Wage gender discrimination and segmentation in the Brazilian labor market

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RESUMO

Este estudo calcula os retornos à educação e experiência, a discriminação salarial por gênero e a segmentação de mercado, baseado nos coeficientes de equações de rendimentos obtidas de um modelo de correção de seletividade amostral. Uma análise detalhada usando um modelo lógite multinomial é desenvolvida, onde são atribuídos valores 0 à variável dependente, caso os indivíduos não estejam trabalhando, 1 se trabalham no mercado formal e 2 se trabalham no mercado informal. Baseado nos coeficientes estimados desse modelo, a variável lambda (inverso da razão de Mill) é calculada e usada na equação de rendimentos para obter estimativas consistentes. Observa-se que os retornos à educação e experiência diferem quando obtidos de coeficientes de equações de rendimentos com correção e sem correção de seletividade amostral. O retorno à educação dos homens no setor informal, por exemplo, mais do que dobra quando a variável lambda é excluída da equação. Observa-se grande discriminação salarial por gênero quando o rendimento médio estimado das mulheres é obtido por meio da substituição das suas características na equação (estrutura) dos homens. Enquanto o rendimento médio das mulheres é 25% abaixo do dos homens, o rendimento médio estimado das mulheres fica acima do rendimento médio dos homens. Constata-se também que 20% dos diferenciais de rendimento entre os setores formal e informal é atribuído à segmentação de mercado.

Palavras-chave: seletividade amostral, discriminação por gênero, segmentação de mercado

ABSTRACT

This study calculates the returns to education and experience, wage gender discrimination and market segmentation, based on the earnings equations coefficients, obtained by using a sample selectivity bias correction model. To this end, a detailed analysis using a multinomial logit model is developed, where the dependent variable takes value 0 if a person is not working, 1 if he or she is in the formal market place, or 2 if the individual is employed in the informal sector. Based on the coefficients estimated in the polychotomus choice model, a lambda variable (inverse of Mill's ratio) is calculated and used in the wage equation to obtain consistent estimates without sample selectivity bias. Large differences are observed when comparing the returns to education and experience obtained from the coefficients of the earnings equations when both correcting and not correcting for sample selectivity bias. The men's return to education in the informal sector, for example, more than double when excluding lambda. Large gender discrimination was found when the women's average estimated wages is obtained by substituting their characteristics in the men's structure. While the actual average women's earnings is approximately 25% below the men's wage, the estimated average women's earnings surpassed the average men's earnings. Finally, it was observed that 20% of the earnings differentials between formal and informal sectors is attributed to market segmentation.

Key words: selectivity bias, gender discrimination, market segmentation.

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1 Introduction

The number of workers in informal jobs is very high in Brazil. Data from PNAD (National Research Household Samples) show that, in 1993, 38.6% of the workers did not have signed work booklets. Moreover, while the number of formal workers decreased 13% from 1990 to 1993, a 10% increase in the number of informal workers was observed. The PME (Monthly Employment Survey) data, which collects information from six of the main state capitals of Brazil, show a 4.4% decrease in the number of workers with work booklets signed, from 1993 to 1995, and a 4.2% increase in the number of workers without work booklets signed, in the same period.

The increase in informal sectors of the labor force is considered by the IBGE (Brazilian Geographical and Statistical Institute) researchers as a reflection of the economic crisis that the country has been going through. Differences in percentages of formal workers among regions reflect the level of development. While in the Southeast of Brazil there is a high percentage of formal workers, in the Northeast the largest percentage is of informal workers.

Interesting differences are observed between formal and informal workers regarding education, experience, earnings and others, showing the necessity for research in this area. For example, formal workers have higher level of education and salaries compared to informal workers. Barros & Varandas (1987) concluded that informal workers have, in general, inferior work conditions to formal workers.

Returns on education and experience, wage gender discrimination and market segmentation will be analyzed in this study, based on the earnings equation coefficients. However, traditional analyses estimating earnings equations may incur in sample selectivity bias, since wages are observed only for those individuals employed in either formal or informal sectors. To solve this problem, a sample selectivity bias correction method, proposed by Lee (1983), is used.

For this purpose, a detailed analysis using a multinomial logit model is developed, where the dependent variable takes zero value if the person is not working, one if he or she is in the formal market place, or two if the individual is employed in the informal sector. Education, age, number of children, race, region and non-labor income are some of the factors assumed to affect the individual's job market participation. Based on the coefficients estimated in the polychotomus choice model, a lambda variable (inverse of Mill's ratio) is calculated and used in the wage equation to obtain consistent estimates without sample selectivity bias.

There are a number of studies differentiating formal and informal sectors in Brazil (Barros & Varandas, 1987· Sedlaceck, Barros & Varandas, 1990; Cacciamali, 1991, 1993), but a small

number of studies estimating the determinants of labor participation and earnings in these sectors of the economy and, moreover, correcting for sample selectivity bias.(Tiefenthaler, 1994a)

This study, then, intends to caiculate the returns on education and experience for men and women in the formal and informal sectors, based on the earnings equations coefficients, obtained by using a sample selectivity bias correction model. The results will then be compared to those obtained by a traditional method of estimation.

Wage gender discrimination and market segmentation will be analyzed free of sample selectivity bias. Based on the estimated coefficients from the earnings equations, a discrimination analysis is carried out for each sector of the economy, comparing women's actual earnings with their potential earnings. A similar analysis is undertaken to measure market segmentation, comparing earnings from workers with similar characteristics but in distinct market sectors. Barros, Mello and Pero (1993) observed the existence of market segmentation in Brazil, using the fact that equally productive workers were receiving different wages depending on whether they were in the formal or informal sector.

Understanding the determinants of labor participation and earnings as well as the divergence between men and women and the formal and informal sectors is essential to orient policy decisions to decrease discrimination and income inequalities in Brazil.

2 Methodology

2.1 Polychotomus - choice model with selectivity

The description of the Polychotomus-choice models with selectivity bias is based on Lee (1983) and Maddala (1990).

