Is the Quality of Education Improving in Brazil? Some Empirical Tests from a Market Based Perspective

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Abstract

This paper studies the evolution of the quality of education in Brazil in the last fifty years. It starts by explaining why there was a genesis of low quality education in the country during this period and the role such bad quality may have had on its economic efficiency and development. Some tests of the hypothesis that there has been improvement in the quality of education in the last fifty years are presented. The results support the idea that, as a consequence of lack of priority on public policies and social changes, which engaged women in the labour market, there was a sensible fall in the quality of education in Brazil in the same period. This certainly increased the costs of productivity improvements and catch up, thus consisting in a serious liability for the future development of the country.

Resumo

Este trabalho estuda a evolução da qualidade da educação no Brasil nos últimos cinqüenta anos. Ele apresenta inicialmente uma explicação da baixa qualidade da educação neste período e o papel que esta má qualidade pode tr tido no desempenho econômico do país. Alguns testes da variação da qualidade da educação no período analisado são apresentados. Eles indicam que houve queda desta qualidade no período. Apenas nos anos mais recentes já começa a se identificar uma pequena recuperação. Esta queda seguramente terá conseqüências adversas para o desenvolvimento de longo prazo do país.

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1. Introduction

Recent improvements in the Human Capital Theory have placed human capital accumulation in the centre of economic development.[1] This literature recognises that it is one of the crucial engines of economic growth, not only because of its ability to increase other productivity factors through its direct and accountable effects, but also through its non controllable positive effects, which are externalities. The availability of human capital also plays a major role on the determination of technological innovation, which is another important engine of growth performance.[2]

There are several ways of accumulating human capital. The key ones are: (i) formal education, (ii) professional training, and (iii) learning by doing. Among these, the first one plays a crucial role, as it produces a major impact on the development of intellectual abilities, and as such defines the ability of workers to acquire new skills and the potential level of sophistication of such skills they can bear.

Formal education has two important components, namely: quantity, in terms of the amount of time spent at school, and quality, which is determined by the quality of education. Traditionally, economic analysis has concentrated its attention on the quantity of education, following Mincer's (1974) original study. Nevertheless, intuitively it is known that quality also matters, although most studies have undermined its relevance.[3] This study will emphasise the role of quality and will indicate how it may appear in the Mincer equation.

Brazil has gone through radical changes in its educational system since the early sixties. The reach of primary education has spread largely and secondary education is placed as the challenge for the next years. During this period, the average of years of schooling has increased, although it is still below what should be expected of a country with Brazil's per capita income. In spite of some success in expanding education quantitatively, the quality of public education is still a major concern, as there are clear signs of deficiency, unveiled by the media everyday. Under such critiques, it is worth evaluating if this quality has at least increased or if the expansions of the access have damaged the quality of education, as has often been claimed by critiques of the educational policies adopted. This paper's goal is exactly to discuss the historical change in the quality of education in the last five decades.

The paper is organised as follows. Next section discusses some basic statistics on the Brazilian educational achievements and tries to justify historically the sources of quality deficiency. Section 3 presents the Mincer Equation and unveils the consequences of changes in the quality of education on its structure. Its arguments also reveal an appropriate test for the major hypothesis of the paper, which is that there were important changes in the quality of education in Brazil in the last forty years. Section 4 brings a description of the dataset used and forwards the statistical results. Section 5 summarises the major conclusions.

2. Basic Indicators of Brazilian Educational Achievements and the Roots of its Quality Deficiency

[1] See for example Lucas (1988, 1993), Barro and Sala-i-Martin (1995), World Bank (1991) and Krueger, A. and M. Lindahl (1999).
[2] See Romer (1990) and Grossman and Helpman (1991).
[3] There are exceptions, which call attention to the role of quality of education, such as Ferreira (2000).

Figure 1 brings some statistics on average schooling per age group of the Brazilian employed population. It shows that there has been a reasonable improvement on the average schooling in the last four decades, as each generation is staying longer in school. This indicates to some extent that there has been an increase in the performance of the educational system in the country.

Nevertheless, table 2 brings the results of a simple international comparison of educational standards, which shows that Brazil still has to improve its educational standards to catch up with the international ones. It was build from the estimation of a relationship between per capita GNP (for 1997, corrected for purchasing power parity) and average registration on school (primary, secondary and tertiary, 1997)[4] as a percentage of the age group. After such estimation, the level of this average registration, given the level of international standards for that particular per capita GNP, was calculated for each country. This was used to build an educational gap, which defines the percentage deviation of the average registration from the level determined by international standards and the actual data. Figure 2 brings the estimated relationship between these two variables and table 3 the list of countries and their ranking in the sample. The sample size was determined by data availability. All these data are from World Bank, World Development Reports (more than one issue). From the sample, Brazil has the third largest gap. It means that despite the rise in educational quantitative standards in the country, it is still below what is necessary to catch up with international standards.

The reasons for the less than necessary investments in education in Brazil are a consequence of the class structure of the society and their relationships, as emphasised by Barros (1996) and Ferreira (2000). Brazilian society was very divided until few years ago. The local elite did not recognise any responsibility towards the lower classes standard of living, as they did not have any cultural or even ethnic identity with them. Their strong control of the state and of public policies, together with this ideology, pushed for educational policies borne on segregation and consequently low commitment to quality and extent.

Under such social structure, the educational policy in the country would respond only to the demands for qualification in the labour market. As Brazil historically specialised in exports of primary commodities, such as sugar, coffee and cocoa, all of which demand very low qualified workers for their production, the local elite could not identify any benefits that an improvement on the educational standards could bring them. Therefore, the low educational standards in the country persisted. The utility that its increase may bring to the beneficiaries, as more social status, economic opportunities and ability to increase his/her consumption ability, was not relevant to the determination of the supply of education. As a consequence, no externalities from such motivations for human capital accumulation were captured in the country. By weakening its long-term economic performance. Brazil ended up locked in by historical events,[5] not benefiting from one of the most important sources of growth, which are the externalities associated to the human capital accumulation.

The elite in Brazil has a different social background than the lower classes. This social differences are very deep as they range from culture to ethnic origin. While the elite of the country is Portuguese and other European descendent, the lower classes have their background on African slaves and native Indians. Furthermore, the elite in the country did not have any national identity until very recently. They used to be ashamed of being Brazilian, as they judged themselves as descending from superior origins, such as European countries. Thus, they did not have any

[4] Data for tertiary education is to 1992.
[5] See Arthur (1989) for a growth model which allows for such outcome.

commitment to the image of the country or even to its long-term development, as they tended to see their permanence in Brazil as transitory, a period of wealth accumulation. This wealth should actually be spent abroad.

