179
DISCUSSION PAPER
Originally published by Ipea in April 2007 as number 1272a of the series Texto para Discussão.

SHEEPSKIN EFFECTS AND THE RELATIONSHIP BETWEEN EARNINGS AND EDUCATION: ANALYZING THE EVOLUTION OVER TIME IN BRAZIL

Anna Crespo
Maurício Cortez Reis

ipea

179

DISCUSSION PAPER

Originally published by Ipea in April 2007 as number 1272a of the series Texto para Discussão.

Brasília, January 2015

SHEEPSKIN EFFECTS AND THE RELATIONSHIP BETWEEN EARNINGS AND EDUCATION: ANALYZING THE EVOLUTION OVER TIME IN BRAZIL

Anna Crespo[1]
Maurício Cortez Reis[2]

1. From Princeton University.
2. From Institute for Applied Economics Research (Ipea).

DISCUSSION PAPER

A publication to disseminate the findings of research directly or indirectly conducted by the Institute for Applied Economic Research (Ipea). Due to their relevance, they provide information to specialists and encourage contributions.

Discussion paper / Institute for Applied Economic

Research.- Brasília : Rio de Janeiro : Ipea, 1990-

ISSN 1415-4765

1. Brazil. 2. Economic Aspects. 3. Social Aspects. I. Institute for Applied Economic Research.

CDD 330.908

JEL: I20, J30.

SINOPSE

Este artigo procura analisar tendências no efeito-diploma e na relação entre rendimentos e educação no mercado de trabalho brasileiro de 1982 até 2004. Usando dados da Pesquisa Nacional por Amostra de Domicílios (Pnad) são estimadas equações de rendimentos incluindo funções com saltos e mudanças de inclinação nos anos de educação correspondentes à obtenção de diploma ou à conclusão de um determinado grau, assim como regressões semiparamétricas. Os resultados mostram uma redução no efeito-diploma entre 1982 e 2004, indicando que a conclusão de um ciclo educacional no Brasil vem perdendo valor ao longo do tempo. Também, a relação entre o logaritmo dos rendimentos e o nível de escolaridade tem se tornado mais convexa.

ABSTRACT

This paper seeks to analyze trends in sheepskin effects and earnings-education relationship on the Brazilian labor market from 1982 to 2004. Using data from the Brazilian National Household Sample Survey (Pnad) are estimated earnings equations including linear years of schooling, and splines and discontinuous functions for completed degrees, as well as semi-parametric regressions. Empirical evidence reports a reduction in the sheepskin effects from 1982 to 2004, indicating that a diploma or degree completion in Brazil has been loosing its value over time. At the same time, the relationship between log earnings and education has become more convex. Similar trends are verified when the analysis is carried out separately by region.

SUMÁRIO

1 INTRODUCTION 7

2 DATA 9

3 EMPIRICAL FRAMEWORK 13

4 EMPIRICAL EVIDENCES 14

5 CONCLUSION 19

REFERENCES 19

APPENDIXES 21

1 INTRODUCTION

There are a vast number of papers in the literature showing that earnings and education are positively related (see CARD, 1999). Following Mincer's (1974) model, most of those papers represent log of earnings as a linear function of education. Nevertheless, according to the sheepskin effects hypothesis, an additional year of schooling has an even stronger impact on earnings if it corresponds to a diploma or degree completion. The argument is that employers may use the information offered by a diploma or degree as a signal positively related to workers' unobserved productivity.[1] Therefore, sheepskin effects imply in a non-linear and discontinuous relationship between education and log of earnings, opposed to the standard linear earnings function established by Mincer (1974).

Evidences for different countries are consistent with the presence of sheepskin effects.[2] In Brazil, estimates reported by Lam and Schoeni (1993) and Ramos and Vieira (1996) show that returns to schooling[3] are highly non-linear, with the completion of a degree representing a substantial earnings gain. Ramos and Vieira (1996), using Pnad data for 1990, find that an upper primary school degree (8 years of completed schooling) increases earnings by 6%, and secondary school (11 years of schooling) and college (15 years of schooling) degrees increase earnings by 18%. Comparing 1976 with 1990 these authors show that sheepskin effects are very stable across time, except for the lower primary degree (4 years of schooling), which reduced slightly.

There is a body of evidence showing that log earnings have become an increasingly convex function of years of schooling in the United States since 1980 (MINCER, 1997; LEMIEUX, 2006; DESCHÊNES, 2006). Autor, Katz and Kearney (2006) argue that computerization displaced semi-skilled workers, in performing routine tasks. Since computers complement skilled workers performing abstract tasks and neither substitute nor complement unskilled workers engaged in manual tasks, changes in earnings structure could be attributed to labor demand shifts associated to computerization, according to Autor, Katz and Kearney (2006).

The structure of the Brazilian labor market has been changing considerably in the last decades, what could have changed the returns to education. From 1982 to 2004 the labor force educational level experienced a remarkable increase. In 1982 more than one third of the workers did not have finished the lower primary school, which requires four years of completed schooling. In 2004, this proportion reduced to about 15%. It is possible to notice also that changes in educational distribution during this period were much more intense across workers with completed degrees than for other individuals who did not have this kind of credential. These facts may have changed the signal value represented by the completion of a given degree, and

1. The completion of a degree could increase the signal value, since it should indicate, for example, workers perseverance and motivation, which are factors that enhance the productivity (WEISS, 1995).

2. See, for example, Hungerford and Solon (1987), Belman and Heywood (1991), Jaeger and Page (1996) and Park (1999) for the United States; Ferrer and Riddell (2002) for Canada; Schady (2003) for Philippines; and Pons (2006) for Spain.

3. It should be stressed that, although labor economists refer to the effect of an additional year of education on earnings as the "return to schooling", a carefully calculation of the "return" would incorporate the tuition cost of schooling.

then it is expected that sheepskin effects have been loosing their importance, in particular for lower degrees. A lower primary degree could be a positive signal about individual non-observed characteristics in 1982, since a great share of the workers did not reach this level of education, but probably, it offers a very different kind of information for employers in 2004.

On the other hand, important changes occurred on the labor demand side, especially after the nineties, when the country went through trade liberalization process intensification and the technological progress was amplified. As documented in many papers, the technological progress should increase the relative demand for more skilled workers.[4] In addition, there is the impact depicted by Autor, Katz and Kearney (2006). So, it is possible that the technological progress could have contributed to increase the convexity of the relationship between log of earnings and education, as well as to increase the sheepskin effects for high level degrees and decrease for low level ones.

The objective of this paper is to analyze the evolution of sheepskin effects in the Brazilian labor market from 1982 to 2004. The paper pretends also to analyze changes over time in the relationship between education and earnings. These issues seem to be important in the Brazilian case, because the intense changes occurred on the labor market during the last decades. In addition, we explore regional differences in the labor market structure, investigating disparities in the returns to schooling and their pattern over time.

In order to proceed with the empirical analysis, this paper uses data from Pnad. The empirical strategy adopted to identify the sheepskin effects consists in estimating earnings equations including linear years of schooling, and splines and discontinuous functions for completed degrees, using demographic and labor market experience controls. The results show that sheepskin effects represent a substantial gain on earnings. Also, the patterns of sheepskin effects changed very much from 1982 to 2004, with their importance reducing over time. The lower degree, corresponding to the lower primary school, which influenced earnings in a significant way in the beginning of eighties, became unimportant in 2004. The effects of higher degrees also reduced from 1982 to 2004, but they are still relatively elevated in this last period. The analysis by region shows similar trends to those observed for the whole country. Empirical evidence indicates also a growing convexity in the relationship between education and earnings over time in each region.

The structure of the paper is the following. The next section presents the Pnad data used in this paper, and describes educational distribution differences across periods and regions. Section 3 discusses the empirical strategy implemented in the paper. The subsequent section presents the results about the evolution of sheepskin effects and the relationship between earnings and schooling during the last decades. Section 6 summarizes and concludes the paper.

4. See, for example, Bound and Johnson (1992); Berman, Bound and Griliches (1994); and Autor, Katz and Krueger (1998). Evidences from Brazil provided by Fernandes and Menezes-Filho (2002) and Menezes-Filho and Rodrigues (2003) are consistent with this argument.

2 DATA

This paper uses data from the 1982, 1992, 1998 and 2004 Pnad. This survey is conducted each September by the Brazilian Census Bureau (IBGE) and the sample is representative of the Brazilian population. The sample used in this paper includes workers aged 25 to 60 years old, living in urban areas. All employers were excluded from the sample.

For each individual in the sample there is information about the following variables: earnings, hourly earnings, age, gender, race, region, number of years of completed schooling and potential labor market experience. This last variable is calculated using the difference between the age and the age the worker started to work.[5] The data contains information about 71,366 individuals in 1982; 55,542 in 1992; 63,920 in 1998 and 83,988 individuals in 2004.

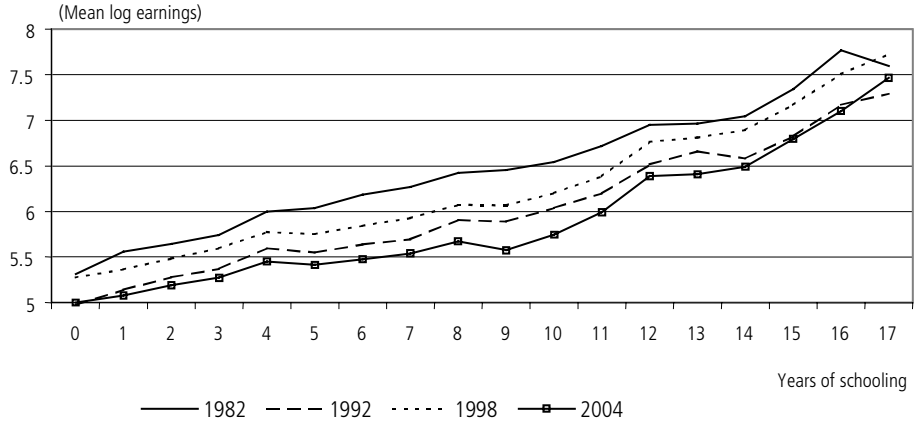
Four degrees are considered in this paper. The first degree (lower primary school) corresponds to four years of completed schooling. Although it had been vanished during an educational system reform in the beginning of the seventies, the first segment of the primary school is included in the empirical analysis because there is a great share of workers with exactly four years of completed schooling, specially in older generations, and it could still be used as reference. The second degree is the upper primary school, which corresponds to eight years of completed schooling. The next degree (secondary school) is obtained with 11 years of completed schooling, and finally, the fourth degree (college) is acquired with 15 years of completed schooling. Pnad does not distinguish between Master and Ph.D. diplomas, and attributes 17 years of schooling for these degrees. Although, these groups of workers are included in the sample, these degrees are not used in the paper to account for sheepskin effects. In addition there are very few individuals with these levels of education.

