

# Gender wage gaps in formal and informal jobs, evidence from Brazil.

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## **Abstract**

Informal employment represents a large share of total employment in developing countries. This paper explores how the existence of informal jobs shapes gender inequality in the labour market using data from Brazil. Is the gender wage gap higher or lower among informal employees compare to formal employees? We find that the raw wage gaps are higher in the formal sector and that the difference in the gaps varies across education groups. Is the difference in gender wage gaps across formal and informal jobs explained by different characteristics or by a gendered selection into formal and informal employment or by other factors such as labour regulation?

Controlling for observables characteristics, the adjusted wage gaps are not statistically different in the formal and informal segment of the labour market for most education groups. This pattern points to the heterogeneity of informal workers and to different labour market selection processes.

We further show that controlling for selection into multiple employment statuses reduces the gender wage gaps in both segments of the labour market and reverse the pattern observed on the raw wage gaps. The gender wage gap is actually higher among informal employees where labour regulation is not respected.

# 1 Introduction

A striking characteristic of labour markets in developing countries is the existence of a large informal sector. It is thus important to distinguish the formal and the informal segments of the labour market when examining the gender wage gaps. This paper investigates how informality shapes labour market outcomes differently for men and women. Is the gender wage gap higher or lower among informal employees compare to formal employees? Do men and women sort differently across labour market statuses? How does the selection process affect the gender wage gaps in formal and informal jobs?

We find that women are more often unemployed than men and that the informality rate is higher among occupied women compare to occupied men, especially for people with a medium level of education. We further quantify to what extent the raw gender wage gaps differ across formal and informal jobs. Higher gender wage gaps in formal jobs could indicate that the expected labour costs of regulation are considered higher for women so that employers compensate for it by paying lower wages to female employees especially in jobs with formal contracts. However, higher estimated gender wage gaps in formal jobs could also be due to different sorting of men and women. Indeed, the analysis shows that the gaps across formal and informal jobs vary across groups of education. This pattern is in line with recent evidence on the heterogeneity of informal labour markets (Gunther and Launov (2012)) and points to different labour market selection processes across formal and informal sectors. This paper seeks to understand whether the differences in gender wage gaps across formal and informal jobs are due to labour regulation or to gendered selection into formal and informal employment.

In order to control for the non-random selection into different employment statuses, we distinguish between inactive individuals, unemployed, formal salaried workers, informal salaried workers including domestic workers, self-employed and employers. Selection is specified as a multinomial logit model that allows for correlation between alternatives (Bourguignon et al. (2007)). Wage equations are estimated for formal salaried workers and informal salaried workers separately. We show that controlling for selection into potential labour statuses reduces the gender wage gaps in both segments of the labour market ; and reverse the pattern observed on the raw wage gaps. The gender wage gap is actually higher among informal employees. Because labour market decisions and the gender wage gaps differ across the schooling distribution, we replicate the exercise for five different education groups.

A few papers explore how the existence of informal jobs affects the gender wage gap. Tansel (2001) investigates labour market inequalities in Turkey. She defines informality as the absence of social security protection and estimates the gender wage gaps among covered and uncovered wage earners in 1994. In the wage equation, she controls for selection into multiple outcomes using the strategy developed by Lee (1983) and finds that the adjusted wage gap is substantial among formal workers but not significant among informal workers. Deininger et al. (2013) look at the gender wage gap in India. Contrary to Tansel (2001), and in line with our findings for Brazil, they show that the gender wage gap due to is higher among informal workers in India. They control for selection into labour market participation but they do

not take into account the selection into multiple employment statuses conditional on being active.

Other studies have focused on the difference in the formal wage premium for men and women. Arab-sheibani et al. (2003) find that informality is more penalizing for men than for women, in other words that the formal wage premium is greater for men.