Of course this was the common sense which generated the ideology, even though many members of the elite actually did not follow such pattern. Nonetheless, they acted according to the conclusions of this ideology, with very low commitment to the long-term development of the country or the welfare of the majority of its population. This ideology was fully reflected by public policies towards education and explains why Brazil always had a positive educational gap, as shown in table 1.

Figure 1
Brazil: Average schooling years per age group

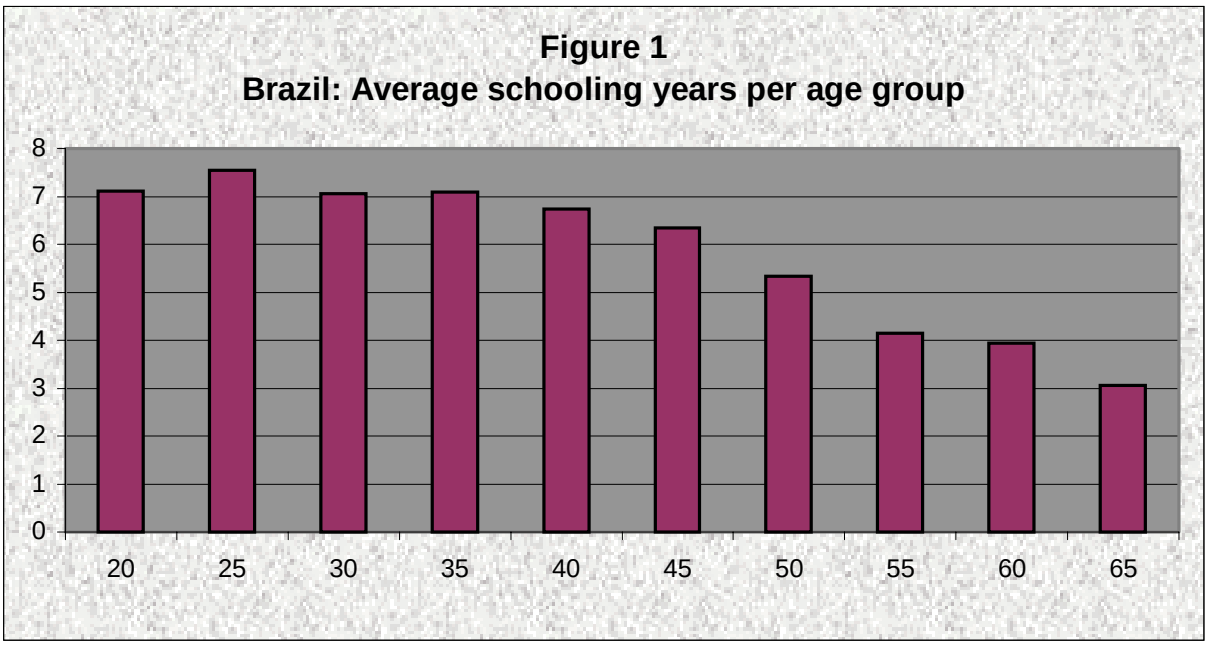
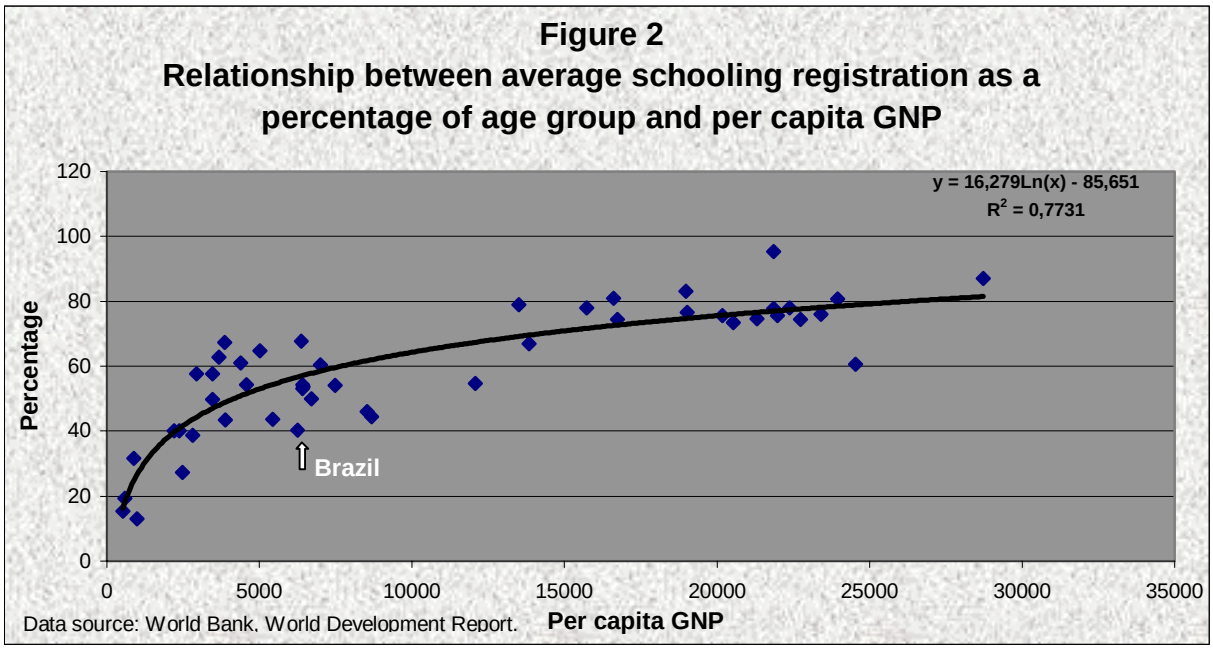


Figure 2
Relationship between average schooling registration as a percentage of age group and per capita GNP



During a large period of Brazilian history, starting in the seventeenth century and continuing until the beginning of the twentieth century, education for the poor was seen as charity. The Catholic Church organisations and the upper class women tended to pursue such effort, but under this ideology of charity. Since those who were involved in such tasks had good educational standards, as they were part of the elite, the standard of education was above what would be justified by the concern of the dominant ideology with the welfare of the majority of the population. Nevertheless, the extent of their efforts was limited because those engaged in such activities were not many, given the needs of the country.