Figure 1 presents the mean log earnings in the main job by years of completed schooling. From 1982 to 1992, after a period of intense macroeconomic crisis in the beginning of 90's, mean earnings reduced for each year of education. Mean earnings recovered in 1998 and drop again in 2004. Figure 1 shows also that the relationship between log earnings and education was almost linear in 1982. But it is possible to notice an increased convexity in this relationship over time. In 1982, mean earnings for workers with ten years of schooling was around 123% higher than for those who did not completed the first year of education. In 2004, this difference reduced to 75%. Mean earnings for workers with 17 years of schooling in 1982 was twice of those with ten years of schooling, but in 2004 the difference between these two groups increased to 172%.

Table 1 reports descriptive statistics for some variables for each year considered in this paper. Evidence for the total sample, in the top panel, shows that mean earnings reduced from R$ 690 in 1982 to R$ 458 in 2004. A similar trend is verified for mean hourly earnings. Average years of schooling increased from 5.2 in 1982 to 7.7 in 2004, while age and potential labor market experience increased slightly during this period.

5. In 1982, Pnad information about potential labor market experience is available only for the head of the household and their spouse or husband, who correspond to about 85% of the total of individuals. Then, the same filter is applied for 1992, 1998 and 2004. Estimates including other persons in the household are very similar for these last three years.

FIGURE 1
Mean log earnings and years of schooling



Source: Based on Pnad data for workers aged 25 to 60 years old, living in urban areas, who are the head of the household or the spouse or husband of the head.

TABLE 1
Descriptive statistics

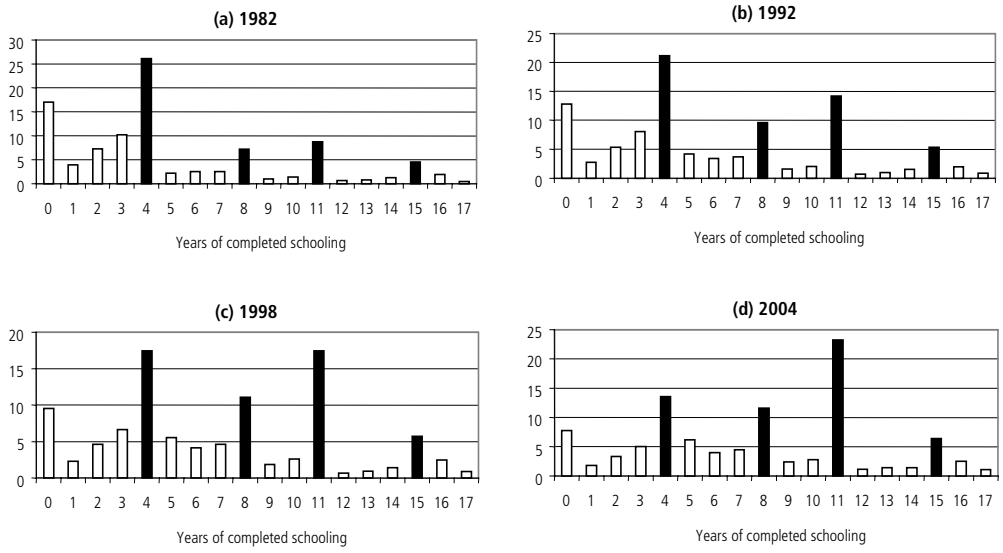
	1982	1992	1998	2004
Brazil				
Earnings in the main job	689,555	489,172	626,638	458,830
	(985.64)	(844.05)	(960.06)	(704.14)
Hourly earnings in the main job	16,28	12,41	16,75	12,75
	(25.90)	(20.42)	(28.88)	(40.77)
Years of schooling	5,187	6,241	6,910	7,677
	(4.48)	(4.60)	(4.53)	(4.47)
Age	38,649	38,643	39,372	39,785
	(9.31)	(9.01)	(8.99)	(9.14)
Experience	24,885	24,478	25,240	25,368
	(10.67)	(10.27)	(10.18)	(10.25)
Number of observations	77837	59308	68862	89483
Northeast				
Earnings in the main job	466,70	321,24	394,80	297,21
	(716.97)	(534.65)	(665.16)	(497.19)
Hourly earnings in the main job	11,51	8,68	11,03	8,83
	(20.99)	(16.51)	(21.01)	(29.38)
Years of schooling	4,06	5,34	5,98	6,68
	(4.40)	(4.75)	(4.72)	(4.69)
Age	39,26	38,62	39,22	39,39
	(9.40)	(9.09)	(9.18)	(9.23)
Experience	25,20	24,26	24,97	24,91
	(10.98)	(10.61)	(10.66)	(10.55)
Number of observations	17076	15002	18817	25271
Southeast				
Earnings in the main job	772,09	563,96	733,54	517,75
	(1087.77)	(811.62)	(1079.21)	(729.48)
Hourly earnings in the main job	18,17	14,11	19,51	14,42
	(28.31)	(19.95)	(30.62)	(51.77)
Years of schooling	5,53	6,54	7,30	8,04
	(4.47)	(4.56)	(4.47)	(4.34)
Age	38,64	38,89	39,68	40,18
	(9.31)	(8.96)	(8.92)	(9.08)
Experience	24,98	24,62	25,32	25,57
	(10.56)	(10.17)	(10.04)	(10.09)
Number of observations	30,034	22,796	25,497	30,051

Notes: Based on Pnad data for individuals aged 25 to 60 years old, living in urban area, who are the head of the household or the spouse or husband of the head.
Standard deviations are in parenteses. Earnings in 1999 reais.

Table 1 presents also descriptive statistics comparing Southeast and Northeast. These two regions comprise around 70% of the Brazilian labor force.[6] Mean earnings and years of schooling differences between the two regions are impressive. In 1982 earnings in Southeast were 65% higher than in Northeast, and in 2004 this ratio increased to 75%. From 1982 to 2004 Southeast keeps one and a half more year of schooling relative to Northeast. Table B.1 in the appendix shows that earnings in South and Center-West were slightly lower than in Southeast, while average years of schooling in the former two regions were similar to that in Southeast. Earnings and average education in North were higher than in Northeast, but much lower than in Southeast.

Figure 2 shows the fraction of workers in the labor force with each number of completed years of schooling in 1982, 1992, 1998 and 2002. Completed degrees are represented by dark bars. The educational level among Brazilian workers was extremely low in 1982. More than 35% of the workers had less than four years of completed schooling and more than 80% had less than 11 years of education. From 1982 to 2004 the labor force educational level increased, although it was still considerably low in 2004. The proportions with less than 4 and 11 years of schooling reduced to about 20% and 60%, respectively.

FIGURE 2
Educational distribution of the labor force



Source: Pnad data for workers aged 25 to 60 years old, living in urban areas, who are the head of the household or the spouse or husband of the head.

It is interesting to notice spikes in years corresponding to completion of a degree in all periods. In 1982, the highest concentration occurred for those with a lower primary degree – near one quarter of the labor force. The proportion of workers with less than one year of education was also very high (about 17%). Seven per cent of the workers had eight years of education in 1982, while 9% of them had 11 years of schooling. From 1982 to 2004 the change in educational distribution was mainly driven by reductions on the shares for workers with zero and four years of schooling

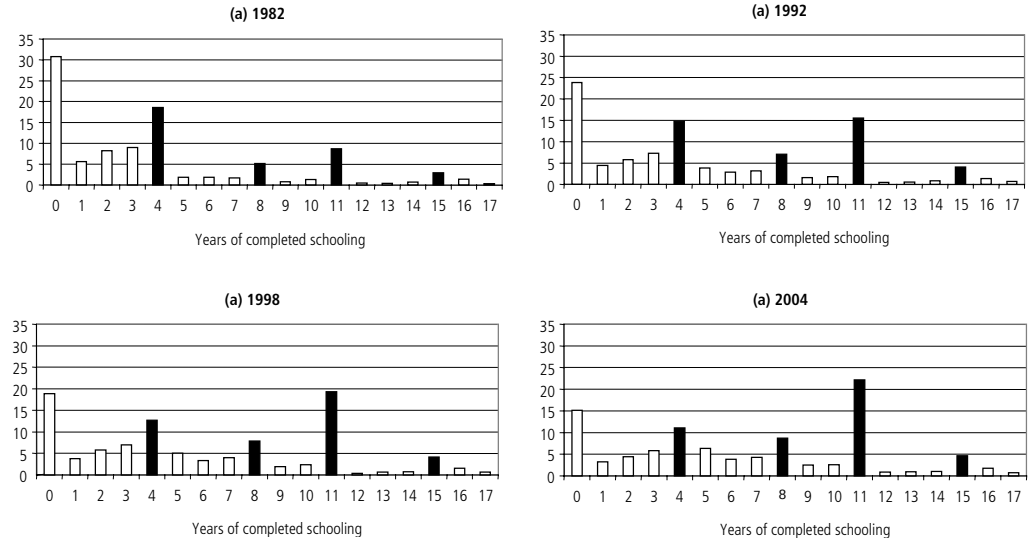
6. Summary statistics for other regions are reported in the appendix.

to 8% and 14% and an increase on the proportion of workers with a secondary degree to 23%.

Remarkable differences in the educational distribution between Southeast and Northeast are showed in figure 3. Notice, for example, that 30% of the labor force in Northeast had less than one year of schooling in 1982, while this proportion was 13% in Southeast. The shares of workers with 8, 11 and 15 years of schooling increased in a similar magnitude in the two regions from 1982 to 2004. But for individuals with four years of schooling the reduction was more intense in Southeast. The appendix shows that changes in South and North were like those verified in Southeast, while shifts in Center-West were similar to those observed in Northeast.

