0]$ and $P[i,t]$ are sector (i) productivity levels in 0 and t in constant prices

The difference (1) can also be written, after some algebraic manipulation, as the sum of two parts:

$$\Sigma P[i,t].(a[i,t] - a[i,0]) \tag{2}$$

and

$$\Sigma a[i,0].(P[i,t] - P[i,0])$$

The first term (2) above can be called the structural effect: it can be interpreted as the productivity change that would take place if productivity levels remained constant at end-period levels and all change were due to relative reduction of employment in low productivity sectors and increase in high productivity sectors. The second term can be called the technological effect: it measures the productivity change that would take place if employment shares remained constant at the beginning-of-the-period levels and all change were due to productivity deepening, or sector productivity increases.

Applying the above expressions to productivity levels and employment structures of the 42 sectors in the economy yields the results shown in Table 7.

Table 7: Decomposition of aggregate productivity change, 1990-2000 (%)

Structural change effect	-139.8
Technological change effect	239.8
Total	100.0

The decomposition results show that the structural effect was highly negative (-140%). Therefore, all observed labour productivity gain in the 1990s came from the technological effect, or productivity deepening (+240%). In other words, labour shifted in the 1990s primarily towards low productivity sectors (Services and Commerce, as we saw above) and away from high productivity ones (mostly Mining, Manufacturing and Public Utilities; especially away from Manufacturing, due to its employment levels). The only high productivity sector that benefited from positive labour shifts was Communications. On the other hand, low productivity sectors such as Agriculture and Construction made a positive contribution to overall productivity change because their employment shares decreased between 1990 and 2000. In addition, productivity growth was concentrated in sectors with low employment levels with the exception of agriculture.

This last point naturally leads to the issue of convergence of sector productivity levels over time: has convergence occurred in Brazil in the 1990s? Although no one would expect that productivity levels in all sectors converged to a common level, it is desirable that some convergence occurs, so that low productivity sectors progressively close the gap relative to the higher productivity ones.

This issue can be approached in different ways, for instance, by examining the evolution of ratios of productivity levels between pairs of sectors over time. Table 8 shows the ratios of the six highest productivity level sectors to the lowest six in 1990 and 2000 ³².

Table 8: Ratio of six highest to six lowest productivity levels, 1990 and 2000

Pairs of sectors	1990	2000
1 Oil refining and petrochemicals <i>versus</i> Private non profit services	113	327
2 Extractive minerals: oil, gas, coal, fuels <i>versus</i> Clothing and accessories	113	195
3 Chemicals, non petrochemicals <i>versus</i> Agriculture and animal production	27	33
4 Public utilities <i>versus</i> Services to families	12	31
5 Communications <i>versus</i> Footwear and leather products	10	26
6 Steel <i>versus</i> Commerce	8	21

The above comparisons reveal that, as far as the highest and lowest productivity sectors are concerned, there was no convergence of productivity levels during the 1990s. Quite the contrary, productivity gaps widened over time by a ratio of approximately 2.5 times for most sectors shown in the table (except for the third comparison, due to Agriculture's favourable labour productivity performance).

A more complete and formal test of the convergence hypothesis can be performed by running a regression of productivity growth rates from 1990 to 2000 on productivity levels in the initial year (1990). If productivity levels converged, one would expect an estimated negative coefficient for the independent variable (1990 productivity level) in case of divergence we would expect a positive coefficient. See the estimated regression results below.

OLS regression

Dependent variable: productivity growth rates, average 1990-2000

Independent variable: productivity level in 1990

Number of observations: 42

$R^2 = 0.078$

Estimated coefficients (t-values in parenthesis):

Constant = 2.848 (4.95)

Prod. Level = 0.136 (2.11)

Both the small magnitude of the correlation coefficient and the sign of the estimated independent variable coefficient allow us to reject the convergence hypothesis for the time period under consideration. There was no convergence of productivity levels for the whole data sample. In fact, the opposite is closer to the truth, as suggested by the increasing ratios between high and low productivity sectors over the decade shown above. Note that the estimated regression coefficient has a sign that is the opposite of the expected by the convergence hypothesis and is significantly different from zero at the 5% level of confidence – implying that some “divergence” took place among at least a sub-group of sectors. As seen, it characterized at least the highest *vis a vis* the lowest productivity level sectors.

4. Who benefited from the differentiated productivity gains in the 1990s?

The following analysis considers how productivity gains may benefit a number of social groups, including: (1) consumers (or buyers of a sector’s output, in general); (2) workers in each sector, via rising real wages; (3) firms, via increased shares of profits in sector income or Value Added.

4.1. Consumers are the main beneficiaries of productivity increases if the gains are reflected in lower relative prices for the sector’s output. A regression of productivity growth on relative prices³³ was run to test if this was the case during the 1990s. The answer was no. That is, there is no observed correlation, or general association, between relative price changes and productivity gains between 1990 and 2000 (regression results below).

³² We omitted from the comparisons the Real State sector, the highest labour productivity among all, for reasons already discussed.

³³ The index of sector relative prices for the decade is given by the accumulated ratios of yearly relative sector prices. These last series are obtained by dividing each sector’s deflator by the overall price deflator.

Note, besides, that the estimated coefficient is positive, contrary to the expected hypothesis – but not significantly different from zero.

<p><u>OLS regression</u> Dependent variable: productivity growth rate, average 1990-2000 Independent variable: 2000 relative price index (1990 = 1) Number of observations: 42 $R^2 = 0.022$ Estimated coefficients (t-values in parenthesis): Constant = - 6.19 (0.78) Relative prices = 0.553 (0.33)</p>
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However, if we break the sample into sub-groups, we note that a negative relationship holds in the case of a number of sectors. This was particularly the case for the nine sectors listed below:

Table 10: Relative prices and productivity High p growth, decrease relative prices (9)	2000 Relative prices	Productivity growth % per year
	1990 = 1	1990-2000
Agriculture and animal production	0.909	3.01
Mineral extraction (non-oil)	0.715	5.28
Non metallic minerals	0.810	3.85
Non ferrous metals	0.684	6.82
Electric equipment	0.439	8.62
Electronic equipment	0.740	4.36
Other vehicles	0.734	6.12
Rubber products	0.772	7.06
Miscellaneous (Chemicals)	0.647	4.80

In a few cases, very high productivity growth was accompanied by unchanged relative prices, as reported in Table 11:

Table 11: Relative prices and productivity High p, unchanged relative prices (3)	2000 Relative prices	Productivity growth % per year
	1990 = 1	1990-2000
Cars, trucks, buses	1.033	8.31
Oil refining for domestic use	1.008	7.61
Communications	1.013	10.62

But for another group of sectors the opposite occurred: high productivity growth rates were accompanied by increases in relative prices, defined as positive changes in excess of 8%. This was the case in the following sectors:

Table 12: Relative prices and productivity	2000 Relative prices	Productivity growth %
High p, increase relative prices (7)	1990 = 1	per year
		1990-2000
Extractive minerals: oil, gas, coal, fuels	1.382	4.75
Steel	1.087	9.84
Machinery and tractors	1.087	4.67
Paper and printing & publishing	1.222	3.18
Chemicals, non petrochemicals	1.525	5.23
Oil refining and petrochemicals	1.127	9.23
Public utilities	1.082	9.50

This behavior may be explained by market power in the hands of the incumbent leading firms due to increased concentration of production in a small number of firms, which may lead to oligopolistic pricing. But in some cases it may also reflect the influence of international prices and of the exchange rate.