This paper is also related to two strands of literature. First, it is linked to the vast literature on the segmentation of the labour market and the formal wage premium. Carneiro and Henley (2002) explore how expected earnings differ in the informal and formal sectors controlling for selection of workers. Their selection correction approach consists in estimating the probability of being either a formal or an informal worker which has a significant impact on the estimation of earnings for both formal and informal workers. They find that some workers are actually better off choosing the informal segment of the labour market. Second, this work is also contributes to the literature on the gender wage gaps and the selection into labour market participation, in particular to the empirical research on the evolution of wage gaps along the education distribution (see e.g. Albrecht et al. (2003), de la Rica et al. (2008)).

The remainder of the paper is organized as follow. We start by providing descriptive statistics on gender inequalities in the Brazilian labour market. Section 3 sets up the empirical model. In section 4 we discuss the results, looking at the selection into potential outcomes for men and women before moving onto the comparison of the gender wage gaps between formal and informal wage-earners. The last section concludes.

## 2 Evidence on Brazil

### 2.1 The data

Individual information is taken from the annual household survey, the Pesquisa Nacional por Amostras de Domicilio (PNAD). This survey covers the whole country, rural and urban areas. The PNAD provides information about the individuals of roughly 100,000 households from both urban and rural areas. In 2009, around 252,000 working-age people (18-65) were interviewed, among whom 52% were women and 85% lived in urban areas. Sample weights ensure the representativeness of the survey.

The survey provides direct and reliable information on the existence of a formal contract for wage-earners. Individuals are asked if their labour card is signed by their employer; if it is not, they are not registered and are not entitled to any labour rights or benefits.

In this paper, we differentiate informal employees from self-employed and unpaid or family workers and we focus on gender differences among informal *wage-earners* only, including domestic workers employed by private households.

### 2.2 Descriptive statistics

Table 2 highlights differences across gender and educational level in 2009. Among women with less than three years of education, only 52% decide to participate to the labour market while 83% of men

Table 1: Descriptive statistics by sex, 2009

	Formal				Informal			
	Men		Women		Men		Women	
	Share	sd	Share	sd	Share	sd	Share	sd
<i>Demographics</i>								
Age (mean)	38.15	12.04	38.06	11.66	33.98	12.17	35.31	11.64
Head of household	0.64	0.48	0.27	0.45	0.51	0.50	0.30	0.46
Living in couple	0.81	0.39	0.70	0.46	0.76	0.43	0.62	0.48
Children under 14	0.40	0.49	0.40	0.49	0.40	0.49	0.45	0.50
<i>Education</i>								
Illiterate	0.07	0.26	0.05	0.22	0.12	0.33	0.07	0.25
Years of schooling (mean)	8.16	4.34	9.30	4.35	6.73	4.36	7.93	4.21
<i>Job related variables</i>								
Full time	0.87	0.34	0.65	0.48	0.80	0.40	0.54	0.50
Several jobs	0.05	0.22	0.05	0.22	0.05	0.22	0.05	0.21
<i>Age at first job</i>								
Under 10	0.13	0.34	0.10	0.30	0.13	0.34	0.09	0.29
10-14	0.39	0.49	0.31	0.46	0.42	0.49	0.34	0.47
15-17	0.26	0.44	0.26	0.44	0.26	0.44	0.27	0.44
17-19	0.14	0.35	0.18	0.39	0.12	0.33	0.15	0.36
20-24	0.06	0.24	0.12	0.32	0.05	0.22	0.10	0.30
25-29	0.01	0.09	0.02	0.16	0.01	0.09	0.02	0.15
More than 30	0.00	0.03	0.02	0.12	0.00	0.04	0.02	0.14
Tenure (mean number of years)	2.80	3.00	2.82	3.06	2.77	2.90	2.96	3.03
Night work	0.02	0.14	0.01	0.08	0.02	0.13	0.01	0.08
<i>N</i>	81057		57600		19320		19580	

Source: Author's calculation based on the PNAD, 2009, IBGE, Brazil.

with less than three year of education do. 8% of uneducated active women are unemployed while 5% of uneducated active men are. The informality rate measures the share of workers without a contract. Focusing on workers with 4 to 14 years of education, informality rate is always higher for women. Among women with 4 to 7 years of education, 30% have no contract while for men with the same educational level, 21% have no contract. As for uneducated workers and for workers with more than 14 years of education, informality rates are similar among the female workers and the male workers.

