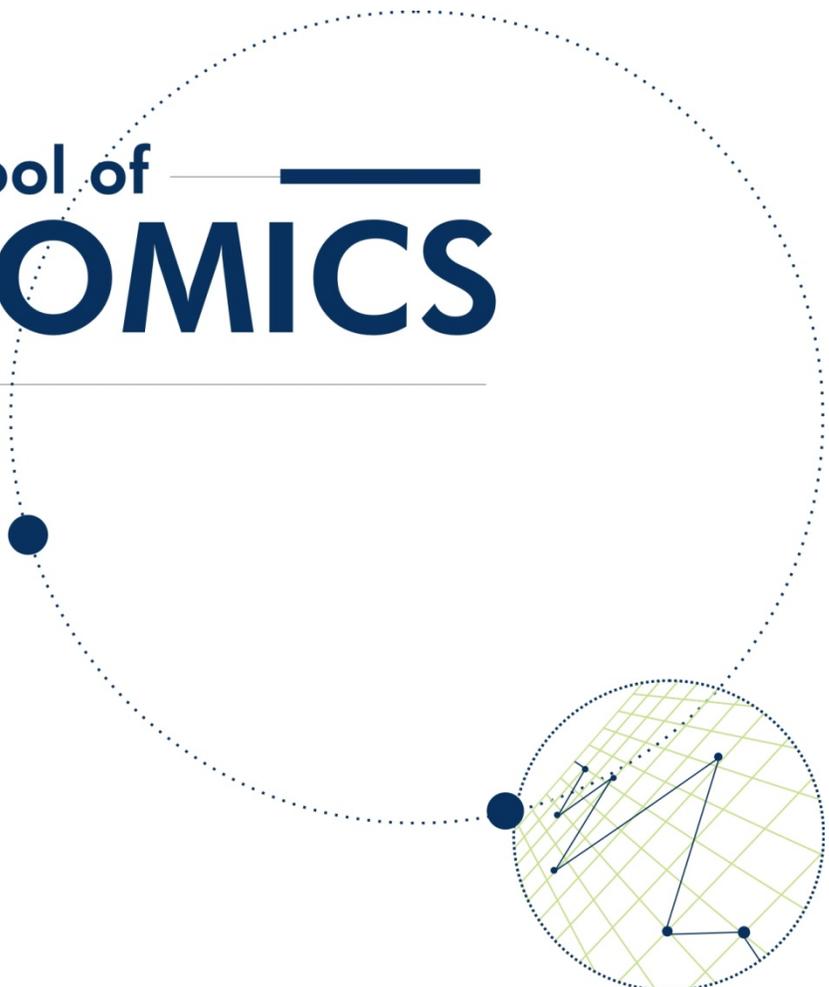


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**The Effects of Adult Literacy on Earnings
and Employment**

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Abstract

This paper provides evidence of the effects of adult literacy on individuals' income and employability in Brazil based on information obtained from the monthly employment survey (PME). The OLS results indicate that after controlling for observable characteristics, there is a 21.25% increase in wages for individuals who become literate; however, there is no significant impact on employability. Moreover, the findings show an 8.1% increase in the probability of being employed in the formal sector. We also explore the longitudinal structure of the dataset to control for unobservable fixed characteristics of individuals. The fixed-effects estimators show smaller effects compared to the OLS estimators. We find that literacy has a 4.4% effect on wages and a 4.3% impact on the probability of being formally employed. The effects are significantly different from zero.

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1 Introduction

The importance of education for human capital accumulation has been the subject of several studies in various areas of the social sciences, particularly in economics. Since the seminal work of Becker (1964), the effects of human capital accumulation on the various characteristics of individuals and societies have been analyzed in depth. Income, employment, health and other dimensions of well being have been the focal points of these studies that attempted to correlate an individual's level of education to that person's overall state of well-being.