Note that most of the other sectors, with the exception of those in Tables 10 to 12, had low rates of productivity growth in the 1990s. Their performance in terms of price movements shows no consistent pattern and does not allow us to make any firm conclusions on the association between productivity and price movements.

Thus, consumers were the main beneficiaries of productivity growth in only a small number of cases. Several qualifications and explanations are needed in order to explain the behavior of the remaining sectors, including the role of demand shifts — which may have been substantial over a ten-year period.

4.2. The sectors' workers are the main beneficiaries of productivity change if their average real earnings rise faster than productivity. This hypothesis can be tested by comparing productivity change with the evolution of real wages and/or product wages³⁴. Different patterns emerge, depending on which of these two wage concepts is adopted for the comparison. In the case of the former, real average wage³⁵ increases were observed in five sectors only in the 1990s (see Table 13). Noteworthy among them is the

³⁴ As in the previous case, no association was found when running a regression of productivity change on either real wages or product wages.

³⁵ Real wages are defined as nominal wages deflated by the overall consumer price index, or by the GDP implicit deflator, a proxy for the former. We adopted this option here.

Communications sector, with a 58% real wage increase between 1990 and 2000. The three first sectors in the table were also characterized by very high rates of productivity change, as already shown. Public Administration, as mentioned, is a peculiar case in terms of productivity measurement.

Table 13: Real wage gains, 1990-2000	% Change
Cars, trucks, buses	6.9
Public utilities	7.3
Communications	57.6
Real estate	15.7
Public administration	7.7

In four other cases, the real wage in 2000 was essentially unchanged from the 1990 level, that is, the relative percent change was between – or + 5% (see Table 14). Note that only one sector in the table displayed high rates of productivity change over the decade (Other vehicles: + 6.1% per year), the remaining were characterized by average (Agriculture) or mediocre results.

Table 14: Real wage gains, 1990-2000	% Change
Agriculture and animal production	-3.1
Other vehicles	-2.9
Pharmaceuticals and cleansing products	4.9
Financial institutions	3.4

In the remaining 33 sectors, the real wage in 2000 was below its 1990 level. On average, the estimated decrease reached an accumulated 24% in the decade, with extreme values ranging from – 8% (Non metallic minerals) to – 41% (Footwear and leather).

A slightly different picture emerges when product wages are examined³⁶. The following table summarizes the evidence for fourteen sectors in which product wages either increased or, at a minimum, did not fall between the beginning and the end of the 1990s³⁷. No clear relationship appears as far as wage and productivity gains are concerned. Note also that the sectors in Table 15 are not the same as in the previous ones (Tables 13 and 14), due to

³⁶ Product wages are nominal wages deflated by own-sector price indices. They differ from real wages in that these, being deflated by cost of living indices, measure changes in welfare while the former reflects costs to the firms.

³⁷ Decrease meaning a greater than 5% negative change.

differentiated relative price changes, which generated different real and product wage changes.

Table 15: Product wage change, 1990-2000

	% Change
Agriculture and animal production	6.7
Mineral extraction (non-oil)	4.5 *
Non metallic minerals	13.3 *
Non ferrous metals	-4.5 *
Metal products	-1.9
Electric equipment	60.6 *
Wood and furniture	-2.3
Rubber products	-0.9 *
Miscellaneous (chemicals)	27.0 *
Plastics (transformation)	10.9
Textiles	31.5
Clothing and accessories	-2.0
Commerce	8.6
Transportation	10.1

* above average productivity growth

It seems safe to conclude, therefore, that, as far as wage behavior is concerned, there is no clear-cut answer to the question of who benefited from productivity growth in the 1990s.

4.3. The incumbent firms in a given sector are the main beneficiaries of productivity change if the profits to VA ratio increase over time, that is, if the functional distribution of income changes in favour of profits and against labour compensation.

Again, running a regression of productivity growth rates on profit ratios (or their complement, the labour compensation ratios) change can provide a test for this hypothesis. The regression results (not shown here) show no association. Note that, since VA is divided into either employment compensation or gross profits, this hypothesis is identical to the previous one when product wages were considered as the wage indicator. In other words, either employees were the beneficiaries of productivity growth via higher earnings or firms were the main beneficiaries via increased profits to sector income ratios and decreased product-wages.

Table 16 shows the basic 1990 and 2000 data for the 20 sectors in which the labour share in value added decreased. Note that there is some

relationship between labour/VA change (decreases) and productivity growth in a number of sectors: eleven sectors in the table had above average productivity growth (see Table 5). The incumbent firms were, therefore, the main beneficiaries of higher than average productivity growth. This was the case of Mineral Extraction (oil), Steel, Non ferrous metals, Machinery and tractors, Electronic equipment, Cars, trucks and buses, Rubber products, Chemicals (non-petrochemicals), Oil refining and petrochemicals, Oil refining for domestic use, and Public utilities.

But, note also, that in some cases, the productivity performance was good and the labour share increased during the decade (table 17), indicating that some firms did not benefit from productivity increases in terms of increasing profit shares. This was the case in 6 of the 22 sectors in Table 17: Extractive minerals (oil, etc), Non metallic minerals, Electric equipment, Other vehicles, Miscellaneous (chemicals), and Communications.

Overall, the hypothesis holds true for 11 out of 20 sectors (increased profits share with high productivity growth, indicating that firm profits were the main beneficiaries of productivity growth), but it does not hold in six out of 22 cases (where there were decreased profits shares with high productivity growth).

It is safe to conclude that although no definitive answer could be given, in a number of cases the hypothesis that firms were the main beneficiaries of fast productivity change has proven true. There are many other sectors, however, in which this was not the case: either profits increased but productivity didn't (9 out of 20) or profits decreased but productivity increased quickly (6 out of 22 cases).

Table 16: Decreased labour shares (20 sectors)	Labour compensation on total remuneration	
	1990	2000
Agriculture and animal production	0.183	0.155
Mineral extraction (non-oil)	0.501	0.399
Steel	0.252	0.102
Non ferrous metals	0.229	0.168
Metal products	0.752	0.705

Machinery and tractors	0.448	0.272
Electronic equipment	0.288	0.255
Cars, trucks, buses	0.383	0.255
Pulp, paper and printing & publishing	0.604	0.398
Rubber products	0.325	0.253
Chemicals, non petrochemicals	0.292	0.112
Oil refining and petrochemicals	0.145	0.092
Footwear and leather products	0.691	0.669
Sugar refining	0.423	0.337
Oil refining for domestic use	0.226	0.146
Other food products and beverages	0.514	0.425
Miscellaneous	0.369	0.329
Public utilities	0.556	0.333
Construction industry	0.391	0.197
Real estate	0.056	0.025
TOTAL	0.616	0.515