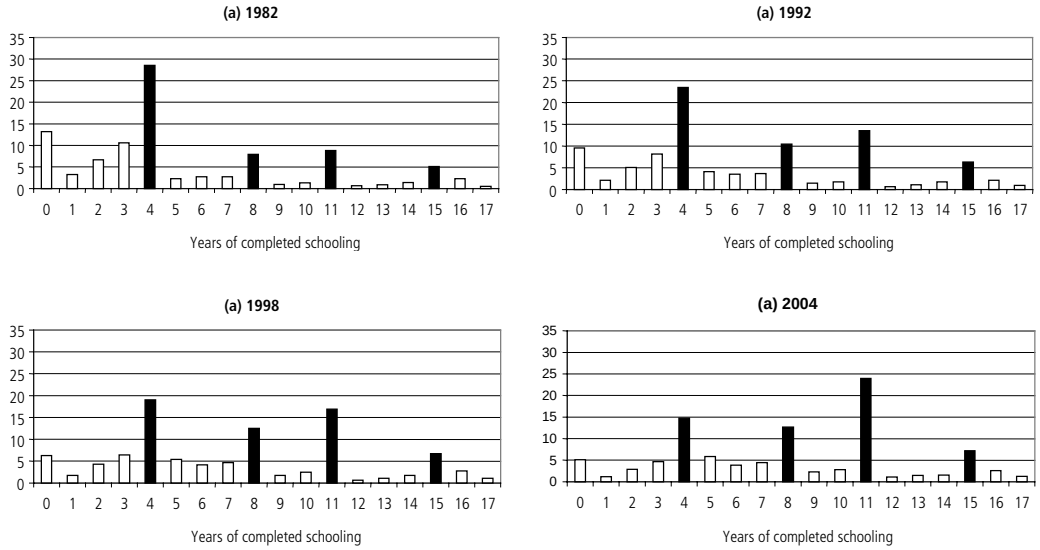
FIGURE 3
Educational distribution of the labor force by region

Northeast



Source: Pnad data for workers aged 25 to 60 years old, living in urban areas, who are the head of the household or the spouse or husband of the head.

Southeast



Source: Pnad data for workers aged 25 to 60 years old, living in urban areas, who are the head of the household or the spouse or husband of the head.

3 EMPIRICAL FRAMEWORK

In order to investigate the sheepskin effects we use the standard approach adopted by Hungerford and Solon (1987) and Belman and Heywood (1991). It consists on estimate earnings returns to education that allows for spline functions with discontinuities at years of completed schooling corresponding to a diploma or degree completion. Spline functions may capture convexity in the relationship between earnings and education.

The dependent variable in basic regressions is the logarithm of earnings in the main job.[7] Regressions include years of completed schooling (*S*), experience (*Exp)*, experience squared (*Exp*2) and an interactive term between schooling and experience. The sheepskin effects are estimated including four dummies corresponding to completed degrees. The first dummy (*D*4) is equal to 1 if $S \geq 4$, the second (*D*8) is equal to 1 if $S \geq 8$, the third (*D*11) is equal to 1 if $S \geq 11$ and finally, there is a dummy (*D*15) which is equal to 1 if $S \geq 15$. In order to allow for slope changes in the returns to the lower primary school, *D*4 is interacted with a variable equal to years of schooling minus 4. The same procedure is used for splines in upper primary, secondary and college degrees. A dummy variable for individuals with 16 years of schooling is also included. The regressions include controls for gender, race and region, represented by X_i.

Belman and Heywood (1997) argue that sheepskin effects are important signals of productivity for younger cohorts, but once workers accumulate experience in the labor market, the returns to these signals reduce, because employers have more information about employees' productivity. In order to account for this effect, the dummies *D*4, *D*8, *D*11 and *D*15 are interacted with potential labor marker experience.

Representing the earnings for individual *i* by w_i, the estimated specification is the following:

$$\begin{aligned}\ln(w_i) = {} & \beta_0 + \beta_1 S_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 Exp_i * S_i + \beta_5 D4_i + \beta_6 D8_i + \beta_7 D11_i \\ & + \beta_8 D15_i + \beta_9 D4_i * (S_i - 4) + \beta_{10} D8_i * (S_i - 8) + \beta_{11} D11_i * (S_i - 11) \\ & + \beta_{12} D15_i * (S_i - 15) + \beta_{13} S16 \quad + \beta_{14} Exp * D4_i + \beta_{15} Exp * D8_i \\ & + \quad \beta_{16} Exp * D11_i + \beta_{17} Exp * D15_i + \gamma X_i + \varepsilon_i\end{aligned} \tag{1}$$

We also estimate a more flexible specification. In this semi-parametric model log of earnings is regressed on an unrestricted set of schooling dummies:

$$\ln(w_i) = \beta_0 + \sum_{j=1}^{17} \beta_j S_{ji} + \beta_{18} Exp_i + \beta_{19} Exp_i^2 + \beta_{20} Exp_i * S_i + \gamma X_i + \varepsilon_i \tag{2}$$

Where S_j represents dummy variables for years of education *j* (*j*=1,…17*)*. Regressions are estimated for 1982, 1992, 1998 and 2002 for Brazil as a whole, and later separately for each region in all these years. Therefore, evolutions of sheepskin

7. Regressions that use the logarithm of hourly earnings as dependent variable are reported in the appendix and the results are similar.

effects coefficients are compared over time. The results of these regressions are presented and discussed in the next section.

4 EMPIRICAL EVIDENCES

The estimated results are presented in two subsections. Subsection IV.1 reports the evidence for the total sample of workers in Brazil. The next subsection presents evidence for Northeast and Southeast, comparing the results for these two regions. Regressions for other regions are showed in the appendix.

4.1 THE EVOLUTION OF SHEEPSKIN EFFECTS AND THE EARNINGS-EDUCATION PROFILE IN THE BRAZILIAN LABOR MARKET

Table 2 presents the estimated results for equation (1) in 1982, 1992, 1998 and 2004. Evidence supporting sheepskin effects could be verified in all four years reported. According to table 2, the sheepskin effects were higher for more advanced degrees, and they had a decreasing trend from 1982 to 2004. The lower primary school degree increased earnings by 12% in 1982, and became non significant after the nineties.[8] The upper primary degree effect was 12% in 1982, and increased slightly in 2004, when it was equal to 14%. The reductions on coefficients for completed degrees were intense for higher credentials, but sheepskin effects were still very impressive in 2004. The secondary degree effect, which was 32% in 1982, drop to 27% in 2004. The college degree represented an earnings increase of 31% in 1982. Twenty two years later this effect reduced to 19%.

Changes in slope associated to a completed degree were different across periods too. There was a drop in the spline related to the lower primary school from 1982 to 2004. On the other hand, splines for secondary school and college presented an increasing trend, indicating that the reduction in sheepskin effects was accompanied by an increase in non-linearity of log earnings returns to education. Figure C.1 in appendix plots the log earnings-education relationship estimated in table 2 for 1982 and 2004. The increased non-linearity in returns to education seems very clear in this figure. F-tests reported in table 2 indicate that sheepskin effects and spline functions related to a completed degree influence earnings in a significant way.

Table 2 shows also that interactive terms between completed degrees and experience are negative and significant in most of the regressions. So, although workers with a diploma or a degree have an extra gain in their earnings, this effect reduces with labor market experience, as predicted by Belman and Heywood (1997).

Table 3 presents results based on semi-parametric regressions for 1982, 1992, 1998 and 2004. Except for the highest level of education, it is possible to notice that estimated coefficients for each year of schooling are lower in 2004 than in 1982. This gap has an increasing trend from one to ten years of education, while after 11 years the tendency is reversed. The top left graph in figure C.2 shows the increasing convexity in earnings-education relationship from 1982 to 2004.

8. It is important to notice that this result could be due to fact that the lower primary weakened part of its status during the educational system reform.

TABLE 2
Earnings equation
(Dependent variable: log of earnings in the main job)

	1982	1992	1998	2004
	(1)	(2)	(3)	(4)
Years of schooling (S)	0,0659	0,0477	0,0397	0,0479
	[7.05]***	[3.94]***	[3.72]***	[4.99]***
Experience	0,0176	0,0208	0,0184	0,0181
	[10.10]***	[9.41]***	[9.71]***	[11.05]***
Experience squared	–0,0004	–0,0004	–0,0004	–0,0003
	[14.06]***	[13.33]***	[13.15]***	[13.24]***
Experience x schooling	0,0013	0,0015	0,001	0,0006
	[4.32]***	[4.05]***	[2.94]***	[2.16]**
Lower primary (D4)	0,1158	0,0354	–0,0335	–0,034
	[3.49]***	[0.81]	[0.84]	[0.87]
Upper primary (D8)	0,1095	0,2018	0,1159	0,136
	[2.67]***	[4.56]***	[3.02]***	[4.15]***
Secondary school (D11)	0,3179	0,4054	0,3138	0,2718
	[6.70]***	[8.27]***	[7.75]***	[8.39]***
College (D15)	0,3106	0,2183	0,2176	0,192
	[6.52]***	[3.64]***	[3.93]***	[4.29]***
Experience x D4	0	0,0017	0,0038	0,0032
	[0.03]	[1.14]	[2.85]***	[2.48]**
Experience x D8	–0,0022	–0,0041	–0,0024	–0,0036
	[1.29]	[2.16]**	[1.50]	[2.77]***
Experience x D11	–0,0066	–0,0118	–0,007	–0,0006
	[3.78]***	[6.49]***	[4.75]***	[0.55]
Experience x D15	–0,0103	–0,0085	–0,0066	–0,0068
	[5.16]***	[3.64]***	[3.23]***	[4.14]***
Schooling=16	0,1565	0,0666	–0,0022	–0,0418
	[5.21]***	[1.92]*	[0.08]	[1.75]*
D4 x (S-4)	–0,0019	–0,0259	0,0038	–0,0118
	[0.26]	[3.08]***	[0.52]	[1.77]*
D8 x (S-8)	–0,0058	0,0316	0,0205	–0,0031
	[0.40]	[2.28]**	[1.87]*	[0.33]
D11 x (S-11)	0,0418	0,0628	0,0873	0,1465
	[2.66]***	[3.96]***	[6.76]***	[14.01]***
D15 x (S-15)	–0,0628	0,0203	0,0727	0,0954
	[2.66]***	[0.87]	[3.64]***	[6.09]***
Woman	–0,8701	–0,7234	–0,6327	–0,5966
	[120.96]***	[95.16]***	[101.62]***	[111.51]***
Black	–0,1493	–0,1557	–0,1517	–0,1601
	[22.22]***	[19.94]***	[22.79]***	[28.32]***
Northeast	–0,3403	–0,2398	–0,2568	–0,3103
	[29.82]***	[16.17]***	[20.41]***	[34.44]***
Southeast	–0,0238	0,2348	0,2173	0,1423
	[2.29]**	[17.36]***	[18.09]***	[17.23]***
South	–0,1074	0,1221	0,0982	0,0726
	[8.96]***	[8.08]***	[7.39]***	[7.56]***
Center-west	–0,1087	0,0703	0,0882	0,1437
	[9.10]***	[4.58]***	[6.48]***	[14.79]***
Constant	5,7142	5,1527	5,442	5,1679
	[185.57]***	[124.77]***	[150.83]***	[163.33]***
F-test for sheepskin effects=0	20,87	25,600	25,530	29,900
Prob>F	0,000	0,000	0,000	0,000
F-test for splines=0	4,51	21,680	55,030	147,180
Prob>F	0,001	0,000	0,000	0,000
Observations	71366	55542	63920	83988
R-squared	0,54	0,46	0,50	0,48