Consider the following polychotomus-choice model with three categories represented by subscript s and N individuals represented by subscript i:

$$w_{si} = x_{si}\beta_s + u_{si} \qquad (s = 0,1,2)$$

$$I_{si}^{*} = z_{si}\gamma_s + \eta_{si} \qquad (i = 1,2,\ldots,N)$$

where x_s and z_s are exogenous variables and $E(u_s \# \# \# x_0, x_1, x_2, z_0, z_1, z_2)=0$ and $E(\eta_s \# \# \# x_0 x_1, x_2, z_0, z_1, z_2)=0$. The 3 categories analyzed in this study are: not working, working in a formal job and working in an informal job. Each category is represented by an equation. The wage w_s is observed only if the sth category is chosen. In practice, I^* is not observed. What we observe is a polychotomus variable I taking values 0, 1 and 2. The sth category is chosen if $I=s$, which happens if and only if,

$$I_s^* > \text{Max } I_j^* \quad (j = 0,1,2, \quad j \neq s)$$

Let

$$\varepsilon_s = \text{Max } I_j^* - \eta_s \quad (j = 0,1,2, \quad j \neq s)$$

It follows that

$$I = s \quad \text{if} \quad \varepsilon_s < z_s \gamma_s$$

Suppose that $\#\#\#_j$ (j=0,1,2) have cumulative distribution function

$$F(\eta_i < c) = \exp[-\exp(-c)]$$

Then, it can be shown that

$$Prob(\varepsilon_s < z_s \gamma_s) = Prob(I = s) = \frac{exp(z_s \gamma_s)}{\sum_j exp(z_j \gamma_j)}$$

Thus, the distribution function of $\#\#\#_s$ is given by

$$F_s = Prob(\varepsilon_s < \varepsilon) = Prob\left[\left(\underset{j=0,1,2 \quad j \neq s}{Max} I_j^* - \eta_s\right) < \varepsilon\right] = \frac{exp(\varepsilon)}{exp(\varepsilon) + \sum_{j=0,1,2 \quad j \neq s} exp(z_j \gamma_j)}$$

Therefore, for each choice s we have the model

$$w_s = x_s \beta_s + u_s$$

where the dependent variable ws is observed if and only if the category s is being chosen, i.e., ###$_s$ < z$_s$###. Consider the following transformation to normality:

$$\varepsilon_s^* = J_s(\varepsilon_s) = \Phi^{-1}[F_s(\varepsilon)]$$

where ###(###) is the distribution function of the standard normal.

The condition ###$_s$ < z$_s$###$_s$ ### ### ###$_s$ < J$_s$(z$_s$###$_s$), and if u is normal distributed we have that,

$$E(w_s \mid w_s \text{ is observed}) = E(w_s \mid I = s) = E(w_s \mid \varepsilon_s < z_s\gamma_s) =$$

$$= E[w_s \mid \varepsilon_s^* < J_s(z_s\gamma_s)] = x_s\beta_s + E[u_s \mid \varepsilon_s^* < J_s(z_s\gamma_s)] = x_s\beta_s + \sigma_s\rho_s \frac{\phi[J_s(z_s\gamma_s)]}{\Phi[\Phi^{-1}[F_s(z_s\gamma_s)]]}$$

where ### is the density function of the standard normal, ###$_s^2$=Var(u$_s$), and ###$_s$ is the correlation coefficient between u$_s$ and ###$_s^*$

The following model can be estimated by the two-stage method. The equation

$$w_s = x_s \beta_s + \sigma_s\rho_s \frac{\phi[J_s(z_s\gamma_s)]}{F_s(z_s\gamma_s)} + v_s$$

can be estimated by ordinary least squares after substituting the estimated values of ###$_s$ from the multinomial logit model where I_s is regressed on z_s by maximum likelihood.

3 Data

The data set used to conduct this study is the 1989 National Health and Nutrition Survey, undertaken by the Brazilian Geographical and Statistical Institute (IBGE), the Institute of Social

Economic Planning (IPEA) and the National Institute of Food and Nutrition (INAN). Approximately 63,000 individuals were interviewed from 17,920 households. It is possible to obtain information from specific regions of Brazil (North, Northeast, Central, South and Southeast) and sectors (rural and urban). However, data from the rural part of the Northern region were not collected.

The data set provides information on monthly earnings (in US dollars) for individuals participating in the labor force a week before the interview, and any sort of payment in-kind received by the individual per month, which was already transformed into dollars. These variables were added to get the monthly earnings. Information on the number of hours worked per week is also available. This variable was multiplied by 4 to obtain the number of hours worked per month. The monthly earnings were divided by the number of hours worked per month to get the hourly earnings.

The sample used in this study is made up of 14,661 men and 15,417 women, aged 18 to 65, which includes those who do not participate in the labor market, as well as those participating in the formal or informal sector of the economy. There are a large number of definitions in the literature that try to characterize the informal sector. Some characterize it according to the nature and structure of the productive process, by the legality of economic activities, by labor contracts, etc.. The IBGE considers formal workers as those having their work booklets signed and informal workers as those not having their work booklets signed and self-employed workers. However, in this paper, formal workers are those who pay social security tax.[1] Recent literature has considered workers that do not pay social security taxes as belonging to an underground economy.(Cacciamali, 1991)

The mean, standard deviation and the description of the variables for 6,139 men in the formal, 6,924 men in the informal, 3,192 women in the formal and 3,284 women in the informal sector are presented in Table 3.1. There are 13% and 3% more male and female workers, respectively, in the informal than in the formal sector.

1 The reason for using social security tax as a way to differentiate the formal from the informal sectors is that the information available in the data set on signed work booklets presented an extremely large number of missing values, precluding the analysis. However, for the objectives of this paper, it is an adequate measure to differentiate the market sectors and interesting to be analyzed so that the results could be compared with other studies using different variables.

In each sector, the women's earnings are 20 to 30% lower than the men's earnings. Moreover, the earnings in the informal sector are about 50% of the earnings in the formal sector. One explanation for the lower earnings in the informal sector is that the formal sector requires a higher level of education and training. Note that the average number of years of education in the formal sector is almost twice that observed in the informal sector, for men and women. Moreover, the average age in the formal sector is a little higher than in the informal sector.

The set of data used in this study does not provide information on job training or experience. Therefore, a measure of experience was calculated as age minus years of schooling minus six. Table 3.1 shows that the average experience in the informal sector is greater than in the formal sector, which is a consequence of the method used to calculate experience. As has been discussed, workers in the formal sector have significantly more years of schooling than those in the informal sector, but the age is almost the same in the two sectors of the economy.

