EDUCATION, EARNINGS, AND INEQUALITY IN BRAZIL 1982-1998;

IMPLICATIONS FOR EDUCATION POLICY

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Abstract:
The educational attainment of the Brazilian labor force gradually expanded during the last two decades. Concurrently, a series of economic structural adjustment policies have been pursued. This paper investigates how these two simultaneous advances have altered the relationship between labor market earnings and education. We find that the remuneration of education fundamentally changed from 1982 to 1998. Returns to tertiary education increased sharply while returns to primary and lower secondary education dropped, 26 and 35 percent, respectively. Furthermore, we argue that the marginal reduction in wage inequality, which took place from 1982 to 1998, primarily was linked to a reduction in returns to schooling and only secondarily linked to a more equitable distribution of schooling. The findings suggest that the available supply of highly skilled labor inadequately meets demand. Therefore, policy action aiming at increasing access and completion of tertiary education is desirable. An increased supply would improve prospects for both economic growth and reductions in wage inequality.

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1. INTRODUCTION

In the last two decades, Brazil, along with many other developing countries, has witnessed a major expansion in its education system. Simultaneously, structural economic reforms have swept the country's economy that now stands much more liberalized internally and externally. This paper investigates how the remuneration of education has evolved during the period of these reforms.

The study joins a strand of literature focusing on the changes of labor demand that have taken place in a period of market liberalization and increased integration of developing countries into the global economy. This strand of literature documents an increased convexity of the earnings function. That is, the returns to one additional year of schooling rises with the years of completed schooling. Or in other words, a skilled worker earns increasingly more than an unskilled worker.[2]

The empirical findings on increased rewards of skills are theoretically underpinned by Feenstra and Hanson (1996) and Wood (2000). They argue that the economic reforms in developing countries combined with lowered transportation and communication costs could have given developing countries a comparative advantage in industries with an increasing intensity in human capital, although still low intensity relative to developed countries. The move of these industries to reforming developing countries have caused the average input of human capital in production, in both developing and developed countries to increase. Consequently, both groups of countries have experienced an increased demand for skilled workers. Findings from Costa Rica, Robbins and Gindling (1999), and Columbia, Santamaria (2000), show that Latin American countries, indeed, have experienced a shift in labor demand favoring highly skilled workers.

We solidly confirm the pattern of increased convexity in the earnings function in the case of Brazil. We do so by estimating private returns to primary, lower secondary, upper secondary and tertiary schooling separately. We estimate the returns from 1982 to 1998 using the Brazilian labor market survey. We apply both traditional Ordinary Least Squares (OLS) and the quantile regression methodology.

The changed remuneration of education on the labor market is important, since it indicates that highly skilled workers increasingly have become scarce in the Brazilian labor market. A scarcity would impede domestic companies and administration in acquiring the demanded advanced knowledge. The scarcity would therefore hamper economic growth. If the market for education functions smoothly, the supply of education would adapt to the shifts in demand. However, the market for education is in many countries severely restricted, see Prichett (2000). The shifts in demand for education might, therefore, not be accommodated by changes in supply, in which case there is need for policy intervention. This paper examines the case of Brazil and seeks to answer three questions: (a) Did the earnings function, in the Brazilian labor market, become increasingly convex over the last two decades? (b) Do education policymakers in Brazil

[2] See Katz and Murphy (1992), Murphy, Riddle, and Romer (1998), Robbins and Gindling (1999), Santamaria (2000), World Bank (1999), Lächler (1998), and Schady (2000) among others.

need to react to the changes in the remuneration of education? And (c) What would be the appropriate actions and the expected benefits?

The paper is organized as follows: the subsequent section describes the data. Section three provides background information on the Brazilian education system. Section four outlines the developments in the relations between education and earnings in Brazil for the last two decades. Section five presents the regression methodology we used, and the sixth section presents regression results and discusses policy implications.

The appendices are organized in five sections. Appendix A lists definitions of the variables used in this paper; Appendix B gives summary statistics; Appendix C contains the regression findings for both OLS and quantile regressions; Appendix D plots different variables and presents graphs with quantile regression results. Finally, the strategies and recommendations for Higher Education in Brazil from The World Bank's sector study of higher education in Brazil is presented in Appendix E.

2.DATA

The study analyzes the monthly labor market data *Pesquisa Mensal de Emprego* (PME) from *Instituto Brasileiro de Geografia e Estatística* (IBGE), the Brazilian Statistical Bureau[3]. The average number of available observations is 230,000 per year[4]. The large number of observations implies that the statistical significance of our findings largely exceed conventional significance levels. Nevertheless, two limitations should be noted when using this dataset. First, the data covers 6 metropolitan areas in Brazil: São Paulo, Rio de Janeiro, Porto Alegre, Belo Horizonte, Recife, and Salvador. These metropolitan areas cover 31.9 million people in the economic active age out of an estimated 79 million for Brazil in total. Moreover, in 1997, the states of the 6 surveyed metropolitan areas produced 72 percent of the Brazilian GNP[5]. Our findings are hence representative for the large and modern parts of the Brazilian labor market, but do not necessarily carry over to the rural economy. Second, being a labor market survey, the PME-survey only includes income from the labor market, namely, salary, earnings of self-employed workers, non-monetary earnings, and implicitly employer's earnings. These suffice for analysis of wage determinants and wage inequality, but are insufficient for characterization of total income inequality, since data does not report other important sources of income, such as public transfers and income from capital.

[3] The PME-data has a rolling panel structure. Respondents enter in 4 consecutive months and, then, are out of the sample for 8 months and, finally, surveyed for another consecutive 4 months. The panel structure isn't used in this article. We estimate with a yearly frequency which implies that the same individual could enter up till 4 times in the same regression. However, salary and potentially other characteristics change from each observation.

[4] For 1998 only data up till July is included reducing the 1998 sample size to 108,000.

[5] Source: IBGE accounts of gross regional products in current market prices. Brazilian GNP was R$ 864,112 mil and the six states: São Paulo; Rio de Janeiro; Rio Grande do Sul; Minais Gerais; Pernambuco; and; Bahia together accounted for R$ 618,728 mil.

The main indicator for education is completed years of schooling which is computed using an algorithm based on three survey questions on education[6]. For definition of other variables see Appendix A. All reported schooling variables are completed levels of education. Hence, when completed grades of education are reported, dropouts are counted as having completed the level of education below the level of drop out. For example, the group of workers with completed primary education includes dropouts of lower secondary education.

3.BASICS OF THE BRAZILIAN EDUCATION SYSTEM

The Brazilian education system consists of four levels with graduation tests: primary, lower secondary, upper secondary and tertiary. The basics for the system are presented in table 1. Noticeable is the relatively high average number of years it takes to graduate. It takes 35 percent longer time to complete primary education than planned and 23 percent longer for both lower secondary and upper secondary. This points to a low internal efficiency that includes a severe problem with high repetition rates. Moreover, annual cost per student increases significantly from upper secondary to tertiary education suggesting even further inefficiencies at the latter level.

[6] The algorithm follows the standard conversion used elsewhere, see Lam and Schonie (1993), Lam (1999), and Barros and Ramos (1996).

Table 1 Basic data of the Brazilian Education System

Brazilian structure	This paper's terminology	Grade	Length	Average No. of years to complete[1*]	Estimated cost in R$ per student /year[2*]	Legal responsibility [3*]
Ensino Fundamental	Primary Education	1-4	4	5.4	517	Shared between Municipality and State
	Lower Secondary Education	5-8	4	4.9	637	
Ensino médio	Upper Secondary Education	9-11	3	3.7	661	State
Supérior	Tertiary Education	12-17	4-6[4*]	4.5	13,654	Federal[5*]

[1*] Source: Klein (1999) for the first three cycles and Paul and Wolff (1992) for tertiary education.
[2*] Calculation of unit cost per student involves many uncertainties and assumptions. One should therefore be very cautious when drawing conclusions based on unit costs. The above unit costs do not take into account the high rates of dropping out or repetition. Adjusting for these problems would especially increase unit cost for the lower levels of education. The cost for tertiary is calculated only for federal universities, which normally are considered to be the most expensive. Source: World Bank (2000a) "Secondary Education in Brazil" and World Bank (2000b) "Brazil Higher Education Sector Study".
[3*] Other providers than the legally responsible authority also provide education. For example, for lower and upper secondary education, the actual providers are municipalities, states, federal government, and, private institutions(15%, 69%, 1%, and 15 %). For tertiary education, the same partition is 4%, 13%, 22%, and 61%, respectively. Source: World Bank (2000a) and World Bank (2000b).
[4*] Minimal nominal length of a degree program is 4 years, but some degrees at federal universities take 5 or 6 years.
[5*] Tertiary education is regulated by a subcommittee within the federal "*Conselho Nacional de Educação*" (CNE).

4. DESCRIPTIVE STATISTICS ON EDUCATION AND EARNINGS

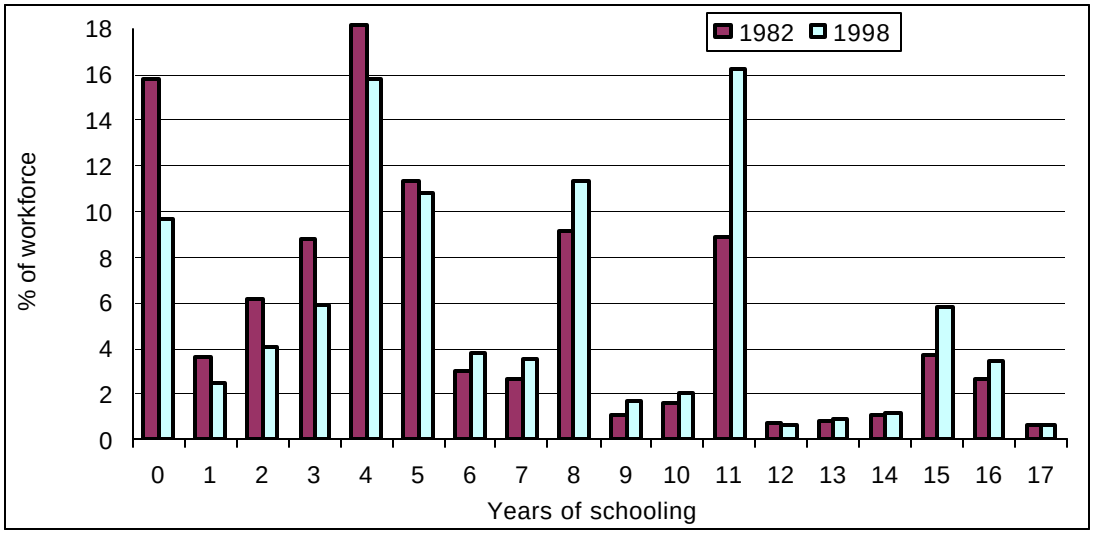
This section describes the educational composition of the Brazilian workforce and labor market earnings from 1982 to 1998. Appendix C contains additional descriptive statistics[7].

4.1. Educational composition of the metropolitan Brazilian workforce

Undeniably, *the stock of human capital* has increased in Brazil over the last two decades. In 1998, a worker had, on average, acquired 6.8 years of completed schooling. This compares to 5.4 years in the begin of the 1980s. This 26 percent increase in school attainment is the result of a steady process where less educated workers retired while a younger more schooled generation entered into the labor market. However, by international standards the Brazilian workforce still remains "under-educated" given its per capita income, Birdsall and Sabot (1996).

[7] Barros and Ramos (1996) presents an analysis of education and earnings for the period 1976-1989. This period overlaps with the period investigated in this paper, 1982-1998. For the overlapping years, 1982-1989, the figures presented in this paper correspond with those computed by Barros and Ramos, despite that their calculations are based on a different dataset, namely, the Brazilian national household survey, PNAD.

Figure 1 The educational composition of the workforce in 1982 and 1998



Source: author's calculation based on PME-data.

The *educational composition of the workforce* in 1982 and 1998 is displayed in figure 1. The spikes at 4, 8, 11, and 15-17 years of schooling correspond to the years with graduation exams (primary, lower secondary, upper secondary, and tertiary education, respectively). Two shortcomings of the education system are visible. First, in 1998, still 22 percent of the workforce is without any formal diploma of schooling, despite it coming down from 34 percent in 1982.[8] Second, a large proportion of workers dropped out of school in-between two degrees, namely 37 percent in 1998 down from 41 percent in 1982.

The accumulation process of human capital stock was strongest in the 1980s. In the 1990s, the pace slowed down. This trend holds for 4 out of 5 levels of education, the exception being lower secondary education, table 2.

Table 2 The accumulation of schooling by level for 1982-1990 and 1990-1998

	% of workforce by level of schooling			% change from 1982 to 1990	% change from 1990 to 1998	% change from 1982 to 1998
	1982	1990	1998			
No degree	36.7	27.7	21.5	-24.8%	-22.1%	-41.4%
Primary	32.7	34.2	34.3	4.6%	0.3%	4.9%
Lower sec	11.9	13.2	15.1	10.9%	14.4%	26.9%
Upper sec	11.2	15.5	18.8	38.4%	21.3%	67.9%
Tertiary	7.5	9.5	10.3	26.7%	8.4%	37.3%
Sum	100	100	100	-	-	-
Years of sch	5.4	6.2	6.8	14.8%	9.9%	26.2%

Source: authors' calculation based on PME-data.

In the 1980s, the percentage of workers with completed *primary education* slowly climbed up to 34.4 percent, but stagnated in the 1990s. This stagnation can be seen as a

[8] This number is constructed as the sum of the first four bars of figure 1.

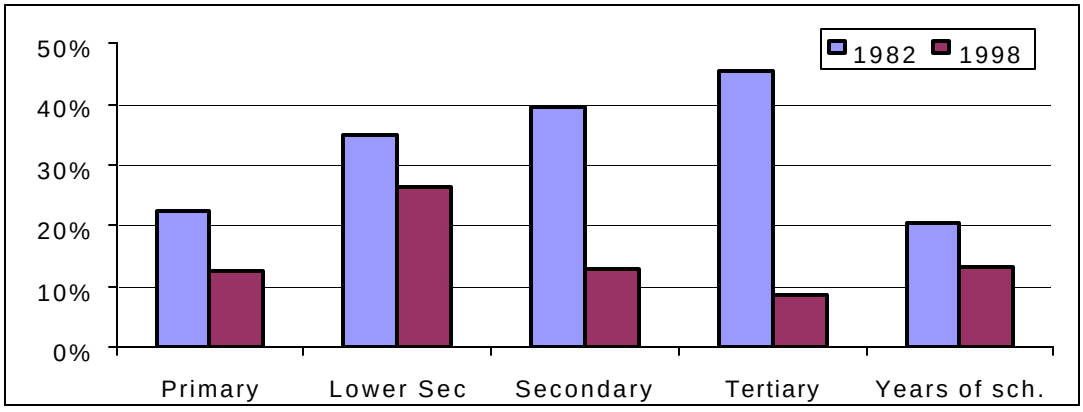
consequence of two principal factors. First, a high drop out rate. Second, a substantial increase in the enrollment rate into lower secondary education.

By far the largest expansion in completed schooling has taken place among the *middle levels of education*. The group of workers with completed lower secondary education increased by 27 percent and the share of workers with upper secondary education expanded by a remarkable 68 percent.

For *tertiary education*, a decomposition into two periods is informative. In the 1980s, the share of workers with completed tertiary education increased by 27 percent versus only 8 percent in the 1990s. This slowdown indicates a deceleration of enrollment and a declining efficiency of the Brazilian tertiary education system during the nineties. This in turn, partly explains the massive increase in the group of workers with completed upper secondary education.

The increased number of graduates at the middle of the education scale resulted in a more equal distribution of education in Brazil. The Gini coefficient for completed schooling fell every single year in the observed period, starting from the zenith of 0.44 in 1982 and ended 0.36 in 1998 [9].

Figure 2 The school gender gap in 1982 and 1998 by education level



Note: The gender gap is computed as the gender difference in percentage of workers who completed the particular level of schooling divide by the male percentage, (%male-%female)/ %male. For years of schooling: (YoS[male] – YoS[female])/ YoS[male].
Source: authors' calculation based on PME-data.

The *gender gap in education* has been reduced over the two decades. In 1998, the stock of male workers had completed 13 percent more years of schooling than their female colleagues. This figure compares to 20 percent in 1982. The data hence show that females have acquired further schooling at a faster pace than their male counterparts over the last two decades. Furthermore, the pattern of the gender gap in the education system has been reversed. In 1982, the gender gap monotonically increased with the level of education. By 1998, the gender gap was most pronounced for lower levels of schooling, in particular for lower secondary education.

[9] Inequality of human capital in a population can be assessed by the same measures as income inequality, such as Gini coefficient, Theil-L, Theil-T, and coefficient of variance. The Gini coefficient measure is adopted as standard measure for inequality in both income and schooling through out this paper.

4.2. Evolution of earnings: 1982-1998

In 1998, an average metropolitan worker earned R$ 199 a week for an average work week of 41.9 hours.[10] This implies an hourly wage of R$ 4.7. Education is a key determinant of wage in Brazil, see table 3. The large difference between educational groups is epitomized by the 814 percent difference between the monthly wage of a university graduate and a worker with no degree.

Table 3 Earnings by education level in 1998

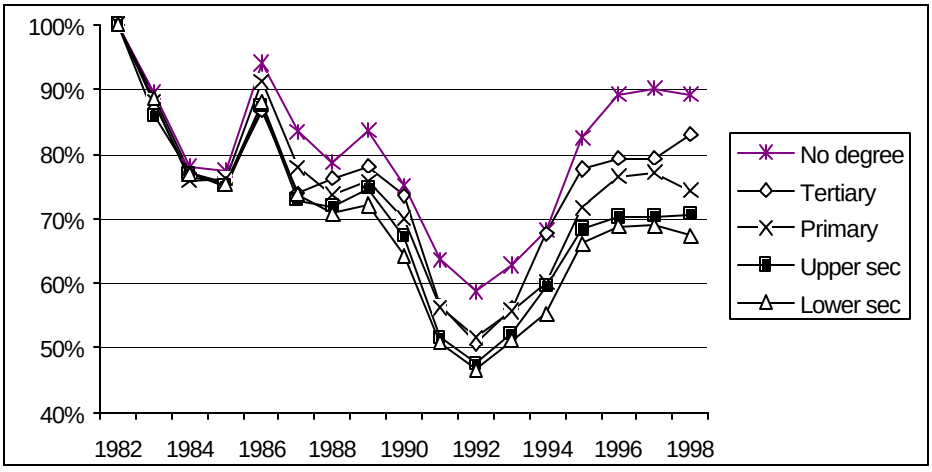
Completed degree of education	Medium hourly wage in 1998 (R$)	Average hourly wage in 1998 (R$)	Relative to the wage of a worker with no degree
No degree	1.47	1.94	100%
Primary	1.86	2.56	132%
Lower sec	2.55	3.60	186%
Upper sec	4.18	6.31	325%
Tertiary	12.2	15.8	814%
Total	2.48	4.84	249%

Source: authors' calculation based on PME-data

Earnings for the different education groups closely followed the same pattern during the 1980s, figure 3. The co-movement may be a result of the large role played by common determinants of wages, such as macroeconomic policy, macro economic shocks, investment, and, productivity. Since the recovery from the recession in the early 1990s, earnings by education level have diverged. Workers at the two ends of the education scale, no completed degree and completed tertiary education, have experienced the highest increase in salary. For these two groups, the current wage levels are more or less equal to the levels obtained during the boom in 1986, but, remarkably, it's still lower than earnings in 1982. For the group of semi-skilled workers (with completed lower and upper secondary education) that expanded during the 1980s, the recovery in wages has only been partial. This pattern suggests a link from relative supply of workers with a level of education to the remuneration of that level of education. That is, the remuneration of lower and upper secondary education fell because of an increase in the relative supply of workers with these education levels. We shall return to this hypothesis below.

[10] All earnings are in fixed 1997 prices.

Figure 3 Wage Index by education level (1982=100)



Source: authors' calculation based on PME-data

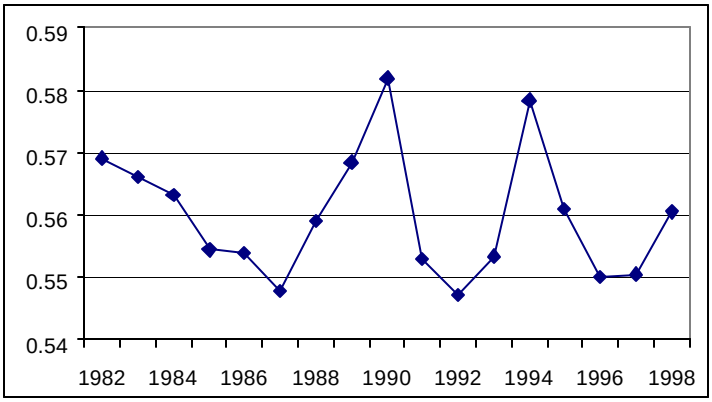
Other factors than educational composition of the workforce influence the average wage, such as, age, gender, labor market position, and, region of living. For example, in 1998, the average age of a worker with no degree was 42.3 years old while the typical worker with secondary education was 38 years old. Since age also affects wages, the age-difference partially explains the observed wage difference. This stresses the need for purging observed earnings for other effects in order to clarify the relationship between education and earnings. This is done by regression methods as outlined in Section 5 Methodology.

Earnings inequality is notoriously high in Brazil. In 1998, the Gini coefficient was 0.56, figure 4. The extremely unequal income distribution has sparked a number of studies of the evolution and determinants of the inequality, see Neri and Camargo (1999), Ferreira and Barros (1999), Lam (1999), and Birdsall and Sabot (1996). It is generally accepted that wage inequality in 1998 was marginally below the level of 1982, as is also indicated by the PME-data. However, for short run changes no clear consensus exist with the notable exception of the launch of the *Real* plan in 1994 that clearly succeeded in stabilizing prices which benefited the poor more than the rich. Hence the *Real* plan reduced inequality [11] [12].