- The female unemployment rate is higher in all education-groups.
- The female informality rate is higher than the male one, the difference being larger for people with medium level of education.

Table 4 reveals that, in 2009, women have a higher educational level whatever the employment status. Active women have a higher level of education, there are fewer low-educated women and more high-educated women on the labour market. The same applies for unemployed and shadow workers. Figure 1 additionally show that the average number of years among formal and informal workers has increased in the 90s and in the years 2000 for both men and women; working women still display a higher level of

education than working men in both segments of the labour market.

This is consistent with a sorting story where sex is signal and education level compensate for a higher quite probability.

Table 2: Descriptive statistics by education and sex groups, 1999

Years of education	Participation rate		Unemployment rate		Informality rate among employees	
	Men	Women	Men	Women	Men	Women
Total	89	66	6	11	19	25
Less than 3	87	52	5	8	28	29
Between 4 and 7	90	56	8	12	21	30
Between 8 and 14	89	67	10	15	16	21
More than 14	92	83	3	5	10	10

Source: Author's calculation based on the PNAD, 2009, IBGE, Brazil.

Table 3: Employment shares and informality rate by sex groups

Sector	Employment share			Informality rate		
	Overall	Men	Women	Overall	Men	Women
Agriculture	22	24	18	20	27	8
Industry	14	16	12	16	16	15
Construction Mining	7	12	1	29	28	57
Services	57	48	69	24	18	30

Source: Author's calculation based on the PNAD, 1999, IBGE, Brazil.

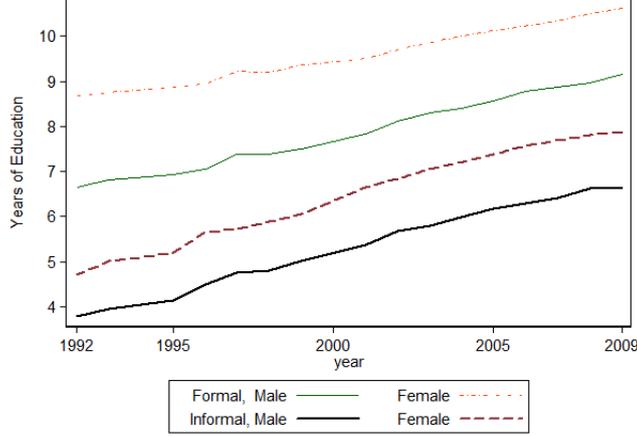
Do formal employees have better productive characteristics?

Table 4: Share of educated people among active, unemployed and informal workers

	All		Active		Unemployed		Informal workers	
	Men	Women	Men	Women	Men	Women	Men	Women
Less than 3	19	17	18	12	11	9	26	16
Between 4 and 7	24	22	24	20	22	18	28	27
Between 8 and 11	17	16	17	15	22	21	18	18
Between 11 and 14	32	35	33	39	40	46	23	32
More than 14	8	10	8	13	5	6	5	7
	100	100	100	100	100	100	100	100

Source: Author's calculation based on the PNAD, 2009, IBGE, Brazil.

Figure 1: Average number of years of education among male and female employees



Source: PNAD, 1992-2009, IBGE, Brazil.