Table 17: Increased or constant labour shares (22 sectors)	Labour compensation on total remuneration	
	1990	2000
Extractive minerals: oil, gas, coal, fuels	0.114	0.099
Non metallic minerals	0.350	0.370
Electric equipment	0.456	0.489
Other vehicles	0.291	0.497
Wood and furniture	0.574	0.593
Miscellaneous (chemicals)	0.410	0.424
Pharmaceuticals and cleansing products	0.287	0.282
Plastics (transformation)	0.364	0.644
Textiles	0.269	0.506
Clothing and accessories	0.772	0.931
Coffee	0.333	0.166
Other industrialized vegetal, inc. tobacco	0.352	0.351
Prepared meats	0.426	0.587
Milk and dairy products	0.277	0.280
Commerce	0.633	0.813
Transportation	0.700	0.884
Communications	0.504	0.329
Financial institutions	0.351	0.706
Services to families	0.872	0.947
Services to firms	0.630	0.672
Public administration	1.000	1.000
Private non profit services	0.981	1.000

5. What is the relationship between productivity change and import liberalization?

The issue of productivity change and import liberalisation is an important one, because the accepted view on the subject is that one of the main causes of, or motivations for, Brazilian productivity change in the 1990s was the import liberalisation process that began in the late 1980s and accelerated in the first half of the 1990s. The underlying (admittedly simple) model is one in which under the threat of increasing imports, firms are forced to react to decreased market shares by raising productivity.

Among the many desirable outcomes of liberalisation processes³⁸, the positive impact of import liberalisation on productivity growth was not only due to direct effects on product markets in terms of increased competition from goods produced abroad, which forced the domestic firms to increase productivity so as to compete, but also due to the higher quality of increasingly imported raw materials, parts and components made available by liberalization. It may also be the case that import competition forces the least productive firms out of business. The exit of low productivity firms has the effect of increasing the productivity of the remaining ones³⁹.

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 a direct test of the hypotheses.

It seems clear that only sectors producing tradeables should be considered in testing for the influence of trade liberalisation on productivity change. This means that we should exclude all non-tradeables from the analysis: Services, Communications, Construction, Public Utilities, Commerce, Transportation, Government, Real Estate, and Financial Intermediaries. Thus, the following analysis only considers 31 sectors⁴⁰.

³⁸ This issue has been tackled by, among others, Hay (1997), Rossi and Ferreira (1999), Muendler (2001) and Lisboa et alii (2002). Except for Rossi and Ferreira, all the other authors rely on micro data (at the firm level) to test to what extent the increased use of imported material in production led to productivity increases. The answers are positive in all studies cited, but emphasize different aspects of increased imported inputs use.

³⁹ This point was explored in detail by Muendler (2001).

⁴⁰ The reader is referred to Appendix 2 for the list of sectors considered and trade related selected indicators.

The regression analysis chose the vector of productivity growth rates between 1990 and 2000 as dependent variable, as has been documented above and explored in this paper. A number of possibilities were considered for the independent variables ⁴¹:

- The absolute and relative changes in the level of effective protection between the late 1980s and the late 1990s
- The absolute and relative changes in the level of nominal protection between the late 1980s and the late 1990s
- The level of protection (nominal or effective) in the final year
- Import penetration ratios and their rates of change

In all cases, no association was found between productivity growth and indicators of trade liberalisation and/or import penetration ratios and their respective rates of change. This came as a surprise and deserves closer scrutiny, since Rossi and Ferreira's (1999) pioneering study established that there was a close (negative) association between productivity growth ⁴² and changes in import tariff protection at the two-digit level of aggregation for 18 manufacturing industries.

Initially, we divided the 31 tradeables producing sectors into different groups according to the degree of import penetration and their change over time ⁴³. We were able to identify 6 different groups, which will be analysed next according to the import to total supply behaviour displayed during the 1990s.

The first group of sectors was characterized by little change over time in the (generally low) import coefficients. All the sectors included in this group were close to the primary economic base. Unsurprisingly, import penetration ratios remained small and showed little change over time for sectors such as coffee, sugar, other industrialized vegetables (tobacco, mainly) and prepared meats – all sectors in which Brazil is believed to have a comparative

⁴¹ Except for the fourth group, all the other information came from Kume, Piani and Braz de Souza (2000).

⁴² Their measure of labour productivity is the same as the one examined in section 3 and shown in Appendix 2. Their measure of import protection is similar to ours (see Appendix 3). As noted, the productivity indicator adopted in this section is VA per occupied person.

⁴³ Import penetration is defined as the ratio of imports to imports plus domestic production. Data come from the Brazilian System of National Accounts.

advantage in international markets. In all these cases productivity growth was very small.

The exception in this first group is the mineral sector, also one in which Brazil has a natural comparative advantage (iron ore and manganese extraction, for instance). Agriculture's productivity performance was favorable and near the simple average for all sectors (3.5%). But, in essence, this first group presented no surprises: import competition was weak, as expected, due to low import penetration ratios. There was no actual threat from imports to justify or induce better productivity performance.

Table 18: Import penetration and productivity change

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
Low import coefficients, little change					
Agriculture and animal production	3.5	2.9	2.7	2.7	3.0
Mineral extraction (non-oil)	6.6	6.4	6.8	8.1	5.3
Coffee	0.0	0.0	0.0	0.0	2.1
Other industrialized vegetables, inc. tobacco	2.5	3.9	3.8	3.1	2.4
Prepared meats	2.6	1.2	1.5	0.9	0.3
Sugar refining	0.0	0.2	0.1	0.1	1.2

The second group includes sectors in which the import coefficients were low in the beginning of the decade, when import liberalization began, and increased as the decade progressed. But has this been enough to induce upwards shifts in productivity? Table 19 suggests that this was not necessarily so. In fact, very different outcomes characterize this group.

Table 19: Import penetration and productivity change (cont.)

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
Low import coefficients, some change					
Non metallic minerals	1.3	2.0	3.1	2.9	3.9
Steel	1.8	1.9	2.9	3.1	9.8
Wood and furniture	0.4	0.9	2.4	2.2	1.3
Pulp, paper and printing & publishing	2.5	3.5	6.0	4.9	3.2
Clothing and accessories	0.5	1.4	3.7	2.6	-0.8
Footwear and leather products	3.5	5.4	7.1	6.5	0.2
Milk and dairy products	3.0	4.5	4.5	5.2	1.6
Oil refining for domestic use	1.0	3.4	3.1	2.4	7.6
Other food products and beverages	2.4	2.7	4.6	4.3	2.5

The best performance in terms of productivity change was in Steel (where privatisation was the main driving force behind an extremely high productivity growth rate of 9.8 % yearly over a 10-year time span) and Oil refining for domestic use sectors. In the latter case, Brazil is virtually self-sufficient in all popular types of oils, the increased import penetration being due to special types not-produced domestically. Therefore, in both cases it is not easy to explain good productivity performance on the basis of an imports competition motive.

With the exception of Non metallic minerals (construction materials), all other sectors had meager productivity performance, despite large increases in import penetration ratios. All the same, imports were not sufficiently high to become a real threat to domestic producers, on average, and did not induce fast productivity growth.

The next two cases are one-sector groups. First, take the case of Chemicals (except petrochemicals). It was surprising to find in this case a high, but constant, import penetration ratio alongside a reasonably high rate of productivity change. Since imports increased substantially, this means that rising imports were concomitant to rising domestic production and fast productivity growth. The result seems to indicate a healthy industrial sector, where continued foreign competition was met by rising labour productivity.