[11] This finding corresponds with international evidence from Dollar and Kraay (2000). Based on data from 80 countries, they find that elimination of hyper-inflation is a pro-poor policy.

[12] Prior to the *Real* plan, the sign of change in wage inequality not only depends upon the chosen measure of inequality, but also upon the chosen income source, such as wage or total household income per capita. Therefore no clear pattern is detectable.

Figure 4 Wage inequality from 1982-1998



Source: authors' calculation based on PME-data

5.METHODOLOGY

This section is organized in two sub-sections. The first sub-section outlines the economic model applied in the analysis and the second explains the applied estimation techniques.

5.1.Economic model

The underlying economic model used in the analysis will simply follow Mincer's (1974) human capital earnings function extended to control for a number of other variables that relate to location of living and labor market status. In particular, we apply a semi-logarithmic framework that has the form:

$$\ln y_i = f(s_i, x_i, z_i) + u_i \qquad (1)$$

where $\ln y_i$ is the log of labor market earnings for an individual; i, s_i stands for completed years of schooling, x_i is a matrix of personal characteristics other than schooling, namely, age, age squared, gender, and, labor market status[13]. z_i represents a matrix of metropolitan dummies. The last component, u_i, is a random disturbance term that captures unobserved characteristics.

The functional form is left unspecified in equation (1). We estimate returns to schooling in two different ways. First, a linear specification of years of schooling:

$$\ln y_i = ß_0 + ß_s s_i + x_i'ß_x + z_i'ß_z + u_i \qquad (2)$$

Second, we estimate a spline form of years of schooling to estimate the average returns to one additional year of schooling regardless of the level of education

$$\ln y_i = ß_0 + ß_{pri}\, s_{pri} + ß_{losec}\, s_{losec} + ß_{upsec}\, s_{upsec} + ß_{ter}\, s_{ter} + x_i'ß + z_i'ß_z + u_i \qquad (3)$$

[13] Labor market status is either employee, self-employed, or employer. Furthermore, employees are partitioned into formal employees and informal employees. The split-up of employees is based on whether an employee has "*carteira assinada*" (signed workbook) which entitles the employee to a series of benefits. The variables are dummies.

Where each s refers to the number of years of schooling completed at the level of either primary, lower secondary, upper secondary, or, tertiary education[14]. Moreover, the schooling variables in model (2) and (3) are interacted with a gender dummy in order to estimate the returns to schooling for each gender separately[15].

5.2.Estimation techniques

We estimate the above economic models using two different estimation techniques, namely, Ordinary Least Squares (OLS) and quantile regressions. Normally, labor market studies make use of conditional mean regression estimators, such as OLS. We use this technique to obtain the general picture of the relationship between education and earnings. However, the OLS-technique is subject to criticism because of several, usually heroic, assumptions underlying the approach. One is the assumption of homoskedasticity in the distribution of the error terms. If the sample is not completely homogenous, this approach, by forcing the parameters to be the same across the entire distribution of individuals, may be too restrictive and may hide important information. Therefore, we also apply quantile regression.

The advantage of quantile regressions is that one can choose any quantile and, thus, obtain many different parameter estimates on the same variable depending on what part of the wage distribution information is wanted. We estimate for each of the following quantiles: 10^{th}, 25^{th}, 50^{th}, 75^{th}, and, 90^{th}. In this manner the entire conditional wage distribution is explored. By testing whether coefficients for a given variable across different quantiles are significantly different, one implicitly also tests for conditional heteroskedasticity across the wage distribution.

Intuitively, quantile regression estimates convey information on wage differentials arising from non-observable characteristics among individuals otherwise observationally equivalent. In other words, by using quantile regressions, we can determine if individuals that rank in different positions in the conditional distribution (i.e., individuals that have higher or lower wages than predicted by observable characteristics) receive different premiums to education, experience, or to other relevant observable variables. This is in particular interesting for countries such as Brazil where wage disparities are huge and returns to, for example, human capital may vary across the distribution.

The method has many other virtues apart from being robust to heteroskedasticity. When the error term is non-normal, for instance, quantile regression estimators may be more efficient than least square estimators. Furthermore, since the quantile regression objective function is a weighted sum of absolute deviations, one obtains a robust measure of

[14] Specifically, we estimate the spline function with knots at the graduation year of each education level, hence 4, 8, and, 11 years of completed schooling.

[15] We estimate private returns to schooling. Interpretation of private returns to schooling as an ordinary rate of return to an investment necessitates inclusion of a series of additional information, such as costs (opportunity cost, private out-of-the-pocket costs, and public costs), the incidence of repetition, and externalities from education. We do not interpret the computed returns to schooling as an absolute percentage return. We interpret the returns to schooling as an indicator for the interaction between existing supply of education and prevailing demand for education on the labor market.

location and, as a consequence, the estimated coefficient vector is not sensitive to outlier observations on the dependent variable.[16]

Formally the method, first developed by Koenker and Basset (1978), can be formulated as[17]

$$y_i = x_i'\beta_\theta + u_{\theta i} = \text{Quant}_\theta(y_i \mid x_i) = x_i'\beta_\theta \qquad (2)$$

where $\text{Quant}_\theta(y_i \mid x_i)$ denotes the θ^{th} conditional quantile of y given x, and *i* denotes an index over all individuals, $i = 1,\ldots,n$.

In general, the θ^{th} sample quantile ($0 < \theta < 1$) of y solves

$$\min_b = \frac{1}{n}\left\{ \sum_{i: y_i \geq x_i'b} \theta \mid y_i - x_i'b \mid + \sum_{i: y_i < x_i'b} (1-\theta) \mid y_i - x_i'b \mid \right\} \qquad (3)$$

Buchinsky (1998) examines various estimators for the asymptotic covariance matrix and concludes that the *design matrix bootstrap* performs the best. In this paper, the standard errors are obtained by bootstrapping using 20 repetitions[18].

6. WAGE REGRESSION FINDINGS

This section discusses findings and their implications for future education policy.

6.1. Returns to one additional year of schooling

Figure 5 presents the estimated returns to one additional year of completed schooling for the 1982 to 1998 period. The estimates are statistically very significant, as indicated by the narrow 95% confidence interval displayed by the two dotted lines[19]. Appendix C

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[16] That is, if $y_i - x_i'\hat{b}_\theta > 0$, then y_i can be increased toward + 8, or if $y_i - x_i'\hat{b}_\theta < 0$, y_i can be decreased toward -8, without altering the solution $\hat{b}_\theta$. In other words, it is not the magnitude of the dependent variable that matters but on which side of the estimated hyperplane the observation is. This is most easily seen by considering the first-order-condition, which can be shown to be given as (see Buchinsky 1998) $\frac{1}{n}\sum_{i=1}^{n} (\theta - \frac{1}{2} + \frac{1}{2}\text{sgn}(y_i - x_i'\hat{b}_\theta))x_i = 0$.

This can be seen both as a strength and weakness of the method. To the extent that a given outlier represents a feature of "the true" distribution of the population, one would prefer the estimator to be sensitive to such an outlier – at least to a certain degree.

[17] See Buchinsky (1998).

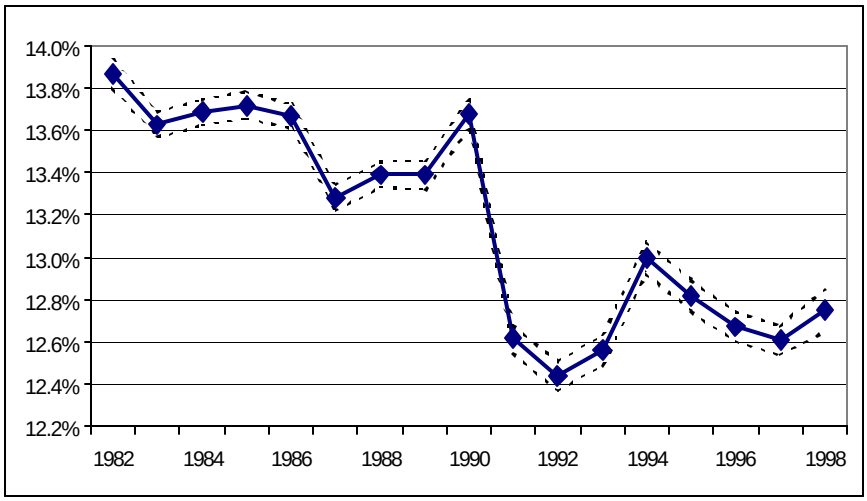
[18] The chosen number of repetitions is fairly low compared to the standard of 200 in the literature. We have limited the number of iterations due to time constraints. Because of the enormous dataset, each repetition lasts one hour implying that an estimation for one year with the standard 200 iterations would take 200 hours. The choice of a relative few iterations has no impact on the estimated coefficient, only the standard error is affected. The standard error may be underestimated. We ran a "control-regression" with 50 iterations. The standard errors originating from the bootstrapping with 50 iterations only showed minor deviations from the standard errors derived from the bootstrapping with 20 iterations.

[19] The t-value for the coefficient of years of schooling ranges from 248 to 445. The t-values decreases during the period. This suggests that either the specified linear relationship between wage and schooling

contains the complete estimation results from all regressions. Returns to schooling shown in this section are for males which in 1998 constituted 74 percent of the labor force. The returns to schooling for females largely follow the same pattern as for males.

In 1982, the returns to one additional year of schooling was 13.9 percent. The returns to education fell steadily over from 1982 to 1998 reaching 12.8 percent. This corresponds to an eight percent decline. The relative persistency of the estimated returns to schooling indicates that pay-off to human capital is primarily driven by long-term structural processes. The decline in returns to education can plausibly be explained by the equally steady accumulation of human capital that took place during the last two decades, leading to a larger increase in supply of skilled labor relative to the increase in demand.

Figure 5 The returns to one additional year of schooling



Source: authors' calculation based on PME-data
Note: The figure depicts the private returns to one additional year of schooling as estimated by a linear specification of years of completed schooling. The model includes control variables and is estimated by OLS. The dotted lines indicate the 95% confidence interval.

6.2.Returns to schooling by education level

We now split the above coefficient of years of schooling into four coefficients, one for each level of education; primary, lower secondary, upper secondary, and tertiary education. This is done by estimating model (3) where years of schooling is specified with splines.[20] The estimated coefficient for each level of education indicates the rate of returns to one additional year of schooling at that particular level.

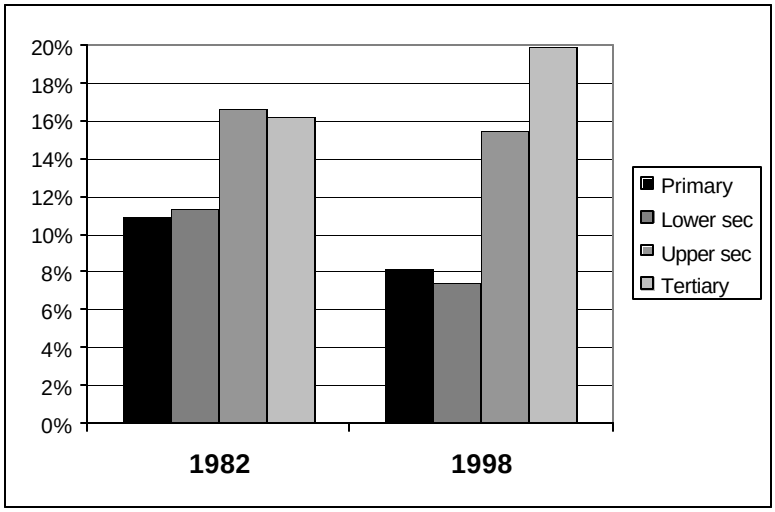
The returns to schooling by education levels for 1982 and 1998 are displayed in figure 6. In 1982, primary graduates received the lowest returns to one additional year of education, namely 10.9 percent. This was slightly below the returns to lower secondary education at 11.4 percent. The pay-off per year to upper secondary and tertiary education

becomes less appropriate or that schooling mattered less for wages in the later years. Subsequent findings show that the linear specification became less appropriate.

[20] The estimation technique remains OLS.

were approximately five percentage points higher, namely, 16.7 and 16.2 percent, respectively[21].

Figure 6 Returns to education by level for 1982 and 1998



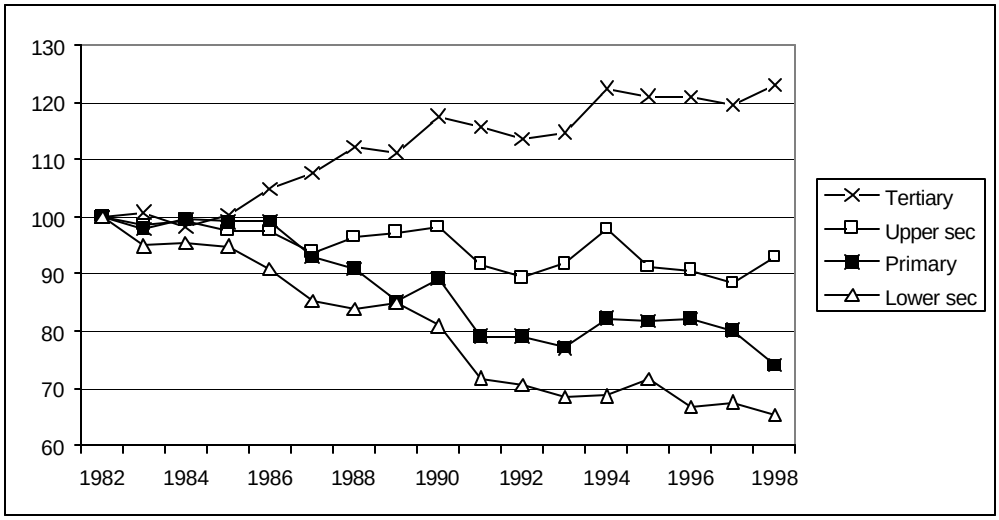
Source: authors' calculation based on PME-data.
Note: Each bar indicates the private returns to one additional year of completed schooling at the designated level. The model includes control variables and is estimated by OLS.

By 1998, returns to schooling by level of education have moved in different directions. Workers with lower levels of education experienced a substantial decrease in returns to education. Workers who only attended primary education, between one and four years of completed education received 8.1 percent, corresponding to a 26 percent decline over the period. Also, the returns to lower secondary schooling plunged 35 percent reaching 7.1 percent in 1998, down from 11.4 percent in 1982. Workers holding a secondary education diploma experienced only a slight fall in returns from 16.7 percent to 15.5 percent, a decline of 8 percent from the 1982 level. As the only group, workers with a completed tertiary education, saw an increase in returns to schooling. The returns rose from 16.1 percent in 1982 to 19.9 percent in 1998. This corresponds to a 24 percent increase.

Figure 7 shows the evolution of returns to schooling by level of education over the period. The returns are indexed to 100 in 1982. Generally, the return to each level of education changed slowly and persistently indicating that structural mechanisms caused the evolution. The graph underscores that a clear divergence in returns to schooling took place in the last two decades.

[21] The statistical significance, or in other words the reliability of the estimate, is once again very high. The lowest t-value is 31.6 pertaining to the coefficient estimate of primary education in 1998.

Figure 7 Indexed returns by level of education (1982=100)



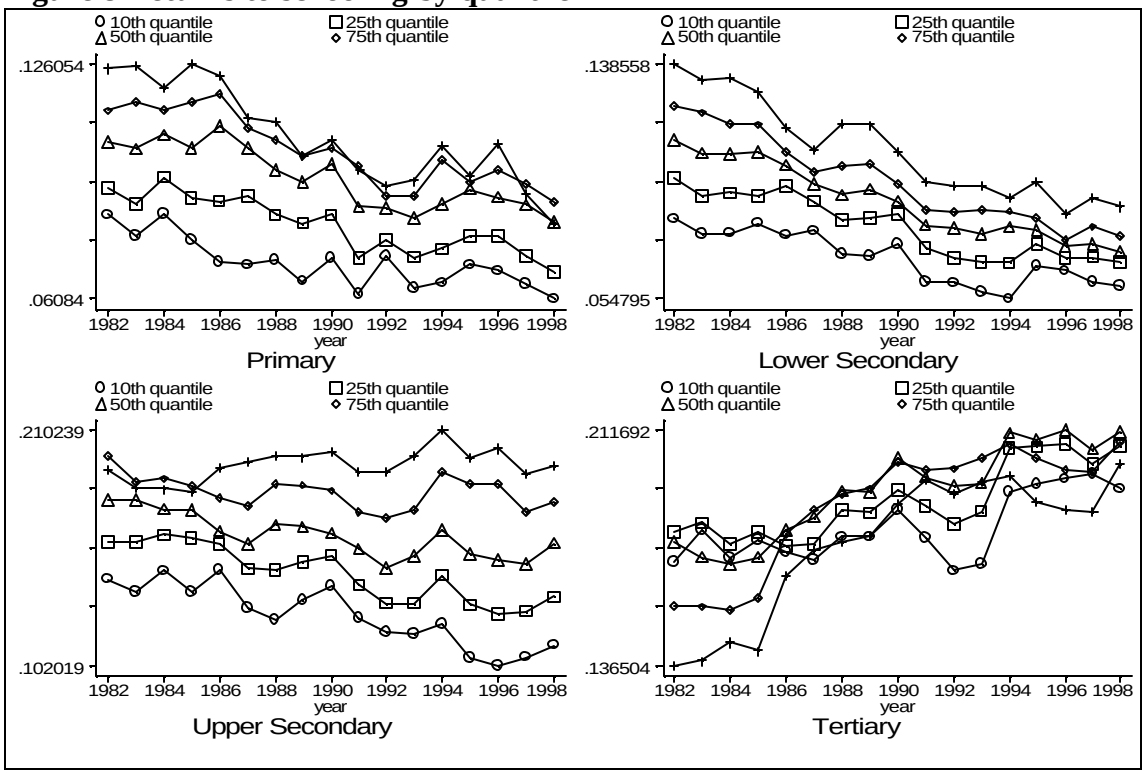
Source: authors' calculation based on PME-data.
Note: The coefficients are indexed returns to schooling estimated from earnings-regression with control variables.

This divergence in returns to schooling by level of education has caused an increasingly convex curve of returns to schooling as shown in figure 6. Workers with lower levels of education, between 1 and 8 years of schooling, which already received a wage substantially below the wage of highly educated workers, witnessed the returns to schooling fall. Conversely, workers with more than 12 years of schooling positioned higher in the wage distribution saw an increase in the returns to schooling. The increased convexity corresponds to findings by Arbache, Green and Dickerson (2000) and Ferreira and Barros (1999).

6.3.Returns to schooling within education levels

The above reported returns are estimated with the OLS-regression technique that assumes individuals in the same education group receive identical returns to schooling. This is a quite wide ranging assumption taking into consideration the size of each education group. For instance, the group of workers with primary education consists of 10.9 mil. workers (34.4 percent of urban workers). The estimates do not convey any information whether the above identified changes in returns to education have been common to all workers within the education group? For example, is the rising returns to tertiary education reserved relatively few with extravagant salaries or is the increment in pay-off due to a group-wide wage increase? The quantile regression technique provides an answer to this question. With quantile regressions, we can assess whether workers across the whole wage-distribution in an education group experienced the same change in returns to schooling. We estimate returns to schooling for each of the following quantiles: 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th}. The coefficient indicates how much a worker positioned around the estimated percentile in the wage distribution received in returns for his or her schooling. The full regression results are presented in Appendix C. The returns to schooling for each education level by quantile are depicted in figure 8.

Figure 8 Returns to schooling by quantile



Source*: authors' calculation based on PME-data.*
Note: The returns to schooling for the 90th quantile is indicated by "+".
The graph depicts returns to schooling for one additional completed year of schooling for five quantiles. The estimation technique is quantile regressions.

The findings show that returns to schooling within education groups differ considerably across the wage distribution. Whenever returns to schooling for different quantiles are statistically different, wage earners in the highest quantile receive the highest returns. That is, whenever the difference is statistically significant, the returns to schooling for workers in the 90th quantile consistently exceeds the returns to workers in the 75th quantile which in turn exceeds the returns for the 50th quantile and so on. The exception being returns to tertiary education where returns for the wealthier quantiles, 75th and 90th, were inferior to the less wealthier quantiles [22] [23]. The large dispersion indicates that schooling is not uniformly rewarded in the labor market.

Figure 9 equally shows how the dispersion of returns to schooling within each education group has evolved over time. The graphs indicate that returns within the primary, lower secondary and tertiary education groups became more homogeneous. We computed the relative spread of returns to schooling within each education group as the numeric difference between returns to schooling for the 90th quantile and returns to schooling for

[22] Other determinants of wage have the opposite pattern across the wage distribution. For instance, being a formal employee (having a signed workbook, "*carteira assinada*") or working in the construction sector benefits more the poor workers (10th quantile) than the richer (90th quantile).

[23] We tested the equality of coefficients across quantiles. For example, is returns to schooling for the 90th quantile equal to the returns to schooling for the 75th quantile? These tests are available from the authors upon request.

the 10th quantile divided by returns to the 10th quantile, table 4. A drop implies that returns to the less well-paid in the education group approached returns to the well-paid in the education group. Hence, all quantiles in the education group experienced the same direction of change

Table 4 Convergence or divergence in returns within education groups

	Absolute spread 1982	Absolute spread 1998	Change in absolute spread	Relative spread 1982	Relative spread 1998	Change in relative spread
Primary	4.1%	2.1%	-2.0 %point	48%	34%	**-14** %point
Lower sec	5.5%	2.8%	-2.7 %point	66%	47%	**-19** %point
Upper sec	5.0%	8.3%	3.2 %point	35%	74%	**39** %point
Tertiary	3.3%	0.8%	-2.5 %point	19%	4%	**-15** %point

Source: authors' calculation based on PME-data.
Note: The absolute spread is calculated as the numeric difference in the estimated returns to schooling for the 90th and the 10th quantiles. The relative spread is the absolute spread divided by the estimated returns to the lowest quantile (10th).