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

TABLE 3
Earnings equation – Semi-parametric approach
(Dependent variable: log of earnings in the main job)

	1982	1992	1998	2004
	(1)	(2)	(3)	(4)
Years of schooling=1	0,1301	0,1072	0,0529	0,0519
	[7.88]***	[4.49]***	[2.39]**	[2.48]**
Years of schooling=2	0,2125	0,1891	0,1115	0,1035
	[15.10]***	[10.02]***	[6.59]***	[6.07]***
Years of schooling=3	0,2915	0,2552	0,1824	0,1632
	[20.42]***	[14.14]***	[11.56]***	[10.57]***
Years of schooling=4	0,5085	0,4349	0,3123	0,2778
	[37.02]***	[25.96]***	[20.99]***	[20.08]***
Years of schooling=5	0,5706	0,4329	0,3388	0,2903
	[23.61]***	[18.63]***	[18.04]***	[17.43]***
Years of schooling=6	0,6823	0,522	0,4106	0,3386
	[27.23]***	[20.85]***	[19.63]***	[18.18]***
Years of schooling=7	0,7559	0,5611	0,475	0,3865
	[30.33]***	[21.70]***	[21.90]***	[19.97]***
Years of schooling=8	0,915	0,7362	0,5921	0,4776
	[41.75]***	[30.39]***	[28.58]***	[25.81]***
Years of schooling=9	0,9472	0,7818	0,6662	0,4693
	[27.02]***	[23.28]***	[24.44]***	[20.10]***
Years of schooling=10	1,0682	0,8801	0,711	0,5657
	[32.68]***	[26.79]***	[25.87]***	[23.41]***
Years of schooling=11	1,3302	1,1038	0,9561	0,822
	[53.74]***	[39.75]***	[40.31]***	[39.03]***
Years of schooling=12	1,4876	1,3573	1,2468	1,1951
	[35.31]***	[29.54]***	[29.41]***	[39.63]***
Years of schooling=13	1,5162	1,4577	1,2853	1,1958
	[38.18]***	[33.54]***	[34.05]***	[40.53]***
Years of schooling=14	1,703	1,4713	1,4087	1,2784
	[47.16]***	[35.32]***	[38.96]***	[41.50]***
Years of schooling=15	1,9269	1,7222	1,6785	1,5781
	[61.22]***	[48.05]***	[53.56]***	[57.59]***
Years of schooling=16	2,1381	1,9483	1,9191	1,8144
	[59.89]***	[45.37]***	[53.46]***	[57.40]***
Years of schooling=17	2,055	2,0709	2,1716	2,1575
	[39.46]***	[38.90]***	[48.76]***	[57.61]***
Constant	5,609	4,9041	5,2281	5,0254
	[201.85]***	[149.41]***	[185.03]***	[202.03]***
Observations	71366	64342	74335	98414
R-squared	0,54	0,44	0,48	0,46

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

Regressions control for potencial experience, potencial experience squared, gender, race, region and years of schooling x potencial experience.

Summing up, there was a reduction in the sheepskin effects from 1982 to 2004, according to the evidence. This result could be due to the fact that the proportion of more educated workers increased over time, reducing the signal value represented by the completion of a degree. In addition, evidence shows that the relationship between earnings and education has become more convex over time.

4.2 THE EVOLUTION OF SHEEPSKIN EFFECTS AND THE EARNINGS-EDUCATION PROFILE BY REGION

Regressions for Northeast and Southeast are presented in table 4. Earnings gains associated to sheepskin effects in Southeast have a decreasing trend over time for all degrees. Trends are not so clear in Northeast, but indicate a reduction in sheepskin effects too. In southeast as well as in northeast, returns to lower primary school were positive in 1982 and have become non significant thereafter. The same pattern is verified for the upper primary in Southeast. The coefficient associated with secondary school decreased in Northeast and remained almost constant in Southeast. College degree coefficient was non significant in 1982 and 1992 in Northeast and became positive and significant in 1998 and 2004. In Southeast, the extra earnings gain associated with the completion of college presents a decreasing trend, but it was still very high in 2004 (19%). F-tests show that sheepskin effects coefficients were significantly different from zero in all regressions reported. It is possible to notice in table 4 that each additional year of schooling has a stronger impact on log earnings in Northeast than in Southeast. These linear effects decreased from 1982 to 2004 in both regions.

According to table 4, only for the Southeast it is verified a positive trend over time for the spline associated with college degree, while spline functions related to secondary school presents an increasing trend in both regions. F-tests for spline functions are significant in all cases, except for the Southeast in 1982. These changes in spline functions imply a growing convexity of the log earnings-schooling relationship, which is more dramatic for Southeast, as showed in figure C.1. Evidence from semi-parametric regressions is presented in figure C.2. Returns to schooling seem to be an even more convex function of years of education using this specification.

Evidence provided by Lemieux (2006) shows that since the 1980's log earnings have become as increasingly convex function of years of schooling in the United States. According to Autor, Katz and Kearney (2006), these changes could be explained by the intensive use of computers, which complements non-routine and more complex tasks of highly educated workers and substitutes the routine tasks performed by workers in the middle of the education distribution. Computers may have lower consequences for non-routine manual tasks of less educated individuals. Our evidence reported in figure C.1 is consistent with Autor, Katz and Kearney (2006) argument. Mean labor earnings drop from 1982 to 2004 was much more intense for middle-educated workers with years of schooling between 4 and 10, mainly in Southeast relative to Northeast.

TABLE 4
Earnings equation
(Dependent variable: log of earnings in the main job)

	Northeast				Southeast			
	1982	1992	1998	2004	1982	1992	1998	2004
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years of schooling (S)	0,0823	0,0668	0,0647	0,0561	0,0488	0,0441	0,0063	0,0163
	[4.10]***	[2.54]**	[3.10]***	[2.88]***	[3.47]***	[2.32]**	[0.36]	[1.03]
Experience	0,0091	0,0173	0,0215	0,0136	0,0216	0,023	0,0182	0,0196
	[2.47]**	[3.71]***	[5.82]***	[4.05]***	[8.17]***	[6.71]***	[5.94]***	[7.35]***
Experience squared	–0,0002	–0,0004	–0,0004	–0,0003	–0,0005	-0,0005	-0,0004	-0,0004
	[4.18]***	[4.71]***	[7.05]***	[4.97]***	[11.41]***	[10.13]***	[8.79]***	[9.23]***
Experience x schooling	0,0014	0,0012	0,0006	0,001	0,0015	0,0012	0,0011	0,0005
	[1.99]**	[1.33]	[0.92]	[1.68]*	[3.26]***	[2.17]**	[2.10]**	[1.03]
Lower primary (D4)	0,1339	0,0244	0,0129	0,009	0,1259	-0,0255	-0,0429	-0,0338
	[1.72]*	[0.22]	[0.15]	[0.11]	[2.62]***	[0.39]	[0.69]	[0.54]
Upper primary (D8)	–0,1467	0,2977	0,0941	0,0217	0,2129	0,1222	0,1284	0,1447
	[1.49]	[2.85]***	[1.14]	[0.30]	[3.54]***	[1.81]*	[2.13]**	[2.78]***
Secondary school (D11)	0,4276	0,4712	0,27	0,3389	0,2694	0,33	0,3076	0,2722
	[3.81]***	[4.15]***	[3.27]***	[4.88]***	[3.76]***	[4.25]***	[4.67]***	[5.16]***
College (D15)	0,1138	–0,0083	0,2673	0,1664	0,3392	0,2512	0,1585	0,1869
	[0.97]	[0.05]	[2.10]**	[1.71]*	[4.93]***	[2.80]***	[1.91]*	[2.61]***
Experience x D4	–0,0025	0,004	0,0016	0,0006	0,001	0,0038	0,0052	0,0048
	[0.84]	[1.03]	[0.52]	[0.22]	[0.57]	[1.77]*	[2.52]**	[2.40]**
Experience x D8	0,0062	–0,0056	–0,0016	–0,0024	–0,0055	-0,0022	-0,0037	-0,0038
	[1.53]	[1.25]	[0.47]	[0.80]	[2.24]**	[0.77]	[1.47]	[1.87]*
Experience x D11	–0,0119	–0,0063	–0,0018	–0,0008	–0,0049	-0,0116	-0,0076	-0,0008
	[2.94]***	[1.53]	[0.61]	[0.32]	[1.94]*	[4.16]***	[3.18]***	[0.45]
Experience x D15	–0,0108	–0,0083	–0,006	–0,0099	–0,0114	-0,0091	-0,0052	-0,005
	[2.30]**	[1.51]	[1.34]	[2.66]***	[4.09]***	[2.65]***	[1.65]*	[1.97]**
Schooling=16	0,1692	0,0177	0,0474	0,1496	0,1887	0,0895	0,0091	-0,0984
	[2.46]**	[0.22]	[0.72]	[2.69]***	[4.31]***	[1.73]*	[0.22]	[2.70]***
D4 x (S–4)	–0,0115	–0,0517	–0,0197	0,0005	0,0091	-0,0106	0,0387	0,0218
	[0.67]	[2.56]**	[1.29]	[0.03]	[0.88]	[0.83]	[3.35]***	[2.05]**
D8 x (S–8)	0,0037	0,0062	0,0288	–0,0285	–0,0047	0,0339	0,0087	-0,0051
	[0.10]	[0.17]	[1.13]	[1.35]	[0.22]	[1.59]	[0.51]	[0.34]
D11 x (S–11)	0,1224	0,1907	0,0961	0,186	0,0264	0,0497	0,0992	0,1383
	[3.09]***	[4.41]***	[2.99]***	[7.89]***	[1.14]	[2.06]**	[5.10]***	[8.37]***
D15 x (S–15)	–0,1139	–0,045	0,0748	0,0487	–0,0633	0,0104	0,0751	0,1028
	[2.07]**	[0.79]	[1.67]*	[1.27]	[1.79]*	[0.31]	[2.58]***	[4.39]***
Woman	–0,9434	–0,7884	–0,6397	–0,6045	–0,8758	-0,7199	-0,626	-0,6025
	[57.08]***	[43.31]***	[48.47]***	[50.01]***	[84.46]***	[64.26]***	[64.86]***	[72.22]***
Black	–0,0808	–0,1278	–0,1085	–0,125	–0,1806	-0,1744	-0,1744	-0,1832
	[5.38]***	[6.97]***	[7.54]***	[9.94]***	[19.12]***	[15.92]***	[18.00]***	[21.89]***
Constant	5,4246	4,8625	5,0393	4,7956	5,6883	5,4416	5,7818	5,4132
	[92.16]***	[64.27]***	[81.68]***	[81.76]***	[123.78]***	[85.29]***	[99.99]***	[101.94]***
F–test for sheepskin effects=0	4,920	6,860	4,230	7,330	10,220	8,460	9,350	11,330
Prob>F	0,001	0,000	0,002	0,000	0,000	0,000	0,000	0,000
F–test for splines=0	6,620	11,030	11,040	30,920	1,640	8,210	34,120	65,370
Prob>F	0,000	0,000	0,000	0,000	0,162	0,000	0,000	0,000
Observations	15402	13361	16512	22391	27592	21051	22809	26957
R–squared	0,50	0,4	0,44	0,41	0,53	0,44	0,47	0,47