When there was a first expansion of the supply of education to the poor in this century, there was a parallel change of the social source of teachers, as at the same time there were some changes in the role of women in society. They started entering the labour market progressively and started to engage in professional employment relationships. Therefore, they only would get involved in public education if there was an adequate return to such activity. This led to a crisis of quality, as the elite was not willing to pay much for such expanded services to the lower classes and enrolment of teachers started to draw from less qualified social groups. This problem was quite accentuated after 1960 when there were remarkable changes in the relationship of women with the labour market. Then, the quality of teachers dropped sharply and all the quantitative expansion of access to education came at the expense of a reduction in its quality.

As time passed, there was a timid but continuous rise in the quality of education for all social groups. As a consequence, there was also an increase on the quality of teachers and this became a circular cumulative process for the last forty years. Nevertheless, salaries for other job opportunities in the labour market rose more than those for teaching. This also had severe consequences for the quality of education in Brazil.

Table 1
Basic statistics on educational achievements and GNP per country in the sample, 1997

Country	Average Schooling registration (%)	Per capita GNP (Corrected goes PPP, 1997 US $)	Gap (%)	Ordering by size of GAP	Ordering per capita by GNP
Burkina Faso	13,00	990	1,049	45	1
Lesotho	27,33	2480	0,521	42	2
Brazil	40,33	6240	0,403	30	3
Oman	44,33	8690	0,398	21	4
Venezuela	46,00	8530	0,341	22	5
Hong Kong, China	60,67	24540	0,301	2	6
Namibia	43,67	5440	0,245	31	7
Chile	54,67	12080	0,232	20	8
Colombia	50,00	6720	0,156	25	9
El Salvador	38,67	2810	0,128	41	10
Paraguay	43,33	3870	0,127	35	11
South Africa	54,00	7490	0,103	23	12
Trinidad & Tobago	53,00	6410	0,076	27	13
Turkey	53,67	6430	0,064	26	14
Mozambique	15,33	520	0,054	48	15
Costa Rica	54,33	6410	0,050	28	16
Denmark	74,33	22740	0,045	5	17
Portugal	67,00	13840	0,038	18	18
United Kingdom	73,33	20520	0,036	11	19
Japan	76,00	23400	0,028	4	20
Germany	74,67	21300	0,026	10	21
Nicaragua	40,00	2370	0,021	43	22
Austria	75,67	21980	0,019	7	23
Australia	75,67	20170	0,001	12	24
Belgium	78,00	22370	-0,008	6	25
France	77,67	21860	-0,008	8	26
Honduras	40,00	2200	-0,009	44	27
Ireland	74,33	16740	-0,022	15	28
Sweden	76,67	19030	-0,025	13	29
Norway	80,67	23940	-0,027	3	30
Hungary	60,33	7000	-0,031	24	31
Algeria	54,33	4580	-0,051	33	32
Indonesia	49,67	3450	-0,054	39	33
Burundi	19,33	590	-0,058	47	34
United States	87,00	28740	-0,064	1	35
Spain	78,00	15720	-0,081	17	36
Finland	83,00	18980	-0,100	14	37
New Zealand	81,00	16600	-0,105	16	38
Korea, Rep. of	79,00	13500	-0,124	19	39
Poland	67,67	6380	-0,158	29	40
Peru	61,00	4390	-0,166	34	41
Estonia	64,67	5010	-0,180	32	42
Jamaica	57,67	3470	-0,184	38	43
Canada	95,33	21860	-0,192	9	44
Zambia	31,67	890	-0,214	46	45
Egypt, Arabic Rep. of	57,67	2940	-0,231	40	46
Philippines	62,67	3670	-0,235	37	47
Bulgaria	67,33	3860	-0,275	36	48

Source: World Development Report, 1999/2000 and 1997 and estimations by the author.

In addition to this supply side of qualified teachers, the demand side of the labour market is also important in the definition of the economic quality of education. For a constant quality of teachers, if there is a change in the demanded attributes of workers in the labour market and teachers are weaker on those more valued new attributes, the quality of education, as evaluated by the labour market, will fall. As the Brazilian economy has gone through a deep change in the major technological paradigm of its productive sectors,[6] it is possible to have had changes in the demand attributes that have reverted the slow evolution in the quality of teachers. This possible hypothesis will be object of some empirical analysis in this paper.

3. Theoretical background and empirical method

This section will derive the Mincerian equation to clarify the meaning of the return to education, which appear in such equation. It is worth firstly to emphasise that this approach focus on the supply equilibrium, in which workers make rational decisions on their time allocation. As the labour supply to each particular labour skill only adjusts through training, education or retirement, these are more long-term processes. Only in the case of adjustments through training such changes may be of shorter term, which would fit more on the intuitive idea of median term. Nevertheless, even on such adjustments, there is a limited scope for such, as a consequence of the restricted range of qualification a training program can move a worker. Therefore, at any moment, the equilibrium relationships only will exist as an approximation.

3.1. Mincerian Equation

Mincer's Model starts with the following equilibrium:

$$\int_0^{\infty} w e^{-Rs} ds = \int_0^{T} 0 e^{-Rs} ds + \int_T^{\infty} w' e^{-Rs} ds \qquad (1)$$

Where:

$$w = \overline{w} e^{\phi s} \qquad (2)$$

$$w' = \overline{w'} e^{\phi (s-T)} \qquad (3)$$

In these equations:

w = labour income when the person does not have any schooling.
w' = labour income after T years of schooling.
R = expected rate of return to one year of schooling.
ϕ = rate of return to experience, which is defined as (s-T)≥0.
$\overline{w}$ = labour income when the person does not have any schooling or experience.
$\overline{w}$ ' = labour income of worker after T years of schooling and who does not have any profession obtained through further training.

[6] See Barros (1998).

Equation (1) shows an arbitrage equilibrium in which workers do not see studying as any effort, neither derive any utility from higher education in itself. Consequently, they choose to continue studying if the present value of the additional income generated by this extra time on school will be higher than the one they will get if they drop from school and starts working immediately. If this does not happen, he/she will continue studying. By supply and demand in the labour market, these two alternatives for each new entrant will force the market to converge for such an equilibrium.

The rate of return R in this model is the one which workers use to deflate a future stream of income, which is comparable under two different assumptions, one in which he/she goes to school and another one in which he/she does not go and use that period to work. This rate measures the return the specific worker expect to get investing in his/her own education instead of collecting his/her wages and salaries earned in the first year and use it in a different application. Therefore, it is the expected rate of return on his/her investment in education.

This rate may vary among workers, as each one of them faces different realities in the labour market, which are defined by their specific attributes set, which will be defined as Ω_i, where the i identifies the worker. For instance, a worker with a large professional network inherited from his family background will have a higher R than one with a smaller professional network, *ceteris paribus*. In the same way, a worker which has access to an education of better quality will have a higher R than otherwise, as he/she will offer a higher productivity in the labour market and as such will qualify for a premium.