Specifically, beginning with Mincer (1974), empirical studies on the effects of education on individual income have been a primary focus. Several studies have estimated this relationship in various countries using a host of econometric techniques to derive consistent indicators (Card, 1995; Psacharopoulos, 1994; Psacharopoulos, Velez & Patrinos, 1994; Psacharopoulos & Velez, 1994; and Psacharopoulos & Patrinos, 2002). In Brazil, studies by Fernandes and Narita (2001) and Anuati Neto and Fernandes (2000) are of particular note as they examine how a return to education for Brazilian youths and adults at several educational levels affects one's state of well-being

Despite the many studies found in the literature on returns to education at various levels, little research has been conducted on the impact of adult literacy on such characteristics as income, employment and health. Today, approximately 16% of the world's population over 15 years of age (759 million people) can neither read nor write (UNESCO, 2010)¹. Among Brazilian adults, 10% are found to be illiterate according to the 2007 National Household Sample Survey (Pesquisa Nacional por Amostras de Domicílios — PNAD). Therefore, many people already lag behind in performing the simplest of tasks that require literacy, not to mention the more complex abilities that employers are increasingly demanding.

Internationally, there are studies that have attempted to assess the impact of adult literacy programs on the well being of the adult's beneficiaries. With data from a Ghana household survey,

¹ According to UNESCO (2010, p. 281): "In most countries, particularly developing countries, current literacy data are derived from methods of self-declaration or third-party reporting (e.g., the household head responding on behalf of other household members) used in censuses or household surveys. In other cases, particularly as regards developed countries, they are based on education attainment proxies as measured in labor force surveys. Neither method is based on any test, and both are subject to bias (overestimation of literacy), which affects the quality and accuracy of literacy data."

Blunch and Verner (2000) examined the effect of adult literacy programs on the living standards of households as measured by *per capita* spending. Because the decision to participate in such programs is potentially endogenous, that is, correlated with the variables that measure the program's impact, the authors used the instrumental variables method. The availability of literacy programs in the community and the absence of any household member currently enrolled in a literacy program served as instruments for individual participation in the program. These authors found that participation in a literacy program has a significant effect on living standards and that this effect is larger for those households where no member was formally literate prior to participating.

Using data from the International Adult Literacy Survey² on immigrants into Canada, Green and Riddell (2003) found a statistically significant effect of literacy on wages. Their estimations further suggest that literacy plays an important role in the labor-market adjustment of immigrants who earn on average 35% lower than native Canadians³. Similarly, Chiswick and Repetto (2000) studied immigrant adjustment in Israel with data from the 1972 census. The authors found that literacy and fluency in Hebrew (as the primary or sole language) increased earnings by 20 percentage points. Furthermore, after controlling for home country, fluency in English also had a sizeable impact on earnings, by as much as 15 percentage points. Literacy can be understood as a continuous variable that captures reading and vocabulary skills. This understanding is especially important in the context of developed countries where adult illiteracy is rare. In a developing country environment, the effects of a discontinuous classification of illiteracy or literacy are important because a relevant proportion of the adult population remains unable to read and write.

A different approach treats literacy as a continuous variable and explores the variation not only in the extensive margin (illiterate to literate status) but also in the intensive margin (how well an individual is able to read and write). For instance, Bishop (1992), Blackburn and Neumark (1995), Murnane, Willett, and Levy (1995), McIntosh and Vignoles (2001), Dougherty (2003), and Green and Riddell (2003) analyzed the effects of literacy and/or numeracy as continuous indicators on earnings. On one hand, Bishop (1992) and Blackburn and Neumark (1995), both using National Longitudinal Survey of Youth (NLSY) data, found no significant effects of literacy and numeracy on earnings equations. On the other hand, Murnane *et al.* (1995) and McIntosh and Vignoles (2001) reported positive, significant and persistent premium for numeracy but not for literacy.

² The survey was applied by seven countries to obtain literacy data comparable across countries. For additional information, see <http://www.statcan.ca/english/Dli/Data/Ftp/ials.htm>. It is important to note that the type of literacy measured in the survey's dataset refers to the capacity to retrieve and use information from texts and other sources of printed information. This is different from the basic skills of reading and writing that we are dealing with in this study.

³ These data concern immigrants arriving in Canada between 1980 and 1994. Earlier immigrants, in the 1965 to 1979 period, do not show significant wage gaps relative to native Canadians.