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

The appendix reports evidence for the other three Brazilian regions. In each one of these cases sheepskin effects also present a negative trend over time. In addition, it is possible to notice that spline functions for high degrees have the same positive trend verified for the whole country. Growing convexity in log earnings-education relationship was identified for South and Center-West in figure C.1, which uses splines and discontinuous functions, as well as for the former region in figure C.2 using dummies for years of schooling.

5 CONCLUSION

This paper is concerned in analyzing the evolution of sheepskin effects in Brazil from 1982 to 2004. During this period occurred a lot of changes in the Brazilian labor market, what could be connected with alterations in the relationship between earnings and schooling. On one hand, there was a substantial increase in the supply of more educated individuals. On the other hand, firms increased the necessity of hiring high skilled workers as they adopted new technologies, especially after the nineties.

The results estimated using Pnad data show that sheepskin effects changed considerably during the period analyzed, as well as the relationship between education and log earnings. From 1982 to 2004, the sheepskin effect basically disappeared for the first degree (lower primary school), and reduced for secondary and college degrees. This evidence is consistent with the higher supply of more educated workers in the labor force reducing the importance of higher degrees as a signal for more productive workers. However, estimated earnings gains associated with the completion of these degrees were still elevated in 2004.

For higher degrees spline functions have a positive trend, indicating that the convexity patterns of returns to education were exacerbated over time. From 1982 to 2004, the mean earnings reduction was more dramatic for middle-educated workers, who had between 4 and 10 years of completed schooling. For those with very low educational level or with more than 12 years of schooling earnings drop were not so strong.

The results by region show that growing convexity of the relationship between log earnings and education were more intense in Southeast, South and Center-West. In addition, we estimated reductions in the sheepskin effects over time in each one of the Brazilian regions separately.

REFERENCES

AUTOR, D.; KATZ, L.; KRUEGER, A. Computing inequality: have computers changed the labor market? *Quarterly Journal of Economics,* v. 113, n. 4, 1998.

AUTOR, D.; KATZ, L.; KEARNEY, M. *The polarization of the U.S. labor market*. 2006. Mimeo.

BELMAN, D.; HEYWOOD, J. Sheepskin effects in return to education: an examination of women and minorities. *Review of Economics and Statistics,* v. 73, p. 720-724, 1991.

———————. Sheepskin effects by cohorts: implications of job matching in a signaling model. *Oxford Economic Papers,* v. 49, n. 4, p. 623-637, 1997.

BERMAN, E.; BOUND, J.; GRILICHES, Z. Changes in the demand for skilled labor within U. S. manufacturing industries: evidence from the annual survey of manufactures. *Quarterly Journal of Economics*, v. 109, n. 2, 1994.

BOUND, J.; JOHNSON, G. Changes in the structure of wages in the 1980s: an evaluation of alternative explanations. *American Economic Review,* v. 82, n. 2, 1992.

CARD, D. The casual effect of education on earnings. In: ASHENFELTER, O.; CARD, D. (Eds.). *Handbook of Labor Economics*, v. 3, 1999.

DESCHÊNES, O. *Unobserved ability, comparative advantage, and the rising return to education in the United States 1979-2002*. 2006. Mimeo.

FERNANDES, R.; MENEZES-FILHO, N. Escolaridade e demanda relativa por trabalho. In: MENEZES-FILHO, N.; CHAHAD, J. (Orgs.). *O mercado de trabalho no Brasil*. 1ª ed. São Paulo: LTR, v. 1, 2002.

FERRER, A.; RIDDELL, W. The role credentials in the Canadian labour market. *Canadian Journal of Economics*, v. 35, n. 4, 2002.

HUNGERFORD, T.; SOLON, G. Sheepskin effects in the return to education. *Review of Economics and Statistics*, v. 69, p. 175-177, 1987.

JAEGER, D.; PAGE, M. Degrees matter: new evidence on the sheepskin effects in the return to education. *Review of Economics and Statistics*, v. 78, p. 733-740, 1996.

LAM, D.; SCHOENI, R. Effects of family backgroung on earnings and returns to schooling: evidence from Brazil. *Journal of Political Economy*, v. 101, n. 4, 1993.

LEMIEUX, T. The Mincer equation thirty years after schooling, experience, and earnings, forthcoming. In: GROSSBARD-SHECHTMAN, S. (Ed.). *Jacob Mincer, a Pioneer of Modern Labor Economics*. Springer Verlag, 2006.

MENEZES-FILHO, N.; RODRIGUES, M. Tecnologia e demanda por qualificação na indústria brasileira. *Revista Brasileira de Economia*, v. 57, n. 3, 2003.

MINCER, J. *Schooling, experience and earnings*. New York: Columbia University Press, 1974.

———————. Changes in wage inequality, 1970-1990. *Research in Labor Economics*, v. 16, 1997.

PARK, J. H. Estimation of sheepskin effects using the old and the new measures of educational attainment in the current population survey. *Economics Letters*, v. 62, p. 237-240, 1999.

PONS, E. Diploma effects by gender in the Spanish labour market. *Labour*, v. 20, n. 1, 2006.

RAMOS, L.; VIEIRA, M. L. *A relação entre educação e salários no Brasil*. Rio de Janeiro: Ipea, 1996 (Texto para discussão, n. 21).

SCHADY, N. *Convexity and sheepskin effects in the human capital earnings function:* recent evidence for Filipino men. 2003. Mimeo.

WEISS, A. Human capital vs. signalling explanations of wages. *Journal of Economic Perspectives*, v. 9, n. 4, 1995.

APPENDIX A

TABLE A.1
Earnings equation
(Dependent variable: log of hourly earnings in the main job)