Another interesting point to observe is that in the Southeastern and Southern regions as well as in the urban sector there are more workers in the formal than in the informal sector, for both men and women. However, in the Northeast and Central of Brazil there are more informal than formal workers. Pastore (1981) observed that the wealthier the region, the larger the participation in the protected labor market.

Among races, differences are observable for white workers (including Asians) who, as opposed to blacks and mulattos, are more numerous in the formal sector.

4 Results

4.1 Participation in the formal and informal sectors of the economy

The coefficients for the multinomial logit model, estimated by maximum likelihood, are presented in Table 4.1, for men and women from 18 to 65. The dependent variable takes value 0 if the individual is not working, 1 if he or she is working in the formal sector and 2 if he or she is working in the informal sector. Workers in formal jobs, as opposed to those in informal jobs, pay taxes for social security purposes.

Table 3.1
Description of the Variables, Means and Standard Deviations, for Men and Women in the Formal and Informal Sectors

Variables	Description of the Variables	MEN				WOMEN			
		Formal Sector		Informal Sector		Formal Sector		Informal Sector	
		mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
WAGE	hourly wage rate	1.89	3.45	0.82	1.90	1.36	2.11	0.67	1.42
LNWAGE	logarithm of the hourly wage rate	0.088	0.58	-0.73	0.42	-0.23	0.49	-0.99	0.37
HOURS	number of hours working per week	46.59	12.85	46.41	12.99	39.83	12.10	34.02	17.45
LAMBDA	inverse of Mill's ratio	0.63	0.36	0.83	0.40	1.02	0.47	1.31	0.22
NORTH	=1 if individual resides in the North of Brazil	0.03	0.16	0.03	0.18	0.03	0.18	0.03	0.17
NORTHEAST	=1 if individual resides in the Northeast of Brazil	0.16	0.34	0.42	0.30	0.19	0.38	0.34	0.33
CENTRAL	=1 if individual resides in the Central of Brazil	0.06	0.24	0.08	0.28	0.07	0.25	0.07	0.25
SEAST	=1 if individual resides in the Southeast Brazil	0.60	0.49	0.34	0.47	0.56	0.50	0.42	0.49
SOUTH	=1 if individual resides in the South of Brazil	0.18	0.38	0.16	0.37	0.18	0.38	0.17	0.38
URBAN	=1 if individual resides in the urban sector	0.90	0.31	0.53	0.50	0.94	0.23	0.73	0.45
WHITE	=1 if individual is white or Asian	0.64	0.48	0.43	0.50	0.66	0.48	0.48	0.50
MULATTO	=1 if individual is mulatto	0.30	0.46	0.51	0.50	0.29	0.45	0.44	0.50
BLACK	=1 if individual is black	0.06	0.19	0.06	0.22	0.05	0.19	0.08	0.22
HEAD	=1 if individual is the head of the household	0.77	0.41	0.69	0.46	0.23	0.42	0.18	0.38
WIFE	=1 if individual is a wife in the household					0.45	0.50	0.60	0.49
SON/DAUGT	=1 if individual is son or daughter in the household	0.19	0.37	0.27	0.44	0.25	0.42	0.15	0.37
EXPERIENCE	individual's experience in years	23.17	13.42	26.36	14.41	19.35	12.80	25.21	14.26
EXPERIENCE2	individual's experience squared	716.5	748.43	902.2	864.3	540.22	630.9	848.76	820.1
EDUCATION	individual's number of years in school	6.67	4.47	3.40	3.27	8.21	4.54	4.65	3.77
EDUCEXP	individual's education times experience	122.6	95.95	64.76	68.15	123.7	94.53	79.86	72.57
NONLINC	nonlabor income (rent, pension, alimony, etc.)	22.99	168.38	12.14	75.44	14.52	70.31	8.01	57.10
AGE	individual's age in years	35.82	11.64	35.32	13.03	33.62	10.66	35.83	12.44

The number of children (sons and daughters) with different age ranges, reflecting childcare costs (Tiefenthaler, 1994b) is included in this analysis, as affecting labor force participation. So, the variable representing the number of children from 0 to 2 years old is called CHILD2, from 3 to 5 years old CHILD3-5, from 6 to 12 CHILD6-12, the number of sons 13 years old or older CHILDM13, and the number of daughters 13 or older CHILDF13. Some of those variables can increase childcare costs (young children) and others decrease childcare costs (teenagers).

While the presence of very young children had practically no effect or a positive effect on men's participation in the labor market, it had a strong negative effect on women's participation. The presence of children in the household increases the father´s participation in the labor market, since it increases the need for household income. On the other hand, as the number of young children increases, the mother´s reservation wage increases, i.e., the amount of extra earnings required by an individual, who is not working, to give up one unit of leisure. So, the participation in the labor force of mothers decreases as the number of young children at home increases. Young children demand lots of care, increasing the value of the mother's time. It is interesting to observe that teenager daughters presented a positive effect on female job market participation. This fact can be explained by considering older daughters as mother substitutes, taking care of very young children, allowing the mothers to work outside the home even in the presence of young children. On the other hand, teenage sons had a negative effect on the mother's labor participation, acting as labor substitutes in the job market.

In the previous analysis, fertility is seen as an exogenous decision. However, it is possible to have an endogenous fertility decision and, then, care has to be taken to interpret the results. If, for example, some mothers enjoy having children and staying at home to take care of them more than others, then the negative correlation between number of children and labor force participation may be indicating that it is not the children that prevent mothers from participating in the job market, but that mothers who enjoy having children and staying home with them also tend to have more children.

Tiefenthaler (1994a) also found that in Brazil the participation of women with children under five is decreased in both sectors. However, she obtained a negative effect of teenager daughters on women's participation, indicating that they were not replacing their mothers as child minders, as we found, but were instead replacing mothers in earning income.