Table 20: Import penetration and productivity change (cont.)

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
High import coefficients, little change over time					
Chemicals, non petrochemicals	14.2	14.1	14.1	15.5	5.2

The next group shows an unexpectedly favourable performance: oil and gas extraction is a sector in which the share of imports in total supply decreased markedly during the 1990s, and the incumbent monopolist ⁴⁴ was able to increase productivity at a very fast rate during the decade. Import competition had little to do with this, as long-term plans were in effect to increase domestic production.

⁴⁴ This is not entirely true: there are firms operating in the mineral extraction (coal mining, for instance) that do not belong to the PETROBRÁS group.

Table 21: Import penetration and productivity change (cont.)

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
High import coefficients, import substitution					
Extractive minerals: oil, gas, coal, fuels	49.0	43.9	39.0	21.2	4.8

We next come to the groups of sectors for which import penetration ratios were already above average at the beginning of the decade and increased markedly over time due to trade liberalisation. They were the main sectors to be affected by rising imports. We divided this group into two sub-groups: Metals and the so-called metal-mechanic industries (Table 22)⁴⁵ and the chemicals group of industries (Table 23).

Table 22: Import penetration and productivity change (cont.)

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
High M penetration 1: metals & equipment					
Non ferrous metals	4.7	7.5	10.4	11.3	6.8
Metal products	1.3	2.5	5.5	5.2	2.6
Machinery and tractors	12.6	17.8	27.1	20.4	4.7
Electric equipment	8.9	14.2	19.3	22.8	8.6
Electronic equipment	18.5	35.1	40.0	53.4	4.4
Cars, trucks, buses	0.5	14.2	12.8	11.8	8.3
Other vehicles	9.0	12.8	19.5	24.9	6.1
Miscellaneous	6.8	14.5	21.2	20.2	1.6

Except for the very heterogeneous Miscellaneous and Metal Products sectors, all the remaining faced increased import competition with very fast productivity change. Therefore, they behaved as expected by a priori hypotheses of sector and firm reaction to increased import competition. Note that most sectors in this group are characterized by the presence and leadership of transnational corporations (TNCs).

The results for the chemicals and textiles group are not as clear as for the previous one: only the first three sectors shown in the table below behaved as expected, facing rising import competition via strong productivity growth.

⁴⁵ Electronic equipment and material are usually included in the metal-mechanics group. Note that the Miscellaneous industries in Brazil include precision equipment producers and related industries.

The Pharmaceuticals, cleansing and related products category is a sector dominated by foreign firms which, contrary to the group shown in Table 22, displayed only modest productivity increases. Plastics are a very small and heterogeneous sector: it is difficult to predict what its behaviour should have been, due to the extreme variety of products it produces.

Table 23: Import penetration and productivity change (conclusion)

	Import penetration ratios (M / M + VP)				1990-2000
	1990	1994	1997	2000	p.a. % productivity
High M penetration 2: chemicals group					
Rubber products	4.9	8.0	10.8	11.8	7.1
Oil refining and petrochemicals	3.7	7.1	8.9	9.9	9.2
Miscellaneous (chemicals)	5.9	9.3	11.3	13.9	4.8
Pharmaceuticals, cleansing and related products	7.1	12.0	14.1	18.6	1.7
Plastics (transformation)	2.2	4.8	7.2	8.9	-1.0
Textiles	2.4	7.8	11.7	10.0	1.7

Finally, the domestic textiles sector has been strongly affected by rising imports up to the second half of the decade, but has also been able to withstand competition, displaying modest productivity increases over the decade ⁴⁶.

It seems safe to conclude that 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, ranging from the well known case of import substitution under the aegis of a (monopoly) State firm to cases where increased import penetration in competitive sectors had no apparent impact on productivity change.

6. Conclusion

The long-term analysis conducted in the first part of the paper aimed at providing some historical perspective on the issue of labour productivity change in Brazil ⁴⁷. The main conclusion from this part was that productivity

⁴⁶ Again, it is unfortunate that we cannot split the decade into different sub-periods: this would allow time patterns of productivity change to emerge, showing the response of individual industries to increased competition.

⁴⁷ It is useful to remind the reader that there exist other measures of productivity, besides the labour productivity indicators analysed in the paper. A non-comprehensive list of studies on Brazil that use alternative measures (i. e.,

change has been a major source of GDP growth in Brazil since the 1940s, however, its importance decreased over time, particularly in the 1980s, when productivity change was negative, on average. In the 1990s, despite slow GDP growth, productivity accounted for almost 40% of the observed GDP increase.

We conclude that the 1990s were, despite slower GDP growth than historically registered, characterised by productivity gains that represented a reversal of the record of the 1980s. Therefore, one could claim that one of the “prices paid for stabilization” in the 1990s – as some critics labelled lower than average long term GDP growth during the present government – was not excessive, especially considering that: (i) external shocks hit the economy in the second half of the 1990s; (ii) productivity growth resumed; and (iii) employment levels were not sacrificed to the extent believed so far, although quality of employment has deteriorated.

The second part of the paper concentrated on productivity gains in the manufacturing industries, the main *loci* of productivity change in the economy. In evaluating the period from the late 1940s to the present, we found that labour productivity growth rates decreased over each decade from the late 1940s to 1990. Indeed, they even became negative in 1980-1985.

After 1985, the trend of (on average) negative labour productivity growth rates continued: productivity decreased by – 0.7% yearly between 1985 and 1990. Actually, despite very high output growth in the mid-1980s, labour productivity growth was nearly nil and fluctuated around zero during most of the 1986-90 period. At the end of this period, in President Collor’s inauguration year, productivity evolved at a negative rate of almost 5% per year as a result of a failed stabilisation attempt and aggregate output contracted very sharply.

There is a marked change in the 1990s, when productivity growth attained very high rates. In mid 1997, labour productivity in the manufacturing sector was growing at 15% on a yearly basis. At this point, the effects of the Asian crisis hit Brazil. Productivity continued to grow at very high rates after

total factor productivity) includes: Bonelli (1975), Braga and Rossi (1988), Pinheiro (1989), Abreu and Verner (1997), Bonelli and Fonseca (1998), Gomes (2001), Muendler (2001), Pinheiro (2001) and Bacha and Bonelli (2002).

the Asian crisis, but the overall trend from that date onward is a clearly decreasing one. Even so, the long-term (1949-2000) labour productivity average growth rate of 3.45% was only exceeded in the 1950s and in the 1990s.

The paper then considered criticisms of the available data, especially the fact that manufacturing productivity results were not based on Value Added, but on physical output indicators. Thus, if an increasing amount of raw materials, parts and components is imported, instead of being domestically produced, the “physical output productivity” measure will result in a (upward) biased measure of productivity growth. The same happens when there is outsourcing to the service sector.

This is precisely what happened in Brazil in the 1990s, because of import liberalisation. Unfortunately, there were no easily available long term value added (VA) and comparable employment data at the sectoral level until recently, when Brazilian National Accounts began reporting real VA per occupied person in 42 sectors of the economy. These estimates provide the basis for sections three to five of the paper, which offer a more complete picture of the economy in the 1990s.

Our first finding was that labour productivity grew at 1.53% yearly between 1990 and 2000, although there was a sizeable variation of productivity growth rates in individual sectors, around the simple arithmetic average of 3.49%.