From a combination of the three previous equations, it is possible to obtain:

$$\int_0^{\infty} \bar{w} e^{-(R-\phi)s} ds = \int_T^{\infty} \bar{w}' e^{-(R-\phi)s-\phi T} ds \tag{1'}$$

In this model it is necessary that $(R-\phi)>0$, otherwise no worker would ever go to school, as the return to experience would be higher than the one for education. Solving this model, one gets:

$$-\frac{\bar{w}}{R-\phi}\left[e^{-(R-\phi)s}\right]_0^{\infty} = \frac{-\bar{w}' e^{-\phi T}}{R-\phi}\left[e^{-(R-\phi)s}\right]_T^{\infty}$$

This can be further developed to yield:

$$\ln w' = \ln \bar{w} + RT + \phi(s-T) \tag{4}$$

This is the standard Mincerian equation. It should be noticed that it is obtained from individual decisions taken by each worker. It means that rigorously the R which appears in equation (4) is an expected rate of return to the investments on education given the particular set Ω_i of the individual worker.

If there are two workers i and j who have access to education of different qualities, although all other attributes in Ω_i and Ω_j are the same, as long as both have rational expectations, it is possible to say that $R_i \neq R_j$. To state this more rigorously, it is necessary to introduce some definitions and assumptions:

Definition 1: An agent has rational expectations when $E_i(X_{t+h})+e_{t+h}=X_{t+h}$, where $E(e_{t+h})=0$ and $E(e_{t+h}e_{t-s})=0$, $E_i(X_{t+h})$ is the expectation made by worker i at time t for the variable X at time t+h, $E(e_{t+h})$ and $E(e_{t+h}e_{t-s})$ are the mathematical expectation of e_{t+h} and the covariance of e_{t+h} and e_{t-s}, respectively. If there is a set $\varphi(\delta)$ of known variables δ_m, it is also necessary that $E(e_{t+h}\delta_m)=0$, for all $h\geq 0$ and all m.

Definition 2: There is a set called Q, which is composed of all possible attributes q for individual workers. The attribute q identifies the possible quality of education and is one of the components of all Ω_i.

Assumption 1: All agents have rational expectations, according to definition 1.

Assumption 2: There is a full ordering from the set Q to the Real numbers, which defines a hierarchy of quality of education. The larger the real number to which a quality of education is associated, the better will be this quality. This ordering may be represented by Q(q). Therefore, there is a Real number associated to each q.

Assumption 3: $\Omega_i(v)=\Omega_j(v)$, for all v with exception of v=q, where v is an index for a specific attribute in the set Ω and q is the index for the attribute quality of education, as specified above.

Therefore, it is possible to state:

Proposition 1: If assumptions 1, 2 and 3 hold and $Q(q_i)>Q(q_j)$ then $R_i>R_j$.

In words, it means that if there are two workers with similar attributes, but with different education, the one with better education will have a higher expected rate of return to education. This proposition arises from the labour demand, rather than from its supply, as the Mincerian Equation. This may be seen from a simple model. Suppose firms face the following problem:

$$Max \quad \pi = AK^{\beta}\left[\left(L_1^{\phi_1}\right)^{\alpha}\left(L_2^{\phi_2}\right)^{1-\alpha}\right]^{1-\beta} - w_1L_1 - w_2L_2 - rK \qquad (5)$$

Where:

K = stock of capital used as input.
L_1= quantity of labour of type 1 used on production.
L_2=quantity of labour of type 2 used on production.
ϕ_1= Human capital multiplier of labour type 1.
ϕ_2= Human capital multiplier of labour type 2.
A = a technological productivity index.
w_1 = real wages paid to workers of type 1, which also pay for their human capital.
w_2 = real wages paid to workers of type 2, which also pay for their human capital.
r = interest rate.

It was assumed in this model that there are only two workers, which are a qualified one, whose labour supply is L_1 and a non-qualified one, whose labour supply is L_2.[7] The

[7] Both L_1 and L_2 are measured in hours of work.

effective amount of these two types of labour depends on their stock of human capital, which may be accumulated through education. The parameters ϕ_1 and ϕ_2 define this effective amount of labour for each hour of work spent. By assumption $\phi_2=1$. As simplifying assumptions, the time spent for training is leisure time and its reduction does not have any impact on productivity. The decisions on education are made by workers and firms take this as given.

Under such assumptions, firms only decide the amount they allocate on production of L_1 and L_2. Individual firms solve this problem to K, L_1 and L_2 and takes r, w_1 and w_2 as given. The solution to this problem implies that:

$$\frac{w_1}{w_2} = \left(\frac{\alpha}{1-\alpha}\right)\left(\frac{\phi_1}{\phi_2}\right)\frac{L_2}{L_1} \tag{6}$$

This equation yields:

$$\ln w_1 = \ln w_2 + \ln \alpha - \ln (1-\alpha) + \ln \phi_1 + \ln L_2 - \ln L_1 \tag{7}$$

If $L_1=L_2$, this simplifies to:

$$\ln w_1 = \ln w_2 + \ln \alpha - \ln (1-\alpha) + \ln \phi_1 \tag{8}$$

This equation implies that the natural logarithm of the wage firms are willing to pay to workers with more qualification increases with his productivity, which is indicated by the parameter ϕ_1 in this model. The higher ϕ_1, and as such this productivity, the higher will be the wage they are prepared to pay. For the firms it will not make any difference the way the worker obtained his/her qualification, if through education, training or whatever. It is not the time this worker spent on school, which matter, but actually his/her production ability.

Suppose there are two workers, with the same labour market experience and schooling years. If one of them has more skills because of better education, he/she will actually have a higher ϕ_1, if all other attributes on their Ω are exactly the same. Such skills could mean higher ability to adjust himself to new processes or even more innovative capacity to improve the efficiency of processes. Therefore, firms would always choose to work with this more skilful worker and would actually bid for his/her services in the labour market. Therefore, his/her wage would rise over the one offered to the worker with lower quality of education.

If workers have perfect foresight, equation (4) would hold for both these workers. As the first and third terms of the right hand side are exactly the same, by assumption, this can only be justified by a higher R for the worker with higher educational quality. Therefore, the higher the quality of his/her education, the higher the return to education a worker is able to reach. This conclusion is the key hypothesis underlining the tests procedures on the change of the quality of education in Brazil in the last fifty years.