### 3 The Econometric model

The main objective of the paper is to compare the gender wage gaps among formal employees and among informal employees and to explore how the selection of individuals shapes the gender wage gaps in these two different segments of the labour market. To do so, we first compute the raw wage gaps in both segments, we then compute the the adjusted wage gap, i.e. after controlling for observable characteristics ; comparing the raw and the adjusted wage gaps enables us to say something about the role of observables on gender wage inequality. Finally, we compute the wage gaps controlling for both observable characteristics and the selection into the different labour statuses ;

The raw wage gap in sector  $j$  is estimated from the equation:

$$\log w_{ij} = \beta_0 + \alpha_j F_{i(j)} + u_i \tag{1}$$

where  $F$  is a dummy for women and the raw wage gap is  $E(\log w|female = 1) - E(\log w|female = 0) = \hat{\alpha}_j$ .

The adjusted wage gap is estimated from the equation:

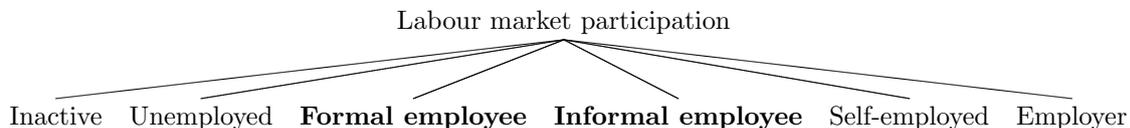
$$\log w_{ij} = \beta_0 + \alpha_j F_{i(j)} + \lambda X_i + u_i \tag{2}$$

where  $X$  is a set of control variables that includes years of education, potential experience, whether the person lives in an urban area or not, categorical variables for regions, sectors and occupations. The adjusted wage gap is computed from equation (2) as  $E(\log w|female = 1) - E(\log w|female = 0) = \hat{\alpha}_j$ .

This wage gap takes into account the observable differences in characteristics between men and women however it does account for the selection of men and women into formal or informal jobs because of unobserved characteristics. This can be problematic as first we have seen that women have a much lower labour market participation rate, second, the selection of women into participation and into employment is certainly not random and differs from the selection of men. What is more, selection into employment follows different processes depending on the type of job workers are eventually employed in. The descriptive statistics additionally show that the female unemployment rate is higher than the male one and that the informality rate is higher among women.

To deal with the selection of individuals into different working status, we develop a setting similar to a Roy model, where individuals have to choose between working or not and if entering the labour force, have different probabilities to be in a given job depending on their preferences and on demand constraints leading to job rationing. Controlling for Roy sorting can be particularly important in the analysis of discrimination as there might be a ‘crowding effect’ into certain occupations (Bergmann, 1971) based on pre-labor market discrimination. The occupational distribution of workers depends on certain characteristics and the difference in the occupational attainment between male and female workers might be explained by segregative constraints above differences in human capital.

We divide the potential outcomes into six mutually-exclusive statuses denoted  $j$ : inactivity, unemployment, formal employment, informal employment, self-employment and employer.



Individual  $i$  earns an income  $w_{ij}$  if she is in status  $j$ . Given that individuals maximize the expected value of their positions, we can write the following model:

$$\log w_{ij} = X_i\beta_j + \alpha_j F_i + u_{ij} \text{ if } Y_i = j \quad (3a)$$

$$Y_i = j \text{ if } V_j > \max_{k \neq j} (V_k) \quad (3b)$$

where  $V_j$  is the value associated with being status  $j$ , and  $Y_i = j$  if status  $j$  is the best option for individual  $i$ . We further define :

$$V_j = z\alpha_j + \mu_j, \quad j = 1, \dots, N$$

Assuming that the log-odds of each outcome follow a linear model, the probability of being in status  $j$  is for individual  $i$ :

$$P_{ik} = Pr(Y_{ij} = 1) = \frac{\exp(Z_i \alpha_j)}{N \sum_j \exp(Z_i \alpha_j)}$$

A selection bias arises if the unobserved characteristics that influence wages are correlated with the determinants of selection into an employment status (if  $u_{ij}$  is not independent of all the error terms in the outcome equations  $\mu_{ij}$ ).