Table 4.1
Participation Equations for Men and Women in the Formal and Informal Sectors

	Men		Women	
Variables	**Formal**	**Informal**	**Formal**	**Informal**
CONSTANT	-1.80	1.18	-5.79	-1.864
	(-6.52)***	(4.25)***	(-22.56)***	(-8.27)***
CHILD2	-0.0866	0.00371	-0.815	-0.536
	(-1.00)	(0.04)	(-12.81)***	(-10.25)***
CHILD3-5	0.252	0.258	-0.192	-0.0449
	(2.72)***	(2.77)***	(-3.57)***	(-0.99)
CHILD6-12	0.122	0.163	-0.158	0.0827
	(2.64)***	(3.52)***	(-5.04)***	(3.28)***
CHILDM13	-0.0126	0.00359	-0.203	-0.0285
	(-0.29)	(0.08)	(-5.45)***	(-1.00)
CHILDF13	0.201	-0.00586	0.0529	0.0719
	(3.83)***	(-0.11)	(1.26)	(2.09)**
HEAD	0.940	0.837	0.847	0.561
	(6.58)***	(5.67)***	(6.10)***	(4.21)***
WIFE			-0.359	-0.252
			(-2.68)***	(-1.99)**
SON/DAUGT	-0.683	-0.203	0.176	-0.0408
	(-5.00)***	(-1.44)	(1.30)	(-0.30)
OTHERS	0.803	1.169	2.108	2.138
	(1.90)*	(2.79)***	(9.29)***	(9.84)***
WHITE	0.0735	-0.0942	-0.244	-0.569
	(0.59)	(-0.74)	(-2.36)**	(-6.40)***
MULATTO	-0.088	-0.0383	-0.189	-0.406
	(-0.69)	(-0.30)	(-1.76)*	(-4.49)***
NONLINC	-0.00181	-0.00123	-0.00233	-0.00233
	(-9.28)***	(-5.09)***	(-5.79)***	(-5.79)***
NORTH	0.384	0.479	0.424	0.0162
	(2.28)**	(2.92)***	(3.13)***	(0.13)
CENTRAL	0.668	0.415	0.249	-0.0563
	(5.17)***	(3.29)***	(2.45)***	(-0.63)
SEAST	1.001	0.0492	0.561	-0.0101
	(12.82)***	(0.64)	(8.40)***	(-0.18)
SOUTH	0.914	0.201	0.777	0.0561
	(8.78)***	(1.94)*	(9.28)***	(0.74)
URBAN	0.303	-1.09	0.981	0.317
	(3.66)***	(-14.34)***	(11.82)***	(5.58)***
EDUCATION	0.198	0.00335	0.406	0.137
	(11.28)***	(0.18)	(26.48)***	(9.14)***
EXPERIENCE	0.139	0.0762	0.256	0.106
	(9.99)***	(5.41)***	(20.19)***	(9.37)***
EXPERIENCE2	-0.00262	-0.00165	-0.00401	-0.00174
	(-13.80)***	(-8.61)***	(-21.46)***	(-10.79)***
EDUCEXP	-0.00464	-0.00344	-0.00955	-0.00477
	(-7.08)***	(-4.86)***	(-15.65)***	(-8.16)***
EXPERIENCEH			-0.00174	-0.000667
			(-1.18)	(-0.48)
EDUCATIONH			-0.0363	-0.0327
			(-5.53)***	(-4.70)***
Likelihood Ratio	5054.7 ***	5054.7 ***	4416.3 ***	4416.3 ***

The t-statistics are given in parentheses below the coefficients.

* denotes significance at the 10% level; ** denotes significance at the 5% level and; *** denotes significance at the 1% level.

Hill (1989), using a sample from Japan, concluded that young children reduce women's propensity to work as employees or family workers.

Tiefenthaler (1994b), studying Philippine women working in formal and informal piece-work sectors, observed that the number of children younger than 6 decreases the probability of participation in both formal and piece-work sectors and is insignificant in determining informal-sector participation. Moreover, she concluded that the presence of daughters older than 13 increased the probability of the mothers working in all of the three sectors, as they can reduce childcare costs or help their mothers with informal-sector work.

Variables representing the position of the individuals in the family (HEAD, WIFE, SON/DAUGT, OTHERS) showed that the head participates more in the job market than the son and also the female head works more outside the house than the wives, as we would expect. Women that are heads of families are usually divorced, widows or single and need to work to survive. On the other hand, wives may depend on their husbands as is very common in Brazilian society.

The coefficients of the race variables (WHITE, MULATTO, black is omitted) were negative, when significant. This reflects the fact that blacks participate more in the job market than whites or mulattos. The data show that while 10% of white male workers are not on the job market (49% work in formal jobs and 41% in informal jobs) and 12% of mulattos do not work (35% work in formal jobs and 53% in informal jobs) only 9% of blacks do not participate in the labor market (36% work in formal jobs and 55% in informal jobs).

The non-labor income variable (NONLINC) represents all sort of income that does not come from salaries. Income from rent, pensions, alimony, etc., was added up to obtain the value of the family non-labor income per month. According to the results, the higher the income from non-labor sources, the less likely the person is to be employed, in both formal and informal sectors.

The results also showed a positive relation between the North, Central, Southeastern and Southern regions of Brazil and job participation in the formal sector (the Northeast variable was omitted to avoid perfect collinearity). Job opportunities in the formal sector may increase as development and wealth in the regions increase. However, the results for participation in the informal sector were different. There was almost no statistical significance in the regions' coefficients. Table 3.1 shows that there are more informal workers in the Northeastern region than in any other region. The lack of formal jobs in poor regions induce individuals to participate in informal types of jobs.

Different results were also found between male workers in the formal and informal sectors living in the urban areas. While a significant positive coefficient was obtained in the formal sector, a negative one appeared in the informal sector. In the rural sector most the farmers do not pay social security tax.[2]

Tiefenthaler (1994b) considered the urban dummy variable as a proxy for transportation costs and obtained results similar to the present one.

The variable EDUCATION is the highest degree of education in years. It has the expected positive coefficient, indicating that more years of schooling increases the possibility of being employed. Only the result for men in informal jobs is not significant.

Tiefenthaler (1994) found that education has stronger effects on increasing the participation of women in the formal sector than in the informal sector. In fact, her results show that additional education decreases the probability of women's participation in the informal sector, which contradicts our findings.

The stock of on-the-job training human capital (EXPERIENCE) is hardly measured in survey questionnaires. Due to this fact, job experience is commonly estimated as the individual's age minus years of schooling minus 6. In doing this we are assuming that all workers begin elementary school at six and that no time is spent outside the labor force or school.(Berndt, 1991) Work experience and together with schooling are forms through which human capital can be accumulated. However, human capital can also depreciate, following a parabolic curve. The results indicate that as a person gets more experience, more job opportunities appear until a point is reached after which participation in the labor force starts decreasing, reflecting the fact that as the people age, their ability is reduced. This is shown in Table 4.1 by the positive coefficient for EXPERIENCE and the negative coefficient for EXPERIENCE2, respectively.[3]

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2 In the rural sector the concept of informal jobs does not apply very well. Based on this, the whole analysis was repeated considering only urban workers, but the results were practically the same.