For workers with primary, lower secondary, and tertiary schooling, returns to schooling became more homogeneous. The relative spread was reduced by 14, 19 and 15 percentage points, respectively. The reduction in spreads shows that workers with the same education level shared the evolution of returns to the schooling, regardless of their income. That is, the decline in returns to primary and lower secondary education estimated on the basis of mean earnings (by OLS-technique) equally pertains to workers in the 10th quantile as for workers in the 90th quantile. Similarly, we can conclude that the rise in returns to tertiary education estimated by the OLS-techniques has affected both the relatively low-income workers with tertiary education as the high-income workers with tertiary education.

For workers with upper secondary education, the returns to schooling across quantiles diverged. All quantiles except the 90th quantile suffered deteriorating returns. Returns to schooling for workers around the 90th quantile increased slightly over the two decades. In 1998, the 10 percent highest paid workers (90th quantile) with secondary education received 74 percent more than the 10 percent lowest paid workers (10th quantile) in returns to the same number of years of schooling. The decline in returns to schooling for the group as a whole observed by the OLS-estimate, has consequently been shouldered by the majority of the workers in the group. However, a subgroup has continued to enjoy elevated returns to schooling.

It's a puzzle why the reward to upper secondary schooling became increasingly uneven, when the other three education levels became more homogeneously rewarded. Equally surprising is the large spread existing within the pre-tertiary education groups, 34, 47 and 74 percent for primary, lower secondary, and upper secondary education, respectively. The large dispersion in returns to schooling suggests that: First, factors not controlled for in the model, are linked to the returns to schooling; and/or second, the estimated model should allow for interaction between returns to schooling and observable characteristics,

such as experience, job-status, industry of employment and region of living.[24] Three uncontrolled factors have been asserted that could explain the large spread.

- *Quality of schooling*. Students that attended high-quality schools, accumulated human capital at a faster pace than students enrolled in low-quality schools. The human capital difference subsequently implies a wage-difference in the labor market. Behrman, Birdsall, and Kapland (1996) find a substantial effect from quality of schooling to returns to schooling in Brazil.

- *Social Capital*. If the benefit of "knowing somebody" rises with the years of schooling, then returns to schooling depend on each individual's amount of social capital[25].

- *Unobserved ability.* Unobserved ability increases knowledge acquired in school. Consequently, "high" ability learners pick up more in school and, therefore, obtain higher returns to time spent in school than "low ability" learners[26].

We do not try to assess the relevance of each factor in the explanation of our findings. For now, we settle with the important information that the change in returns to schooling for each education group identified by the OLS-estimations has affected the vast majority of workers within each education group. The increased convexity in returns to schooling is hence a general phenomenon in the Brazilian economy.

6.4.Impact of other personal characteristics on wage.

The estimated regression model contains several other personal characteristics than education. Below we briefly comment on the impact of personal characteristics other than education on wage.[27]

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[24] Robbins and Minowa (1996) examine the impact of industry of employment on returns to schooling in Brazil. They argue from an efficiency-wage perspective. The cost of monitoring an employee's effort depends on the sector's production technology. Returns to schooling therefore differ across industries. In accordance with theory, they find large differences in returns to schooling between industries. Card and Lemieux (2000) find that returns to the same level of schooling may vary between age-cohorts, since younger graduates are imperfect substitutes for older graduates due to lack of experience. Similarly, returns to schooling could differ across metropolitan regions.

[25] Social capital has been defined in many ways. Social capital is here thought of as an individual asset characterized by (a) the number of persons that you know and (b) the extent to which they will put you "in front of the rest".

[26] Rosenbaum (2000) discusses the role of unobserved ability in the increased college/high school wage differential in USA. As a proxy for unobserved ability, he uses cohort specific educational ranking, assuming (a) a positive relationship between education and unobserved ability and (b) that relative unobserved ability remained stable over the period investigated (1940-1996). The idea is that due to the education expansion over time, the unobserved ability of an average high school graduate has fallen. In 1940, high school graduates were between the 68% and 86% best educated in the population. By 1996, they were among the 9th and 43rd percentile. The relative ability of a high school graduate had hence decreased which partially explains the observed relative decrease in earnings of high school graduates. A vast amount of literature investigates the relationships between ability, choice of education and returns to education. For a review see Card(2000).

- Experience. The returns to experience has steadily declined over the two decades. Two possible explanations exist for this decline: (i) the aging of the labor force; in 1982, the average worker was 43.2 years old. This compares to 46.6 years in 1998. The aging of the labor force implied that the supply of experienced workers increased which in turn reduced the returns. (ii) The value of experience declined due to the introduction of new products and production techniques.

- Female wage-gap. The participation of females in the labor market rose considerably during the two last decades. In 1998, women made up 26 percent of the labor force, which compares to 19 percent in 1982. Concurrently, the wage gap associated with being a female approximately halved over the period. Nevertheless, the wage difference between male and female workers, keeping other observable factors constant, still remains substantial. The wage gap amounts to 1.3 *reais* per hour which is 28 percent of the average hourly wage.

- Job-status. The economic reforms of the 1980s and 1990s seem to have benefited the employers and self-employed relatively more than employees. The wage-premium given to employers and self-employed relative to informal employees grew R$ 0.5 and R$ 0.1, respectively. The wage-premium for employees linked to a formal wage-contract, *"cartiera assinada"*, has marginally declined over the period. The increased wage premium to self-employed and the reduction in wage-premium to formal employees could be one of the reasons for the gradual increase in informality that took place during the two examined decades. In 1982, the share of informal workers, defined as self-employed and employees without a signed workbook, made up 34 percent of the workforce compared to 47 percent in 1998. In particular the share of self-employed workers rose. Additional, we find that having a signed workbook is especially beneficial for low-income employees, 10^{th} and 25^{th} quantile, where the wage premium per hour attains R$ 1.2. The wage-differences between job-status depend to a high degree upon the economic cycle. Compared to employees without a signed workbook, the wage premium for employers and self-employed are pro-cyclical while the premium attached to a signed workbook moves counter-cyclical. In non-technical terms, these findings show that employers and self-employed suffer relatively more in economic recessions while workers with a signed workbook are cushioned. Hence, the increase in informal jobs could has lead to a rise wage volatility.

- Wage premium between sectors. During the two examined decades, the hourly wage-premium to workers employed in the service sector increased by R$ 1.1 compared to the reference group of workers employed in commerce. Concurrently, the wage premium to workers in manufacturing declined 15 percent corresponding to R$ 1. In particular during the trade-liberalization from 1988 to 1990 did the well-off manufacturing workers, the 75^{th} and 90^{th} quantiles, suffer a drastic drop in wage-premiums, 42 and 45 percent, respectively. These shifts in wage-premiums were accompanied by a flow of labor from manufacturing to services. The share of

[27] Descriptive statistics cited in this paragraph are from Appendix B. The impact of a personal characteristics on hourly wage is calculated as the exponential value of the estimated coefficient depicted in Appendix D.

employees in manufacturing decreased from 24 percent in 1982 to 17 percent in 1998, whereas the share of employees in services swelled from 40 percent to 49 percent in the same period. Furthermore, the quantile regression findings reveal that employment in the construction sector is lucrative for workers in the upper end of the wage-distribution, 75th and 90th quantiles, whereas for workers in the 10th and 25th quantiles, the wage premium is consistently negative.

- Metropolitan areas. From 1982 to 1994, the wage-level in all covered metropolitan areas decreased compared to the wage level prevailing in São Paulo. Since then, there has been a partial recovery, especially in Recife, Belo Horizonte and Rio de Janeiro.

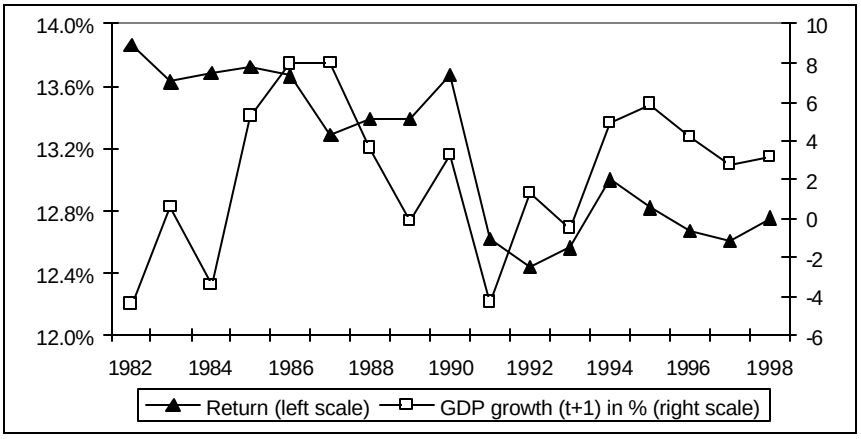
Although we believe these findings merit additional attention, this cannot be given in this paper due to its focus on education. We therefore return to the main agenda.

6.5.Reasons behind the change in returns to schooling

The findings of a fundamentally different relationship between wages and education naturally leads to the question of what are the forces causing the increased convexity of returns to schooling. This section discusses plausible answers.

First, *fluctuation in GDP* seems to impact the average returns to schooling, figure 9. A relationship is, indeed, discernible, but only after 1986. The simple correlation coefficient between the two series is –0.01 for the whole period 1982-1998, but 0.46 for the period after 1986. After 1986, GDP-growth, thus, seems to be weakly related to the average returns to schooling in the subsequent year. That is, GDP-growth, all other factors equal, increases the reward to human capital.

Figure 9 The returns to schooling and leaded GDP growth



Source: authors' calculation based on PME-data and for GDP-growth: World Bank database SIMA.
Note: The returns to schooling is given by the coefficient to years of schooling in an earnings regression with control variables.

GDP growth or factors associated with GDP-growth could affect returns to schooling by various channels. In a standard neo-classical production function with factor neutral technology and three factor inputs: capital, raw labor and human capital, the marginal product of human capital depends positively upon the other two inputs. Consequently, the marginal value of schooling increases with capital investments, the availability of raw

labor and the technological level. Hence, increased capital investments and increases in total factory productivity linked to economic growth plausibly explains the positive relationship between economic growth and returns to schooling depicted in figure 9. However, the volatile movements in GDP cannot explain the increased convexity in returns to schooling. The steadily growing difference between returns to lower levels of education and returns to tertiary education fits poorly with the volatile movements in economic growth. Therefore, we turn to other mechanisms for an explanation. Previous research has explained movements in the skill premium by five structural mechanisms. Below the essence of each hypothesis and the relevance in the Brazilian case are discussed.

- *Institutional change in the labor market*. This explanation asserts that deregulation of the labor market, such as diminished labor union power, reduced real minimum wages, or expansion of the informal sector, have affected returns to schooling.[28] As presented in the previous subsection, a significant expansion of the informal sector has taken place during the two decades.[29]

The remaining four hypotheses are best illustrated in a supply and demand framework for skilled versus unskilled labor.

- *Shifts in labor supply.* Assuming labor, skilled as well as unskilled, is a normal good, an increase in supply of one of the types of labor, would, all other things equal, cause the price, which in this case is the returns to education, to fall. As presented above, several shifts in supply have taken place during 1980s and 1990s. The group of semi-skilled workers (workers with lower and upper secondary education) rapidly expanded (by 27 and 67 percent, respectively).

- *New technology* has sharpened demand for skilled labor. Since, new technology is primarily accessible by workers with higher education, the demand for skills rises as new technology is introduced in the economy.

- *Increased openness* has increased demand for skilled labor. Reductions in tariffs and elimination of most non-tariff barriers supposedly have altered the national (autarchy) price on skills to the world market price. On the world market, high returns to tertiary schooling prevails because of scarcity of skilled labor in the world[30]. In the case of Brazil, the increase in skill-premium due to a change from autarchy prices to national prices is unsatisfying. The argument hinges on national endowments of skilled labor

[28] The minimum wage is expected to affect returns to schooling negatively. A rise in a binding minimum wage increases the wage of the lowest paid workers who are mainly without or have little education. For workers with higher levels of education for whom the minimum wage is not binding, the salary will not be affected by a rise in minimum wage. Consequently, the returns to the first years of schooling will decline. The decline in returns to schooling would be mitigated if wage contacts above the minimum wage were nominated in multitudes of the minimum wage.

[29] For the increased informality to have caused the observed changes in returns to schooling, the returns to schooling should differ between formal and informal returns. Preliminary estimates, not shown here, but available from the authors on request, suggest that this is not the case.

[30] Sachs and Shatz (1996) discuss the theoretical foundations for the openness-explanation.

exceeding the world market's endowment which is rarely the case for developing countries. Nevertheless, increased openness could still have impacted the returns to education, if the increased openness implied a significant transfer of new technology that in turn altered returns to schooling.

- *Change in the relative size of sectors* in the economy. If sectors with relative high demand for skilled workers have expanded, then total demand for high skills would increase. See Katz and Murphy (1992).

These explanations might very well be interrelated, as hinted above. For example, increased openness could have spurred domestic companies to update production lines (new technology) or/and caused a change in the size of certain sectors.

From the evidence shown this far, it is plausible that multiple factors are at play. The supply-explanation could account for the falling returns to primary, lower secondary and upper secondary education. However, other factors than increased supply of tertiary graduates must have impacted. Otherwise, the returns to tertiary education would have declined which is not the observed trend. Consequently, one or multiple of the remaining four factors must have build up demand for tertiary educated workers. This explanation is in line with findings for other countries, see for example Murphy, Riddle and Romer (1998).

6.6.The impact of education on wage inequality

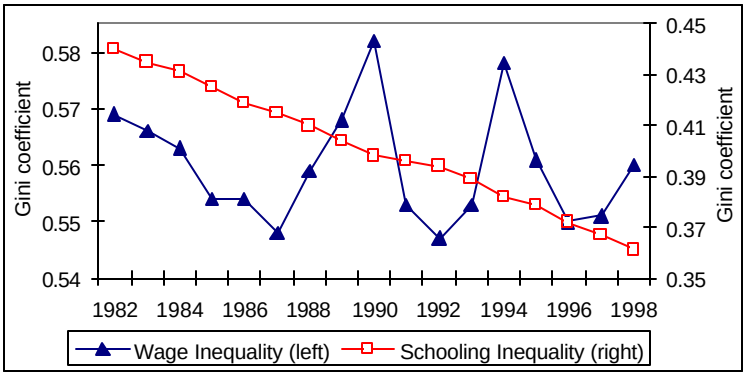
Education is a key determinant of wage. The importance of education for wages can be measured by the fraction of variation in wages that education explains. In Brazil, education accounts for around 40 percent of variation in labor market income.[31] In 1982, schooling explained 42 percent of variation in earnings, which marginally exceeds the level in 1998; 39 percent. This puts education as the single most important determinant of labor market earnings and, thus, for inequality of earnings.

The impact of education on wage inequality is a combination of (1) the distribution of education in the workforce and (2) the remuneration of education in the labor market.[32] To assess the impact of these two effects we take first take a graphic approach.

[31] This is the R^2 of a estimation with only schooling variables as regressors. It is hence the gross explanatory power of education. The explanatory power cannot completely be attributed to the causal effect of schooling on income due to co-variation with both observed factors, such as region, and unobserved factors, such as ability.

[32] Education indirectly affects income inequality by other channels than labor market earnings. For example, more education often leads to improved health that in turn increases income and decreases wage-inequality. Additionally, education has dynamic effects on future income inequality, for example by reducing the size of households.

Figure 10 Wage inequality and schooling inequality



Source: authors' calculation based on PME-data

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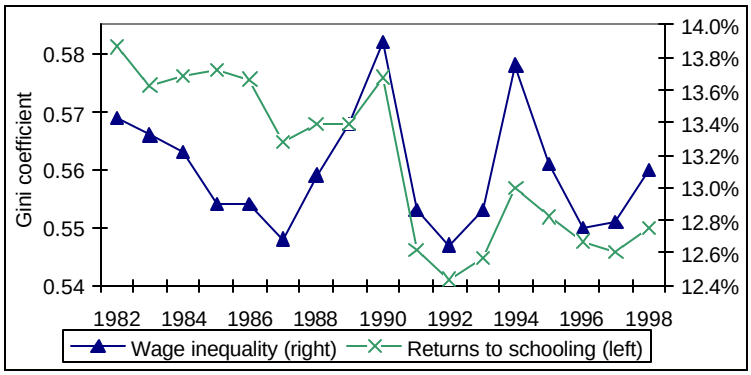
The link between the distribution of schooling and the distribution of wages appears weak at least in the short run, figure 10. In the long run, the substantial decrease in schooling inequality equally failed to translate into a visible decrease in wage inequality. However, other factors than the distribution of schooling affect wage-inequality, a causal relationship between wage inequality and schooling inequality could hence fail to be visible if another determinant of wage-inequality simultaneously had offset the impact.

Figure 11 Wage inequality and returns to schooling



Source: authors' calculation based on PME-data.

Conversely, the link between returns to schooling and wage-inequality appears strong, figure 11.[33] We read these findings as suggestive evidence that it is primarily the returns to schooling that matters for wage-inequality and only secondarily the distribution of schooling.

For a parametric assessment on the roles that returns to schooling and the distribution of schooling played in wage-inequality, we rely on analysis done by Ferreira and Barros

[33] Both the wage-inequality and the returns to schooling are calculated from the same data set, PME. Measurement error in wages could hence intensify the relation between inequality and returns. To evaluate the seriousness of the measurement error, we compared the estimated returns to schooling with inequality measures based on the national household survey, PNAD. The co-movement between the two series weakened, but remained salient. However, the weakening is not necessarily a sign of serious measurement error, it could indicate that wage inequality has developed differently in rural areas not surveyed by the PME-data, but covered by the PNAD data.

(1999). They analyze changes in the distribution of income from 1981-1996 by using the technique of micro-simulations and the national household survey, PNAD. [34] The change over the last two decades in the role of education in wage inequality is decomposed into two effects, a composition effect (change in the distribution of schooling) and a price effect (the change in rate of returns to schooling).

Ferreira and Barros find that the change in returns to schooling, the price effect, slightly improved wage-inequality. The Gini coefficient decreased from 0.561 to 0.554 due to the change in returns to schooling. This effect is an outcome of two impacts: first, the fall in average returns to schooling decreased wage inequality. Second, the increased convexity in returns to schooling worsened wage-inequality. The overall decrease shows that the impact from the average fall in returns dominated the impact from the increased convexity.

The increase in attained schooling, the composition effect, exacerbated wage equality. All other factors equal, the increase in completed years of schooling caused the coefficient to increase from 0.561in 1981 to 0.582 in 1998. [35]

These findings underscore the need for focus on returns to schooling for equity and not only focus on the distribution of schooling. In Brazil, the fall in returns to schooling actually proved to be the equalizing factor for wage-inequality over the last two decades.

The importance of the rate of returns to schooling for wage inequality in Brazil is also emphasized by research done by Lam (1999). Lam analyzes what would happen to wage inequality in Brazil if the distribution of schooling in the Brazilian labor force was identical to that of South Africa. The level of human capital differs significantly in the two countries. South Africa succeeded early in providing universal primary education and broad coverage of secondary education, which Brazil only recently achieved. Consequently, the average South African worker has substantially more schooling, and the distribution of schooling is considerably more equitable compared to that of Brazil. However, the relative share of Brazilians with tertiary education is larger than that of South Africa, 7.5 percent and 4.8 percent, respectively.[36] Surprisingly, Lam finds that the level of wage inequality in Brazil practically would remain constant at the current

[34] The goal of micro-simulations is to identify reasons for differences in wage structure over time or between countries. For comparison across time, a mincerian wage regression is estimated at the start of the examined period and at the end. Subsequently, the change in pay structure is broken into two impacts. First, the effect of change in personal characteristics, the composition effect, such as accumulation of education or experience. This effect is observed by simulating the wage structure if the returns to personal characteristics remained constant while the personal characteristics changed. Similarly, the impact of changed returns to personal characteristics, the price effect, is observed by simulating the wage-structure arising from changed returns but constant personal characteristics.

[35] Notably, the expansion in primary and secondary education scale has a tremendous say in eradication of poverty, not only through higher labor market earnings, but also through other channels such as decreased fertility.

[36] In 1995, the Brazilian population, rural and urban, had on average completed 5.6 years of schooling which compares to 7.9 in South Africa. The coefficient of variation for completed schooling, an inequality-measure, was 0.77 in Brazil and 0.53 in South Africa. The figures are based upon two nation-wide households data sets, PNAD for Brazil and October Household Survey for South Africa.

notorious high level. This finding shows that even if the Brazilian labor force was to attain the same high and equal distribution of schooling as that of South Africa, which at the current speed of educational attainment would take more than 20 years, the level of income inequality would more or less remain the same.[37]

We interpret the presented findings as piecewise evidence that the returns to schooling is the primary link from education to wage inequality. The impact of a more equitable distribution of schooling only influences wage inequality through the supply impact on returns to schooling. In this regard, the increased convexity arisen from the surge in returns to tertiary education inhibits substantial reductions in wage-inequality. The findings suggest that as long as the returns to schooling rises sharply with years of completed schooling, a sizable improvement in wage inequality will not take place.

6.7. Policy implication for education policy

The high demand for tertiary educated labor in Brazil strongly indicates that the available human resources inadequately meet demand. Although the increased demand for skilled labor has had an undesirable impact on wage inequality, curbing the rise in demand for skilled labor would be an inappropriate and detrimental way to address the issue of wage inequality. Trying to restrain the increased demand for skilled labor by reversing previous reforms on openness or deregulation of the labor market could have grave economic consequences. Moreover, a reversal would not necessarily lead to a decrease in returns to tertiary schooling, in particular, if the skill-premium has arisen due to newly available technology.