To control for selection in the wage equation, we introduce a correction term based on the conditional mean of the residuals that is, if outcome  $j$  is observed,  $E(u_j | \mu_1, \dots, \mu_6)$ . We denote the correction term  $m(P_1, \dots, P_6)$ . The selection bias potentially originates in the correlation of  $u_j$  with  $\mu_j$  and/or with  $\mu_k$  for  $k \neq j$ . The correlation between the unobserved determinants of the wage and the unobserved determinants of the potential outcomes can differ depending on the outcome. Thus we follow Dubin and McFadden (1984) who do not make any assumption on the correlation between  $u_j$  and all the  $(\mu_k - \mu_j)$ .

The adjusted wage gap corrected for selection is then estimated from the equation:

$$\log w_{ij} = \beta_0 + \alpha F_i + X_i \beta_j + m(P_{i1}, \dots, P_{i6}) + \epsilon_i \quad (4)$$

The estimation of this model allows us to recover the correlation between  $u_j$  and all the  $\mu_k$  for  $k = 1 \dots j \dots 6$ .

## 4 Results

### 4.1 Employment status: sorting/selection into multiple potential outcomes

The results from the multinomial logit estimation presented in table 5 allow us to derive some conclusions on the impact of supply side and demand side variables on the probability of each outcome relative to the probability of being formally employed.

#### *Supply side variables*

- Women with young children have a higher probability to be inactive relative to working formally while it is the opposite for men.
- having young children also increases the relative probability to work without a formal contract for women whereas it reduces it for men.
- having young children increases the relative probability to be unemployed for women while it is the opposite for men.

#### *Demand side variables*

- Regional unemployment rate reduces labor market participation for women but not for men.

Table 5: Determinants of employment status. Multinomial logit estimation, relative risk ratios  
Base group: formal employees

	Inactive	Informal employee	Self-employed	Employer	Unemployed
Female	2.149*** (0.10)	-0.109 (0.10)	-0.767*** (0.11)	-1.512*** (0.26)	1.409*** (0.11)
Age	0.028*** (0.00)	-0.019*** (0.00)	0.034*** (0.00)	0.049*** (0.00)	-0.023*** (0.00)
Age×female	-0.008*** (0.00)	0.005*** (0.00)	-0.004*** (0.00)	-0.006* (0.00)	0.010*** (0.00)
Years of education	-0.126*** (0.00)	-0.124*** (0.00)	-0.094*** (0.00)	0.069*** (0.00)	-0.108*** (0.00)
Years of education×female	-0.081*** (0.00)	-0.048*** (0.00)	-0.029*** (0.00)	0.010 (0.01)	-0.082*** (0.00)
Children under 14	-1.183*** (0.03)	-0.190*** (0.02)	-0.118*** (0.02)	0.116** (0.04)	-0.809*** (0.03)
Children under 14×female	1.307*** (0.04)	0.141*** (0.04)	0.310*** (0.04)	0.089 (0.08)	0.699*** (0.04)
Couple	-0.436*** (0.03)	-0.285*** (0.03)	-0.225*** (0.03)	0.282*** (0.05)	-0.264*** (0.03)
Couple×female	0.829*** (0.04)	0.183*** (0.04)	0.338*** (0.04)	0.223* (0.09)	0.697*** (0.05)
Lone mother	-0.367*** (0.04)	0.163*** (0.04)	-0.125* (0.06)	-0.129 (0.14)	0.146** (0.05)
Formal workers in the household	0.161*** (0.01)	0.135*** (0.01)	-0.093*** (0.02)	-0.344*** (0.04)	0.150*** (0.01)
Formal workers in the household×female	-0.074*** (0.02)	-0.120*** (0.02)	-0.083* (0.03)	-0.074 (0.09)	-0.050* (0.02)
Urban	0.156*** (0.04)	-0.735*** (0.03)	-0.778*** (0.03)	-0.194*** (0.06)	-1.103*** (0.03)
Urban×female	-0.466*** (0.05)	0.609*** (0.05)	0.441*** (0.05)	0.543*** (0.14)	-0.399*** (0.05)
Unemployment rate	0.594 (0.42)	-2.763*** (0.41)	-2.463*** (0.38)	-3.114*** (0.61)	3.290*** (0.49)
Unemployment rate×female	3.919*** (0.46)	4.018*** (0.48)	5.018*** (0.50)	2.960** (0.97)	-0.128 (0.54)
constant	-1.186*** (0.10)	1.732*** (0.09)	0.003 (0.09)	-4.254*** (0.19)	0.787*** (0.10)

Source: PNAD 2009.