3 Heckman (1980) analyzed a possible endogeneity of labor market experience in the participation decision. According to the author, experience records previous work history and is highly correlated with unmeasured determinants of the current labor force.

It is good to point out that developed regions, urban sector, education and experience variables also have also a positive effect on the earnings equations (Table 4.2). Therefore, there is not only an isolated direct effect on participation but also an indirect effect through earnings. So, a positive coefficient for education, for example, in the participation equation, may be capturing two effects: the direct one shows that higher education increases job participation and the indirect effect shows that higher education increases earnings and hence job participation.

An interaction term EDUCEXP represents years of education times years of experience. The negative sign shows that the effect of education (experience) decreases as the amount of experience (education) increases, i.e., the importance of a person's level of education (experience) to get a job is not so significant if he or she has a very large experience (education) in a specific area.

Variables representing the education of the head of the household (EDUCATIONH) and his or her work experience (EXPERIECEH) are included in the women's equations. The idea is that the wage of the head affects the women's participation in the labor force. However, the wage rate is an endogenous variable, and a better way to account for the head's influence over women's participation in the labor force is to use the head's experience and education as exogenous variables. The result shows that the higher the head's education, the lower the women's participation in work. A highly educated man has great chance to have a good job and a high salary, sparing the woman from working.

4.2 Earnings functions in the formal and informal sectors of the economy

4.2.1 Sample selectivity correction

Table 4.2 shows the earnings equations estimated by least squares, weighted by the sample expansion factors, for men and women in the formal and informal sectors. The dependent variable is the logarithm of the hourly earnings. Table 4.3 also shows the earnings equation, though it differs from Table 4.2 in the fact that in Table 4.2 there is a correction for sample selectivity bias (includes lambda) and in Table 4.3 no correction for sample selectivity bias is made (excluding lambda).

Table 4.2
Earnings Functions for Men and Women in the Formal and Informal Sectors, Including Variable Lambda

Variables	Men		Women	
	Formal	Informal	Formal	Informal
CONSTANT	-3.32	-2.49	-4.33	-3.98
	(-18.17)***	(-31.56)***	(-22.76)***	(-25.96)***
LAMBDA	0.191	1.09	0.396	0.573
	(2.73)***	(8.94)***	(7.97)***	(6.59)***
NORTH	0.230	0.587	0.509	0.557
	(3.68)***	(10.27)***	(6.83)***	(6.48)***
CENTRAL	0.321	0.384	0.405	0.392
	(6.91)***	(10.37)***	(7.00)***	(6.39)***
SEAST	0.320	-0.0686	0.485	0.339
	(8.29)***	(-1.79)*	(11.95)***	(8.60)***
SOUTH	0.224	0.0640	0.422	0.263
	(5.34)***	(1.73)*	(8.54)***	(4.94)***
URBAN	0.360	-0.235	0.490	0.199
	(7.62)***	(-3.79)***	(8.14)***	(4.90)***
WHITE	0.352	0.142	0.312	0.190
	(8.45)***	(3.37)***	(5.47)***	(3.11)***
MULATTO	0.102	0.103	0.181	0.00348
	(2.34)**	(2.48)**	(2.98)***	(0.06)
EXPERIENCE	0.101	0.0506	0.0812	0.0866
	(17.84)***	(11.93)***	(11.50)***	(13.15)***
EXPERIENCE2	-0.00133	-0.000752	-0.00105	-0.00120
	(-15.92)***	(-12.51)***	(-9.73)***	(-12.58)***
EDUCATION	0.191	0.0629	0.219	0.145
	(25.72)***	(6.55)***	(23.45)***	(15.06)***
EDUCEXP	-0.00171	-0.000470	-0.00175	-0.00112
	(-6.96)***	(-1.77)*	(-5.02)***	(-2.90)***
R^2	0,44	0.29	0.48	0.34
F test	395.74***	233.31***	245.60***	139.27***
OBS	6139	6924	3192	3284

The t-statistics are given in parentheses below coefficients.

* denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 4.3
Earnings Functions for Men and Women in the Formal and Informal Sectors Excluding Variable Lambda

	Men		Women	
Variables	**Formal**	**Informal**	**Formal**	**Informal**
CONSTANT	-3.32	-2.49	-4.33	-3.98
	(-18.17)***	(-31.56)***	(-22.76)***	(-25.96)***
LAMBDA	0.191	1.09	0.396	0.573
	(2.73)***	(8.94)***	(7.97)***	(6.59)***
NORTH	0.230	0.587	0.509	0.557
	(3.68)***	(10.27)***	(6.83)***	(6.48)***
CENTRAL	0.321	0.384	0.405	0.392
	(6.91)***	(10.37)***	(7.00)***	(6.39)***
SEAST	0.320	-0.0686	0.485	0.339
	(8.29)***	(-1.79)*	(11.95)***	(8.60)***
SOUTH	0.224	0.0640	0.422	0.263
	(5.34)***	(1.73)*	(8.54)***	(4.94)***
URBAN	0.360	-0.235	0.490	0.199
	(7.62)***	(-3.79)***	(8.14)***	(4.90)***
WHITE	0.352	0.142	0.312	0.190
	(8.45)***	(3.37)***	(5.47)***	(3.11)***
MULATTO	0.102	0.103	0.181	0.00348
	(2.34)**	(2.48)**	(2.98)***	(0.06)
EXPERIENCE	0.101	0.0506	0.0812	0.0866
	(17.84)***	(11.93)***	(11.50)***	(13.15)***
EXPERIENCE2	-0.00133	-0.000752	-0.00105	-0.00120
	(-15.92)***	(-12.51)***	(-9.73)***	(-12.58)***
EDUCATION	0.191	0.0629	0.219	0.145
	(25.72)***	(6.55)***	(23.45)***	(15.06)***
EDUCEXP	-0.00171	-0.000470	-0.00175	-0.00112
	(-6.96)***	(-1.77)*	(-5.02)***	(-2.90)***
R^2	0,44	0.29	0.48	0.34
F test	395.74***	233.31***	245.60***	139.27***
OBS	6139	6924	3192	3284

The t-statistics are given in parentheses below coefficients.

* denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

The correction variable LAMBDA, included as exogenous variable to avoid selectivity bias, presented a highly significant coefficient, indicating that its inclusion was necessary in the model. Its positive sign indicates that unmeasured factors which increase the probability of participation increase earnings.

Observe that the coefficients of variables EXPERIENCE, EXPERIENCE2, EDUCATION and EDUCEXP,[4] shown in Table 4.3, are all smaller in absolute value than those presented in

4 Only these variables are analyzed in detail because they will be used to obtain the returns on education and experience. However, the behavior of the others is very similar.

Table 4.2 for men and women in the formal sector. Therefore, the use of traditional methods (excluding lambda) of estimating the logarithm of hourly earnings, using only a sample of working individuals, gives, in absolute value, a downward bias estimate of the true effect. In the informal sector, the results are not so clear. There is an upward bias estimate of the true effect, in absolute value, for men, if the traditional method is used, and a downward bias estimate of the true effect, for women, except for education which, as opposed to the other coefficients, increased in the traditional method.

4.2.2 Discussion of the results

The following analysis will be based on the earnings equations corrected for sample selectivity bias.

Men and women receive lower earnings in the Northeastern region (omitted variable) than in the North, Central Southeast and South of Brazil. The same phenomenon happens for workers in the urban areas, who receive higher earnings than those in the rural areas. For men in the informal sector, however, the relatively more developed Southeastern region as well as the rural areas pay lower salaries to the workers than in the Northeastern region and urban areas, as we can see by the negative coefficient in the second column of Table 4.2. A considerable number of the workers in the Northeast and rural areas of Brazil are classified as informal workers because they work in agriculture or as craftsmen, where it is not mandatory to pay social security taxes. So, the earnings of those individuals in poor regions or in the rural areas are better than informal workers in developed regions or in the urban areas. This characterizes job conditions as precarious and chosen only as a way to survive in the absence of anything better. The results for women in the informal sector (fourth column of Table 4.2), on the other hand, follow those of the formal sector, indicating that women in the informal sector in developed regions and urban areas might not have such precarious work conditions as men do. The reason is that some women have jobs that are related to crafts or hobbies.

Savedoff (1990), based on household survey data (PNAD) from 1976 to 1986. analyzed the influence of local and national factors on wages. He concluded that regions in Brazil account for a significant part of the wage difference. However, he points out that the wages have also strong national components and it would be wrong to treat wage determination as either a purely national or an isolated regional process.

The results from the race variables show that blacks (variable omitted) receive lower salaries than whites and mulattos, reflecting discrimination against blacks.

Observe that the EXPERIENCE coefficient is positive and EXPERIENCE2 is negative as suggested by the human capital theory, which states that earnings follow a parabolic curve, peaking somewhere in mid-life, due to a depreciation of the workers' human capital in the form of taking more time to perform tasks, for example, as they age.

Education is highly significant. The higher the number of years of schooling, the higher the salaries for men and women in the formal and informal sectors. Observe that the coefficient values and the tests are higher in the formal than informal sector. As also observed by Barros, Mello and Pero (1993), the degree of informality tends to be larger among less-educated workers.

4.3 Returns on the job training and education

4.3.1 Returns and the correction for sample selectivity bias

Consider the following equation

$$ln\, w = \alpha + \beta_1 exp + \beta_2 exp^2 + \beta_3 educ + \beta_4 exp \times educ + \varepsilon$$

where w is hourly earnings, *exp* is experience and *educ* is education.

As suggested by the human capital theory, the earnings function is considered concave in experience, i.e., it is expected a positive coefficient for ###$_1$ and negative for ###$_2$. Besides this, it is assumed that earnings are linear in education and that the effects of experience on earnings do not depend only on experience but also on education. To capture this effect, an interaction term is added (see Berndt, 1991 and Willis, 1986).

To obtain the effect of experience on log earnings, we compute the partial derivative,

$$\frac{\partial \ln w}{\partial\ exp} = \beta_1 + 2\beta_2 exp + \beta_4 educ$$

and for the effect of education on log earnings,

$$\frac{\partial \ln w}{\partial\ educ} = \beta_3 + \beta_4 exp$$

As an example, consider the earnings equation for men in the formal sector given in column 1 of Table 4.2. The effect of experience on log earnings is,

$$\frac{\partial \ \ln w}{\partial \ exp} = 0.1013 - 2 \times 0.00133 \times exp - 0.00171 \times educ \qquad (4.1)$$

which is, considering 8 years of education, 7.70% at 4 years of experience, 6.63% at 8 years of experience and 5.57% at 12 years.

Table 4.4 shows the percentage of returns on experience for men and women in the formal and informal sectors of the economy, based on the results of Tables 4.2 and 4.3, i.e., correcting and not correcting for selectivity bias, respectively.

Table 4.4
The Effect of Experience on Log-earnings, in Percentage, Correcting for Selectivity Bias (including lambda) and not Correcting for Selectivity Bias (excluding lambda)

	Including lambda					Excluding lambda			
	Formal Sector		Informal Sector			Formal Sector		Informal Sector	
Exper.	Men	Women	Men	Women		Men	Women	Men	Women
					Educ=4				
4	8.38	6.57	4.27	7.25		7.63	5.06	5.03	6.87
8	7.32	5.73	3.67	6.28		6.68	4.49	4.41	6.01
12	6.25	4.89	3.07	5.32		5.73	3.92	3.79	5.15
					Educ=8				
4	7.70	5.87	4.08	6.80		7.03	4.69	4.97	6.50
8	6.63	5.03	3.48	5.83		6.08	4.12	4.35	5.64
12	5.57	4.19	2.88	4.87		5.13	3.55	3.73	4.78
					Educ=12				
4	7.02	5.17	3.89	6.35		6.43	4.32	4.91	6.13
8	5.95	4.33	3.29	5.38		5.48	3.75	4.29	5.27
12	4.89	3.49	2.69	4.42		4.54	3.18	3.67	4.41

The effect of schooling on log-earnings, also based on Tables 4.2 and 4.3, is presented in Table 4.5.