3.2. Theoretical Foundations of the Empirical Test

To understand the test procedure, let us assume that all workers in a country have the same attributes in their set Ω, with the exception of their educational quality. Supply and demand in the labour market assures that the higher the quality of one's education, the higher will be his/her return to education. Suppose now that education quality improves each year in

this country, steadily. If this is true, as this quality determines the rate of return to education, it is possible to define a function such as:

$$R=f(s) \tag{9}$$

Where f'(s)<0. This happens because the older a person, the lower the average quality of education he/she obtained during his/her schooling period and, consequently, the lower the return to education he/she will obtain. Substituting equation (9) on equation (4):

$$\ln w' = \ln \overline{w} + f(s)T + \phi(s-T) \tag{4'}$$

There is no *a priori* reason to determine any specific functional form for equation (9), but it is possible to work with a flexible functional form such as:

$$R = \beta_0 + \beta_1 s + \beta_2 \ln(s) + \beta_3 T + e \tag{10}$$

Where β_i's are coefficients and e is a random term with mean zero and constant variance. Under this specification, the hypothesis of improvement on the quality of education would take the form:

$$\frac{\partial R}{\partial s} = \beta_1 + \beta_2 \frac{1}{s} < 0 \tag{11}$$

In the same way, the hypothesis that there was a fall on the quality of education could be represented as:

$$\frac{\partial R}{\partial s} = \beta_1 + \beta_2 \frac{1}{s} > 0 \tag{11'}$$

The hypothesis of no intertemporal change in the quality of education, on its turn, takes the form:

$$\frac{\partial R}{\partial s} = \beta_1 + \beta_2 \frac{1}{s} = 0 \tag{11''}$$

Equation (4') could be re-specified as:

$$\ln w' = \ln \overline{w} + \beta_0 T + \beta_1 s.T + \beta_2 T \ln s + \beta_3 T^2 + \phi(s-T) + u \tag{4''}$$

Where u=(eT+v), and v is the random term that should be included in equation (4'), when it is transformed in a stochastic relation. The term eT in u indicates that there is heteroskedasticity in this equation.

For estimation of the coefficients in equation (4'') through a cross section on a dataset built with information on individuals, it is necessary to assume that the coefficients on this equation are independent of the exogenous variables in the equation and that there is a bounded average of coefficients for all individuals, which will be the estimated parameters. The introduction of such assumptions allows the test of the hypothesis stated in equation (11) from ordinary least square with correction for heteroskedasticity. This is done next section.

4. Data description and empirical results

The data used is from PNAD (Pesquisa Nacional por Amostra a Domicílio), which is a pool made yearly by IBGE (Brazilian National Statistics agency), in its 1998 version. Only data for the two major regions in the country, by a population criteria, which are Northeast and Southeast, were included. This restriction left the sample with 79.187 individuals and avoided to have to include many procedures to capture regional differences.

The sample only included workers with labour income higher than R$ 30,00 per month. This restriction eliminates from the sample a large share of workers with very few hours of labour per week, which are most of them under-employed. The data on labour income was for the major employment. The variable s was represented by the age and experience was calculated as standard in the literature (age-6-years of schooling).

There were two forms to isolate the regional effects. The first one was simply to include a regional dummy, with one for those workers in Northeast Brazil. The other one was to split the sample in two parts and to proceed with estimations for each one of them. Both results are presented below.

Other variables were included in the estimated model. They are those normally taken as relevant to explain individual labour income. They are: (i) a dummy for sex (male=1), a dummy for residents in Metropolitan areas[8] (residents=1), a dummy for residents in urban areas (residents=1), a dummy for workers registered in the National Social Security System (registered=1). Experience was also included on its square, as usual on estimations of the Mincerian equation with Brazilian data.

The results of estimations appear on tables 2, 3 and 4. The estimated R's for the major range of age included in the sample for a set of selected schooling years appear on figures 1, 2 and 3. On these graphics the calendar years included are only indicative of roughly approximate date of changes. Their calculation arbitrarily considered that an average worker starts working at 14 years old and that the last year before entering the labour market defines his/her relative return to education and as such its quality. The range of ten years centred on this number certainly is the key period to determine the quality of education for most of individuals in Brazil. At fourteen years old a Brazilian finish fundamental school, which represents eight years of schooling. This phase on the educational system set up fundamental logic and methods of thought, as well as discipline to perform long planned tasks. As the average schooling in Brazil is between four and five years, a large share of the population has already dropped from school at 14. Nevertheless, most of these people started to study later and as such also ceased to enrol to school around fourteen years old.

[8] Metropolitan areas in Brazil are large cities, which are formed by more than one city integrated in one urban space.

Table 2
Results for the aggregated model

Variable	Coefficient	Standard Errors	T-Statistics	Significance
Constant	4,1424	0,0229	180,9119	0,0000
Schooling	-0,4038	0,0203	-19,9079	0,0000
Schooling squared	0,0062	0,0001	44,2250	0,0000
Experience	0,0266	0,0013	20,1681	0,0000
Experience squared	-0,0003	0,0000	-16,7582	0,0000
Dummy for metropolitan areas	0,1681	0,0051	32,7431	0,0000
Dummy for urban areas	0,2530	0,0071	35,6435	0,0000
Dummy for males	0,5279	0,0050	106,3161	0,0000
Dummy for registration in the National Social Security System	0,1537	0,0051	30,1633	0,0000
Regional dummy (Northeast=1)	-0,4000	0,0050	-79,3029	0,0000
Schooling x age	-0,0034	0,0002	-17,0510	0,0000
Schooling x natural logarithm of age	0,1577	0,0076	20,6650	0,0000
R2	0,534473			

Note: Sample size: 79,187. Estimation was made by OLS with correction for heteroskedasticity by the method of White (1980). Chi-square tests for the hypothesis expressed in equation (11'') against the alternatives were rejected for p-values lower than 1% in all the range of ages, which appears in table A1.

Chi-square tests for the hypothesis that each one of these estimated returns does not depend on age of individuals were also performed. All these tests were for the hypothesis expressed in equation (11'') against the two alternatives, expressed in equations (11) and (11'). In all cases the null hypothesis was rejected for p-values lower than 1% in all the range of ages, which appears in tables A1, A2 and A3.