	1982 (1)	1992 (2)	1998 (3)	2004 (4)
Years of schooling (S)	0,0642	0,0566	0,0327	0,053
	[7.20]***	[4.86]***	[3.04]***	[5.67]***
Experience	0,0107	0,0148	0,0142	0,0133
	[6.59]***	[6.85]***	[7.37]***	[8.18]***
Experience squared	–0,0002	–0,0003	–0,0003	–0,0002
	[9.65]***	[9.57]***	[9.27]***	[8.60]***
Experience x schooling	0,0013	0,0012	0,001	0,0003
	[4.39]***	[3.34]***	[3.07]***	[0.99]
Lower primary (D4)	0,084	–0,0291	–0,0106	–0,0938
	[2.67]***	[0.70]	[0.26]	[2.48]**
Upper primary (D8)	0,0641	0,1419	0,1145	0,0927
	[1.61]	[3.26]***	[2.95]***	[2.87]***
Secondary school (D11)	0,3657	0,4073	0,3543	0,2249
	[7.73]***	[8.38]***	[8.63]***	[7.04]***
College (D15)	0,254	0,1639	0,1601	0,1735
	[5.58]***	[2.79]***	[2.88]***	[3.94]***
Experience x D4	0,0014	0,0036	0,0029	0,0047
	[1.27]	[2.52]**	[2.14]**	[3.81]***
Experience x D8	–0,0001	–0,0017	–0,002	–0,0019
	[0.06]	[0.92]	[1.22]	[1.52]
Experience x D11	–0,0078	–0,012	–0,0073	0,0016
	[4.49]***	[6.57]***	[4.84]***	[1.39]
Experience x D15	–0,0094	–0,0071	–0,0059	–0,0073
	[4.83]***	[3.11]***	[2.90]***	[4.49]***
Schooling=16	0,1194	0,0686	–0,0324	–0,0593
	[4.42]***	[2.05]**	[1.15]	[2.60]***
D4 x (S-4)	0,0097	–0,0223	0,008	–0,0079
	[1.36]	[2.70]***	[1.11]	[1.22]
D8 x (S-8)	–0,0032	0,0435	0,0204	–0,0054
	[0.22]	[3.15]***	[1.81]*	[0.59]
D11 x (S-11)	0,0541	0,0632	0,1166	0,1756
	[3.45]***	[4.01]***	[8.94]***	[16.85]***
D15 x (S-15)	–0,0087	0,0186	0,0602	0,0853
	[0.42]	[0.79]	[2.93]***	[5.76]***
Woman	–0,5306	–0,4428	–0,3641	–0,3393
	[81.53]***	[60.72]***	[58.31]***	[64.45]***
Black	–0,1535	–0,1544	–0,1508	–0,1432
	[23.74]***	[20.01]***	[22.33]***	[25.33]***
Northeast	–0,2864	–0,2049	–0,1946	–0,2693
	[25.82]***	[13.68]***	[15.19]***	[29.46]***
Southeast	–0,0004	0,225	0,2321	0,1272
	[0.04]	[16.34]***	[18.92]***	[15.09]***
South	–0,1113	0,1156	0,1128	0,0648
	[9.52]***	[7.60]***	[8.39]***	[6.70]***
Center	–0,1079	0,0559	0,0763	0,1122
	[9.20]***	[3.56]***	[5.44]***	[11.26]***
Constant	1,8852	1,3806	1,6479	1,4381
	[65.52]***	[34.16]***	[44.79]***	[45.98]***
F-test for sheepskin effects = 0	22,150	26,590	25,760	27,650
Prob>F	0,000	0,000	0,000	0,000
F-test for splines = 0	11,700	28,290	82,780	203,810
Prob>F	0,000	0,000	0,000	0,000
Observations	71366	55520	63862	83949
R-squared	0,54	0,44	0,47	0,46

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

TABLE A.2

Earnings equation

(Dependent variable: log of hourly earnings in the main job)

	Northeast				Southeast			
	1982	1992	1998	2004	1982	1992	1998	2004
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years of schooling (S)	0,0796	0,0798	0,0617	0,047	0,0509	0,0511	0,0048	0,0262
	[4.13]***	[3.08]***	[3.04]***	[2.55]**	[3.80]***	[2.85]***	[0.27]	[1.68]*
Experience	0,0074	0,0117	0,0202	0,0079	0,0122	0,0167	0,014	0,0154
	[2.10]**	[2.52]**	[5.64]***	[2.33]**	[4.99]***	[5.02]***	[4.47]***	[5.73]***
Experience squared	–0,0002	–0,0002	–0,0003	–0,0001	–0,0003	–0,0004	–0,0003	–0,0002
	[3.46]***	[2.86]***	[6.11]***	[2.57]**	[7.35]***	[7.68]***	[6.31]***	[6.33]***
Experience x schooling	0,0015	0,0004	0,0006	0,0011	0,0014	0,0011	0,0011	0,0001
	[2.20]**	[0.46]	[0.83]	[1.95]*	[3.16]***	[2.05]**	[2.13]**	[0.12]
Lower primary (D4)	0,1498	–0,0723	0,0177	0,0121	0,0885	–0,0913	–0,0244	–0,1134
	[2.04]**	[0.67]	[0.21]	[0.15]	[1.93]*	[1.53]	[0.39]	[1.87]*
Upper primary (D8)	–0,1283	0,1892	0,1062	0,0351	0,137	0,0666	0,0991	0,1379
	[1.34]	[1.88]*	[1.30]	[0.50]	[2.36]**	[1.00]	[1.64]	[2.66]***
Secondary school (D11)	0,4616	0,479	0,295	0,3219	0,318	0,3494	0,3632	0,1943
	[4.32]***	[4.43]***	[3.58]***	[4.60]***	[4.40]***	[4.57]***	[5.44]***	[3.77]***
College (D15)	0,1299	–0,1736	0,1401	0,1593	0,2543	0,2137	0,1299	0,195
	[1.18]	[1.18]	[1.12]	[1.67]*	[3.87]***	[2.42]**	[1.53]	[2.74]***
Experience x D4	–0,0031	0,0075	0,001	0,0005	0,0026	0,0054	0,004	0,0071
	[1.08]	[1.99]**	[0.33]	[0.16]	[1.58]	[2.70]***	[1.96]**	[3.62]***
Experience x D8	0,0058	–0,0019	–0,0022	–0,0011	–0,0031	–0,0001	–0,0015	–0,0032
	[1.45]	[0.44]	[0.66]	[0.40]	[1.27]	[0.03]	[0.59]	[1.58]
Experience x D11	–0,0124	–0,0055	–0,0004	–0,0001	–0,0059	–0,0132	–0,0099	0,0023
	[3.14]***	[1.37]	[0.14]	[0.04]	[2.36]**	[4.71]***	[4.07]***	[1.21]
Experience x D15	–0,0093	–0,0041	–0,0052	–0,0124	–0,0097	–0,0074	–0,0042	–0,006
	[1.94]*	[0.77]	[1.22]	[3.43]***	[3.57]***	[2.21]**	[1.32]	[2.35]**
Schooling=16	0,1644	–0,0224	0,0143	0,151	0,1403	0,1121	–0,0313	–0,1207
	[2.44]**	[0.30]	[0.22]	[2.70]***	[3.68]***	[2.26]**	[0.77]	[3.54]***
D4 x (S-4)	–0,0103	–0,0364	–0,0142	–0,0063	0,0221	–0,0076	0,0349	0,0211
	[0.61]	[1.80]*	[0.92]	[0.47]	[2.18]**	[0.62]	[2.95]***	[2.02]**
D8 x (S-8)	0,0192	0,001	0,0197	–0,015	–0,0065	0,0495	0,0209	–0,0021
	[0.55]	[0.03]	[0.78]	[0.73]	[0.30]	[2.36]**	[1.18]	[0.14]
D11 x (S-11)	0,1089	0,2126	0,1497	0,2222	0,0449	0,0388	0,1112	0,1603
	[2.89]***	[5.18]***	[4.81]***	[9.62]***	[1.92]*	[1.64]	[5.58]***	[9.68]***
D15 x (S-15)	–0,0778	–0,0157	0,0642	0,036	–0,0146	0,0078	0,062	0,101
	[1.64]	[0.29]	[1.44]	[0.92]	[0.48]	[0.23]	[2.07]**	[4.66]***
Woman	–0,638	–0,4863	–0,3628	–0,3112	–0,5245	–0,4514	–0,3609	–0,3576
	[41.39]***	[27.65]***	[27.43]***	[26.32]***	[56.64]***	[41.95]***	[37.02]***	[43.38]***
Black	–0,0969	–0,129	–0,1159	–0,1022	–0,1789	–0,1737	–0,1784	–0,1655
	[6.64]***	[7.13]***	[8.04]***	[8.15]***	[19.80]***	[16.05]***	[18.03]***	[19.80]***
Constant	1,5992	1,1156	1,2679	1,1121	1,8984	1,6675	1,9944	1,6496
	[28.58]***	[14.73]***	[21.10]***	[19.39]***	[44.99]***	[27.32]***	[33.16]***	[31.04]***
F-test for sheepskin effects = 0	5,990	7,780	4,110	6,610	8,810	10,610	10,090	11,380
Prob>F	0,000	0,000	0,003	0,000	0,000	0,000	0,000	0,000
F-test for splines = 0	7,500	15,210	19,420	50,530	5,340	9,800	42,290	88,880
Prob>F	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Observations	15402	13357	16499	22378	27592	21044	22791	26949
R-squared	0,49	0,39	0,43	0,40	0,52	0,42	0,45	0,44

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%,

APPENDIX B

RESULTS BY REGION: CENTER-WEST, NORTH AND SOUTH

TABLE B.1
Descriptive statistics

	1982	1992	1998	2004
Center-West				
Earnings in the main job	682,68	446,98	624,95	517,07
	(957.25)	686,066	1037,66	1004,889
Hourly earnings in the main job	16,51	11,79	17,35	14,37
	(25.31)	(17.67)	(43.59)	(32.32)
Years of schooling	5,46	6,45	7,11	7,88
	(4.75)	(4.66)	(4.52)	(4.51)
Age	37,17	37,18	37,81	38,17
	(9.16)	(9.05)	(9.07)	(9.20)
Experience	24,39	23,71	24,12	24,17
	(10.51)	(10.24)	(10.39)	(10.50)
Number of observations		7499	8835	12030
North				
Earnings in the main job	607,91	361,02	487,18	367,57
	730,96	460,36	694,62	510,30
Hourly earnings in the main job	14,67	9,89	13,39	10,50
	24,08	15,42	22,48	18,91
Years of schooling	5,17	6,14	6,48	7,49
	4,34	4,47	4,51	4,42
Age	37,28	37,10	37,92	37,71
	9,35	9,18	9,05	9,08
Experience	24,15	22,72	23,87	23,12
	10,85	10,63	10,42	10,44
Number of observations				
South				
Earnings in the main job	659,19	497,79	618,09	479,72
	857,34	1201,20	859,76	648,93
Hourly earnings in the main job	15,79	12,76	16,53	13,11
	21,81	27,04	24,05	21,08
Years of schooling	5,60	6,66	7,26	8,24
	4,40	4,41	4,37	4,34
Age	37,58	37,76	38,50	39,14
	9,33	9,09	9,04	9,34
Experience	24,51	23,67	24,68	24,94
	10,65	10,29	10,15	10,50
Number of observations	14946	12792	14789	17772

Notes: Based on Pnad data for individuals aged 25 to 60 years old, living in urban area, who are the head of the household or the spouse or husband of the head.
Standard deviations are in parenteses. Earnings in 1999 reais.