Table 4.5
The Effect of Education on Log-earnings, in Percentage, Correcting for Selectivity Bias (including lambda) and not Correcting for Selectivity Bias (excluding lambda)

	Including lambda				Excluding lambda			
	Formal Sector		Informal Sector		Formal Sector		Informal Sector	
Experience	Men	Women	Men	Women	Men	Women	Men	Women
4	18.37	21.17	6.10	14.02	17.13	17.10	12.33	15.31
8	17.69	20.47	5.91	13.57	16.53	16.72	12.27	14.94
12	17.01	19.77	5.73	13.12	15.94	16.36	12.21	14.57

It is interesting to observe the difference in returns on experience and education when correcting for selectivity bias and not correcting. The returns on education for men in the informal sector, for example, was 6.10, when including lambda and 12.33, when excluding lambda, showing, therefore, an increase of more than 100%. The returns on experience for men in the informal sector when excluding lambda increased 25% on average. However, in the formal sector, the results showed decreases in returns when excluding lambda.

Table 4.6 summarizes the results from Tables 4.4 and 4.5. It is observed in the formal sector an average decrease, ranging from 7% to 18%, in the returns on experience and education, when not correcting for selectivity bias compared to correcting. In the informal sector, on the other hand, an increase of 108% in men's returns on education, 10% increase in women's returns on education and 25% increase in men's returns on experience are observed. The only different result in the informal sector is for women's returns on experience, which decrease 3% when excluding lambda.

Table 4.6
The Average Difference in the Returns on Experience and Education when Correcting for Sample Selectivity Bias Compared to Non-correcting

	Formal Sector		Informal Sector	
	Men	Women	Men	Women
Difference in the returns on experience	8% (-)	18% (-)	25% (+)	3% (-)
Difference in the returns on education	7% (-)	18% (-)	108% (+)	10% (+)

4.3.2 Discussion of the results

The subsequent analyses will be made using as a base the model with selectivity correction, as it is intended to be econometrically more correct, as it avoids a possible sample selectivity bias that may appear when the earnings equations are estimated only for those who are employed.

Observe that the returns on experience in Table 4.4 are positive and decline with increases in years of training and schooling. The values range from 2.69% for men in the informal sector to 8.38% for men in the formal sector and from 3.49% for women in the formal sector to 7.25% for women in the informal sector. While the returns on experience for formal male workers are higher than for informal male workers, the opposite is observed for female workers, who have higher returns in the informal sector. Moreover, looking at the formal sector, the returns are higher for men than for women, but the opposite is observed in the informal sector, where the returns on experience are greater for women than for men.

The returns on education presented in Table 4.5 range from 5.73% for men in the informal sector to 18.37% for men in the formal sector and from 13.12% for women in the informal sector to 21.17% for women in the formal sector. These returns are positive and decline with increases in years of experience. Observe that the returns on education are much higher than the returns on experience. Moreover, the returns on education are three times bigger for men and one and a half time bigger for women in formal jobs than informal jobs. Also, women have greater returns on education than men in both formal and informal sectors.

Lam and Levison (1990), using Brazilian household data (PNAD) from 1985, observed that the returns on education increased with age. They reached the same conclusion analyzing data from the United States. Moreover, they observed that the returns were higher in Brazil than in the United States. They found returns on education around 15%, which is close to the values observed in this present study.

Barros and Ramos (1992), analyzing the household surveys (PNAD) from 1976 to 1989, also obtained returns on education of around 15%, when controlling for age and region, and even higher than 15% without control of variables. Psacharopoulos (1985) found a 14% return on education in Latin America, 11% in Asia, 8% in the Intermediate region (Cyprus, Greece, Iran, Portugal), and 9% in the Advanced region (Australia, Canada, France, Germany, Japan, Sweden, UK, USA).

Berndt (1991) presented results found by Psacharopoulos (1981) in the United States, who observed rates of returns on secondary education close to 12% from 1939 to 1976 and rates of returns on college education near 11% from 1939 to 1969, falling to a value close to 5% in 1976. Berndt also reported the returns on experience found by Mincer (1974), who used 1959 data on white, nonfarm, nonstudent, American males up to 65 years-old. Similar to our findings, the returns on experience decreased with an increase in educational attainment and in years of experience. The rates obtained ranged from 11% to 5%.

4.4 The earnings peak

To obtain the number of years of experience at which workers'earnings peak, equation (4.1) is set equal to zero, and solved for experience at different years of schooling. To find the workers' age where earnings peak, the number of years of schooling plus six is added to the number of years of experience. Thus, with 4, 8 and 12 years of education, men in formal jobs maximize earnings at 35.5, 32.9 and 30.4 years of experience, corresponding to ages 45.5, 46.9 and 48.4. These results are presented in Table 4.7 for men and women in the formal and informal sector. As years of education increase, the age at which earnings are maximized increases, but not much. The largest difference occurs for men in the informal sector, where age went from 42 to 48 years. Observe that this age for women in formal jobs almost did not vary with education.

Barros, Mello and Pero (1993) observed that wages reach a peak at 45-55 age group for men with formal contracts, which is very similar to our findings.

Table 4.7
Number of Years of Experience and Age at Which Earnings Peak

	Formal				Informal			
	Men		Women		Men		Women	
Education	Experience	Age	Experience	Age	Experience	Age	Experience	Age
4	35.5	45.5	35.2	45.2	32.4	42.4	34.1	44.1
8	32.9	46.9	31.9	45.9	31.1	45.1	32.2	46.2
12	30.4	48.4	28.6	46.6	29.9	47.9	30.3	48.3

Since the age at which earnings peak does not vary much with respect to different levels of education, it is possible to infer that those spending more time in school and, therefore, starting to work later, reach their earnings peak earlier than those who are less educated, which might be that the age-earnings profile is steeper for the more educated workers. Algebraically,

substituting the variable experience by age minus education (the constant 6 will not alter the results), in Table 4.2 column 1, and taking the derivative of log-earnings with respect to age, instead of experience, as was done in equation (4.1), yields:

$$\frac{\partial \ln w}{\partial age} = 0.101 - 2 \times 0.00133(age - educ) - 0.00171\, educ$$

$$= 0.101 - 0.00266\, age + 0.00266\, educ - 0.00171\, educ$$

$$= 0.101 - 0.00266\, age + 0.00095\, educ$$

Observe that the education coefficient in the above equation is positive, showing that the age-earnings profile is steeper for the more educated worker, as was stated.