In addition to evaluating the effects of literacy and numeracy on earnings, Dougherty (2003) assesses their impacts on the likelihood of college enrollment using data from the United States. Literacy and numeracy are measured by proficiency tests taken by high school students at graduation. The major results of this study suggest that numeracy affects earnings both directly and through college attendance. Literacy does not appear to have an effect on earnings, although it seems to increase the likelihood of attending college.

Among studies in Brazil, we highlight the study of Azevedo, Franco, Mendonça and Ulyseia (2007) with data from the National Household Sample Survey (PNAD), the Living Standards Survey (“Pesquisa sobre Padrões de Vida” — PPV), and the National Demographics and Health Survey (“Pesquisa Nacional de Demografia e Saúde” — PNDS). This study suggests that literacy has a positive impact on employment. However, it should be noted that the majority of Brazilian studies regarding the effects of adult literacy are characterized largely by case studies and investigations of very small populations, thus making it difficult to generalize the results (DiPierro & Graciano, 2003).

The struggle against illiteracy in Brazil has given rise to several governmental literacy-promotion projects and programs. The first important step came with the 1934 Constitution as the public education system was structured under the National Education Plan. The Brazilian Literacy Movement (“Movimento Brasileiro de Alfabetização” — MOBREAL) was created in 1967 with two primary objectives: teach illiterate adults how to read and write, and equip adults with mathematical skills. After failing to reach the proposed goals, the program was terminated by the first post-military government in 1985. In the mid-1990s, three notable federal government programs designed for youths and adults were introduced: the Solidarity Literacy Program (“Programa Alfabetização Solidária”), the National Education under Land Reform Program (“Programa Nacional de Educação na Reforma Agrária”), and the National Workers Training Plan (“Plano Nacional de Formação do Trabalhador”). These programs focused on specific youth or adult populations in low human-development regions, inhabitants of rural areas and land-reform settlements, and workers in general who were pursuing professional skills and expanding basic education. In 2003, the federal government introduced the Literate Brazil Program (“Programa Brasil Alfabetizado”). The main features of this program included the following: additional funds for youth and adult education, with larger earmarks for states and municipalities; institutional reforms to ensure efficient and ongoing management of actions in this area; and the creation of an integrated information system to track and evaluate the program.

To assess the impact of such programs on the well being of young adults, certain steps must be taken to assure reliable estimators. The main issue with studies that attempt to measure the impact of literacy on adults in terms of variables concerned with individual well being emerges

from the possible endogeneity of the decision to become literate. Studies based on cross-sectional data make comparisons between literate and illiterate individuals for the relevant variable (e.g., income) conditional upon other observable variables that may affect the relevant variable. Therefore, impact estimations will be biased if a non-observable variable is related to both literacy program involvement and the relevant variable. For example, literate individuals may show superior motivation and effort that make them more productive *per se*, and, therefore, comparing the wages between the literate and illiterate will fail to reveal only the effect of the return to education. With this in mind, this paper compares estimates of the impact of literacy by controlling for both observable and unobservable characteristics. This is done using data from the Monthly Employment Survey (PME) from 2002 to 2008. The longitudinal structure of the PME permits controlling for fixed unobservable individual characteristics. First, we analyze the impacts of literacy by Mincer-type regressions using OLS estimators. This approach compares the labor market outcomes (wages, employability and being formally employed⁴) of literate and illiterate individuals. Second, we gauge the effects of literacy by a fixed-effects estimator that uses the transitions of the same individuals from illiterate to literate status over time. In addition, we estimate the effects of literacy on several groups based on individual characteristics. This strategy estimates the impact of literacy on the labor income of sub-samples defined according to gender, metropolitan region, age bracket and formal employment.

The results of the pooled OLS estimation, controlling for observable characteristics such as gender, race, age, squared age, and education levels as well as month, year, state and sector dummies, show that literate individuals earn 21.25% more than their illiterate counterparts, have the same probability of getting a job and have an 8.1% higher chance of being formal members of the labor market. The fixed-effects estimators also show positive and significant effects on wages and on the likelihood of being formally employed for those that become literate. However, the impacts are smaller, with a 4.44% impact on wages and a 4.3% effect on becoming a formal worker. As in the OLS regressions, we find no effect of literacy on participation in the labor market.