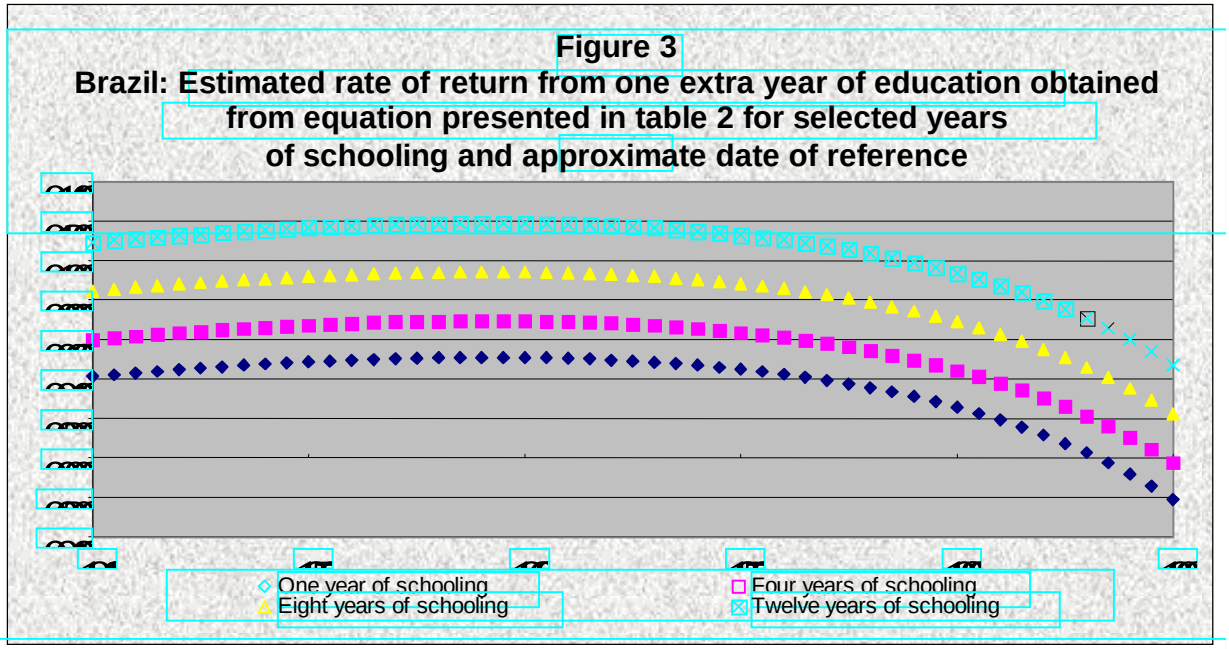
All these estimations and tests confirmed the hypothesis that there were changes in the quality of education in Brazil in the last fifty years. There was at first an increase in this quality, which last until the second half of the sixties and first half of seventies. Afterwards, on the years of the so-called Brazilian Miracle, the quality of education started to decrease. This was exactly when the military regime, which took power in 1964, could spread out its educational reforms, which largely extended the access to education. Nevertheless, this was made at the expenses of its quality.

In spite of all the recent effort to improve the quality of education in the last six years no result appears clearly on figures 1, 2 and 3. Nevertheless, the rigidity in the format of the functions used to capture the changes in the quality of education could be responsible for this no ability to capture the impact of the recent effort to improve the quality of education in Brazil. Therefore, such individual changes only may be captured through more flexible estimation methods.

To increase the precision on the evaluation of the performance of the most recent years, fifty-one regressions, splitting the sample by age from 15 to 65, were conducted. These regressions estimated models similar to the ones on tables 2, 3 and 4, with the exclusion of

schooling squared and all variables which have age as one of its components.[9] Table 5 brings the results only for the estimated returns to education, with the limits of a confidence interval with 95% of chance of containing the true value of each return. Figure 3 plots these returns adopting the same procedure to transform ages on calendar years as made before.

Figure 3
Brazil: Estimated rate of return from one extra year of education obtained from equation presented in table 2 for selected years of schooling and approximate date of reference



Note: Calendar years in the horizontal axe are only indicative of roughly approximate date of changes. Their calculation arbitrarily considered that an average worker starts working at 14 years old and that the last year before entering the labour market defines his/her relative return to education and as such its quality. The range of ten years centred on this number certainly is the key period to determine the quality of education for most individuals in Brazil.

Table 3
Northeast Brazil: Results of estimations

Variable	Coefficient	Standard Errors	T-Statistics	Significance
Constant	3,7605	0,0290	129,7847	0,0000
Schooling	-0,3632	0,0312	-11,6505	0,0000
Schooling squared	0,0069	0,0002	31,4266	0,0000
Experience	0,0265	0,0017	15,3905	0,0000
Experience squared	-0,0003	0,0000	-12,7787	0,0000
Dummy for metropolitan areas	0,1417	0,0083	17,1447	0,0000
Dummy for urban areas	0,2323	0,0096	24,1259	0,0000
Dummy for males	0,5135	0,0076	67,6491	0,0000
Dummy for registration in the National Social Security System	0,1849	0,0082	22,6241	0,0000
Schooling x age	-0,0029	0,0003	-9,0102	0,0000
Schooling x natural logarithm of age	0,1397	0,0119	11,7375	0,0000
R2	0,4918			

Note: Sample size: 35,163. Estimation was made by OLS with correction for heteroskedasticity by the method of White (1980). Chi-square tests for the hypothesis expressed in equation (11'') against the alternatives were rejected for p-values lower than 1% in all the range of ages, which appears in table A2.

Table 4

[9] They are: (i) experience, (ii) experience squared, (iii) age times schooling, and (iv) schooling times natural logarithm of age.

Southeast Brazil: Results of estimations

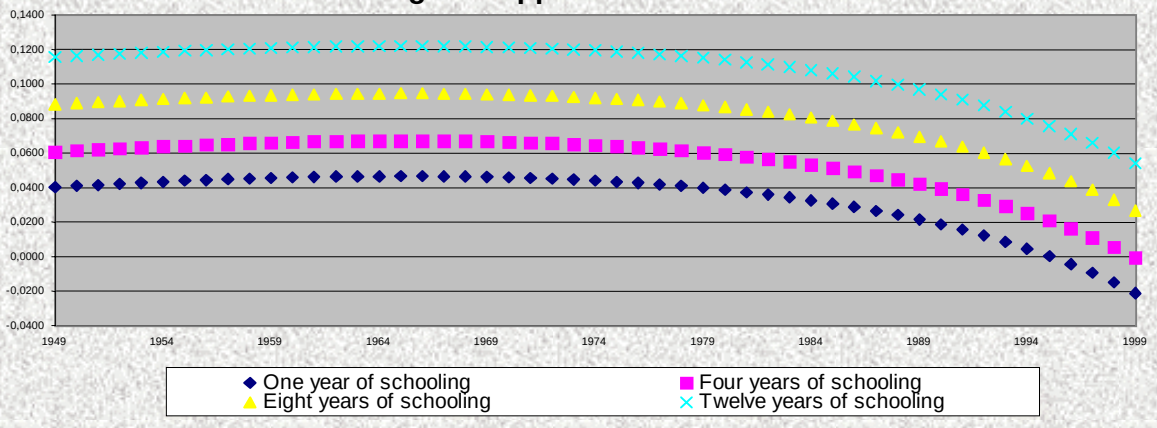
Variable	Coefficient	Standard Errors	T-Statistics	Significance
Constant	4,1451	0,0358	115,7565	0,0000
Schooling	-0,4302	0,0283	-15,1781	0,0000
Schooling squared	0,0060	0,0002	30,8259	0,0000
Experience	0,0262	0,0021	12,6929	0,0000
Experience squared	-0,0003	0,0000	-10,6990	0,0000
Dummy for metropolitan areas	0,1853	0,0066	28,2824	0,0000
Dummy for urban areas	0,2818	0,0107	26,3650	0,0000
Dummy for males	0,5411	0,0066	82,3168	0,0000
Dummy for registration in the	0,1307	0,0066	19,9158	0,0000
Schooling x age	-0,0036	0,0003	-13,8916	0,0000
Schooling x natural logarithm of age	0,1674	0,0105	15,9469	0,0000
R2	0,4892			