Defining as high productivity growth sectors (HPGS) all those characterised by above average productivity growth, we found that among the 17 HPGS, no less than 15 belonged to manufacturing, although the leading and third sectors were non-manufacturing ones (Communications and Public Utilities). The top four HPGS were all characterized by substantial privatisation of assets in the 1990s. Thus, it seems safe to conclude that HPG and privatisation were concomitant, at the very least.

There were 19 low – albeit positive – productivity growth sectors (LPGS) in the 1990s, among them, no less than 11 belong to the manufacturing sector as well. This shows that manufacturing was almost equally distributed between high and low productivity growth sectors.

Moreover, two manufacturing sectors had negative productivity growth rates in the decade, confirming the extreme heterogeneity of sectoral performance.

Negative productivity change occurred in six sectors, four of which were in Services. This poses a special problem, because not only are sizeable proportions of total occupation concentrated in these sectors, but they also have low absolute productivity levels.

What followed was an exercise to decompose total labour productivity change. It separated overall productivity gains into two factors to reflect: (i) changes in the structure of employment; and (ii) changes due to sector productivity increases. The decomposition results show that the structural effect, due to changes in the structure of employment was highly negative, and that all productivity gains in the 1990s came from productivity increases. This means that labour shifted primarily towards low productivity sectors and away from high productivity ones. This implies that Brazil was not able to benefit in the 1990s from a classical source of productivity growth: the relative labour shifts towards high productivity sectors.

This last point naturally leads to the issue of whether convergence of sector productivity levels occurred over time in Brazil in the 1990s. Although nobody would expect productivity levels in all sectors to converge to a common level, it is desirable that some convergence occurs, so that LPS progressively close the gap relative to HPS.

We approached this issue in two ways. First, by examining what happened between the ratios of productivity levels of selected pairs of sectors among those taken from the extremes of the distribution. It was found that productivity gaps widened over time by a ratio of approximately 2.5 times for five out of the six pairs of sectors compared.

Second, a formal test of the convergence hypothesis was performed by running a regression of productivity growth rates from 1990 to 2000 on productivity levels in the initial year (1990). If productivity levels converged, one would expect an estimated negative coefficient for the independent variable, but the regression results pointed to the opposite direction, with some “divergence” taking place among at least a sub-group of sectors.

Next, we proceeded to identify who benefited from the differentiated productivity gains in the 1990s: (i) consumers; (ii) workers in each sector, via

rising real wages; (iii) firms, via increased shares of profits in sector income. Consumers were the main beneficiaries of productivity increases if the gains were reflected in lower relative prices for the sector's output. A regression of relative prices on productivity growth, run to test if this was the case during the 1990s, indicated a negative result: there was no overall observed correlation between relative price changes and productivity growth. However, the relationship held for a sub-sample of sectors. Thus, in general, consumers were the main beneficiaries of productivity growth in only a small number of cases.

The sectors' workers were the main beneficiaries of productivity change, if their average real earnings rose faster than productivity. This hypothesis, tested by comparing productivity change with the evolution of real wages and/or product wages, came to the conclusion that, as far as wage behavior was concerned, there was no clear-cut answer to the question of who benefited from productivity growth in the 1990s.

The incumbent firms in a given sector were the main beneficiaries of productivity change, if the profits to generated sector income ratio increase over time. Running a regression of productivity growth rates on profit ratios change (or their complement, the labour compensation ratios) provided a direct test for this hypothesis and the regression results show that there was no association. A case-by-case analysis showed that, although no definitive answers could be given, in a number of cases, the hypothesis that firms were the main beneficiaries of fast productivity change has proven true. There are many other sectors, however, in which this was not the case: either profits increased but productivity didn't (9 out of 20 sectors) or profits decreased but productivity increased quickly (6 out of 22 sectors).

Finally, we analysed the relationship between productivity change and import liberalisation on tradeables producing sectors. The issue of productivity change and import liberalisation is an important one, because the accepted view on the subject is that one of the main causes of productivity change is the import liberalisation process: under the threat of increasing import competition, firms are forced to react to decreased market shares by raising productivity. No overall association was found between productivity growth and several indicators of trade liberalisation and/or import penetration ratios

and their respective rates of change. We then divided the tradeables producing sectors in different groups according to the degree of import penetration and its change over time. We were able to identify six groups.

The first one was characterised by little change over time in sectors with generally low import coefficients. Not surprisingly, import penetration ratios remained small and showed little change over time. All the sectors included in this group were close to the primary economic base. In all these cases productivity growth was very small, with the exception of Mining. In general, import competition was weak, as expected, due to low import penetration ratios. There was no actual threat from imports to justify or induce better productivity performance.

The second group included sectors in which the import coefficients were low in the beginning of the decade, when import liberalisation began, and increased as the decade progressed, but this was not enough to induce substantial upward productivity shifts.

The two next cases were one-sector groups. In the case of Chemicals (except petrochemicals), it was surprising to find a high, but constant, import penetration ratio together with a reasonably high rate of productivity change. Since imports increased substantially, this means that rising imports were concomitant to rising domestic production and fast productivity growth. The result seems to reveal a healthy industrial sector, where foreign competition was met by rising labour productivity.

The next one-sector group showed an unexpectedly favourable performance: oil and gas extraction was a sector in which the share of imports in total supply decreased markedly during the 1990s, and the incumbent monopolist was able to increase productivity at a very fast rate during the decade. Import competition had little to do with this, as long-term plans were in effect to increase domestic production.

The last two groups of sectors had above average import penetration ratios at the beginning of the decade and these ratios increased markedly over time. These were Metals and the so-called metal-mechanic industries, and the chemicals group of industries.

The first of these, with the exception of the very heterogeneous Miscellaneous and Metal Products sectors, behaved as expected by the

hypotheses of sector and firm reaction to increased competitive imports. It faced increased import competition with very fast productivity change. In the second group the results were not as clear: only half the sectors behaved as expected, facing rising import competition via productivity growth.

It seems safe to conclude that 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, ranging from the well known case of import substitution under the aegis of a (monopoly) State firm to cases where increased import penetration in competitive sectors had no apparent impact on productivity change.

To conclude, the 1990s were a period of intense productivity change in Brazil, as compared with the previous decade. Productivity growth represented a sizeable proportion of aggregate output increase without sacrificing aggregate employment levels to the extent believed so far. A number of manufacturing industries were mainly responsible for this, aided by Public Utilities and Communications, although other sectors lagged behind, mostly in Services, Transportation and Commerce. Since these sectors command a high share of total employment, their recent disappointing performance poses problems for economic and social policies, aimed to improve overall labour productivity performance in Brazil in the future.

Bibliography

Abreu, M. and D. Verner (1997) **Long-Term Brazilian Economic Growth: 1930-94**, OECD, Paris.

Arbache, J. S. (2001) "Liberalização comercial e mercado de trabalho no Brasil", em Lisboa e Menezes Filho, **Microeconomia e Sociedade no Brasil**. Editora Contra Capa, Rio de Janeiro.

Bacha, E. L. and Bonelli, R. (2002) "Ganhos de produtividade no Brasil: o que nos diz o registro de longo prazo", preliminary research report, processed.