Finally, when we segregate the effects of literacy by sub-groups, we find that the impacts of literacy on wages are greater for men between 30 and 34 years of age. We also find that men present a point-estimated impact of literacy on wages that is approximately twice that for women, although the difference is not statistically significant.

The next section describes the data used in this study and how they are organized. We then present a descriptive analysis of the main variables involved in the estimation process, discuss the main results and finish by summarizing our conclusions.

⁴ Registered (or formal) workers have access to several fringe benefits that individuals employed in the underground economy (informal) lack. The benefits include minimum wage, annual bonuses, vacations, advance notice, severance pay, unemployment insurance and seniority premium.

2 Data organization

This study uses microeconomic data from the PME performed by the Brazilian Geography and Statistics Institute (“Instituto Brasileiro de Geografia e Estatística” — IBGE) for the January 2002 through December 2008 period. The PME data currently cover the metropolitan regions of Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo and Porto Alegre. The survey provides situational labor market data beginning in 1980, but its methodology was reformed in 2001 such that data collected under the new methodology are only available since 2002.

The PME is structured as panel data with information on a single individual provided at monthly intervals for four months and then followed by an eight-month interval before another four months of data are obtained. A pool of households is selected for investigation within a certain area in each metropolitan region. One or more individuals in each household complete the survey providing information on all household members; thus, the data are not always self-reported. The questionnaire includes socio-demographic information on every household member as well as the education and labor characteristics of individuals ten years of age or older.

Each household remains in the sample for sixteen months and is interviewed in the first four and last four months with an eight-month period between the two interview cycles. As a result, there is a one-year gap between each pair of monthly interviews; that is, the fifth interview is conducted one year after the first; the sixth is one year after the second; and so on.

Each month of the study yields an average of 98,000 observations. In total, the dataset comprises more than 8 million interviews with information on approximately 1.6 million individuals.

The sample is restricted to individuals between the ages of 25 and 60 at the time of the first interview. To prevent seasonal effects from contaminating the results of the fixed-effects estimators, we only analyze interviews with a one-year interval between them. Income figures are deflated according to the methodology described by Corseuil and Foguel (2002) for IBGE household surveys. The sample includes 319,292 individuals with two observations per person for a total of 638,584 observations.

3 Results

The first two columns of Table 1 show unconditional comparisons between illiterate and literate individuals (hereafter referred to as illiterates and literates, respectively)⁵. Illiterates account for only 2% of the sample. The descriptive analysis reveals that the average hourly wage of the illiterates represents 31.8% (R\$2.08/ R\$6.53) of the average hourly wage of the literates. Literates are less likely to be unemployed than illiterates (7.36% vs. 8.9%). For those who are employed, literates are more likely to have a formal job (81% vs. 64%). Therefore, these unconditional comparisons reveal a positive correlation between literacy and labor outcomes (wages, employability and being employed in the formal sector). Illiterates and literates also differ in several other characteristics that could account for the observed disparities in wages and employment. For instance, men comprise 46% of the literates but only 41% of the illiterates, and white individuals make up 54% of the literates and only 33% of the illiterates. Illiterates are also older, have more children, are less schooled and are concentrated in the metropolitan areas of Recife (23%), Rio de Janeiro (21.5%) and São Paulo (18.4%).

⁵ Literacy is self-reported. It is measured by the respondent's answer to the question "Can you read and write?" and thus results in a binary variable.