Note: Sample size: 44,024. Estimation was made by OLS with correction for heteroskedasticity by the method of White (1980). Chi-square tests for the hypothesis expressed in equation (11'') against the alternatives were rejected for p-values lower than 1% in all the range of ages, which appears in table A3.

The results confirm the previous hypothesis and timing. The gains in flexibility of the functional form, however, introduce some little changes. Firstly, the fall in the quality of education was accentuated after the first half of seventies. Before that, if it exists, it is very mild. The expansion of education promoted by the military regime, which was stronger after the early seventies is the strongest candidate to explain such deepening in the fall of the quality of education in Brazil in this period.[10] Nevertheless, the fall of the quality of teachers by the acceleration of women entering in the labour market and the reduction of supply of teacher by charity incentives certainly also played a major role. The changes in the demand for labour attributes arising from technological changes is also a crucial factor to explain such change, as there were high growth rates and technological absorption in Brazil in this period.

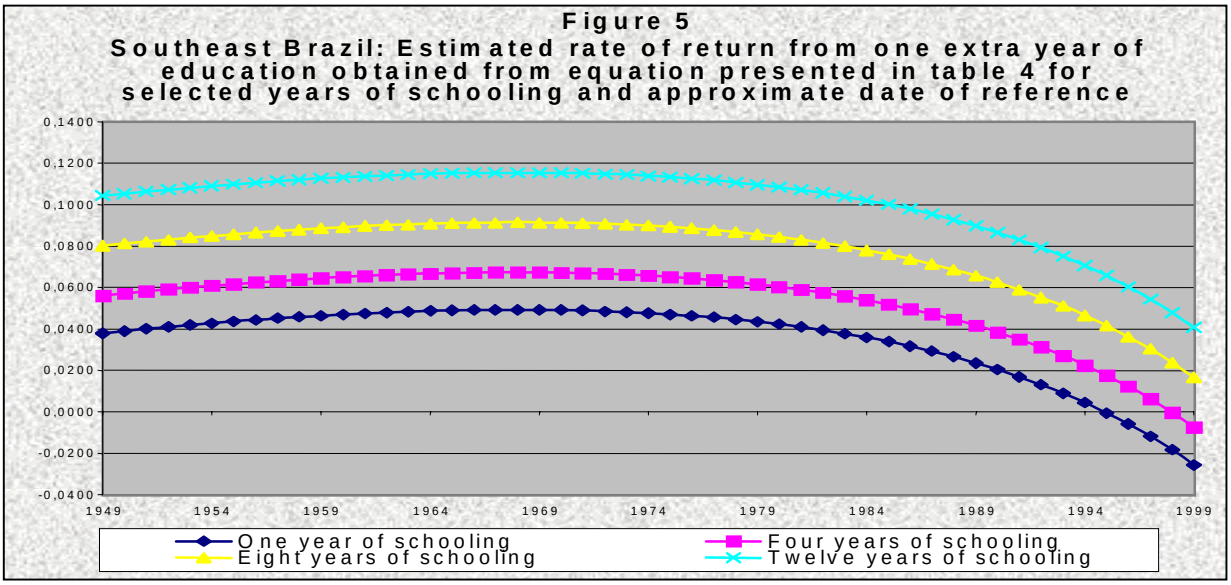
[10] Goldin and Katz (1999) also identified a fall in the return to education after the expansion of secondary education in the US in the beginning of the century.

Figure 4
Northeast Brazil: Estimated rate of return from one extra year of education obtained from equation presented in table 2 for selected years of schooling and approximate date of reference



Note: Calendar years in the horizontal axe are only indicative of roughly approximate date of changes. Their calculation arbitrarily considered that an average worker starts working at 14 years old and that the last year before entering the labour market defines his/her relative return to education and as such its quality. The range of ten years centred on this number certainly is the key period to determine the quality of education for most individuals in Brazil.

Figure 5
Southeast Brazil: Estimated rate of return from one extra year of education obtained from equation presented in table 4 for selected years of schooling and approximate date of reference



Note: Calendar years in the horizontal axe are only indicative of roughly approximate date of changes. Their calculation arbitrarily considered that an average worker starts working at 14 years old and that the last year before entering the labour market defines his/her relative return to education and as such its quality. The range of ten years centred on this number certainly is the key period to determine the quality of education for most individuals in Brazil.

The most flexible relationship which arises from this method of splitting the dataset by age also points to a recent change in the trend of the quality of education in Brazil. The returns to education among the two youngest workers group entering the labour market increased in comparison with the age group immediately after that. This means that the recent concern with education quality, observed in the last six years started to bear some fruits.