FIGURE B.1
Educational distribution

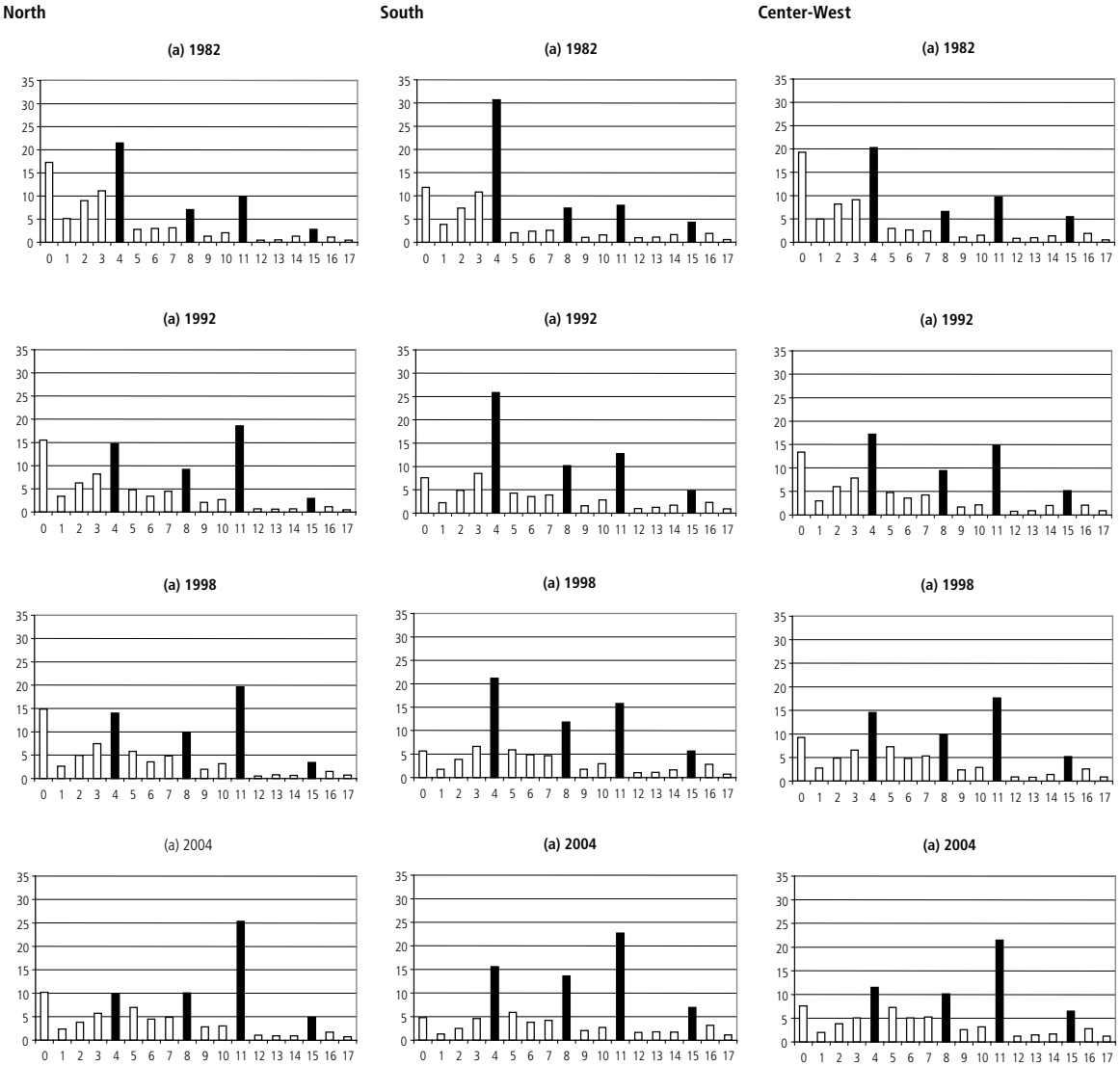


TABLE B.2
Earnings equation–North
(Dependent variable: log of earnings in the main job)

	1982 (1)	1992 (2)	1998 (3)	2004 (4)
Years of schooling (S)	0,0495	–0,065	0,0334	0,0714
	[1.81]*	[1.71]*	[0.95]	[2.87]***
Experience	–0,0013	0,008	0,0143	0,0212
	[0.28]	[1.19]	[2.26]**	[4.95]***
Experience squared	–0,0001	–0,0002	–0,0003	–0,0003
	[1.12]	[2.23]**	[2.77]***	[4.80]***
Experience x schooling	0,0007	0,0046	0,0016	–0,0003
	[0.80]	[3.98]***	[1.47]	[0.35]
Lower primary (D4)	–0,111	0,4838	–0,0501	–0,0405
	[1.13]	[3.26]***	[0.37]	[0.37]
Upper primary (D8)	0,077	0,5483	0,1446	0,0378
	[0.67]	[4.13]***	[1.11]	[0.42]
Secondary school (D11)	0,30	0,5511	0,295	0,2851
	[2.54]**	[3.74]***	[2.22]**	[3.51]***
College (D15)	0,4938	0,1937	0,4706	0,3075
	[3.37]***	[0.85]	[2.20]**	[2.58]***
Experience x D4	0,0079	–0,013	0,0033	0,0029
	[2.30]**	[2.58]***	[0.71]	[0.77]
Experience x D8	–0,0016	–0,0173	–0,0041	0,0045
	[0.31]	[2.85]***	[0.74]	[1.22]
Experience x D11	0,0005	–0,0177	–0,0081	0,002
	[0.10]	[3.09]***	[1.66]*	[0.64]
Experience x D15	–0,0161	–0,018	–0,0198	–0,0135
	[2.77]***	[2.42]**	[2.80]***	[3.07]***
Schooling=16	0,1088	–0,0492	0,0624	0,0173
	[1.26]	[0.46]	[0.67]	[0.23]
D4 x (S-4)	0,0163	–0,0025	0,0044	–0,0548
	[0.75]	[0.09]	[0.18]	[3.06]***
D8 x (S-8)	–0,0189	0,0813	0,0376	0,0104
	[0.49]	[1.97]**	[1.01]	[0.43]
D11 x (S-11)	0,0556	0,0814	0,086	0,1933
	[1.29]	[1.48]	[1.73]*	[7.04]***
D15 x (S-15)	–0,0298	–0,054	0,012	0,107
	[0.48]	[0.66]	[0.17]	[1.86]*
Woman	–0,789	–0,65	–0,5995	–0,5343
	[37.00]***	[24.83]***	[26.72]***	[37.13]***
Black	–0,1283	–0,1769	–0,1538	–0,1612
	[6.03]***	[6.58]***	[6.17]***	[9.66]***
Constant	6,0524	5,3442	5,416	5,1195
	[75.86]***	[44.92]***	[46.08]***	[67.22]***
F-test for sheepskin effects = 0	6,840	7,740	3,190	5,750
Prob>F	0,000	0,000	0,013	0,000
F-test for splines = 0	0,930	4,480	3,630	28,140
Prob>F	0,447	0,001	0,006	0,000
Observations	6300	4201	5127	9928
R-squared	0,45	0,38	0,41	0,41

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

TABLE B.3
Earnings equation–South
(Dependent variable: log of earnings in the main job)

	1982	1992	1998	2004
	(1)	(2)	(3)	(4)
Years of schooling (S)	0,0811	0,002	0,0588	0,0241
	[3.53]***	[0.07]	[2.18]**	[0.97]
Experience	0,0248	0,0167	0,0193	0,0181
	[6.10]***	[3.33]***	[4.12]***	[4.44]***
Experience squared	–0,0005	–0,0004	–0,0004	–0,0003
	[7.25]***	[5.83]***	[5.83]***	[5.87]***
Experience x schooling	0,0008	0,0028	0,0007	0,0015
	[1.11]	[3.43]***	[0.85]	[2.20]**
Lower primary (D4)	0,185	0,1728	–0,0425	0,0413
	[2.48]**	[1.88]*	[0.44]	[0.41]
Upper primary (D8)	–0,0363	0,2676	0,009	0,2806
	[0.40]	[2.77]***	[0.10]	[3.57]***
Secondary school (D11)	0,2919	0,48	0,3666	0,2329
	[2.81]***	[4.53]***	[3.97]***	[3.07]***
College (D15)	0,2663	0,267	0,2777	0,2368
	[2.65]***	[2.15]**	[2.29]**	[2.40]**
Experience x D4	–0,0036	–0,003	0,004	–0,0003
	[1.39]	[0.97]	[1.34]	[0.10]
Experience x D8	0,0019	–0,0061	0,0031	–0,0091
	[0.47]	[1.48]	[0.85]	[2.95]***
Experience x D11	–0,0082	–0,0158	–0,0102	–0,0024
	[2.03]**	[3.82]***	[3.00]***	[0.86]
Experience x D15	–0,0026	–0,0132	–0,0086	–0,0087
	[0.53]	[2.49]**	[1.95]*	[2.35]**
Schooling=16	0,0742	0,0952	–0,0504	–0,1205
	[1.33]	[1.33]	[0.83]	[2.51]**
D4 x (S-4)	0,0027	–0,0068	–0,0111	–0,014
	[0.15]	[0.36]	[0.64]	[0.80]
D8 x (S-8)	0,0104	0,0297	0,0307	0,0137
	[0.35]	[1.06]	[1.37]	[0.67]
D11 x (S-11)	–0,0137	0,0436	0,0479	0,1127
	[0.43]	[1.39]	[1.81]*	[5.10]***
D15 x (S-15)	0,0088	0,0682	0,0876	0,1258
	[0.21]	[1.34]	[2.14]**	[4.02]***
Woman	–0,7882	–0,7112	–0,6498	–0,601
	[47.68]***	[42.21]***	[46.70]***	[50.74]***
Black	–0,1719	–0,1533	–0,1683	–0,1411
	[9.19]***	[6.86]***	[9.11]***	[9.38]***
Constant	5,4583	5,3869	5,5152	5,2996
	[77.60]***	[55.94]***	[59.35]***	[62.89]***
F-test for sheepskin effects = 0	4,570	6,690	6,590	5,500
Prob>F	0,001	0,000	0,000	0,000
F-test for splines = 0	0,060	4,490	7,700	29,270
Prob>F	0,993	0,001	0,000	0,000
Observations	12355	10700	12245	14832
R-squared	0,52	0,41	0,44	0,42

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

TABLE B.4

Earnings equation Center-West

(Dependent variable: log of earnings in the main job)