The strong demand for highly skilled labor originates ultimately from a willingness to pay by the private and public sector. This willingness to pay signals that highly skilled workers can be put into productive positions. It presents Brazilian policymakers with an opportunity for economic growth that can be realized by increasing the output of graduates from the tertiary education system. The increased number of graduates would receive a substantial higher wage compared to the alternative wage of a secondary graduate. Furthermore, domestic companies would be able to hire an increased number of highly skilled workers capable of tapping into the developed world's technology. Skills that are critical for technological transfer and for a knowledge-based production. [38] Policymakers in countries like Brazil have hence a keen interest in assuring available and affordable skilled labor in order to speed up the technological catch-up with developed countries. The past two decades of expansion in primary and secondary education has given policymakers the option to increase the supply of highly skilled workers that previously did not exist. This study shows that this option is exceptionally valuable. Expanding the relative share of graduates with tertiary education is a way to capitalize

[37] The Brazilian labor force acquired approximately one additional year of completed schooling per decade from 1960-1998. Source: Authors own calculations and Birdsall and Sabot (1996). At this speed, it would approximately take Brazil 23 years to reach the current level of schooling in South Africa.

[38] Caselli and Coleman II (2001) and Lee (2001) examine empirically the determinants of computer-technology adoption. Both studies find strong evidence that human capital intensive countries have adopted the digital technology faster. Furthermore, Caselli and Coleman document that the share of population with higher education, in particular, matters for embracing of the new technology.

upon this option and thereby increase the external efficiency of the whole education system.

An increased in supply of skilled workers would equally affect wage inequality. The effect is a combination of two effects previously discussed:

- *The direct composition effect*. The composition effect is the impact on wage inequality following from the increased share of workers with tertiary education, assuming the returns to schooling remains constant. Since tertiary educated workers predominately receive a salary above the average, increasing the share of tertiary educated workers tends to exacerbate wage inequality.

- *The indirect price effect*. Increasing the supply of workers with tertiary education drives down returns to tertiary education. The price effect hence promotes equity. The size of the effect depends critically upon the sensitive of returns to schooling to changes in supply.[39]

The combined effect of an increased supply of skilled workers is hence ambiguous. In the short run the composition effect may dominate the price effect. In that case, policymakers face an efficiency-equity dilemma: An education policy that pursues higher efficiency and economic growth simultaneously compromises equity. Nevertheless, in the long run, increasing the supply of tertiary educated workers appears to be the only growth-promoting way to reduce wage inequality arising from differences in educational endowment. As Lam (1999) shows, reducing the inequality of the distribution of schooling in Brazil only modestly decreases wage inequality. The high rate of returns to schooling, notably the returns to tertiary schooling, plays a key role. Therefore, a reduction in the returns to tertiary education has to take place before wage inequality due to education differences is significantly reduced.[40]

According to our analysis, increasing supply of workers with tertiary education constitutes a visionary long-term policy that promotes economic growth and reduces wage-inequality. The policy would be (a) an appropriate response to the change in demand for schooling and (b) a logical consequence of the past two decades of expansion in primary and secondary education.[41]

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[39] Increasing the enrolment into tertiary education would simultaneously decrease the supply of workers with upper secondary education. Consequently, the returns to upper secondary education would pick up and thereby raise the salary of workers with upper secondary education.

[40] The South Korean education policy is an example where a major education expansion at all levels of education succeeded in satisfying both the equity goal and the efficiency goal. Park, Ross and Sabor(1996) compare the impact of changes in educational composition of the workforce on the inequality of pay in Brazil and in South Korea from 1976 to 1985. For South Korea, they find that a surge in secondary and tertiary education attainment kept returns to schooling from rising and thereby prevented a deterioration in wage inequality. In other words, the egalitarian price-effect dominated the inequality generating composition effect. Hence, the expansion of tertiary education proved both growth-generating and egalitarian.

[41] The policy considerations presented in this section extents beyond the case of Brazil to the degree that education policy and labor demand in other countries have followed a path similar to that of Brazil. Studies previously cited in this paper document that a rise in returns to skills has taken place in a series of both

In a smoothly functioning market for education, high returns to tertiary education would only arise temporarily. High returns to tertiary education would induce secondary graduates to attain tertiary education. Thereby, the supply of workers with tertiary education would increase putting a downward pressure on returns to tertiary education. However, the market for education may work imperfectly. Market failures, such as limited available places at learning institutions and credit constraints, are likely to inhibit potential students in entering tertiary education. This appears to be the case for the Brazilian market for education. The rise in returns to tertiary schooling over the last two decades has not induced an acceleration of the relative share of workers with tertiary education. Actually, the pace of increase in tertiary graduates decelerated in the 1990s despite surging returns to tertiary education. The current institutional set-up seems, therefore, to restrict the quantity of workers with tertiary education creating a monopoly-situation where returns to tertiary education increases excessively. Hence, the findings indicate that the Brazilian market for education is not self-regulating. A reform of the institutional framework of tertiary education appears necessary in order to assure that the education system provides the economy with a sufficient number of workers with advanced skills.

In Brazil, provision of tertiary education is split approximately 60/40 between private and public providers, respectively. An major expansion in the private or / and the public section of the tertiary education system could hence substantially increase the number of graduates. World Bank (2000b) appraised, in collaboration with the Brazilian government, the tertiary education system and came up with policy recommendations aiming at:[42]

- Improving access. An appropriate first step in an expansion could be setting targets for increases in access and completion. Second, addressing market failures such as lack of credit to finance studies, would lead to increased enrollment. An important aspect of such a loan scheme would be that it was designed to have zero or minimal subsidies and be oriented towards poorer segments in the population.

- Improving quality and relevance.[43] Granting increased autonomy to each institution in order to allow the institutions to develop internal quality control and decide on curricula and course structure issues. This could be a decisive step towards increasing flexibility and specialization.

- Improving efficiency in public institutions. Currently the public providers of tertiary education are plagued by low internal efficiency. Additionally, public funding of tertiary education proves extremely poverty regressive: over three fourths of the resources budgeted to public tertiary education pays for education to the wealthiest 20

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developed and developing countries. The linkages between education policy, labor market earnings and wage inequality discussed in the case of Brazil plausibly pertain to other developing countries as well.

[42] The full set of strategies and recommendations for higher education in Brazil is presented in Appendix E.

[43] So far this paper has primarily analyzed the education sector from a quantitative point of view. The quality aspect of the education system is however equally important for generating economic growth. Therefore, it is essential that a quantitative expansion of the tertiary education do not occur at the expense of quality.

percent of the population. Expansion in enrollment into public institutions should hence be financed through resources generated from outside of the public sector or through internal improvements in efficiency, and not by increased public funding.

7. CONCLUSION

This paper has documented that a steady expansion in attainment of education took place in Brazil from 1982 to 1998. A beneficial focus on universal provision of basic education significantly expanded the supply of workers with primary and secondary education. This in turn reduced returns to primary and lower secondary education. Concurrently, demand for highly skilled workers, possibly associated with structural adjustment policies, pushed up returns to tertiary education. The development fundamentally altered the way education was remunerated on the labor market. In particular, we find:

- *The earnings function in Brazil became increasingly convex*. From 1982 to 1998, the returns to a completed year of tertiary schooling surged 24 percent, while returns to primary, lower secondary, and upper secondary schooling declined 26, 35 and 8 percent, respectively. Furthermore, quantile regression shows that the change in the earnings function affected all quantiles of the income distribution. Although, the remuneration of schooling within each education group became more homogeneous in the last two decades, large discrepancies still exist. For example, the 10 percent highest paid workers with upper secondary education receive 74 percent higher returns than the 10 percent lowest paid workers with upper secondary education.

- *Wage inequality decreased as a consequence of an average decline in returns to schooling.* However, the decline was partially offset by the rise in returns to tertiary education. Furthermore, we suggest that the primary influence of education on wage inequality is the impact of returns to schooling and only secondarily the impact of the distribution of schooling. Consequently, policymakers interested in decreasing wage-inequality should implement policies that reduce returns to schooling.

The findings strongly suggest that the current supply of workers with tertiary education in Brazil inadequately meets demand. Furthermore, the institutional framework surrounding the tertiary education system seems to provide institutions with little incentive to respond to the rising needs for highly skilled labor. Therefore, policymakers might consider adopting new regulation that induces private and public providers of tertiary education to increase access, enrollment and completion.

A successful reform of the tertiary education system would offer a larger and broader spectrum of existing and coming workers the opportunity to acquire the highly rewarded advanced skills and thereby raise individual productivity, labor market income and living standards. On an aggregated scale, the increased availability of tertiary educated workers would (a) promote economic growth by increasing labor productivity and lay the foundation for faster technological transfer, and (b) reduce the skill premium that in turn would mitigate wage inequality. Therefore, an increased supply of highly educated workers could in the long run prove both growth-enhancing and equitable.

References

Arbache, J.S., Green, F. and Dickerson, A. (2000) " A Picture of Wage Inequality and the Allocation of Labor in a Period of Trade Liberalization: The Case of Brazil", Universidade de Brasilia.

Arias, O., K.F. Hollack, and W. Sosa (1999). "Individual Heterogeneity in the Returns to Schooling: Instrumental Variables Quantile Regression Using Twins Data," Mimeo, university of Illinois

Barros, R. and Ramos, L. (1996) "Temporal Evolution of the Relationship between Wages and Educational of Brazilian Men" in Birdsall, N. and Sabot, R.H. (1996) ed."Opportunity Foregone; Education in Brazil", Inter-American Development Bank, Washington, DC.

Birdsall, N. and Sabot, R.H. (1996) ed."Opportunity Foregone; Education in Brazil", Inter-American Development Bank, Washington, DC.

Behrman, J.R., Birdsall, N. and Kaplan, R.(1996) "The Quality of Schooling and Labor Markets Outcomes" in Birdsall, N. and Sabot, R.H. (1996) ed."Opportunity Foregone; Education in Brazil", Inter-American Development Bank, Washington, DC.

Buchinsky, M. (1998). "Recent Advances in Quantile Regression Models – A Practical Guideline for Empirical Research", The Journal of Human Resources, Vol. XXXIII, No. 1, pp. 88-126.

Card, D. (1998) "The Causal Effect of Education on Earnings", forthcoming in Handbook of Labor Economics, Vol. 3, Ashenfelter, O. and Card, D. (eds.)

Caselli, F. and Coleman, W. J. (2001) "Cross-Country technology Diffusion: The Case of Computers", NBER working paper 8130.

Deaton, A. (1997) "The Analysis of household Surveys – A Microeconometric Approach to Development Policy", Johns HopkinsUniversity Press, Baltimore.

Ferreira, F. and R. Paes de Barros (1999) "The Slippery Slope: Explaining the Increase in Extreme Poverty in Urban Brazil, 1976-1996", Policy Research Working Paper No. 2210, The World Bank, Washington, DC.

Feenstra, R. and Hanson, G. (1997), "Productivity Measurement and the Impact of Trade and Technology on Wages", NBER Working Paper No. 6052

Gonzaga, M. G. (1996) "The Effect of Openness on Industrial Employment in Brazil" IPEA, Serie Seminarios No 27/96.

Juhn, C., K.M. Murphy, and Pierce, B. (1993) "Wage Inequality and the Rise in Returns to Skills", Journal of Political Economy, Vol. 101, No. 3.

Koenker, R. and Basset, G. Jr. (1978) "Regression Quantiles", Econometrica, Vol. 46, No. 1, pp. 33-50.

Koenker and D'Orey (1993) "Computing Regression Quantiles", Applied Statistics, 36, pp. 383-393, and 43, pp. 410-414.

Koenker, R. and Portnoy (1997) "Quantile Regression", Office of Research Working Paper, No. 97-0100, College of Commerce and Business Administration, University of Illinois at Urbana-Champaign.

Lam, D. (1999) "Generating Extreme Inequality: Schooling, Earnings, and Intergenerational Transmissions of Human Capital in South Africa and Brazil", Research Report, No. 99-439, Population Studies Center, University of Michigan.

Lam, D. and Schoeni, R. (1993) "The effects of Family Background on Earnings and Returns to Schooling: Evidence from Brazil", Journal of Political Economy, 101(4): 710-740

Lächler, U. (1998) "Education and Earnings Inequality in Mexico", Policy Research Working Paper No. 1949, The World Bank, Washington, DC.

Lee, J. (2001), "Education and Technology Readiness: Prospects for Developing Countries" Working Paper, Korea University, 2001.

Levey, F. and R. J. Murnane, (1992) "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations", Journal of Economic Literature, Vol. 30, pp. 1333-1381.

Mankiw, N.G., Romer, D., and Weil, D.N. (1992) "A Contribution to the Empirics of Economic Growth, Quarterly Journal of Economics, Vol. 107, No. 2."

Mincer, J. (1974) "Schooling, Experience and Earnings", NBER Working Paper, New York.

Murphy, K.M., Riddle, W.C. and Romer, P.M. (1998) "Wages, Skills, and technology in the United States and Canada", NBER working paper 6638.

Neri, M.C. and Camargo, C.M.(1999) "Distributive Effects of Brazilian Structural Reforms", Texto Para Discussao, No. 406, Departamento de Economia, PUC-Rio.

Prichett, L. (2000) "An Economist's Midnight Thoughts on Education: The Puzzle of Government Production", Kennedy School of Government.

Rosembaum,D.T (2000) "Ability, Educational Ranks, and Labor Market Trends: The Effects of Shifts in the Skill Composition of the Educational Groups", Department of Economics, University of North Carolina at Greensboro.

Robbins and Gindling(1999), "Trade Liberalization and the Relative Wages for More-Skilled Workers in Costa Rica", Review of Development Economics, 3(2), 155-169.

Sachs, J.D. and Shartz,H.J.(1996). "U.S. Trade with Developing Countries and Wage Inequality", AEA Papers and Proceedings, Vol. 86 No. 2

Santamaria, M. (2000) "External Trade, Skill, Technology and the Recent Increase of Income Inequality in Colombia", Dissertation paper.

Verner, D. (2000) "The Dynamics of Poverty and its Determinants: The Case of Pernambuco and the Northeast Brazil"

Verner, D. (2000) "Wage Determination in Pernambuco, Bahia, Ceará and the Northeast: An Application of Quantile Regressions", The World Bank policy working paper, Washington, DC.

Wodon, T.Q. (2000) "Poverty and Policy in the Latin America and the Caribbean", World Bank Technical Paper No. 467, The World Bank, Washington, DC.

Wood, A. (2000) "Globalization and Wage Inequalities: a Synthesis of Three Theories", Department for International Development, London.

World Bank(2000a) "Brazil, Secondary Education in Brazil", The World Bank, Washington, DC.

World Bank(2000b) "Brazil, Sector Study Higher Education in Brazil", The World Bank, Washington, DC.

Appendix List:

[1] Descriptive statistics for females and males separately can be obtained from the authors, email ablom@worldbank.org

[2] Regression results from the quantile regressions are equally available from the authors.

Appendix A

Table A1 Variable list and coding for the descriptive statistics

Variable Name	**Computed as** (Vxxx refers to the variable coding in PME-questionnaires)
Monthly wage (fixed 1997 R$) (including wage from second jobs, if applicable)	Nominal monthly wage (sum of V309 & V311) deflated by IPCA*
Hourly wage (fixed 1997 R$) (including wage and working hours from second jobs, if applicable)	$\text{Hourly wage} = \frac{\text{Monthly wage}}{\text{Working hours per week} * 4} = \frac{V309 + V311}{(V310 + V312) * 4}$
Education (highest completed level)**	
Hourly wage per Tertiary	Average hourly wage for workers with Tertiary education
Hourly wage per Upper secondary	Average hourly wage for workers with Upper secondary education
Hourly wage per Lower secondary	Average hourly wage for workers with Lower secondary education
Hourly wage per Primary	Average hourly wage for workers with Primary education
Hourly wage per No schooling	Average hourly wage for workers without degree
Ratios of wage	
Hourly wage of Tertiary to other education levels	$\frac{\text{Average hourly wage of Tertiary educated workers}}{\text{Average hourly wage of comparing group}}$ where the comparing groups are: Upper secondary, Lower Secondary, Primary, and No schooling
Labor Market Status	
Hourly wage per employee	Average hourly wage if V306=2
Hourly wage per self-employed	Average hourly wage if V306=4
Hourly wage per employer	Average hourly wage if V306=6
Hourly wage per employee without signed workbook	Average hourly wage if V306=2 and V308=4
Hourly wage per employee with signed workbook	Average hourly wage if V306=2 and V308=2
Sector	
Hourly wage per worker in Industry	Average hourly wage if V305=1
Hourly wage per worker in Construction	Average hourly wage if V305=3
Hourly wage per worker in Commerce	Average hourly wage if V305=5
Hourly wage per worker in Service	Average hourly wage if V305=7
Salary Frequency	
Hourly wage if paid monthly	Average hourly wage if V307=1
Hourly wage if paid every two weeks	Average hourly wage if V307=3
Hourly wage if paid weekly	Average hourly wage if V307=5
Unemployment	
Unemployment rate in % of active population. (As defined by IBGE on www.IBGE.gov.br)	$= \frac{\text{Number of unemployed}}{\text{Number of economic active}}$ where 1) A worker is unemployed if searching for job: V301=4 2) A worker is economic active if being either employee, self-employed, employer (V306=2,4,6) or being unemployed (V301=4).
Unemployment rate in % of wage earners	$= \frac{\text{Number of unemployed}}{\text{Number of wage earners} + \text{Number of unemployed}}$
Wage variation	
Standard deviation of hourly wage	Standard deviation of hourly wage
Years of schooling	Computed following the education structure outlined in table A3.
Education stock	Percentage of the workforce who has completed the degree (hence a tertiary graduate also counts in the Upper secondary, lowers secondary and primary.)
Read and Write % of sample who can read and write	V207=1

Note: * The deflation is carried out on a monthly basis, where the reported wage is deflated by the monthly consumer price index, IPCA, from the preceding month, since wage is reported with a lag.

**** The computation of completed education levels and completed years of schooling is presented in Table A3.**

Appendix A

Table A.2 Variable list and coding of variables in the Quantile regression:

Variable Name	**Explanation**	**Computed from** (Vxxx refers to codes in PME-survey)
Age		V256
Age squared		V256*V256
Primary (Schooling 1-4)	Spline variable for 1-4 years of schoolin g. Corresponding to the years in Primary	Years of completed schooling =1,2,3,4
Lower Secondary (Schooling 5-8)	Spline variable for 5-8 years of schooling. Corresponding to the years in Lower secondary	Years of completed schooling =5,6,7,8
Upper Secondary (Schooling 9-11)	Spline variable for 9-11 years of schooling. Corresponding to the years in Upper secondary	Years of completed schooling =9,10,11
Tertiary (Schooling 12-19)	Spline variable for 12-19 years of schooling. Corresponding to the years in tert iary education.	Years of completed schooling =12,13,14,15,16,17
Female	=1 if female	V202=3
Fem. Primary (Schooling 1-4)	Spline variable for females with 1-4 years of schooling. Corresponding to the years in Primary	Years of completed schooling =1,2,3,4 and V202=3
Fem. Lower Secondary (Schooling 5-8)	Spline variable for females with 5-8 years of schooling. Corresponding to the years in Lower secondary	Years of completed schooling =5,6,7,8 and V202=3
Fem. Upper Secondary (Schooling 9-11)	Spline variable for females with 9-11 years of schooling. Corresponding to the years in Upper secondary	Years of completed schooling =9,10,11 and V202=3
Fem. Tertiary (Schooling 12-19)	Spline variable for females with 12-19 years of schooling. Corresponding to the years in tertiary education.	Years of completed schooling =12,13,14,15,16,17 and V202=3
Sector Dummy Variables		
Industry	=1 if working in Industry	V305=1
Construction	=1 if working in Construction	V305=5
Service	=1 if working in Service	V305=7
Control group	Commerce	
Labor market Status Dummy Variables		
Selfemployed	=1 if Self-employed	V306, 4
Employer	=1 if Employer	V306, 6
Signed workbook	=1 if holding a signed workbook (only possible for Employees)	V308=2
Fem. Signed workbook	=1 if female and holds a signed workbook (only possible for Employees)	V202=3 and V308=2
Control group	Employees without signed workbook	
Metropolitan Dummy Variables		
Salvador	=1 if from Salvador (Bahia)	V10
Recife	=1 if from Recife (Pernambuco)	V10
Belo Horizonte	=1 if from Belo Horizonte (Minas Gerais)	V10
Porto Alegre	=1 if from Porto Alegre (Rio Grande do Sul)	V10
Rio de Janeiro	=1 if from Rio de Janeiro	V10
Control group	São Paulo	

Appendix A

Table A.3 Computation of completed schooling from the PME-questionnaire

Dummy variables for highest completed level of education:		
Primary	=1 if Primary(4 years of schooling) is the highest completed level of education.	
	1st way	V210 Grade: Primary and V211 Completed: Yes
	2nd way	V210 Grade: 1st grade and V209 Last completed class: 4 class
	3rd way	V210 Grade: Lower secondary and V211 Completed: No
Lower Secondary	=1 if Lower secondary (8 years of schooling) is the highest completed level of education	
	1st way	V210 Grade: mid 1st cycle and V211 Completed: Yes
	2nd way	V210 Grade: 1st grade and V209 Last completed class: 8
	3rd way	V210 Grade: 2 grade and V211 Completed: No
Upper Secondary	=1 if Upper secondary (11 years of schooling) is the highest completed level of education	
	1st way	V210 Grade: 2nd grade and V211 Completed: Yes
	2nd way	V210 Grade: Tertiary and V211 Completed: No
Tertiary	=1 if a Tertiary (15-17 years of schooling) education is the highest completed level of education	
	1st way	V210 Grade: Higher Education and V211 Completed: Yes
	2nd way	V210 Grade: Master or Doctor, and V211 Completed: No
Years of Schooling (YoS)	The years of schooling is computed from the above dummies:	
Completed Primary	YoS = 4	If incomplete Primary then YoS = V209 (1-4)
Completed Lower Secondary	YoS = 8	If incomplete lower secondary then YoS = V209 (1-4) + 4 or YoS= V210 (5-8)
Completed Upper Secondary	YoS = 11	If incomplete Upper secondary then YoS = V209 (1-3) + 8
Completed Tertiary	YoS = 15-17	If incomplete tertiary then YoS = V209 (1-5) + 11

The questionnaire asks three questions concerning education. These have to be combined to compute the highest level of education. This computation assumes 4 levels of completed degrees: Primary (1-4 years), Lower secondary(5-8), Upper secondary(9-11), and Tertiary (12-15/17). The structure of the first three levels (and names) follows World Bank(2000a). Respondents with the same level of completed education can answer the education questions in different ways. This ambiguity probably reflects the need for flexibility due to the fact that the working force has attend school in different time periods (and geographical areas) and therefore under different school systems. The above computation has been constructed on the basis of: (1) Algorithm from Lam and Schoeni(1993) as well as Barros and Ramos(1996). (2) Examination of cross tabulations of the three questions V209, V210 and V211. (3) Experience from the PNAD-data (Brazilian Household Survey) which asks 3 questions on education similar to V209, V210 and V211, and, additional to the PME-survey, a 4th question concerning the number of years in school. The reported number of years of schooling corresponds with the above computation. For example, the vast majority of people classified by the above classification as having completed lower secondary school, which, according to the classification takes 8 years, actually reports 8 years of schooling.