Basu, S. and J. Fernald (2000) "Why is productivity procyclical? Why do we care?" **NBER Working Paper** n. 7940.

Bonelli, R. (1975) "Growth and technological change in Brazilian manufacturing industries during the 1960s". PhD dissertation, University of California – Berkeley.

Bonelli, R. (1996) "Produtividade Industrial no Brasil: Controvérsias e Quase-Fatos", in **A Economia Brasileira em Perspectiva - 1996/97**, IPEA, Rio de Janeiro.

Bonelli, R. (2000) "Ganhos de Produtividade na Economia Brasileira na Década de 90: Um Retrato de Corpo Inteiro", **Seminários** n. 20, DIMAC/IPEA, Julho (preliminary).

Bonelli, R and R. Fonseca (1998) "Ganhos de Produtividade e de Eficiência: Novos Resultados para a Economia Brasileira", in Pesquisa e Planejamento Econômico, August, p. 273-314. IPEA, Rio de Janeiro.

Braga, H. and Rossi, J. (1988) "Productividade total dos fatores de produção na indústria brasileira: mensuração e decomposição de sua taxa de crescimento," IPEA **Texto para Discussão** n. 12.

Considera, C. M. and Silva, A. B. (1993) "A produtividade da indústria brasileira". Rio de Janeiro, IPEA/DIPES (*Sumário Executivo*, 1).

De Long, J. B. and L. Summers (1991) "Equipment Investment and Economic Growth", Quarterly Journal of Economics, Vol. 106.

Feijó, C. A. and Carvalho, P. G. M (1994) "Sete teses equivocadas sobre o aumento da produtividade industrial nos anos recentes". Boletim de Conjuntura, Rio de Janeiro, IEI/UFRJ, vol. 14, n. 2, julho.

Giambiagi, F. and M. Moreira (orgs.) (1999) **A Economia Brasileira nos Anos 90**, BNDES, Rio de Janeiro.

- Gomes, V. (2001) "Fatos sobre a produtividade", IPEA, Brasília, processed.
- Gordon, R. (2000) "Does the 'New Economy' measure up to the great inventions of the past?". Northwestern University and NBER, May 1, 2000 draft of a paper for the Journal of Economic Perspectives.
- Haddad, C. L. da Silva (1975) "Crescimento do Produto Real Brasileiro, 1900-1947" Revista Brasileira de Economia 29, Janeiro - Março, FGV, Rio de Janeiro, RJ.
- Hay, D. (1997) "The post 1990 Brazilian trade liberalization and the performance of large manufacturing firms," IPEA **Texto para Discussão** n. 523.
- IBGE (...) **Censos Demográficos**. Rio de Janeiro.
- IBGE (1990) **Estatísticas Históricas do Brasil, Séries Econômicas, Demográficas e Sociais 1950 a 1988**, 2^a edição revista e ampliada. IBGE, Rio de Janeiro, RJ.
- IBGE (2000) **Sistema de Contas Nacionais, Brasil, 1995-1998** Rio de Janeiro.
- IBGE (2002) **Sistema de Contas Nacionais, Brasil 1998-2000**, Rio de Janeiro.
- Jorgenson, D. (1990) "Productivity and economic growth," in E. Berndt and J. Triplett, eds., **Fifty years of economic measurement**. University of Chicago Press.
- Jorgenson, D. and K. Stiroh (2000) "US Economic growth at the industry level," American Economic Review 90(2), 161-167.
- Kume, H., Piani, G. and Braz de Souza, C. F. (2000) "A política brasileira de importação no período 1987-98: descrição e avaliação". IPEA, DIMAC, mimeo.
- Lisboa, M. B., Menezes Filho, N. and Schor, A.(2002) "Os efeitos da liberalização comercial sobre a produtividade: competição ou tecnologia?" *Discussion paper*. Fundação Getúlio Vargas, Rio de Janeiro, 20 de março.
- Maddison, A. (2001) **The World Economy: A Millennial Perspective**. OECD, Paris.
- Mankiw, G., D. Romer and D. Weil (1992) "A Contribution to the Empirics of Economic Growth", Quarterly Journal of Economics, Vol. 107.
- McKinsey (1998) **Productivity—The Key to an Accelerated Development Path for Brazil**, São Paulo.

Moreira, M. M. and P.G. Correa (1998) "A First Look at the Impact of Trade Liberalization on Brazilian Manufacturing Industry," World Development 26(10) pp. 1859-74.

Muendler, M. (2001) "Productivity change among large Brazilian manufacturers," mimeo, U.C. Berkeley.

Oliner, O. and Sichel, D. (2000) "The resurgence of growth in the late 1990s: is information technology the story?", Washington, DC: Federal Reserve Board, May.

Pinheiro, A. C. (1989) "An inquiry into the causes of total factor productivity growth in developing countries: the case of Brazilian manufacturing, 1970-1980". PhD dissertation, University of California – Berkeley.

Pinheiro, A. C., Gill, I. S., Servén, L. and Thomas, M. R. (2001) "Brazilian Economic Growth, 1900–2000: Lessons and Policy Implications", draft, December.

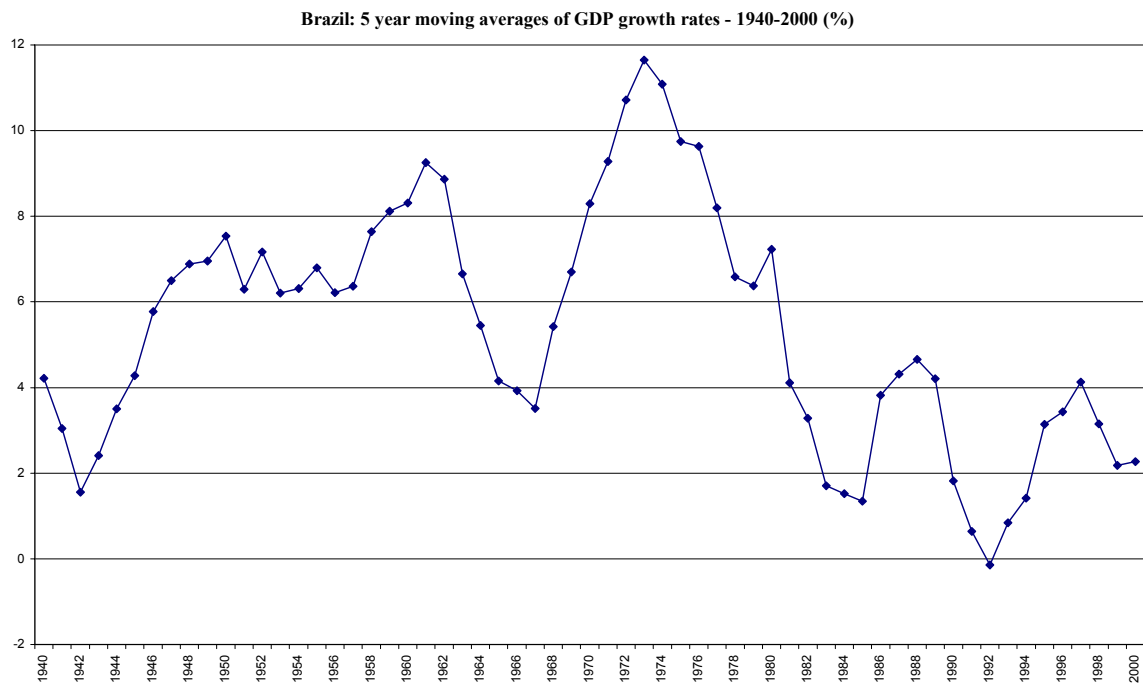
Rossi, J. and Ferreira, P. (1999) "Evolução da produtividade industrial brasileira e abertura comercial," IPEA, Texto para Discussão 651.