	1982	1992	1998	2004
	(1)	(2)	(3)	(4)
Years of schooling (S)	0,0664	0,0383	0,0068	0,0265
	[2.81]***	[1.27]	[0.25]	[1.11]
Experience	0,0104	0,0157	0,005	0,0113
	[2.40]**	[2.87]***	[1.00]	[2.79]***
Experience squared	-0,0002	-0,0003	-0,0002	-0,0002
	[3.34]***	[3.93]***	[2.47]**	[3.99]***
Experience x schooling	0,0017	0,0015	0,0019	0,0009
	[2.08]**	[1.52]	[2.30]**	[1.24]
Lower primary (D4)	0,1196	-0,1078	0,0007	-0,0691
	[1.32]	[0.93]	[0.01]	[0.71]
Upper primary (D8)	0,2629	0,3097	0,3623	0,1938
	[2.60]***	[2.62]***	[3.45]***	[2.34]**
Secondary school (D11)	0,4221	0,3741	0,3956	0,1499
	[3.73]***	[3.08]***	[3.83]***	[1.87]*
College (D15)	0,2325	0,2805	0,1332	0,1837
	[1.96]*	[1.83]*	[0.91]	[1.59]
Experience x D4	-0,0004	0,0039	0,0026	0,004
	[0.10]	[0.97]	[0.72]	[1.23]
Experience x D8	-0,0082	-0,0099	-0,0108	-0,0045
	[1.88]*	[1.99]**	[2.52]**	[1.42]
Experience x D11	-0,0076	-0,0102	-0,0083	0,001
	[1.70]*	[2.15]**	[2.04]**	[0.32]
Experience x D15	-0,0091	-0,0047	-0,006	-0,0099
	[1.78]*	[0.77]	[1.18]	[2.34]**
Schooling=16	0,0696	0,0427	0,0304	0,0846
	[1.05]	[0.50]	[0.40]	[1.40]
D4 x (S-4)	-0,0162	-0,002	0,0004	-0,0084
	[0.87]	[0.09]	[0.02]	[0.52]
D8 x (S-8)	-0,0349	0,044	0,0268	0,0404
	[1.01]	[1.32]	[0.90]	[1.73]*
D11 x (S-11)	0,1454	0,0411	0,1548	0,1608
	[3.88]***	[1.12]	[4.24]***	[6.07]***
D15 x (S-15)	-0,1477	-0,0092	-0,0608	0,0576
	[3.14]***	[0.15]	[1.09]	[1.50]
Woman	-0,8387	-0,6843	-0,6668	-0,6177
	[46.36]***	[34.69]***	[39.68]***	[44.29]***
Black	-0,0873	-0,0941	-0,0949	-0,1356
	[5.58]***	[4.94]***	[5.59]***	[9.77]***
Constant	5,5968	5,2684	5,7257	5,4691
	[79.48]***	[55.99]***	[64.14]***	[72.36]***
F-test for sheepskin effects = 0	5,230	7,370	7,970	4,000
Prob>F	0,000	0,000	0,000	0,003
F-test for splines = 0	6,340	3,360	12,990	36,320
Prob>F	0,000	0,009	0,000	0,000
Observations	9717	6229	7227	9880
R-squared	0,56	0,46	0,48	0,48

Robust t-statistics in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

APPENDIX C

FIGURE C.1
Estimated profiles of years of completed schooling and log earnings

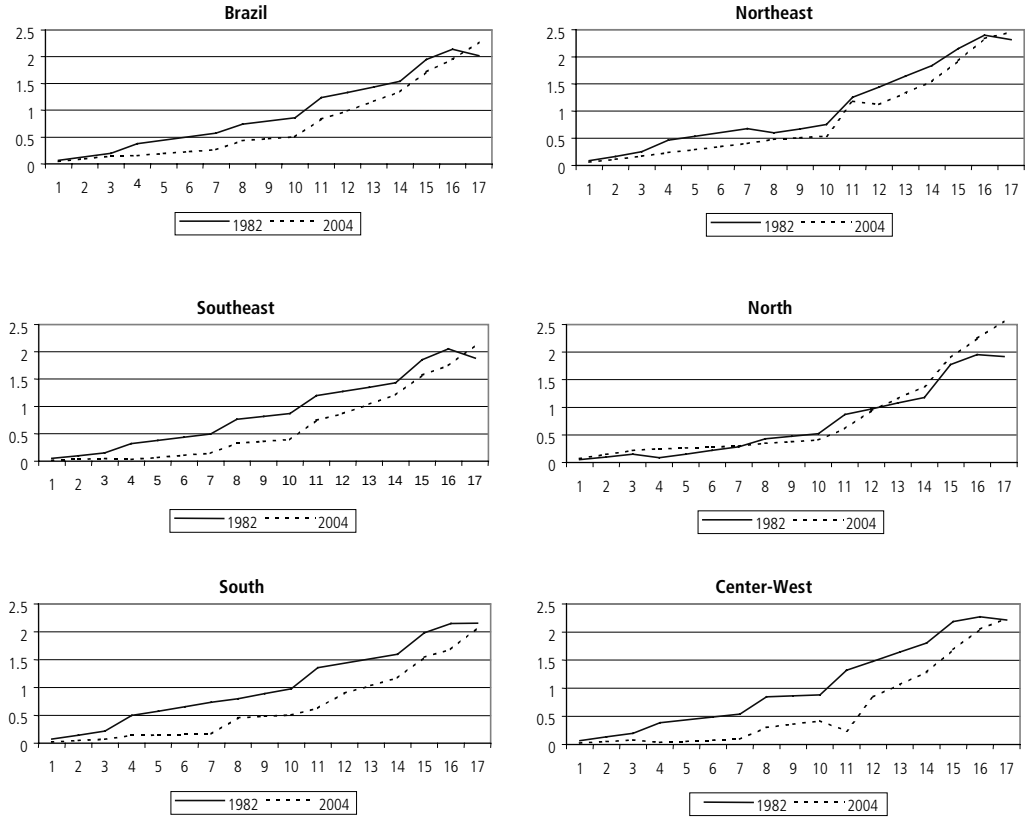
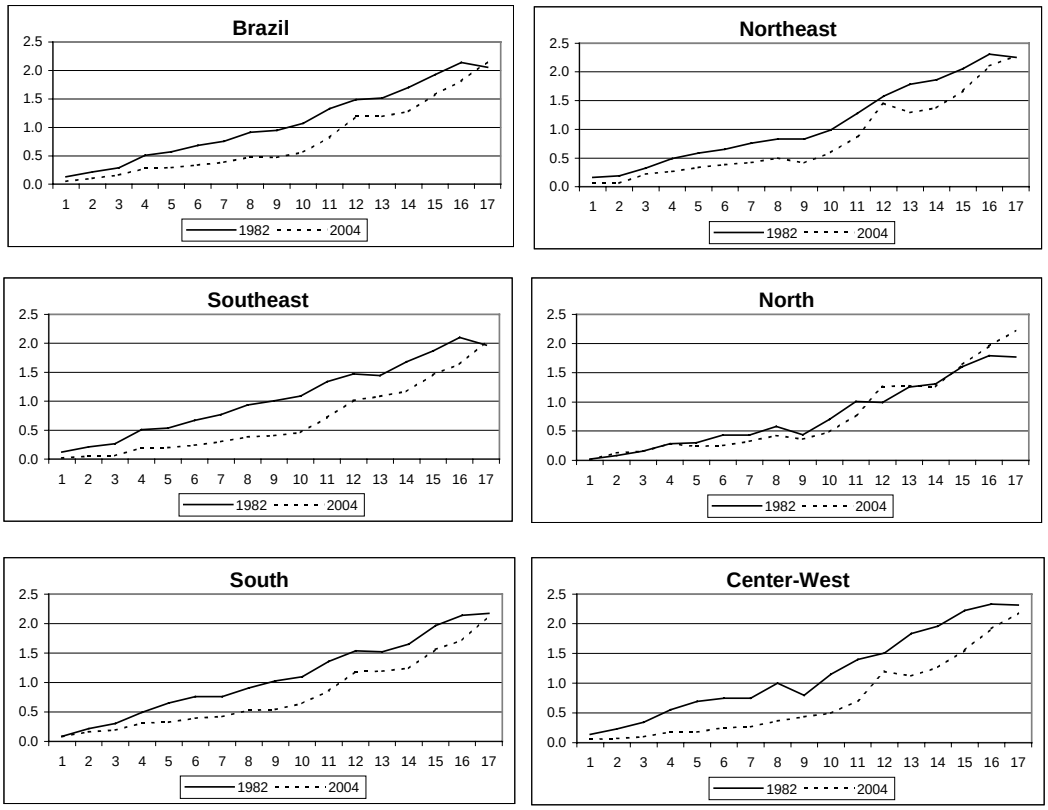


FIGURE C.2
Estimated profiles of years of completed schooling and log earnings–semi-parametric regressions



Ipea – Institute for Applied Economic Research

PUBLISHING DEPARTMENT

Coordination
Cláudio Passos de Oliveira

Supervision
Everson da Silva Moura
Reginaldo da Silva Domingos

Typesetting
Bernar José Vieira
Cristiano Ferreira de Araújo
Daniella Silva Nogueira
Danilo Leite de Macedo Tavares
Diego André Souza Santos
Jeovah Herculano Szervinsk Junior
Leonardo Hideki Higa

Cover design
Luís Cláudio Cardoso da Silva

Graphic design
Renato Rodrigues Buenos

The manuscripts in languages other than Portuguese published herein have not been proofread.

Ipea Bookstore

SBS – Quadra 1 – Bloco J – Ed. BNDES, Térreo
70076-900 – Brasília – DF
Brazil
Tel.: + 55 (61) 3315 5336
E-mail: livraria@ipea.gov.br

Composed in Adobe Garamond 11/13.2 (text)
Frutiger 47 (headings, graphs and tables)
Brasília – DF – Brazil

Ipea's mission
Enhance public policies that are essential to Brazilian development by producing and disseminating knowledge and by advising the state in its strategic decisions.

ISSN 1415-4765

ipea Institute for Applied Economic Research

Secretariat of Strategic Affairs

BRAZILIAN GOVERNMENT BRASIL