Appendix B Descriptive Statistics 1982-1998

Descriptive Statistics 1982-1998 Male and Female

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	% Change 1982-90
All wage are average wages in fixed 1997R$										
Hourly wage	5.37	4.83	4.30	4.24	4.94	4.26	4.26	4.44	4.12	-30%
Monthly wage	856	783	691	678	833	716	718	737	677	-30%
Hours worked per week	43.3	42.9	42.6	42.5	43.4	43.2	43.1	42.0	41.6	-4%
Inequality in hourly wage										
Gini coefficient	0.569	0.566	0.563	0.554	0.554	0.548	0.559	0.568	0.582	2.2%
Hourly wage by education level (% of workforce with the level as the highest level of completed education)										
Tertiary	19.0(7.5%)	16.7(7.8%)	14.5(8.1%)	14.3(8.0%)	16.5(8.3%)	14.0(8.8%)	14.5(9.0%)	14.8(9.4%)	14.0(9.5%)	-36%(1.9%p*)
Upper secondary	8.95(11.2%)	7.68(11.6%)	6.89(12.3%)	6.70(13.0%)	7.82(13.3%)	6.52(13.7%)	6.43(14.3%)	6.68(14.9%)	6.02(15.5%)	-49%(4.3%p*)
Lower Secondary	5.33(11.9%)	4.74(12.1%)	4.10(12.4%)	4.03(12.5%)	4.69(12.8%)	3.93(12.8%)	3.78(12.8%)	3.85(13.3%)	3.43(13.2%)	-55%(1.3%p)
Primary	3.43(32.7%)	3.03(33.0%)	2.61(32.9%)	2.62(32.7%)	3.13(33.4%)	2.67(33.4%)	2.53(33.8%)	2.60(33.7%)	2.41(34.2%)	-43%(1.5%p)
No Schooling	2.17(36.7%)	1.95(35.5%)	1.70(34.4%)	1.69(33.7%)	2.05(32.3%)	1.82(31.3%)	1.71(30.1%)	1.82(28.7%)	1.63(27.7%)	-33%(-9.0%p)
Inequality in Education										
Gini coefficient (for years of schooling)	0.440	0.435	0.431	0.425	0.419	0.415	0.410	0.404	0.398	-9.4%
Ratio of hourly wages between education levels										
Ratio of hourly wage of a worker with tertiary education to the wage of a worker with :										
Upper secondary education	212%	217%	211%	214%	211%	215%	225%	222%	232%	9%
Lower Secondary edu.	356%	352%	354%	356%	351%	356%	383%	386%	407%	13%
Primary edu.	553%	551%	557%	548%	526%	524%	572%	571%	580%	5%
No schooling	873%	857%	855%	851%	805%	772%	846%	816%	856%	-2%
Ratio of hourly wage of a worker with Upper secondary education to a worker with:										
Lower Secondary edu.	168%	162%	168%	166%	167%	166%	170%	174%	175%	4%
Primary edu.	261%	254%	264%	256%	250%	244%	254%	257%	250%	-4%
No schooling	411%	395%	405%	398%	382%	359%	376%	367%	369%	-12%
Ratio of Lower Sec. to Primary	155%	156%	157%	154%	150%	147%	149%	148%	143%	-79%
Ratio of Elemetary to No Schooling	158%	156%	153%	155%	153%	147%	148%	143%	147%	-7%
Hourly wage by Sector (% of workforce employed in the sector)										
Industry	5.93(23.9%)	5.42(23.2%)	4.90(23.2%)	4.75(22.9%)	5.45(24.8%)	4.75(24.5%)	4.88(24.1%)	5.00(24.0%)	4.54(23.1%)	-31% (-0.8%p)
Construction	3.21(13.4%)	3.02(12.1%)	2.64(10.9%)	2.58(10.7%)	3.15(10.5%)	2.83(10.3%)	2.72(10.6%)	2.91(10.6%)	2.72(10.9%)	-18% (-2.5%p)
Commerce	4.30(12.5%)	3.67(13.0%)	3.41(13.1%)	3.38(13.1%)	4.30(12.7%)	3.61(12.7%)	3.46(13.1%)	3.72(13.4%)	3.56(13.7%)	-21% (1.1%p)
Service	5.77(40.2%)	5.20(41.3%)	4.57(41.9%)	4.52(42.1%)	5.12(41.6%)	4.38(42.3%)	4.45(42.2%)	4.65(42.5%)	4.29(43.0%)	-34% (2.7%p)

Note: * For variables denoted in percentages, the change from one year to another year is given in percentage points, %p,. The percentage point is simply calculated by subtracting the percentage value in the end of the period from the percentage in the start. Hence for the share of workers with Upper secondary education, the change from 1982 to 1990 is computed as : 4.3%p= 15.5% -11.2%.

Appendix B

Year	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**%Change 1991-98**	**%Change 1982-98**
All wage are average wages in fixed 1997R$										
Hourly wage	3.27	2.99	3.28	3.62	4.29	4.64	4.78	4.84	48%	-10%
Monthly wage	540	493	543	605	718	780	800	797	48%	-7%
Hours worked per week	41.6	41.9	41.9	42.1	42.3	42.5	42.5	41.9	1%	-3%
Inequality of hourly wage										
Gini coefficient	0.553	0.547	0.553	0.578	0.561	0.550	0.551	0.560	1.3%	-1.5%
Hourly wage by education level (% of workforce with the level as the highest level of completed education)										
Tertiary	10.7(9.6%)	9.6(9.5%)	9.6%(9.8%)	9.5%(9.4%)	14.8(9.7%)	15.1(10.1%)	15.1(10.4%)	15.8(10.3%)	47%(0.8%p*)	-17%(2.8%p)
Upper secondary	4.63(15.9%)	4.26(15.9%)	4.67(16.4%)	5.32(16.4%)	6.12(16.7%)	6.29(17.5%)	6.29(18.3%)	6.31(18.8%)	36%(3.3%p)	-29%(7.5%p)
Lower Secondary	2.71(13.1%)	2.49(13.4%)	2.73(13.7%)	2.95(14.1%)	3.53(14.2%)	3.67(14.2%)	3.68(14.4%)	3.60(15.1%)	33%(1.9%p)	-33%(3.2%p)
Primary	1.93(34.1%)	1.77(34.4%)	1.91(34.4%)	2.07(35.2%)	2.46(35.2%)	2.63(35.2%)	2.65(34.7%)	2.56(34.3%)	32%(0.1%p)	-26%(1.6%p)
No Schooling	1.39(27.3%)	1.28(26.8%)	1.37(25.8%)	1.48(24.9%)	1.80(24.2%)	1.94(23.1%)	1.96(22.2%)	1.94(21.5%)	40%(-6.2%p)	-11%(-15.2%p)
Inequality in Education										
Gini coefficient (for years of schooling)	0.396	0.394	0.389	0.382	0.379	0.372	0.367	0.361	-8.9%	-17.9%
Ratio of hourly wages between education levels										
Ratio of hourly wage of a worker with tertiary education to the wage of a worker with :										
Upper secondary education	232%	226%	228%	242%	241%	240%	239%	250%	8%	18%
Lower Secondary edu.	396%	386%	390%	436%	418%	411%	409%	439%	11%	23%
Primary edu.	555%	543%	557%	623%	600%	574%	569%	617%	11%	11%
No schooling	775%	754%	779%	867%	821%	777%	768%	812%	5%	-7%
Ratio of hourly wage of a worker with Upper secondary education to a worker with:										
Lower Secondary edu.	171%	171%	171%	180%	173%	171%	171%	176%	3%	5%
Primary edu.	239%	240%	244%	258%	249%	240%	238%	247%	3%	-5%
No schooling	334%	333%	342%	359%	341%	324%	321%	325%	-3%	-21%
Ratio of Lower Sec. to Primary	140%	140%	143%	143%	144%	140%	139%	141%	0%	-10%
Ratio of Elemetary to No Schooling	140%	139%	140%	139%	137%	135%	135%	132%	-6%	-17%
Hourly wage by Sector (% of workforce employed in the sector)										
Industry	3.63(21.7%)	3.56(20.5%)	3.91(20.1%)	4.18(20.0%)	4.78(19.5%)	5.18(18.3%)	5.20(17.8%)	5.22(17.4%)	44%(-5.7%p)	-12%(-6.5%p)
Construction	2.30(10.9%)	2.06(10.9%)	2.20(10.4%)	2.26(10.8%)	2.86(10.5%)	3.12(10.8%)	3.23(10.6%)	3.08(10.6%)	34%(-0.4%p)	-4%(-2.8%p)
Commerce	2.79(13.8%)	2.43(14.0%)	2.65(14.1%)	3.11(14.2%)	3.67(14.1%)	4.01(14.2%)	4.07(14.1%)	4.11(14.1%)	47%(0.4%p)	-4%(1.6%p)
Service	3.40(44.2%)	3.10(44.8%)	3.41(45.6%)	3.85(45.3%)	4.54(46.5%)	4.92(47.5%)	5.13(48.3%)	5.17(49.1%)	52%(6.1%p)	-10%(8.9%p)

Appendix B

Year	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**%Change 1982-90**
Hourly wage by Labor Market Status (% of workforce with the status)										
Employee	5.46(74.1%)	4.97(73.4%)	4.41(72.9%)	4.36(73.3%)	4.80(73.8%)	4.19(72.9%)	4.29(72.4%)	4.35(72.0%)	4.01(71.0%)	-36% (-3.1%p)
Selfemployed	3.30(18.7%)	2.87(19.6%)	2.55(20.4%)	2.58(20.2%)	3.56(19.7%)	3.05(20.5%)	2.79(20.9%)	3.06(21.2%)	2.86(22.1%)	-15% (3.4%p)
Employer	9.73(6.9%)	8.67(6.9%)	8.34(6.6%)	8.03(6.4%)	11.05(6.4%)	9.08(6.5%)	8.82(6.5%)	10.17(6.7%)	9.95(6.8%)	2% (-0.2%p)
For Employees										
with signed workbook	5.50(78.7%)	5.05(77.8%)	4.53(77.1%)	4.43(77.9%)	4.83(79.5%)	4.22(79.4%)	4.36(79.8%)	4.45(80.5%)	4.04(80.0%)	-36% (1.2%p)
without signed workbook	5.31(21.3%)	4.64(22.2%)	3.99(22.9%)	4.16(22.1%)	4.70(20.5%)	4.06(20.6%)	4.02(20.2%)	3.97(19.5%)	3.86(20.0%)	-37% (-1.2%p)
Wage ratio for employees with signed workbook to unsigned	104%	109%	114%	106%	103%	104%	108%	112%	105%	1%
Wage ratio for employees to selfemp	166%	173%	173%	169%	135%	137%	154%	142%	140%	-18%
Hourly wage by Salary Frequency wage (% of workforce paid by the frequency)										
Wage if paid monthly	6.73(66.0%)	5.95(68.8%)	5.20(70.8%)	5.11(71.8%)	5.51(73.2%)	4.79(75.4%)	4.96(75.5%)	4.98(76.3%)	4.64(72.9%)	-45% (7.0%p)
Wage if paid per two weeks	4.22(6.5%)	3.76(5.2%)	3.18(5.2%)	3.02(5.2%)	3.39(5.3%)	2.93(7.2%)	3.13(9.5%)	3.15(10.5%)	3.00(14.0%)	-41% (7.5%p)
Wage if paid weekly	2.16(16.8%)	1.95(14.5%)	1.62(13.0%)	1.64(13.0%)	1.88(11.7%)	1.67(12.4%)	1.61(13.5%)	1.64(11.7%)	1.53(11.7%)	-41% (-5.1%p)
Unemployment										
In % of Active population	2.6%	3.6%	3.8%	2.6%	1.7%	1.9%	2.0%	1.8%	2.5%	-1%
In % of Wage earners	2.8%	4.1%	4.3%	2.8%	2.0%	2.1%	2.3%	2.1%	2.9%	2%
In % of Wage earners by education level										
Tertiary	1.0%	1.4%	1.2%	0.8%	0.8%	1.0%	0.9%	0.8%	1.3%	26%
Upper secondary	1.9%	2.6%	2.5%	1.9%	1.7%	2.1%	2.1%	2.0%	2.6%	27%
Lower secondary	2.5%	3.6%	3.9%	2.6%	2.3%	2.4%	2.8%	2.4%	3.6%	29%
Primary	3.3%	4.6%	5.1%	3.4%	2.3%	2.4%	2.7%	2.5%	3.3%	1%
No schooling	3.4%	5.1%	5.4%	3.4%	1.9%	2.1%	2.0%	1.9%	2.7%	-23%

Appendix B

Year	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**Change 1991-98**	**Change 1982-98**
Hourly wage by Labor Market Status (% of workforce with the status)										
Employee	3.23(69.1%)	3.07(68.0%)	3.34(67.9%)	3.55(67.8%)	4.05(66.8%)	4.40(65.3%)	4.49(65.0%)	4.55(65.4%)	41%(-5.6%)	-17%(-8.7%p)
Selfemployed	2.32(24.1%)	2.00(25.3%)	2.22(25.4%)	2.63(26.0%)	3.39(26.7%)	3.69(27.9%)	3.95(28.5%)	3.82(27.8%)	65%(5.7%)	16%(9.1%p)
Employer	7.43(6.7%)	6.22(6.6%)	7.21(6.5%)	9.69(6.1%)	12.04(6.4%)	11.90(6.6%)	11.85(6.5%)	12.53(6.7%)	69%(-0.1%)	29%(-0.3%p)
For Employees										
with signed workbook	3.26(77.3%)	3.16(75.5%)	3.45(74.3%)	3.64(73.3%)	4.03(72.4%)	4.39(71.0%)	4.50(70.5%)	4.52(70.0%)	39%(-9.9%)	-18%(-8.7%p)
without signed workbook	3.15(22.7%)	2.76(24.5%)	3.03(25.7%)	3.28(26.7%)	4.13(27.6%)	4.43(29.0%)	4.48(29.5%)	4.63(30.0%)	47%(9.9%)	-13%(8.7%p)
Wage ratio for employees with signed workbook to unsigned	103%	114%	114%	111%	98%	99%	101%	97%	-6%	-6%
Wage ratio for employees to selfemp	139%	153%	150%	135%	120%	119%	114%	119%	-14%	-28%
Hourly wage by Salary Frequency wage (% of workforce paid by the frequency)										
Wage if paid monthly	3.69(71.1%)	3.43(72.4%)	3.73(72.7%)	3.96(71.1%)	4.47(72.6%)	4.81(72.9%)	4.93(74.0%)	5.01(75.6%)	36%(2.7%p)	-26%(9.6%p)
Wage if paid per two weeks	2.76(15.7%)	2.83(15.0%)	3.05(15.4%)	3.25(17.4%)	3.68(16.6%)	3.97(16.9%)	3.89(16.4%)	3.73(15.2%)	35%(1.2%p)	-12%(8.7%p)
Wage if paid weekly	1.29(11.6%)	1.20(10.9%)	1.28(10.1%)	1.37(9.7%)	1.75(9.1%)	2.01(8.3%)	1.96(7.6%)	1.93(7.0%)	49%(-4.6%p)	-11%(-9.7%p)
Unemployment* **										
In % of Active population	2.8%	3.4%	3.2%	3.1%	2.9%	3.1%	3.4%	4.8%	69%	86%
In % of Wage earners	3.2%	4.0%	3.8%	3.8%	3.5%	3.6%	4.0%	5.6%	72%	96%
In % of wage earners by education level										
Tertiary	1.5%	1.5%	1.7%	1.5%	1.5%	1.9%	1.7%	2.7%	76%	171%
Upper secondary	3.1%	3.6%	3.4%	3.5%	3.3%	3.5%	3.7%	4.9%	61%	160%
Lower secondary	3.9%	4.5%	4.2%	4.6%	3.9%	4.1%	4.6%	5.9%	54%	136%
Primary	3.7%	4.7%	4.5%	4.3%	4.0%	4.1%	4.6%	6.5%	75%	98%
No schooling	2.9%	3.8%	3.7%	3.4%	3.2%	3.5%	3.8%	5.6%	92%	66%

Appendix B

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	%Change 1982-90
Standard deviation of hourly wage (measure of uncertainty)										
Whole sample	11.4	9.1	7.0	6.9	8.6	7.1	7.1	8.3	8.1	-41%
per education level										
Tertiary	19.0	16.4	13.2	13.1	16.8	14.6	14.4	15.2	15.9	-20%
Upper secondary	14.4	10.1	9.0	6.9	10.0	7.6	7.8	9.3	8.6	-67%
Lower secondary	9.7	8.0	5.6	6.8	6.7	5.4	4.7	5.3	4.4	-121%
Primary	9.5	6.2	3.2	4.0	5.0	3.3	3.1	4.9	5.5	-72%
No schooling	5.4	4.9	2.3	2.1	2.4	2.3	2.1	4.6	2.7	-105%
Years of schooling	5.39	5.49	5.59	5.67	5.76	5.87	5.96	6.10	6.19	13%
Stock of Education**										
Tertiary	7.5%	7.8%	8.1%	8.0%	8.3%	8.8%	9.0%	9.4%	9.5%	20%
Upper secondary	18.7%	19.4%	20.4%	21.0%	21.6%	22.5%	23.3%	24.3%	25.0%	25%
Lower secondary	30.6%	31.5%	32.7%	33.5%	34.3%	35.3%	36.1%	37.6%	38.1%	20%
Primary	63.3%	64.5%	65.6%	66.3%	67.7%	68.7%	69.9%	71.3%	72.3%	12%
% who can read and write	86.1%	86.5%	87.0%	87.1%	87.9%	88.2%	88.2%	88.6%	89.0%	3%
Median hourly wage in fixed 1997 R$										
Hourly wage	2.62	2.36	2.15	2.15	2.65	2.35	2.23	2.27	2.06	-27%
Monthly wage	477	428	387	385	470	416	392	393	358	-33%
Per education level										
Tertiary	15.0	12.8	11.1	11.3	12.4	10.3	10.6	10.4	10.1	-49%
Upper secondary	6.18	5.47	4.83	4.90	5.49	4.63	4.48	4.53	4.00	-54%
Lower Secondary	3.58	3.16	2.78	2.75	3.28	2.80	2.67	2.64	2.38	-51%
Elelmentary	2.34	2.09	1.85	1.83	2.25	1.98	1.86	1.87	1.68	-40%
No schooling	1.59	1.41	1.24	1.24	1.51	1.36	1.30	1.30	1.16	-37%
Sample information										
Female % of workforce	18.8%	20.0%	19.8%	20.7%	20.4%	21.4%	20.9%	21.6%	21.7%	14%
Number of observations	334513	425224	439601	407157	441835	441916	402520	346037	353419	5%
Average age of workforce	43.2	43.7	43.7	44.2	44.3	44.9	44.5	44.5	44.5	3%

Appendix B

Year	1991	1992	1993	1994	1995	1996	1997	1998	Change 1991-98	Change 1982-98
Standard deviation of hourly wage (measure of uncertainty)										
Whole sample	88	78	98	115	114	115	124	198	123%	1%
Per education level										
Tertiary	179	160	198	256	237	214	236	285	59%	-17%
Upper secondary	97	82	105	136	119	128	137	343	252%	36%
Lower secondary	53	57	88	68	69	64	68	63	19%	-61%
Primary	37	29	44	45	48	49	49	47	26%	-69%
No schooling	25	23	25	29	32	33	35	30	19%	-66%
Years of schooling	6.24	6.23	6.35	6.35	6.44	6.57	6.70	6.80	9%	26%
Stock of Education**										
Tertiary	9.6%	9.5%	9.8%	9.4%	9.7%	10.1%	10.4%	10.3%	7%	37%
Upper secondary	25.5%	25.4%	26.2%	25.8%	26.4%	27.6%	28.7%	29.1%	14%	55%
Lower secondary	38.7%	38.8%	39.8%	39.9%	40.7%	41.8%	43.1%	44.2%	14%	44%
Primary	72.7%	73.2%	74.2%	75.1%	75.8%	76.9%	77.8%	78.5%	8%	24%
% who can read and write	89.1%	89.0%	89.4%	89.8%	90.1%	90.7%	91.0%	91.3%	2%	6%
Median hourly wage in fixed 1997 R$										
Hourly wage	302	280	302	308	383	424	430	436	45%	-8%
Monthly wage	1.73	1.62	1.74	1.81	2.24	2.47	2.54	2.48	43%	-5%
per education level										
Tertiary	7.8	6.8	7.3	8.7	11.3	12.1	11.8	12.2	57%	-19%
Upper secondary	3.16	2.91	3.16	3.43	4.09	4.22	4.25	4.18	32%	-32%
Lower Secondary	1.93	1.78	1.92	1.98	2.47	2.64	2.61	2.55	32%	-29%
Elelmentary	1.42	1.33	1.42	1.43	1.79	1.94	1.96	1.86	31%	-21%
No schooling	1.03	0.97	1.03	1.06	1.34	1.43	1.49	1.47	42%	-8%
Sample information										
Female % of workforce	23.0%	22.7%	23.8%	23.2%	24.4%	24.3%	25.6%	26.2%	14%	39%
Number of observations	355856	336738	341399	351974	356403	356031	364001	183722	-48%	-45%
Average age of workforce	45.0	45.5	45.9	45.4	45.9	46.2	46.6	46.6	4%	8%

Note: * For variables denoted in percentages, the change from one year to another year is given in percentage points, %p,. The percentage point is simply calculated by subtracting the percentage value in the end of the period from the percentage in the start. Hence for the share of workers with Upper secondary education, the change from 1982 to 1990 is computed as : 4.3%p= 15.5% -11.2%.