Table 5
Estimated returns to education by age group

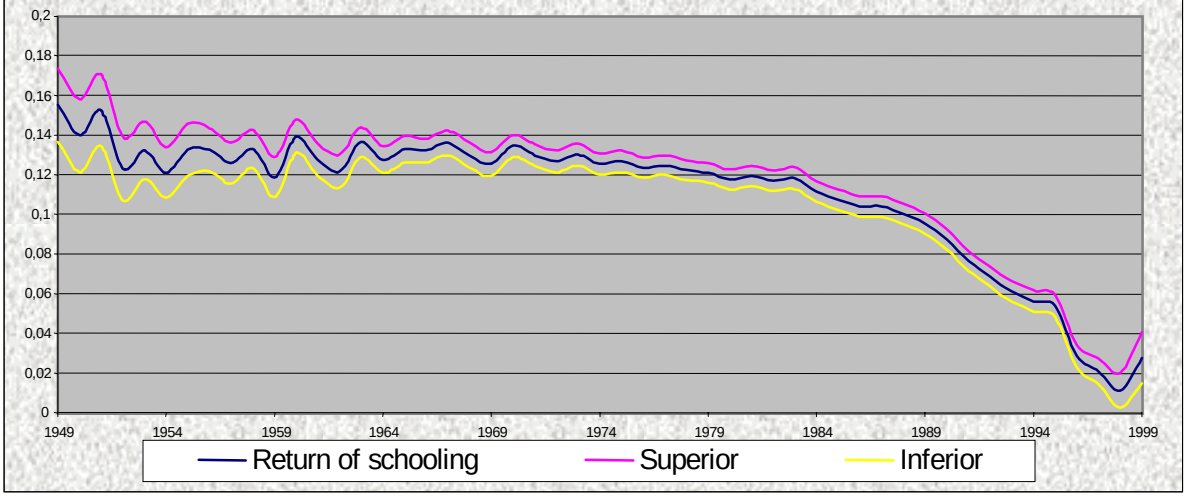
Age group	Rate of return	Superior limit	Inferior limit	Age group	Rate of return	Superior limit	Inferior limit
15	0,0275	0,0404	0,0146	**41**	0,1301	0,1355	0,1247
16	0,0110	0,0197	0,0024	**42**	0,1266	0,1320	0,1211
17	0,0206	0,0271	0,0140	**43**	0,1298	0,1354	0,1243
18	0,0283	0,0340	0,0225	**44**	0,1345	0,1402	0,1287
19	0,0538	0,0592	0,0483	**45**	0,1252	0,1312	0,1192
20	0,0563	0,0616	0,0510	**46**	0,1296	0,1360	0,1233
21	0,0611	0,0660	0,0561	**47**	0,1359	0,1420	0,1297
22	0,0686	0,0735	0,0638	**48**	0,1320	0,1382	0,1259
23	0,0764	0,0813	0,0714	**49**	0,1328	0,1395	0,1260
24	0,0874	0,0924	0,0824	**50**	0,1275	0,1341	0,1210
25	0,0954	0,1005	0,0904	**51**	0,1364	0,1438	0,1289
26	0,0999	0,1050	0,0948	**52**	0,1217	0,1300	0,1134
27	0,1040	0,1092	0,0988	**53**	0,1275	0,1355	0,1195
28	0,1040	0,1091	0,0989	**54**	0,1392	0,1476	0,1307
29	0,1076	0,1126	0,1025	**55**	0,1187	0,1287	0,1086
30	0,1113	0,1164	0,1062	**56**	0,1329	0,1423	0,1234
31	0,1182	0,1237	0,1128	**57**	0,1257	0,1359	0,1155
32	0,1167	0,1218	0,1117	**58**	0,1325	0,1434	0,1216
33	0,1192	0,1243	0,1140	**59**	0,1324	0,1456	0,1192
34	0,1176	0,1226	0,1125	**60**	0,1208	0,1334	0,1082
35	0,1209	0,1259	0,1160	**61**	0,1323	0,1468	0,1178
36	0,1221	0,1271	0,1172	**62**	0,1229	0,1390	0,1068
37	0,1248	0,1298	0,1198	**63**	0,1523	0,1704	0,1343
38	0,1234	0,1285	0,1184	**64**	0,1397	0,1580	0,1214
39	0,1267	0,1321	0,1214	**65**	0,1551	0,1734	0,1368
40	0,1252	0,1304	0,1200				

5. Conclusion

This paper has shown that education quality in Brazil has not been improving in the recent past. The expansion of educational access promoted by the military regime after the coup of 1964 was carried out at the expense of the quality of education. Its rate of return in the country has fallen since the early seventies, as unveiled by the estimations presented here. Only very recently has there been signs of a possible beginning of recovery, after a considerable effort by the Federal Government in the last six years to increase the quality of education. This recovery is still timid and very uncertain. Some time will be necessary before one can measure the real impact which the changes introduced in the last six years have unleashed.

Two hypothesis were forwarded to explain the long-term fall in the quality of education, which may be both working together, as they do not compete. First, it was the weakening of the charity nature of teaching associated with the institution of “sinhazinha”. This social relationship managed to supply the educational system with good teachers at fairly low costs. The charity involved in such activities was more relevant to attract the ladies engaged in teaching than the financial advantage offered. The fall of such incentives and the entrance of women in the formal labour market reduced the supply of such qualified labour for teaching.

Figure 6
Brazil: Estimated returns to education calculated from regressions by age groups in Brazil



Note: Calendar years in the horizontal axe are only indicative of roughly approximate date of changes. Their calculation arbitrarily considered that an average worker starts working at the age of fourteen, and that the last year before entering the labour market defines his/her relative return to education, and as such its quality. The range of ten years centred on this number certainly is the key period to determine the quality of education for most individuals in Brazil.

Parallel to this process, there were also changes in the major technological paradigms within the Brazilian economy. Until the early fifties most of the productive activities in the country relied strongly on low qualified labour as a source of competitiveness. After industry became stronger than agriculture, this source of competitiveness started to fail and each time there was more need of qualified labour. This process accelerated after 1985, when the Brazilian economy had to rely heavily on the adoption of the new paradigms developed in the industrial nations after the sixties, which were very intensive in qualified labour. This change introduced demands for new skills from the labour force, which were not appropriately developed in the Brazilian traditional educational schemes. As a consequence, the quality of education fell with respect to the needs of the labour market and there was a fall in the expectations of return to education in the country.

The changes on the demand for new skills from the labour force introduced in the last three decades are definitive, as there is a large supply of reasonably educated labour in the countries which have world leadership on technological development. Furthermore, this supply tends to increase even more, as the return to education for more qualified labour force is increasing relatively in these countries.[11] Therefore, the long term fall in the quality of education in Brazil identified in this paper will still represent a constraint to the growth of the country in the near future, as the incorporation of new technologies will face shortage of qualified labour for the next years, as already happening in the productive sectors.[12]

These findings and comments point to the necessity of even greater concern among public authorities and the whole society with the quality of education in Brazil. Its fall will have a highly perverse long-term impact on the development of the country and this tends to be higher each time, as the world technological development and demand for more qualified workers is growing fast.

[11] See for example Mincer (1996), Goldin and Katz (1999), Ashenfelter, Harmon and Oosterbeek (2000) and Acemoglu (1999).
[12] See for example Coutinho, L. and J.C. Ferraz, 1994.

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