- Regional unemployment rate reduces the probability to find a formal job for women while this effect is not significant for men. The discouragement effect applies only to women.

As relative risk ratios are difficult to interpret we give the marginal effects of each regressor in table 6.

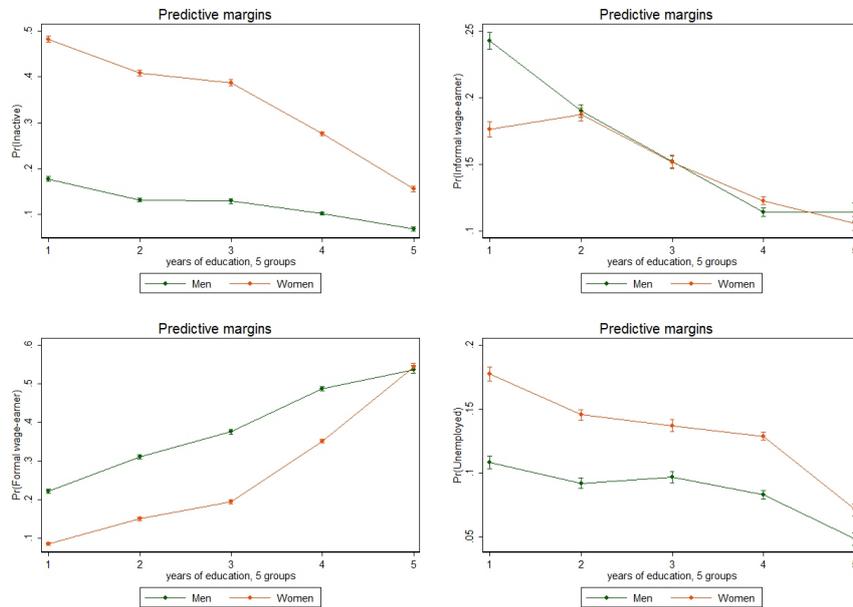
Table 6: Marginal effects

	Inactive	Informal employee	Formal employee	Unemployed
Female	0.228*** (0.00)	-0.009*** (0.00)	-0.133*** (0.00)	0.049*** (0.00)
Age	0.003*** (0.00)	-0.003*** (0.00)	-0.002*** (0.00)	-0.002*** (0.00)
Years of education	-0.015*** (0.00)	-0.007*** (0.00)	0.025*** (0.00)	-0.005*** (0.00)
Having Children	0.010*** (0.00)	-0.002 (0.00)	-0.020*** (0.00)	0.016*** (0.00)
... under 14	-0.030*** (0.00)	-0.002 (0.00)	0.034*** (0.00)	-0.030*** (0.00)
Living in couple	0.016*** (0.00)	-0.031*** (0.00)	0.002 (0.00)	0.011*** (0.00)
Lone mother	-0.058*** (0.00)	0.034*** (0.01)	0.013 (0.01)	0.023*** (0.00)
Formal wokers in the household	0.018*** (0.00)	0.007*** (0.00)	-0.004* (0.00)	0.009*** (0.00)
Urban area	0.050*** (0.00)	-0.003 (0.00)	0.110*** (0.00)	-0.131*** (0.00)
Unemployment rate in the region (education specific)	0.406*** (0.04)	-0.235*** (0.04)	-0.149*** (0.04)	0.193*** (0.03)

Source: PNAD 2009.