**Stock of education: Percentage of workforce graduated from each level of education. A worker with tertiary education also figures in the statistics for Upper secondary and lower levels, since the worker has graduated from these levels as well. This statistic hence differs from the statistics on highest completed level of education reported in the top of the table.

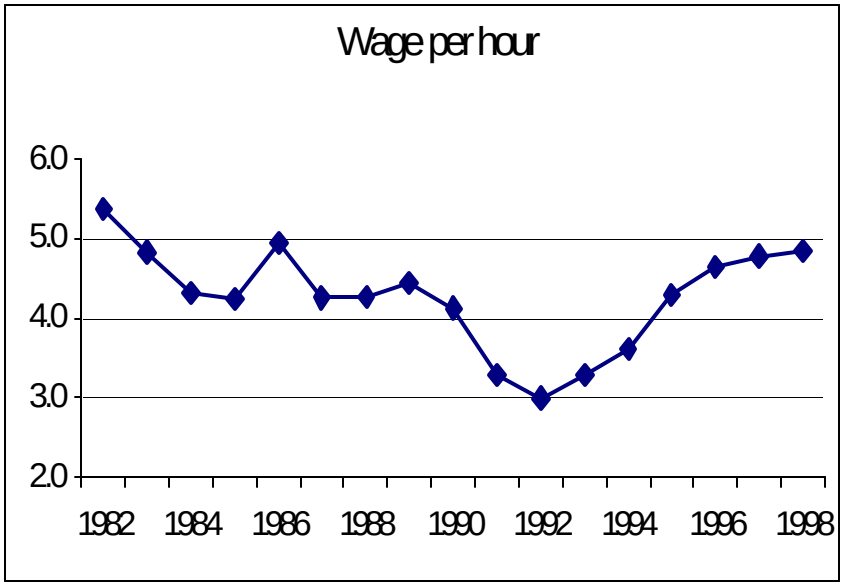
*** The unemployment figures are calculated on the basis of the definition outlined on the web sites of the Brazilian Statistical Bureau (IBGE), www.ibge.gov.br. The reported figures are likely to underestimated the actual level of unemployment.

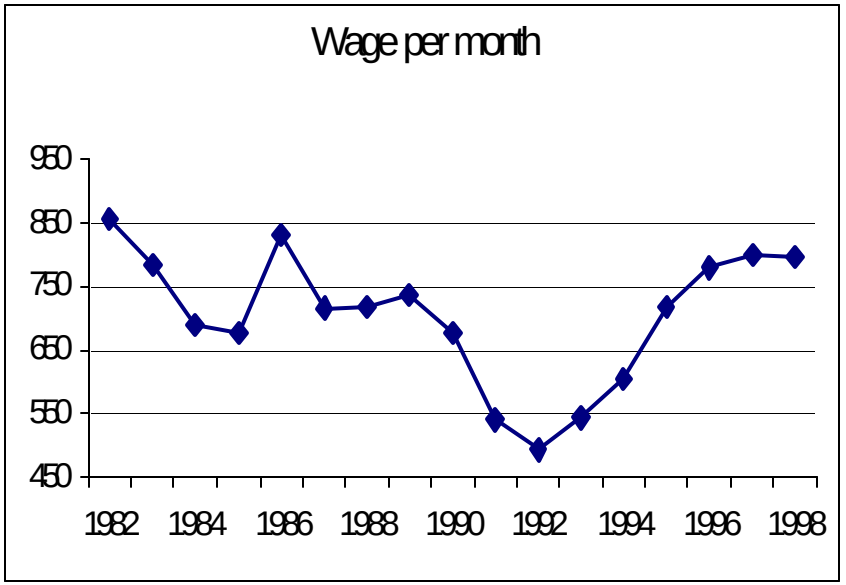
Appendix C Regression Results

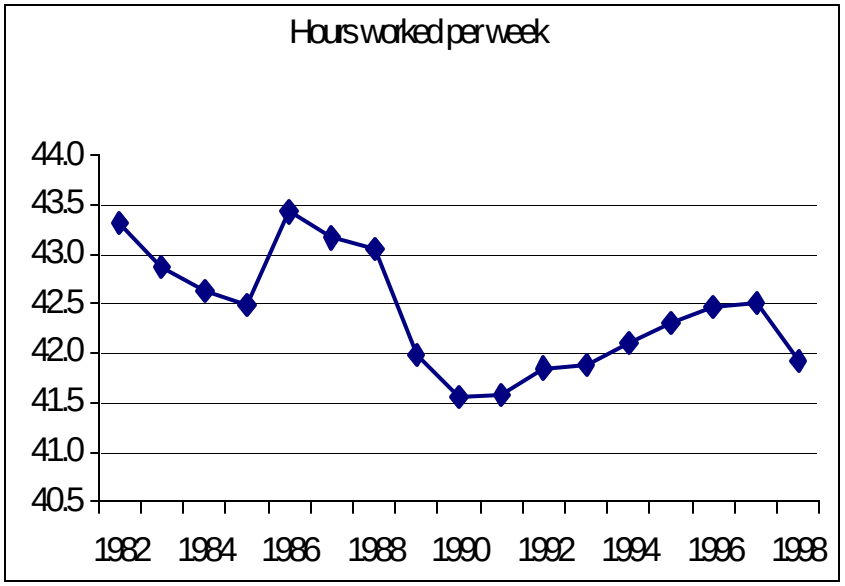
Regression results for alternative schooling specification,
Model (1) linear schooling specification and
R2 for spline specification with schooling variables only.

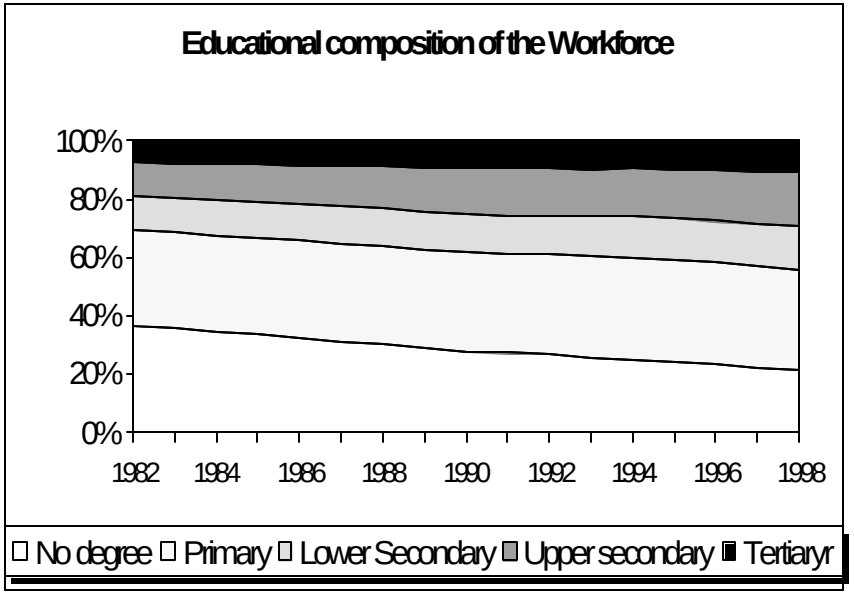
	Linear model			Spline model with Schooling variables ONLY
Year	ß(schooling)	t-value	R^2	R^2
1982	13.87%	412.5	0.519	0.425
1983	13.63%	444.2	0.513	0.414
1984	13.69%	445.1	0.518	0.409
1985	13.72%	413.2	0.503	0.402
1986	13.67%	457.4	0.518	0.411
1987	13.28%	443.0	0.503	0.397
1988	13.39%	432.4	0.516	0.413
1989	13.39%	384.8	0.501	0.400
1990	13.68%	378.6	0.492	0.390
1991	12.62%	375.5	0.489	0.391
1992	12.44%	345.2	0.478	0.375
1993	12.56%	338.9	0.480	0.372
1994	13.00%	337.8	0.483	0.367
1995	12.82%	351.6	0.504	0.381
1996	12.67%	361.7	0.508	0.392
1997	12.61%	359.6	0.503	0.390
1998	12.75%	248.1	0.494	0.390

Appendix D Graphs

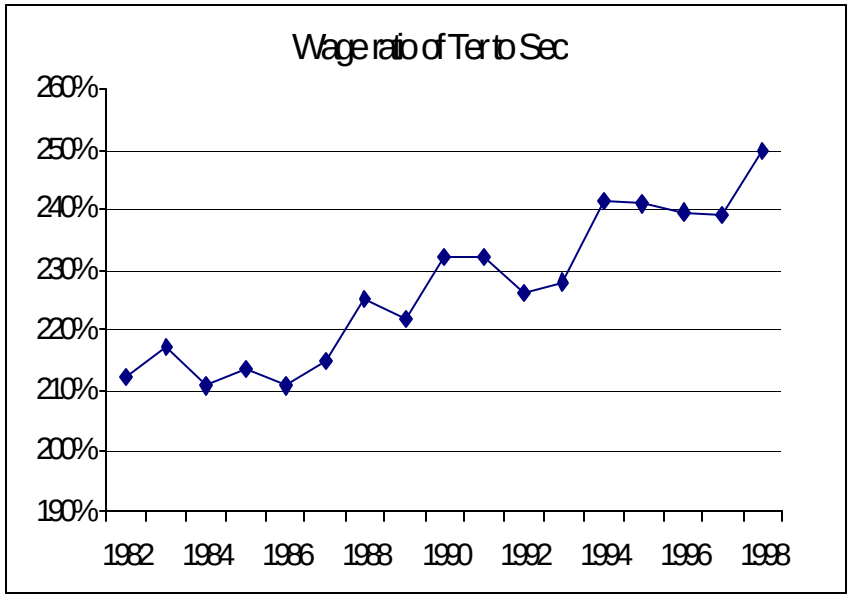


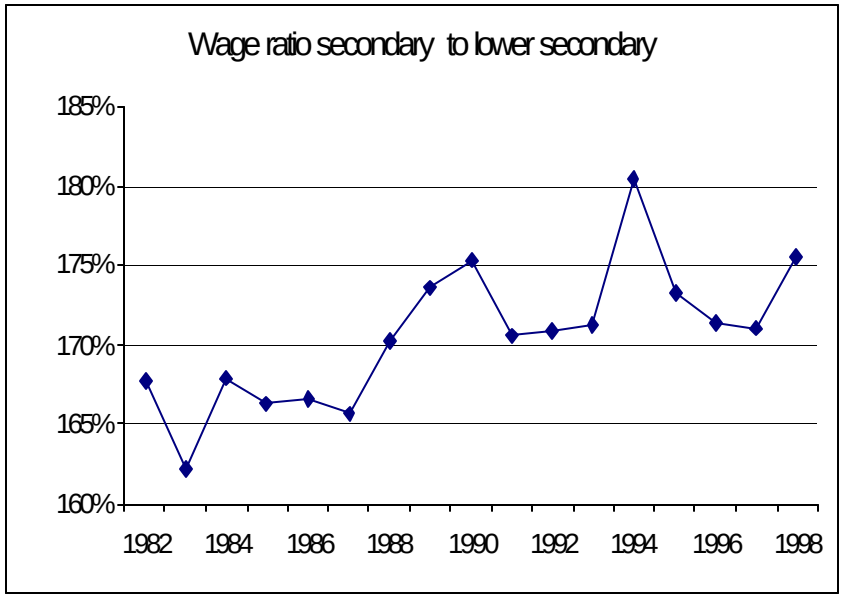


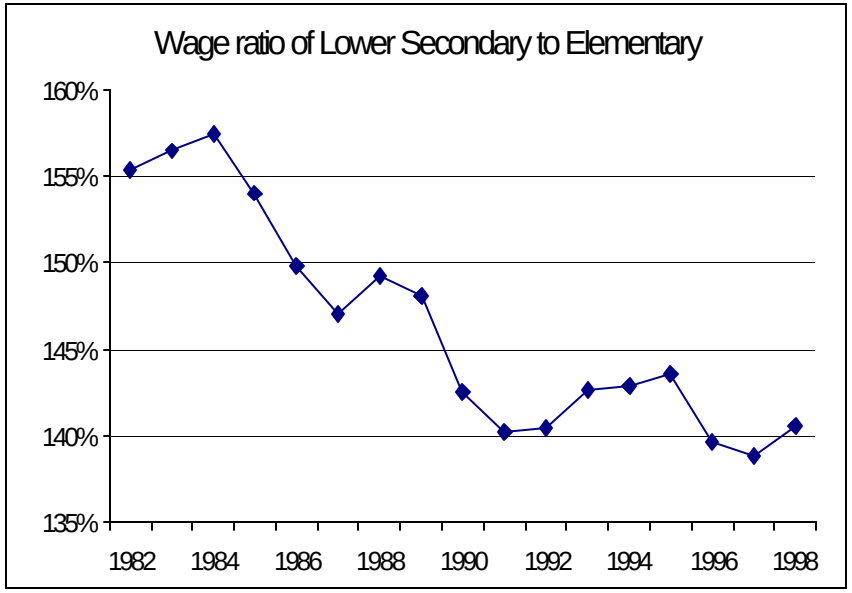


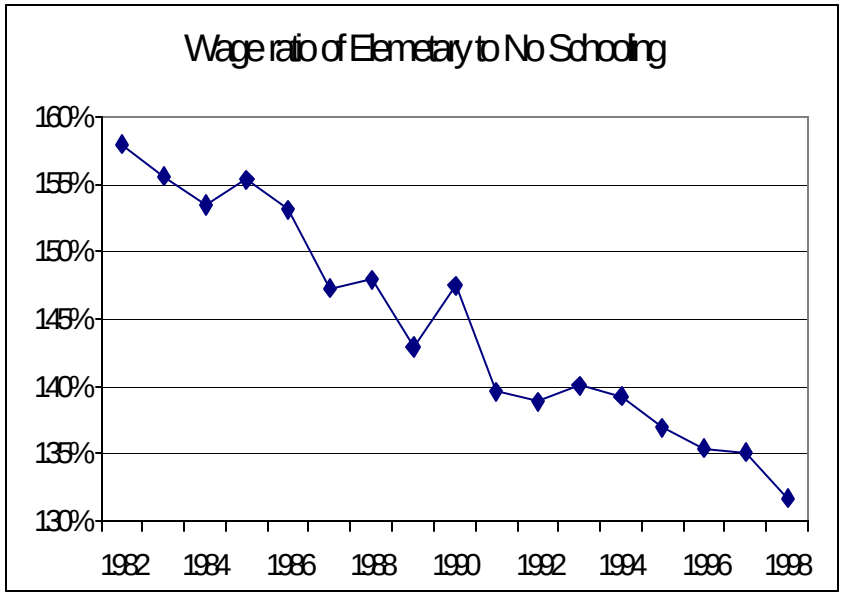


Appendix D


Wage ratio of Ter to Sec
260%
250%
240%
230%
220%
210%
200%
190%
1982
1984
1986
1988
1990
1992
1994
1996
1998

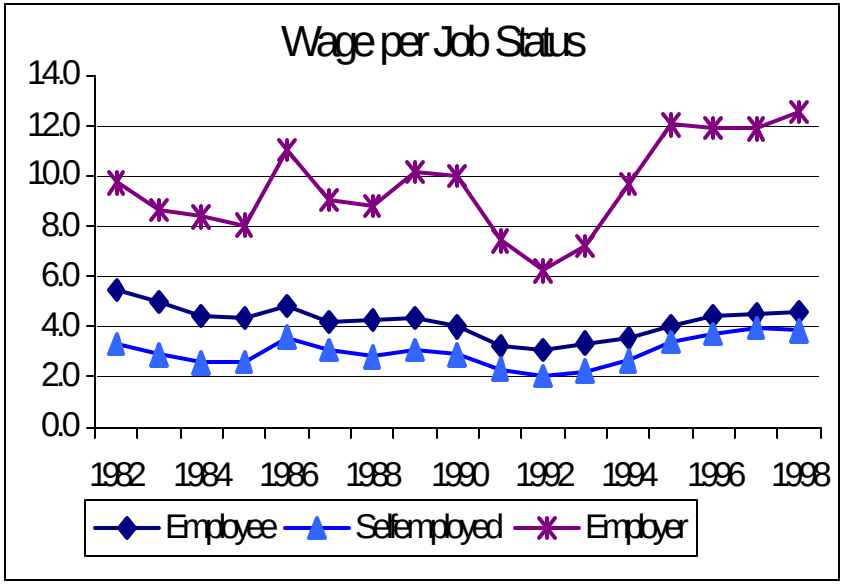

Wage ratio secondary to lower secondary
185%
180%
175%
170%
165%
160%
1982
1984
1986
1988
1990
1992
1994
1996
1998

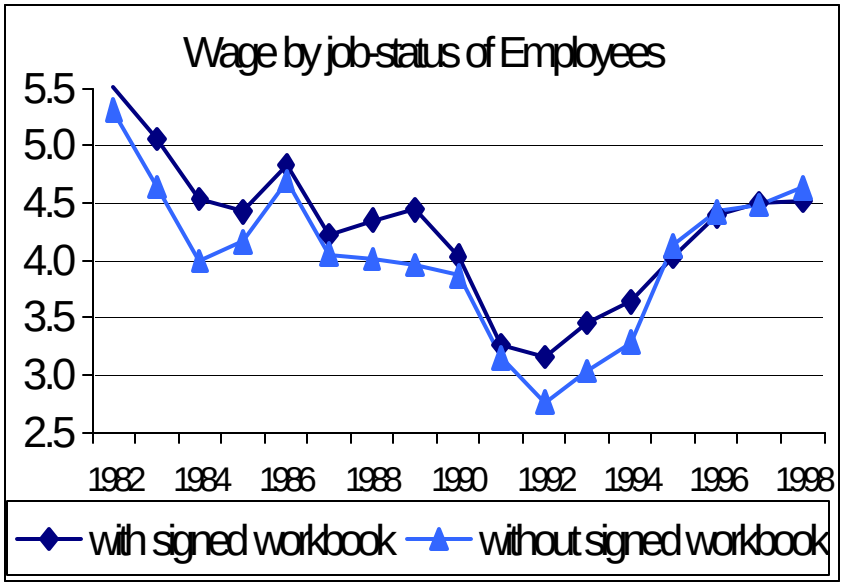

Wage ratio of Lower Secondary to Elementary
160%
155%
150%
145%
140%
135%
1982
1984
1986
1988
1990
1992
1994
1996
1998

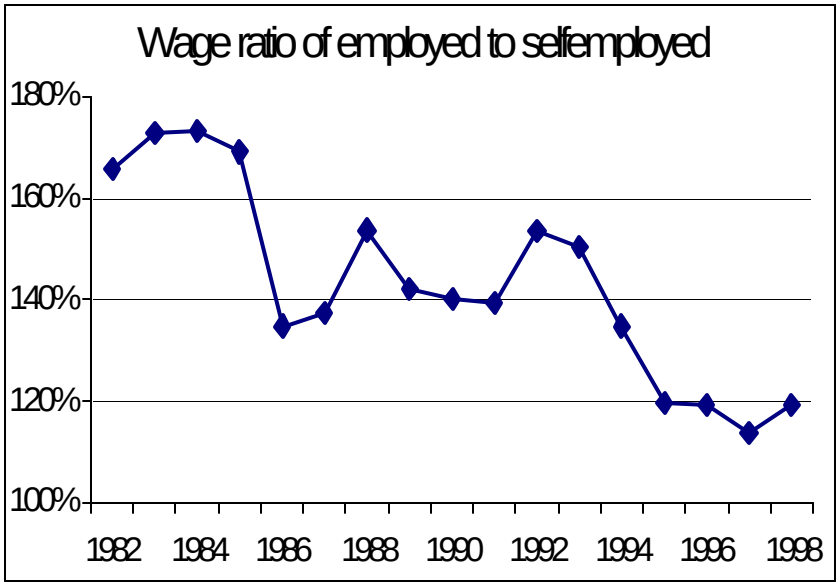

Wage ratio of Elemetary to No Schooling
160%
155%
150%
145%
140%
135%
130%
1982
1984
1986
1988
1990
1992
1994
1996
1998