4.5 Discrimination and market segmentation

To measure the male-female earnings differential, a hypothetical average hourly wage for women is obtained by using their own characteristics (means) and the men's structure (coefficients). After the adjustment, the increase in the women's wages is attributable to discrimination, and the wage differential remaining between men and women is due to differences in characteristics. This approach was used by Brown, Moon and Zoloth (1980) and Barros *et alii* (1995). The bases for these studies, however, go back to Blinder (1973) and Oaxaca (1973), who argued that the coefficients (intercept and slopes) of the earnings regressions estimated separately for men and women, based on a set of personal characteristics, contain information about discrimination.

Table 4.8 displays the specific mean of log earnings for men and women in the formal and informal sectors and the average wage for women that would result if they faced the same wage structure as men. In the formal sector, the actual men's and women's average earnings are 0.088 and -0.23 respectively, i.e., women receive 27% less than men[5] However, the women's log wage estimated by substituting the women's characteristics in the men's earnings equation is 0.32, which shows that women were supposed to receive 26% more than men, given their characteristics, and not suffering discrimination. In the informal sector, men's and women's average earnings are -0.73 and -0.99 respectively, i.e., women receive 23% less than men. In this case, the women's estimated wage is -0.22 or 67% more than the men's wage.

5 To obtain the 27 percentage 1-exp(-0.23-0.088) was calculated.

Based on this analysis, it is possible to conclude that gender discrimination occurs in large proportions in both formal and informal sectors of the economy, being higher in the informal sector compared to the formal sector.

Barros, Machado and Mendonça (1997) observed that one third of the male-female wage differential for workers with the same age and education is attributable to occupational attainment. They showed that female occupations are not only different than men's occupations but also worse, which can be also a form of discrimination.

Table 4.8
Actual Log Earnings for Men and Women in the Formal and Informal Sectors, and Estimated Log Earnings for Women

	Average Men's Earnings	Average Women's Earnings	Estimated women's Earnings
Formal sector	**0.088**	**-0.23**	**0.32**
Informal sector	**-0.73**	**-0.99**	**-0.22**

The same analysis just performed is repeated as a way of measuring the existence of market segmentation, i.e., that equally productive workers receive different wages depending on whether they are in the formal or informal sector. In order to do this, the wages that would result if their characteristics (means) in the informal market were used in the formal sector structure (coefficients) were separately estimated for men and women.

Table 4.9 displays the specific means of log earnings received in the formal and informal sectors, for men and women, and the average wage estimated in the informal sector if the wage structure was the same as in the formal sector. The actual mean log earnings in the formal and informal sectors for men are 0.088 and -0.73 respectively, while the estimated wage in the informal sector, given the structure of the formal sector, is -0.57. Therefore, 80% of the earnings differential is due to differences in characteristics and 20% to market segmentation.[6] For women, while the averages in the formal and informal sectors are -0.23 and -0.99 respectively, the estimated earnings in the informal sector, given the structure of the formal sector, is -0.83, which yields that 79% of the earnings differential is due to difference in characteristics and 21% is due to market segmentation.

6 To obtain 80% (0.088-(-0.57))/(0.088-(-0.73)) is calculated.

These results lead to the conclusion that for both men and women, market segmentation exists and is 20% of the earnings differential observed between formal and informal sectors, the remaining part being attributable to differences in the workers' endowments.

Barros, Mello and Pero (1993),[7] using household surveys (PNAD) from 1981 to 1989, observed that workers with formal contracts earn twice the wages of workers without formal contracts and showed that "*one half of this wage gap is explained by differences between workers with and without formal labor contracts with respect to education, age and region of residence.*" So, they found segmentation in the market, claiming that "*if workers with same age and education who reside in the same metropolitan area were on average equally productive, then the metropolitan labor market of Brazil would be segmented with a randomly drawn worker in a job without formal labor contract experiencing a 50% wage increase if he/she could find a job with a formal contract.*"

Table 4.9
Actual Log Earnings for Men and Women in the Formal and Informal Sectors, and Estimated Log Earnings in the Informal Sector

	Average Formal Earnings	Average Informal Earnings	Estimated Informal Earnings
Men	**0.088**	**-0.73**	**-0.57**
Women	**-0.23**	**-0.99**	**-0.83**

5 Conclusions

The labor force participation for men and women in the formal and informal sectors of the Brazilian economy was estimated by maximum likelihood using a multinomial logit model. The results show that number of children, education, experience, among other variables, affect the decision of men and women to participate in the formal and informal markets. Some differences are present, though. While young children have a negative impact on women's participation, they have a positive impact on men's participation. Moreover, teenager daughters increase the mother's participation in the job market, as they can act as substitutes from the mother's care towards very young children. Connected to this fact is the result that the head of the household

7 This study includes only male employees in the urban segment of nine metropolitan areas in the private sector with and without formal labor contracts.

participates more in the labor force than the wife. Education also has a very strong effect on participation for both men and women in the formal sector. However, in the informal sector, the effect is much smaller for women and even insignificant for men. The level of education required in informal jobs is lower than in formal jobs.

The earnings functions were estimated by weighted least squares, correcting for selectivity bias and the results compared to a traditional method of estimation, showing large differences between coefficients. Race, region, education and experience are variables affecting earnings.

The variable lambda captures the unobservable effect of the variables, which affects both the selection of the workers into the sector and their earnings. It is recommended that further research be conducted to find out which these unobservable variables are and the real necessity to control them for the purpose of the analysis proposed in this study.

Large differences are observed when comparing the returns on education and experience obtained from the coefficients of the earnings equations when both correcting and not correcting for sample selectivity bias. Men's returns on education in the informal sector, for example, more than doubles when excluding lambda. Returns on education ranged from 5,73% for men in the informal sector to 21,17% for women in the formal sector, being much higher in the formal than informal sector. Returns on experience were lower than on education, ranging from 3,18% for women in the formal sector to 8,38% for men in the formal sector.

The number of years of experience and the age at which earnings peak were calculated. The age range was not wide, from 42 to 48 years, which indicates that more highly educated workers reach their peak earlier than less educated ones.

Considerable gender discrimination was found when comparing women's wages estimated by substituting their characteristics in the men's structure. While the actual average women's earnings are approximately 25% below men's wages, the estimated average women's earnings surpassed the average men's earnings.

Finally, it was observed that 20% of the earnings differentials between formal and informal sectors is attributed to market segmentation.

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