Salm, C. , Sabóia, J. and Carvalho, P. G. M (1997) "Produtividade na Indústria Brasileira: questões metodológicas e novas evidências empíricas". Pesquisa e Planejamento Econômico, vol. 27, n.2. IPEA, Rio de Janeiro.

Solow, R. (1957) "Technical Change and the Aggregate Production Function", The Review of Economics and Statistics.

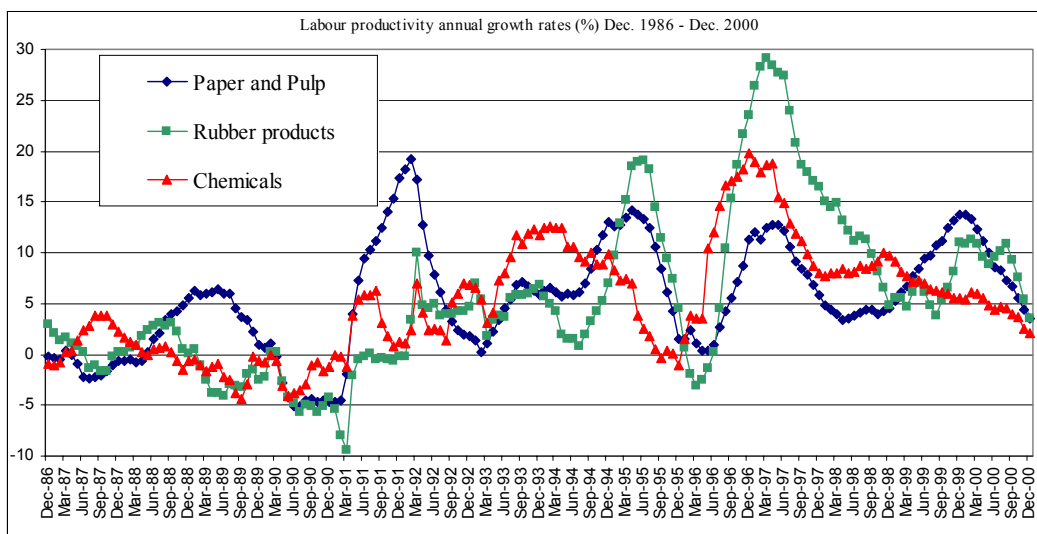
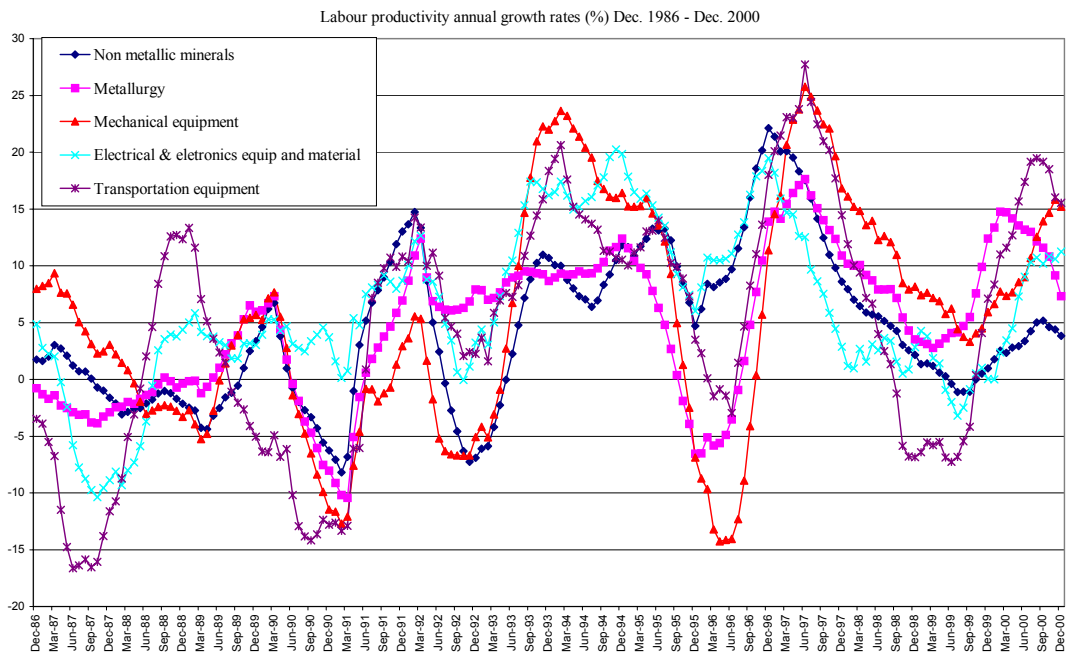
APPENDIX 1