Appendix D

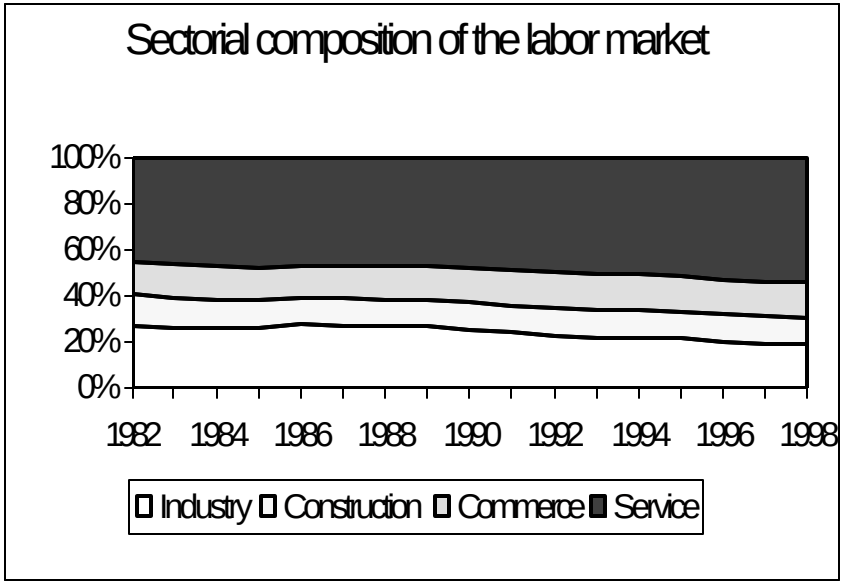

Job status composition of the Workforce
100%
80%
60%
40%
20%
0%
1982 1984 1986 1988 1990 1992 1994 1996 1998
Employee Selfemployed Employer

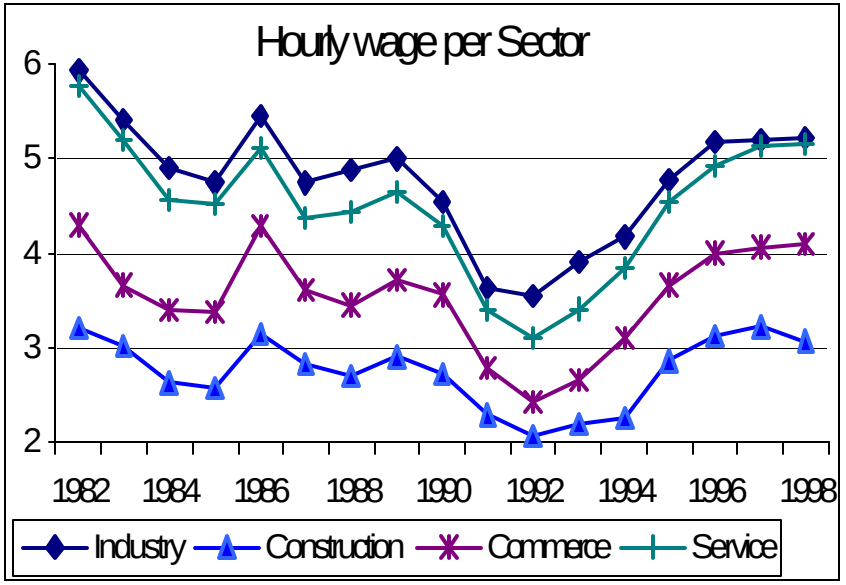

Wage per Job Status
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1982 1984 1986 1988 1990 1992 1994 1996 1998
Employee Selfemployed Employer

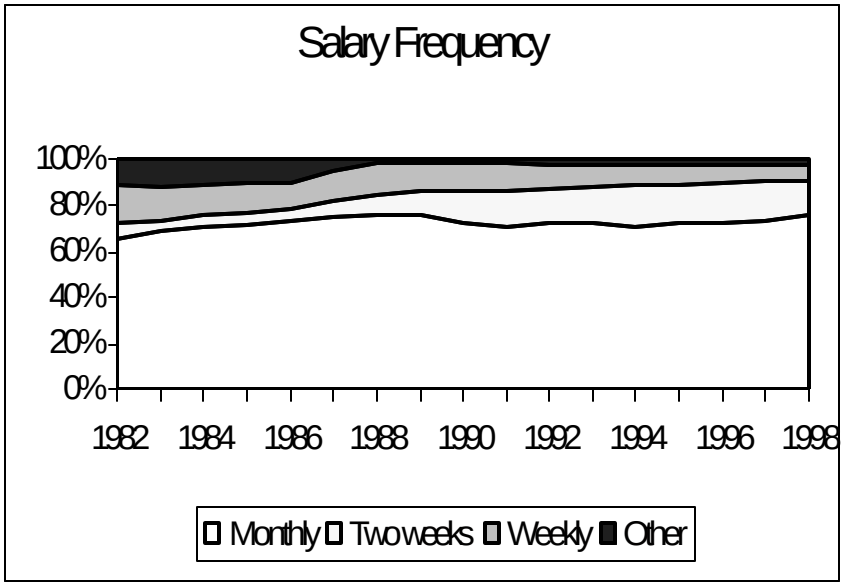

Wage by job-status of Employees
5.5
5.0
4.5
4.0
3.5
3.0
2.5
1982 1984 1986 1988 1990 1992 1994 1996 1998
with signed workbook
without signed workbook

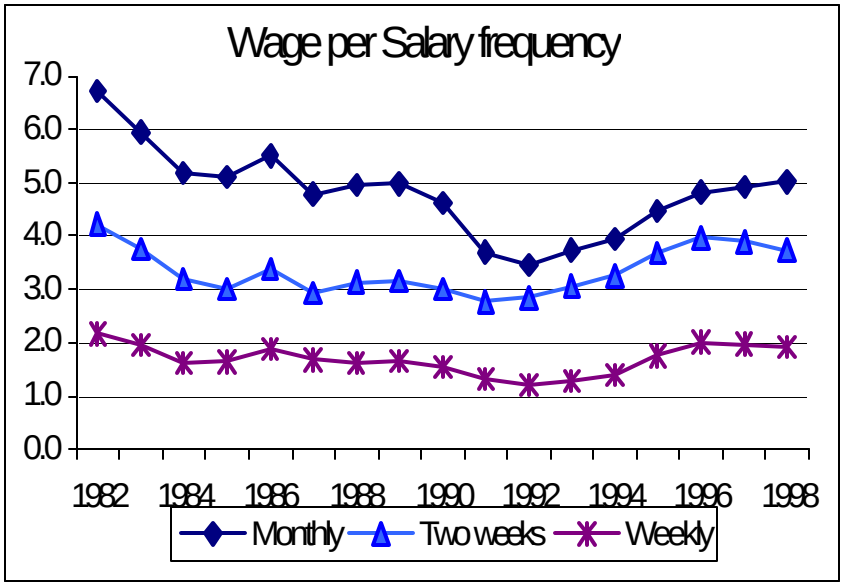

Wage ratio of employed to selfemployed
180%
160%
140%
120%
100%
1982 1984 1986 1988 1990 1992 1994 1996 1998

Appendix D

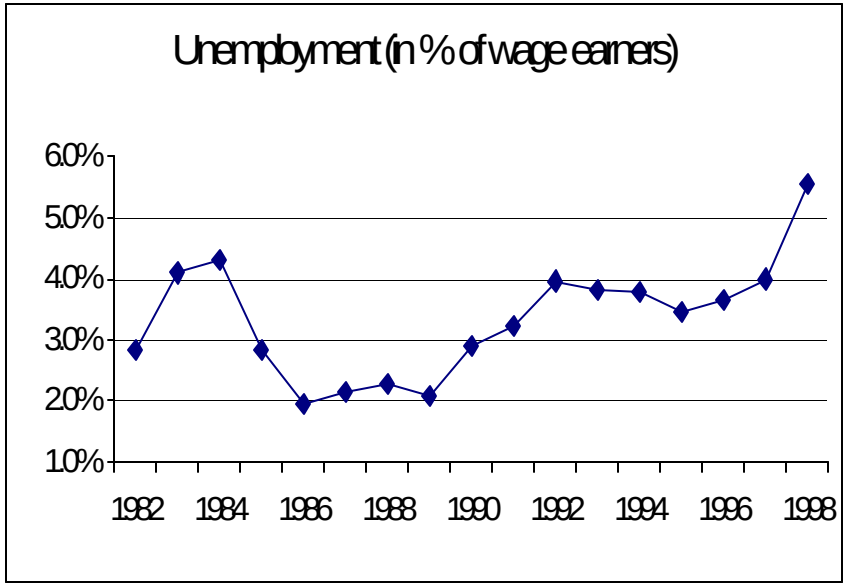

Sectorial composition of the labor market
100%
80%
60%
40%
20%
0%
1982 1984 1986 1988 1990 1992 1994 1996 1998
Industry Construction Commerce Service

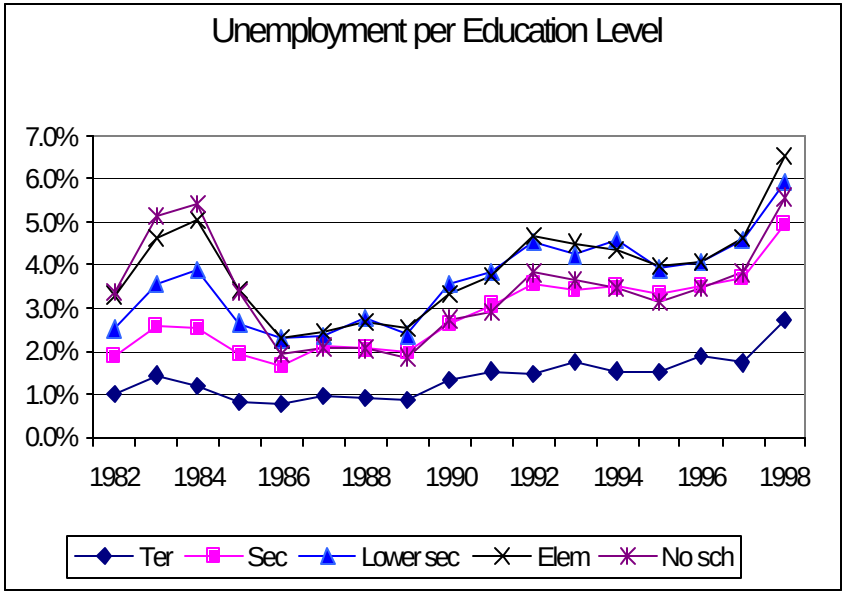

Hourly wage per Sector
6
5
4
3
2
1982 1984 1986 1988 1990 1992 1994 1996 1998
Industry Construction Commerce Service


Salary Frequency
100%
80%
60%
40%
20%
0%
1982 1984 1986 1988 1990 1992 1994 1996 1998
Monthly Two weeks Weekly Other

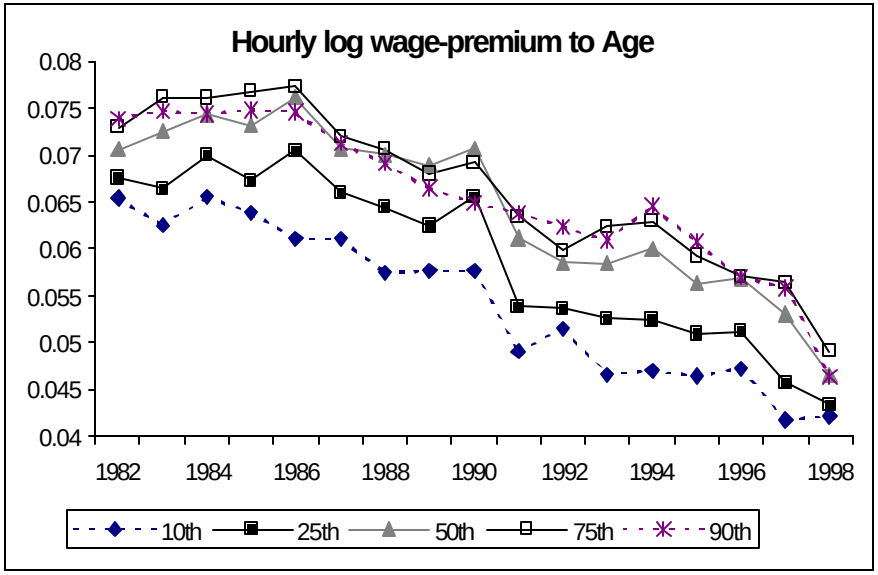

Wage per Salary frequency
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1982 1984 1986 1988 1990 1992 1994 1996 1998
Monthly Two weeks Weekly