The previous table provides a single estimate of the marginal effect. However averages can obscure differences in the effects across groups of people. We expect the impact of gender on the probability of an outcome to vary with the characteristics of the person, e.g. schooling differences. In order to uncover this heterogeneity, we graph the marginal effects at representative values of years of schooling.

Figure 2:



Source: PNAD, 1992-2003, IBGE, Brazil.

## 4.2 Wages

Table 7 displays the estimated raw wage gap for different samples of salaried workers. In particular, we estimate the raw wage gap for the whole employee population, for the informal workers and the formal workers separately and for different groups of education.

- The raw wage gap is higher among formal workers.

The raw difference ranges from 15% to 5% in informal jobs while it ranges from 18% to 30% in formal jobs. The wage gap ranges from 40% to 5% in formal jobs while it ranges from 30% to 20% in informal jobs.

Other comments on the wage regressions: the return to education is stronger in the formal sector.

Controlling for observable characteristics such as potential experience, years of education, sector of activity and location, does the gender pay gap differ systematically between the formal and informal sectors? Does it depend on the education group the workers belong to?

Table 7: Gender wage gaps among formal and informal workers by level of education  
Female dummy

Level of Education	All	No education	3 to 7 years	8 to 11 years	11 to 14 years	More than 14 years
<b>Raw</b>						
Raw wage gap	-0.12 (0.00)	-0.13 (0.01)	-0.24 (0.01)	-0.28 (0.01)	-0.30 (0.01)	-0.36 (0.01)
Raw wage gap Formal	-0.08 0.01	-0.10 0.01	-0.21 0.01	-0.22 0.01	-0.23 0.01	-0.36 0.02
Raw wage gap Informal	-0.05 0.01	-0.02 0.02	-0.04 0.01	-0.16 0.02	-0.26 0.02	-0.31 0.04
<b>Adjusted</b>						
wage gap Formal	-0.21 0.00	-0.07 0.01	-0.19 0.01	-0.20 0.01	-0.21 0.01	-0.29 0.02
wage gap Informal	-0.22 0.01	-0.26 0.03	-0.19 0.02	-0.21 0.02	-0.23 0.02	-0.26 0.04
<b>Adjusted and Selection corrected</b>						
wage gap Formal	-0.01 0.01	-0.08 0.04	-0.17 0.03	-0.04 0.03	-0.10 0.01	-0.07 0.03
wage gap Informal	-0.17 0.02	-0.28 0.05	-0.28 0.05	-0.22 0.05	-0.15 0.02	-0.06 0.08
Number women						
Formal	34188	1661	4187	4109	16788	7443
Informal	19195	3084	5068	3420	6227	1396

Source: PNAD 2009

## 5 Robustness check

Is the pattern of gender wage gaps in formal and informal jobs consistent across the recent period?

Table 8: Adjusted gender wage gap by employment status and levels of education.  
Female dummy

Level of education	Not controlling for selection		Controlling for selection	
	Informal	Formal	Informal	Formal
All education groups	-0.21 (0.0026)	-0.23 (0.0014)	-0.15 (0.0048)	-0.01 (0.0033)
Number of women	241,675	391,182	241,675	391,182
Number of men	259,286	535,816	259,286	535,816
No education	-0.19 (0.0057)	-0.12 (0.0041)	-0.13 (0.0109)	-0.11 (0.0117)
3 to 7 years	-0.22 (0.0050)	-0.23 (0.0028)	-0.19 (0.0129)	-0.17 (0.0087)
8 to 11 years	-0.22 (0.0058)	-0.23 (0.0030)	-0.22 (0.0134)	-0.10 (0.0092)
11 to 14 years	-0.24 (0.0047)	-0.22 (0.0021)	-0.12 (0.0100)	-0.09 (0.0057)
More than 14 years	-0.24 (0.0117)	-0.31 (0.0043)	-0.03 (0.0271)	0.00 (0.0115)

Source: PNAD data base, all years pooled from 1992 to 2009.

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