Brazil: Growth variability in the long term

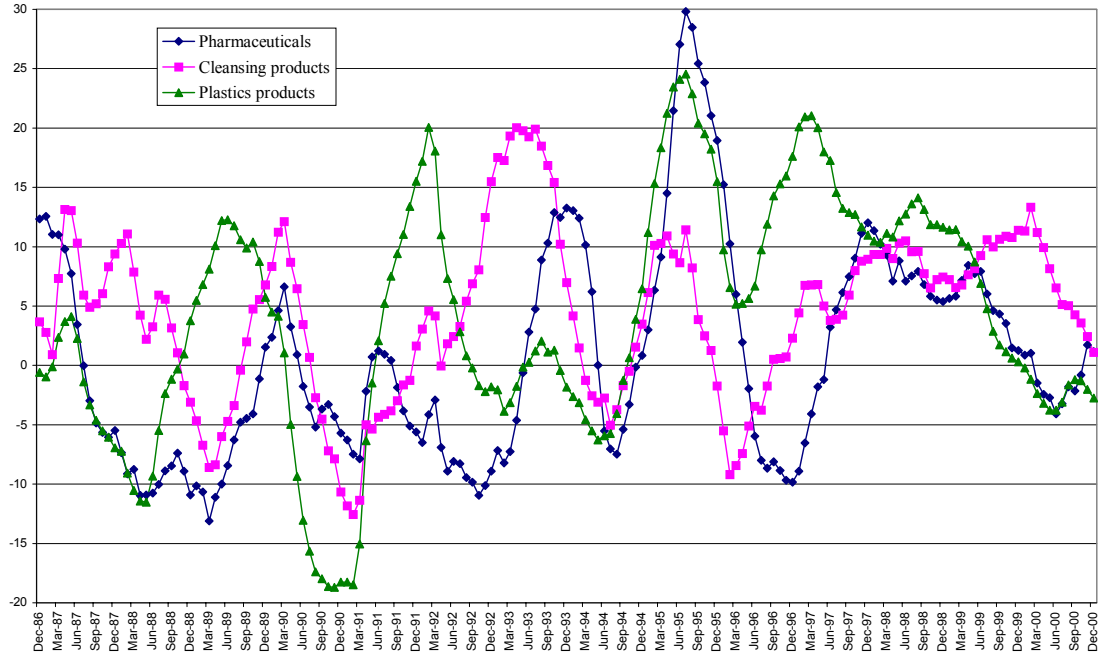


APPENDIX 2

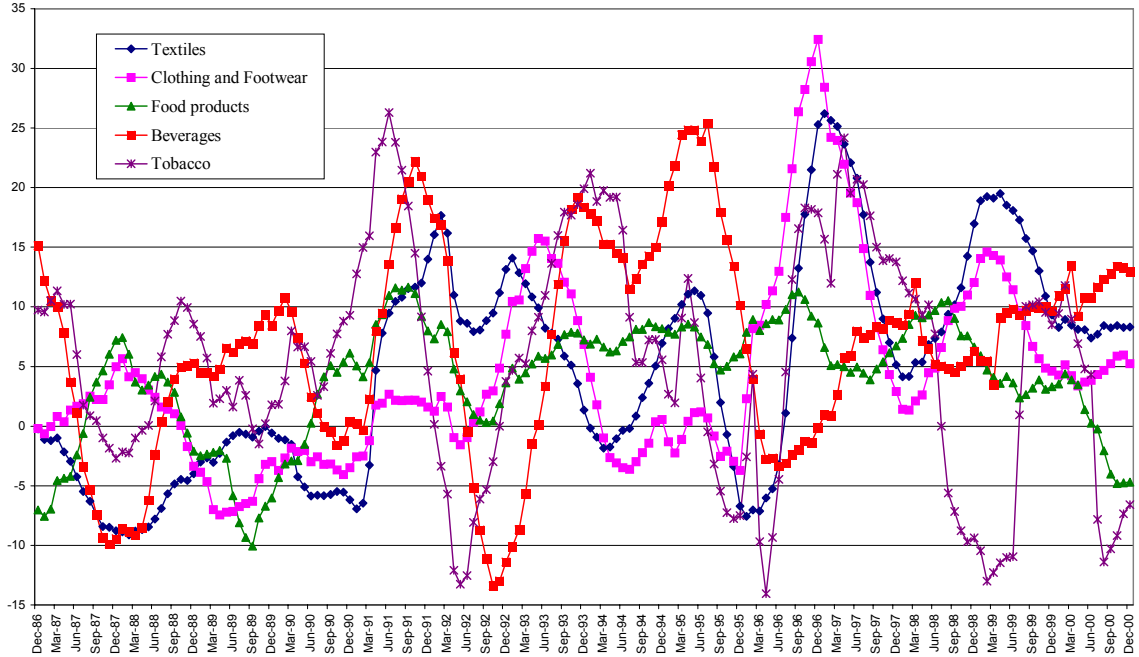
Labour productivity growth rates in selected manufacturing industries -- December 1986 to December 2000 (% per year)



Labour productivity annual growth rates (%) Dec. 1986 - Dec. 2000



Labour productivity annual growth rates (%) Dec. 1986 - Dec. 2000



APPENDIX 3

Selected sector indicators	% p.a. labor productivity	% Imports on (Imports + Value of Prod)				% Change Relative prices 2000		Nominal tariffs (%)		Effective Tariffs (%)	
		1990	1994	1997	2000	to 1990	1988	1998	1988	1998	
Agriculture and animal production	3.01	3.6	3.0	2.8	2.8	-9.1	17	9.9	14.8	9.9	
Mineral extraction (non-oil)	5.28	7.0	6.9	7.3	8.8	-28.5	19.7	6.4	15	4.2	
Extractive minerals: oil, gas, coal, fuels	4.75	96.0	78.3	64.0	27.0	38.2	5.6	0	-2.9	-2.2	
Non metallic minerals	3.85	1.3	2.0	3.2	2.9	-19.0	39.2	13.6	46.2	15.4	
Steel	9.84	1.8	2.0	2.9	3.2	8.7	29	10.2	36.3	14.2	
Non ferrous metals	6.82	5.0	8.1	11.6	12.7	-31.6	30.6	11.7	28	11.9	
Metal products	2.65	1.4	2.5	5.8	5.5	-28.1	45.8	18.9	59.2	24.8	
Machinery and tractors	4.67	14.5	21.6	37.2	25.6	8.7	46.8	17.7	50.2	18.6	
Electric equipment	8.62	9.7	16.6	23.8	29.5	-56.1	50	19.5	61.6	24.5	
Electronic equipment	4.36	22.6	54.1	66.8	114.4	-26.0	48.6	17.4	51.2	17.9	
Cars, trucks, buses	8.31	0.5	16.6	14.7	13.4	3.3	65	38.1	201.3	129.2	
Other vehicles	6.12	9.9	14.7	24.2	33.1	-26.6	42.8	18.5	43.9	20.5	
Wood and furniture	1.31	0.4	0.9	2.5	2.3	-14.7	30.3	14	28.9	15.1	
Pulp, paper and printing & publishing	3.18	2.5	3.7	6.4	5.2	22.2	32.1	14.2	30.1	14.7	
Rubber products	7.06	5.1	8.7	12.1	13.4	-22.8	49.3	14.8	58.5	16	
Chemicals, non petrochemicals	5.23	16.5	16.5	16.4	18.4	52.5	31.4	21.1	30.9	24.2	
Oil refining and petrochemicals	9.23	3.9	7.6	9.8	11.0	12.7	33.8	5.4	70	5.7	
Miscellaneous (chemicals)	4.80	6.2	10.3	12.7	16.1	-35.3	34.7	10.9	44.9	12.5	
Pharmaceuticals, soaps, parfums and related products	1.72	7.6	13.6	16.4	22.9	20.4	45.3	10.8	51.8	10	
Plastics (transformation)	-1.03	2.3	5.0	7.8	9.8	-31.8	57.1	18.2	72.1	21.9	
Textiles	1.75	2.5	8.4	13.2	11.2	-47.5	57.3	19.4	83.9	24.9	
Clothing and accessories	-0.82	0.5	1.4	3.9	2.6	-36.9	76	22.8	94.3	26.1	
Footwear and leather products	0.17	3.7	5.7	7.7	7.0	-16.8	41	17.2	39.8	19.4	
Coffee	2.07	0.0	0.0	0.0	0.0	100.4	35	15	36.2	15.4	
Other industrialized vegetals, inc. tobacco	2.39	2.6	4.1	3.9	3.2	-16.3	42	14.8	86	20.8	
Prepared meats	0.34	2.6	1.2	1.5	0.9	-8.8	29.8	12.2	29.6	12.1	
Milk and dairy products	1.57	3.1	4.7	4.7	5.4	2.0	40.3	23	41.6	24.4	
Sugar refining	1.18	0.0	0.2	0.1	0.1	44.0	29.3	19	24.8	19.9	
Oil refining for domestic use	7.61	1.0	3.5	3.2	2.4	0.8	20.5	11.5	24.1	12	
Other food products and beverages	2.52	2.5	2.8	4.8	4.5	-1.2	51.8	17.9	98.5	24.1	
Miscellaneous	1.57	7.3	16.9	27.0	25.3	-29.5	49.1	16.4	64	17.9	