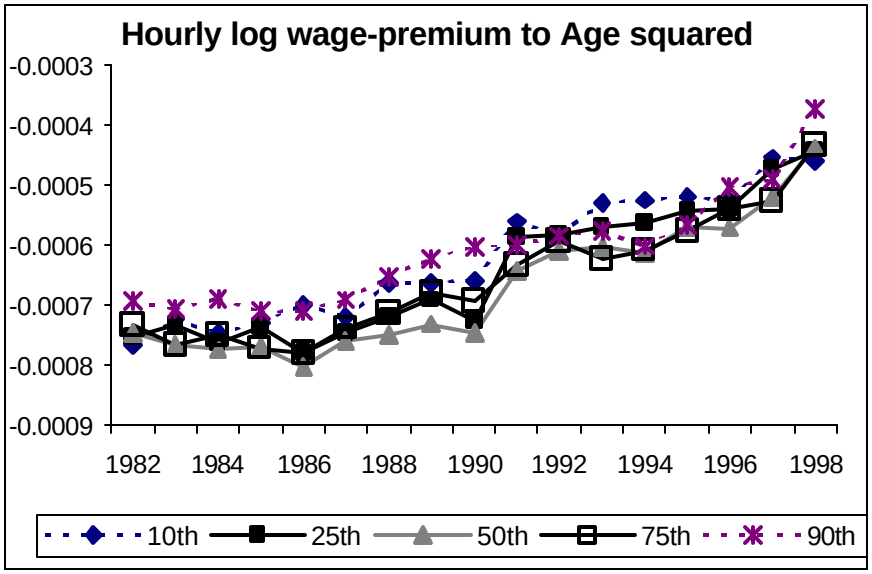
Appendix D



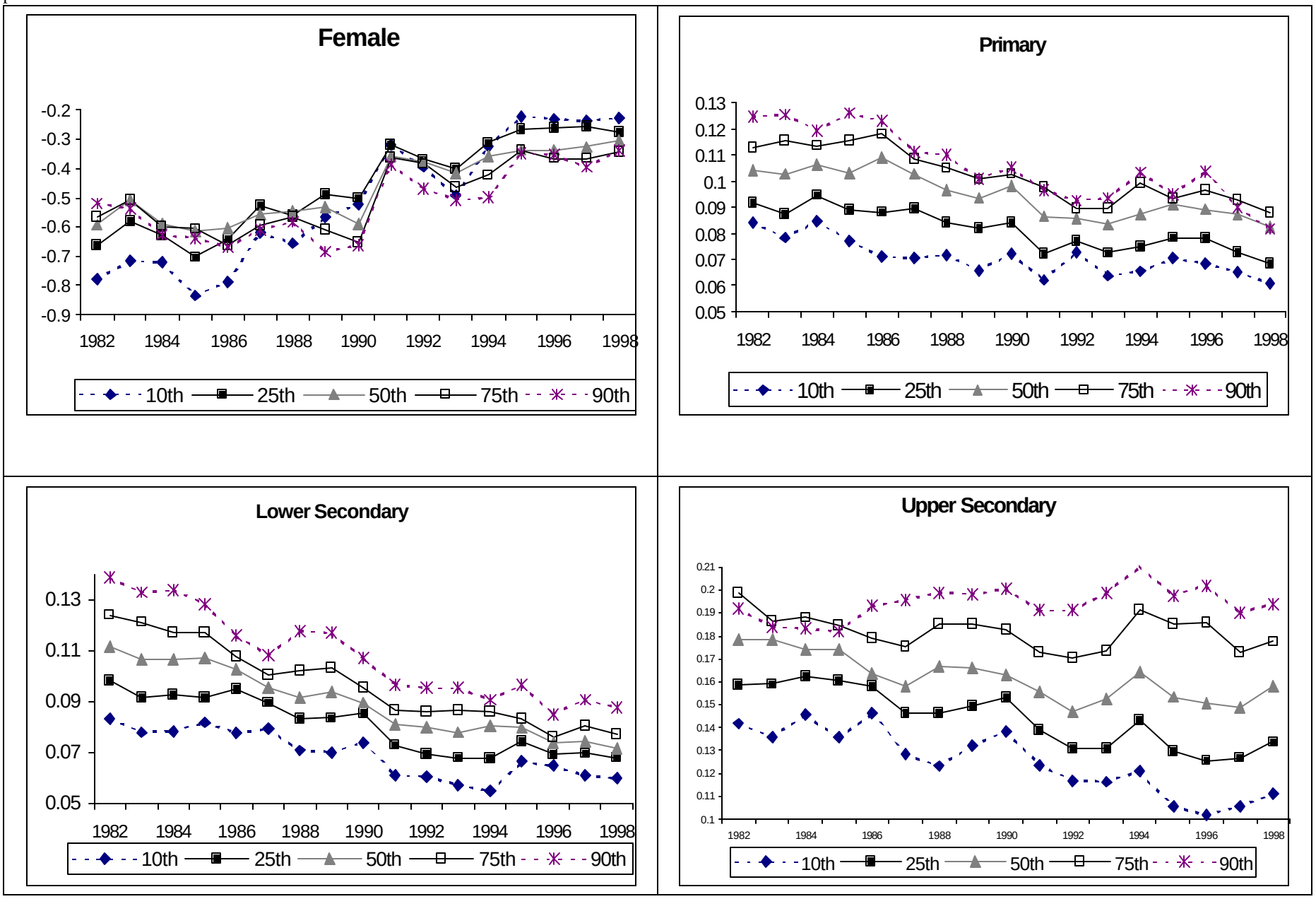


Graph of Quantile Regression Coefficients

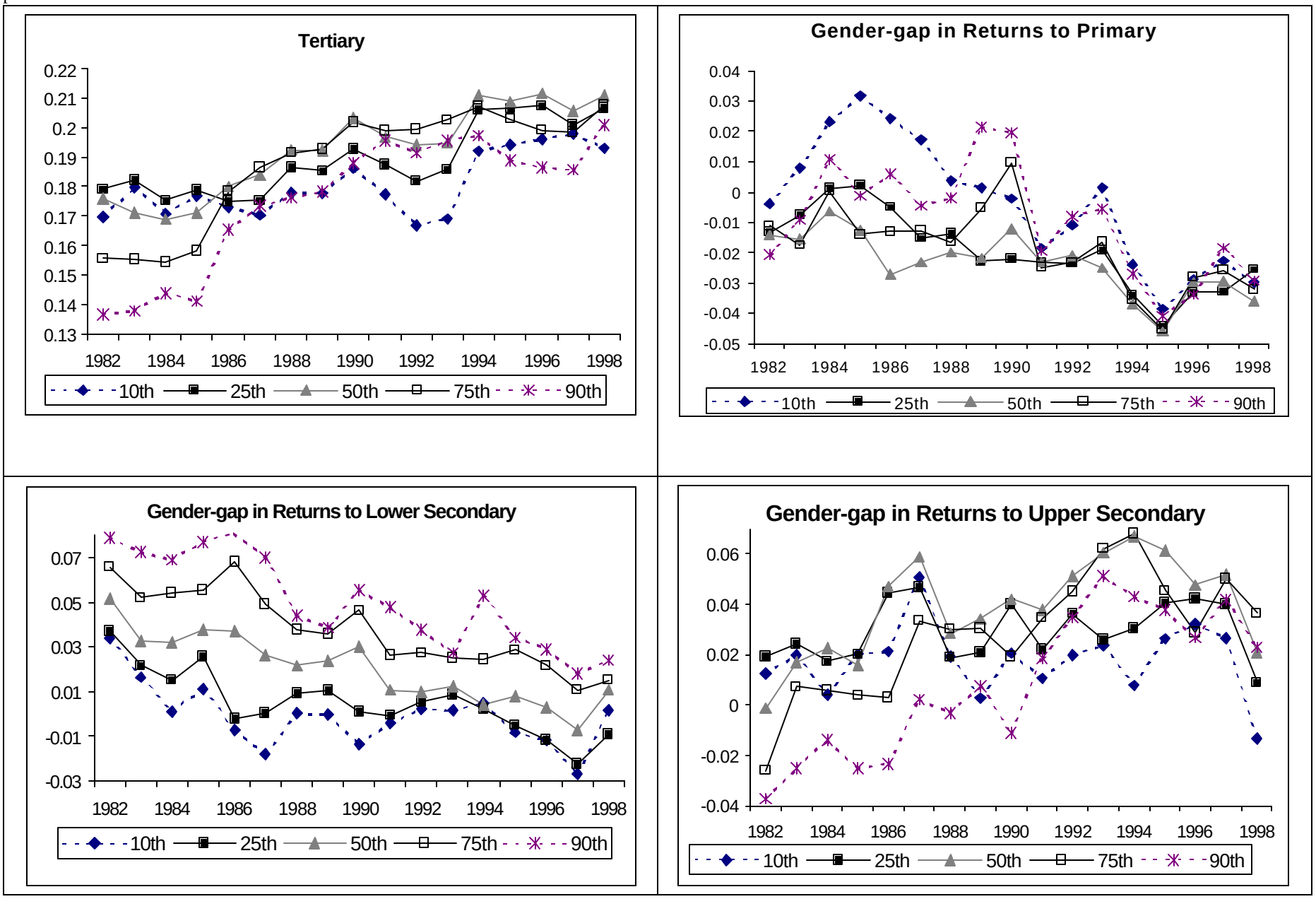




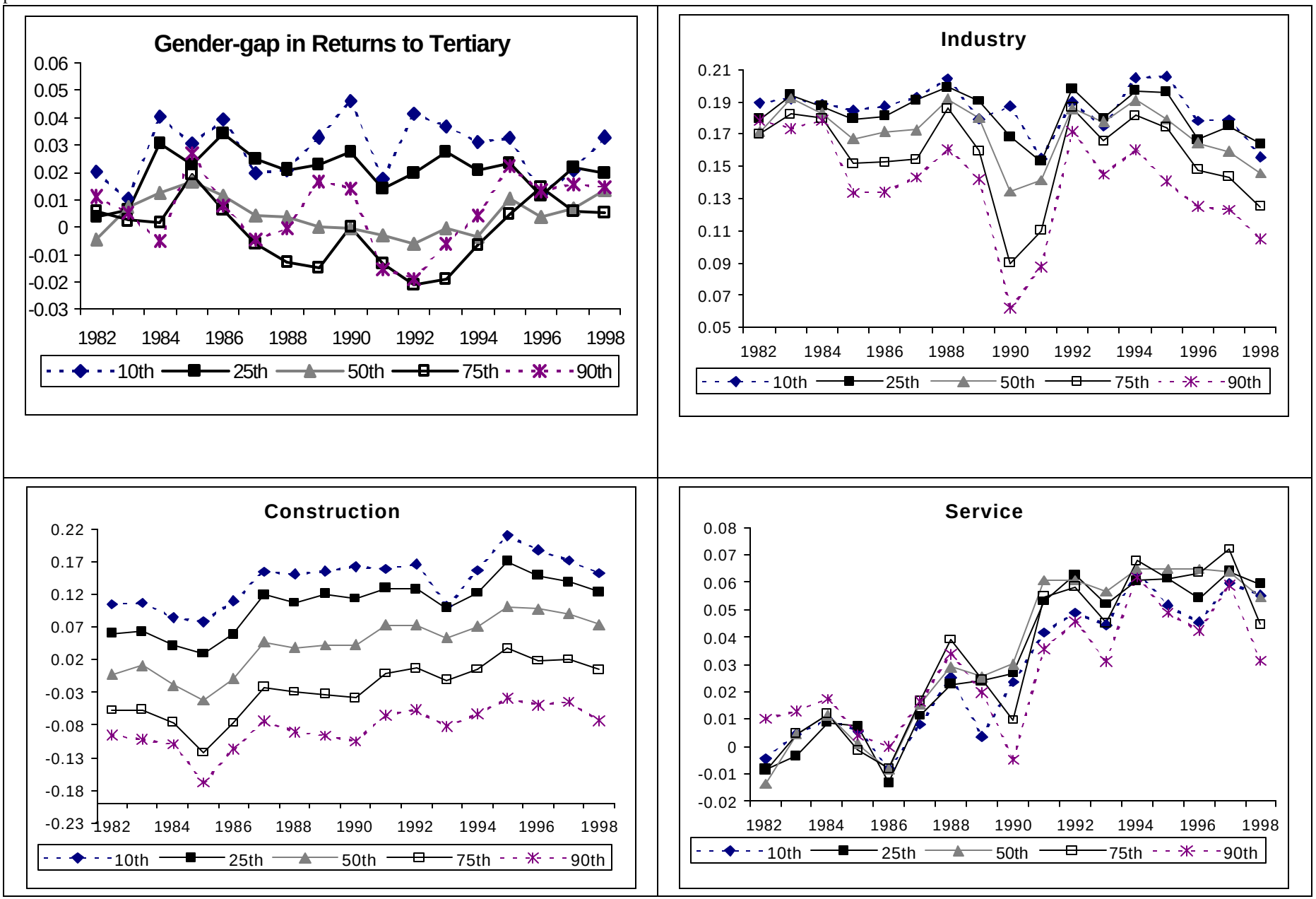
Appendix D


Female
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th
Primary
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th
Lower Secondary
0.13
0.11
0.09
0.07
0.05
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th
Upper Secondary
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th

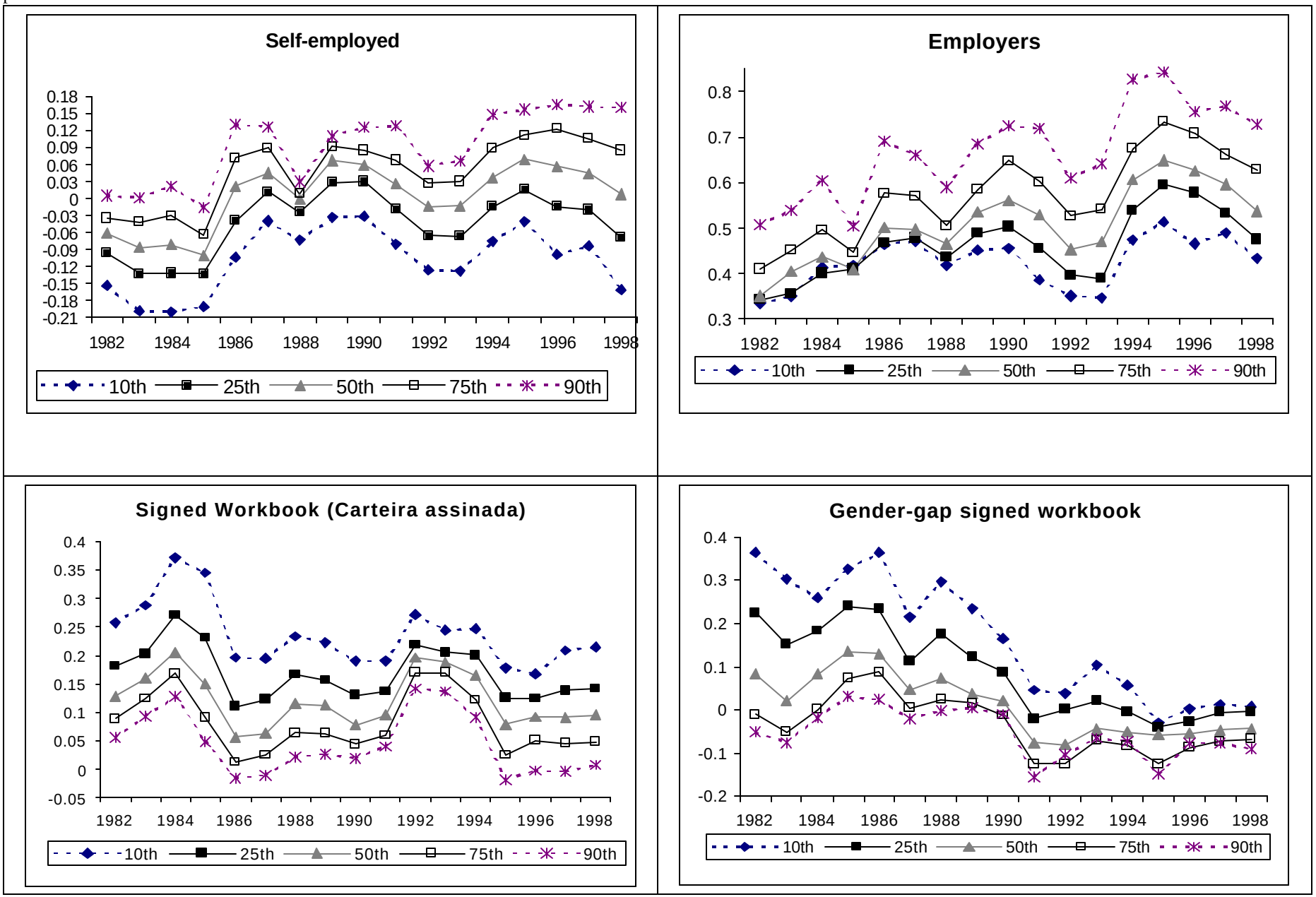
Appendix D


Tertiary
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Gender-gap in Returns to Primary
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Gender-gap in Returns to Lower Secondary
0.07
0.05
0.03
0.01
-0.01
-0.03
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Gender-gap in Returns to Upper Secondary
0.06
0.04
0.02
0
-0.02
-0.04
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th

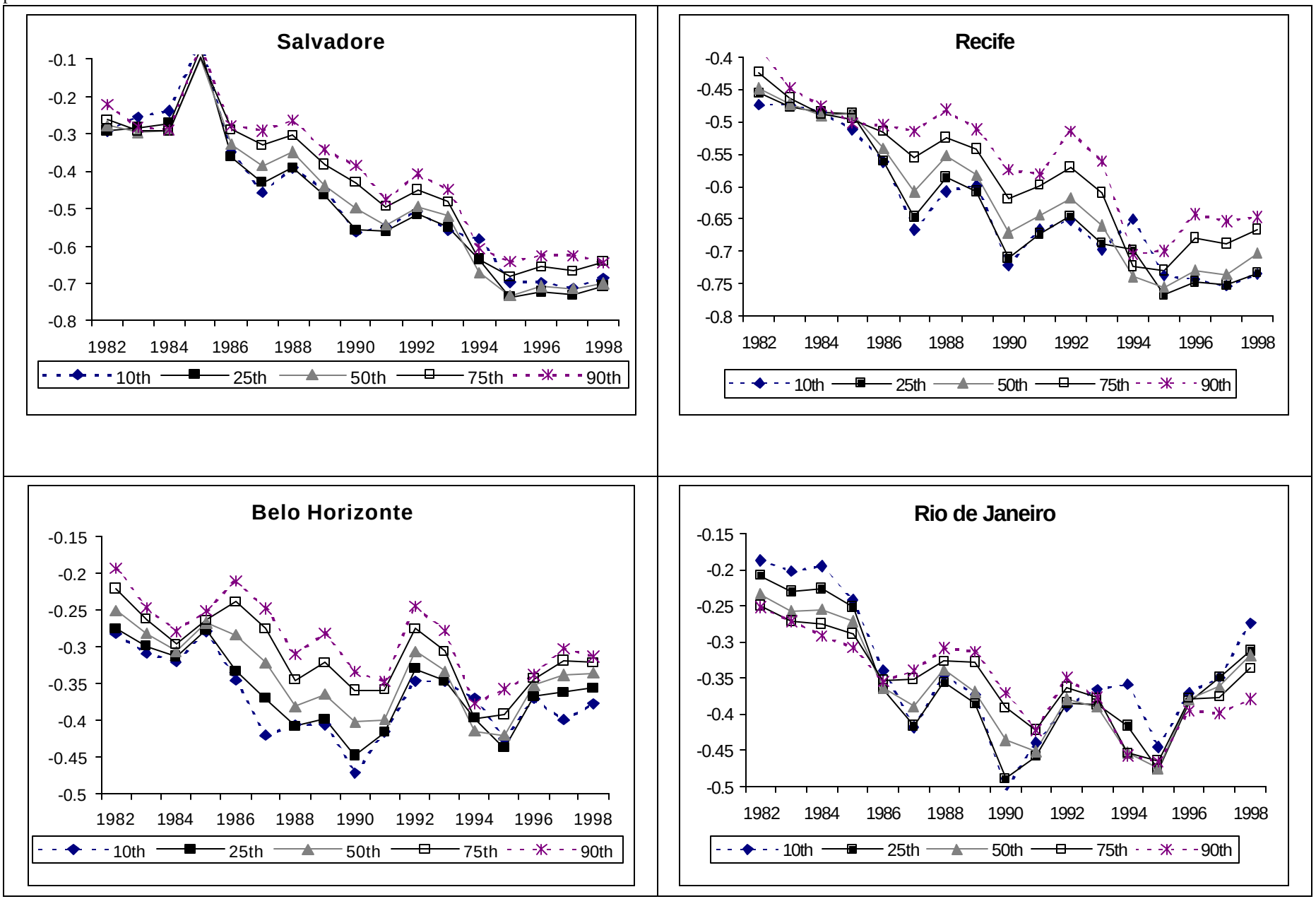
Appendix D


Gender-gap in Returns to Tertiary
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Industry
0.21
0.19
0.17
0.15
0.13
0.11
0.09
0.07
0.05
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Construction
0.22
0.17
0.12
0.07
0.02
-0.03
-0.08
-0.13
-0.18
-0.23
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Service
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th

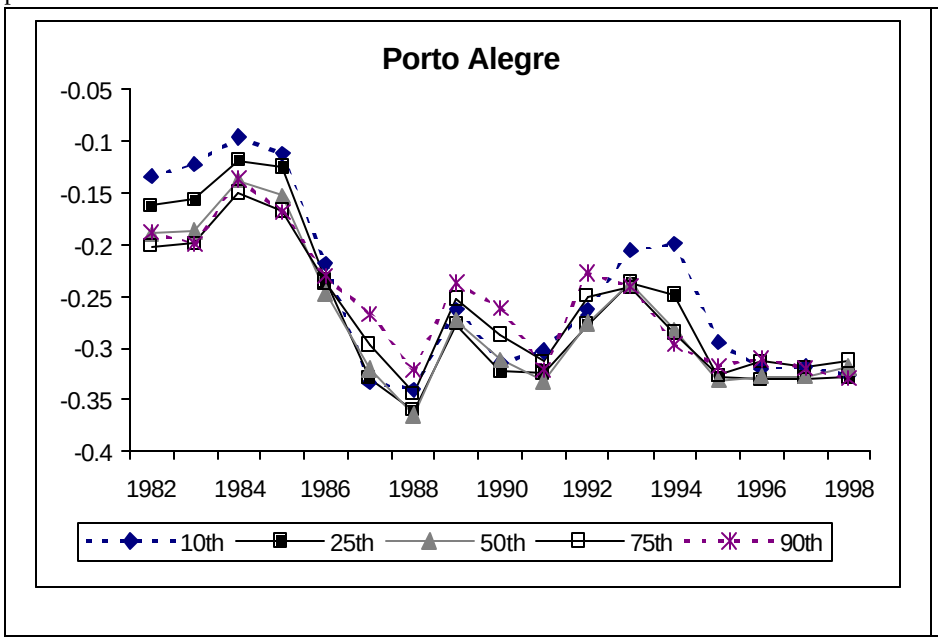
Appendix D

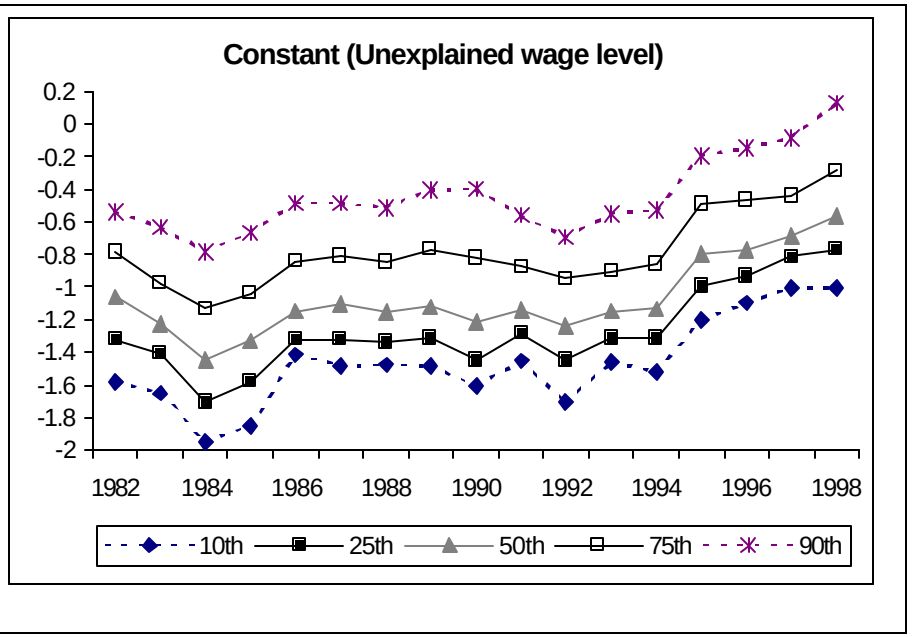

Self-employed
0.18
0.15
0.12
0.09
0.06
0.03
0
-0.03
-0.06
-0.09
-0.12
-0.15
-0.18
-0.21
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Employers
0.8
0.7
0.6
0.5
0.4
0.3
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Signed Workbook (Carteira assinada)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Gender-gap signed workbook
0.4
0.3
0.2
0.1
0
-0.1
-0.2
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th

Appendix D


Salvadore
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Recife
-0.4
-0.45
-0.5
-0.55
-0.6
-0.65
-0.7
-0.75
-0.8
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Belo Horizonte
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th
Rio de Janeiro
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
1982 1984 1986 1988 1990 1992 1994 1996 1998
10th 25th 50th 75th 90th

Appendix D


Porto Alegre
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th


Constant (Unexplained wage level)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
1982
1984
1986
1988
1990
1992
1994
1996
1998
10th
25th
50th
75th
90th

Strategies and Recommendations for Higher Education in Brazil[1]

Brazil has given considerable thought to the development and reform of its tertiary education system and has made significant progress in many important areas. This section of the report suggests further developments to progress already made by Brazil focusing on the strategic goals of access, quality, relevance and efficiency.

1. Improving Access

In the area of improved access, it is suggested that the government consider the following:

- Brazil has taken major steps to diversify the types of tertiary institutions and the delivery methods used as a means of improving access and enrollment. These include the promotion of university centers, the development of sequential courses, the offering of night classes, and the more recent development of remote teaching.. *In order to continue to promote these means of tertiary education the Government may find it useful to set timed targets as a way of monitoring and measuring the progress of each of these interventions in increasing access and enrollments.*

- *Providing further financial assistance to poorer students to enable them to afford the fees at private institutions as well as to offset some of the costs associated with attending public institutions might also serve to improve access and enrollment*. The uneven distribution of tertiary enrollments by income group means that highly targeted aid could have a major impact on who attends. In developing a student aid program/policy, it will be important to identify which segment(s) of the student population would be eligible for assistance and, based on enrollment targets, estimate the total amount of assistance which might be needed. An important aspect of any loan scheme would be that it was designed to have zero or minimal subsidies, coupled with a mix of institutionally based discounts and scholarships. This would generate an expansion in enrollments, targeting of those most in need, and make minimal demands on the government coffers.

- Currently, coverage is about ten percent, significantly lower than other countries comparable to Brazil in size and dynamism. While the Government wishes to improve this, at present, there is no specific target or time frame for the increase. *The Government may want to set a broad enrollment target for 2005 and 2010.* According to the estimates made earlier in the report (see Table 11), if the Government set a gross enrollment rate of 15 percent for the year 2005, that would mean providing places for an additional 800,000 students. This does not seem unreasonable if one considers the large increase in the number of secondary school graduates anticipated. Nor would such an increase require a major increase in public expenditure, if efficiency gains are made in the public sector and the private sector continues to grow in response to demand.

[1] Strategies and Recommendations included in the Brazil: Higher Education Sector Study (WB Report # 19392-BR, June 30, 2000, L. Holm-Nielsen et all.).

2. Improving Quality

The Government has taken major steps to improve the quality of tertiary education consisting of an exit exam, the *Provão*, site visits, and data collection by the INEP. To further develop a culture of quality in tertiary education:

- It will be important to *ensure that the **Provão** remains a flexible tool that changes with curricula developments rather than serve as a rigid guide to set curricula*. It is also important to maintain the expansion of PAIUB activities and the data collection by INEP in order to assure quality controls are in place to ensure institutions remain responsible while gaining various degrees of autonomy.

- *Institutions will need to be actively encouraged to develop more rigorous internal quality assurance mechanisms for themselves*. One way to accomplish this would be for the Government to develop a type of audit of quality to review the effectiveness if the internal quality processes of an institution which, if satisfactory, would mean more relaxed quality assessment by government, a signal to institutions that they were performing the task of assessment well.

3. Improving Relevance

It has always been a concern of countries that its tertiary system serve the needs of society and the economy.

- Brazil has taken a step in this direction by modifying its legal framework to allow greater *flexibility in curriculum content*. It is also important to seek information from employers on the skills and knowledge mix they need and to encourage them to participate in curriculum design.

- *Flexibility is needed in course structure* as well, for example, the major/minor concept used in the US in which students exercise some guided choice over the modules they study. This approach may have to be actively developed with the institutions since it does not fit with the academic tradition of Brazilian universities.

- *Institutions should try to identify both national and regional/local needs which they think they are able to meet or have a comparative advantage in over other institutions, and offer appropriate study programs* . Each institution has any number of stakeholders - the local labor market which it serves, the students who apply and attend, and the local or regional development needs which can be identified through outreach to community and regional organizations. Once the needs of the various groups have been identified, institutions should respond to them by prioritizing them and providing courses and programs that meet the demand. When institutions become more "consumer oriented" there is the bonus of greater diversification in the system.

4. Improving Efficiency

Given Brazil's need to expand the system coupled with ever diminishing public resources, improvements in efficiency in the public sector is imperative.

- *The clearest inefficiency in the public tertiary system is the current civil service structure as it pertains to the hiring, firing, promotion, and reward structure of faculty, technical and administrative personnel*. Brazil will need to think carefully about reform measures if it wants to make operational, in a meaningful way, the principles set forth in the new legal framework .

- The new legal framework developed and adopted by the Government, indicates that Brazil is moving away from direct control of public tertiary education and is moving toward providing an enabling policy environment for institutions. *For institutional autonomy of this type to be meaningful, the Government may want to consider implementing the following guidelines which are considered international good practice*:

  a) provide public funds in the form of Block Grants allowing institutions to determine exact allocations;

  b) permit institutions to keep any revenue they generate without a reduction in the total amount of government funding;

  c) require accountability of institutions receiving public funds through: requiring institutions to produce a five year strategic plan and a one year operational plan (based on the Governments overall national goals); require monitoring of the institutional plan; require participation in accreditation/re-accreditation processes, providing annual budgets that are transparent, and producing detailed annual reports of what has been achieved with the funds.

- There is scope in the system to *increase efficiency in the use of the academic staff in public institutions, to increase the use of physical infrastructure through more intensive use, not only over the course of a day, but throughout the year, and to reduce drop out and failure rates* through improved teaching and increased relevance.