Table 1
Descriptive Statistics

	General	Literates	Illiterates
Number of individuals	319,270	312,801	6,469
%	100	97.97	2.03
Average hourly-wage	6.5	6.5	2.1
Participation in the Labor Market			
Yes	73.5	74.0	45.3
No	26.5	26.0	54.7
Employment %			
Employed	92.6	92.6	91.1
Unemployed	7.4	7.4	8.9
Formal employment %			
Informal	18.7	18.6	36.2
Formal	81.3	81.4	63.8
Men %	45.9	46.0	40.9
White %	53.4	53.8	32.7
Years of schooling			
3 years of schooling or less	8.4	7.3	98.5
4 to 7 years of schooling	26.0	28.9	1.5
8 to 10 years of schooling	16.9	18.8	0.0
11 years of schooling or more	40.4	45.0	0.0
Age group %			
25 to 35 years old	32.0	32.4	16.4
36 to 45 years old	32.3	32.5	25.1
45 to 60 years old	35.7	35.2	58.6
Number of children (under age 10) %			
More than two children	3.0	2.9	5.4
Metropolitan region			
Recife	12.3	12.1	23.0
Salvador	10.9	10.9	11.3
Belo Horizonte	18.5	18.6	16.8
Rio de Janeiro	20.4	20.4	21.5
São Paulo	22.9	22.9	18.4
Porto Alegre	15.0	15.1	8.9

Source: PME 2002-2008.

To isolate the differences in observable characteristics between literates and illiterates, we run *Mincer-type* regressions with the following specification:

$$y_{it} = \alpha + \beta Lit_{it} + X_{it}'\gamma + \delta_t + u_{it} \quad (1)$$

where y_{it} is the outcome of interest for individual i at time t (i.e., the log of hourly wage, employment or being formally employed); Lit_{it} is an indicator variable that assumes the value 1 if the individual is literate; δ_t are year and month dummies; and X_{it} is a vector of observable

characteristics such as age and its square, gender, race, schooling dummies, city dummies, family size, number of children in the household under age ten, and industry dummies. These estimations permit capture of the relationships between literacy, wages and formal employment for employed individuals as well as the relationships of these variables with the likelihood of employment. These regressions are conducted using information obtained from the individuals at the first interview. Pooled OLS (POLS) regressions are run for the three outcomes.⁶

⁶ The standard errors are robust to heteroskedasticity.

Table 2
Results: Cross-section of Income, Employment and Formal Sector.

	Hourly-	Employment	Formal Sector
	wage (log)	POLS	
	coef/se	coef/se	coef/se
Literacy	0.193*** (0.012)	0.004 (0.004)	0.097*** (0.009)
Male	0.267*** (0.003)	0.034*** (0.001)	0.030*** (0.002)
White	0.286*** (0.003)	0.014*** (0.001)	0.003* (0.002)
Number of children in household	0.025*** (0.002)	0.002*** (0.001)	0.002 (0.001)
Family size	-0.045*** (0.001)	-0.005*** (0.000)	-0.007*** (0.001)
Formal	0.242*** (0.003)		
Age	0.048*** (0.001)	0.010*** (0.000)	0.021*** (0.001)
Age squared/100	-0.039*** (0.000)	-0.010*** (0.000)	-0.024*** (0.000)
4 to 7 years of schooling	0.091*** (0.005)	0.005*** (0.002)	0.023*** (0.004)
8 to 10 years of schooling	0.246*** (0.005)	0.005*** (0.002)	0.067*** (0.004)
11 or more years of schooling	0.845*** (0.005)	0.025*** (0.002)	0.129*** (0.004)
2003	0.072*** (0.005)	-0.004** (0.002)	-0.011*** (0.003)
2004	0.114*** (0.005)	-0.002 (0.002)	-0.014*** (0.003)
2005	0.184*** (0.005)	0.009*** (0.002)	-0.015*** (0.003)
2006	0.254*** (0.005)	0.006*** (0.002)	-0.008*** (0.003)
2007	0.315*** (0.005)	0.012*** (0.002)	-0.003 (0.003)
2008	0.395*** (0.006)	0.023*** (0.002)	0.006* (0.004)
Metropolitan region dummy	Yes	Yes	Yes
Month dummy	Yes	Yes	Yes
Occupational-related dummies	Yes	No	No
Constant	-1.304*** (0.028)	0.636*** (0.008)	0.185*** (0.017)
Number of observations	262,593	463,478	274,277

note: *** p<0.01, ** p<0.05, * p<0.1

Omitted dummies: non-whites, 3 or fewer years of schooling and 2002

The results shown in Table 2 indicate that literate individuals earn, on average, 21.25% more than illiterate individuals.⁷ The other control variables show the expected results in terms of coefficient signs: on average, men earn 30.7% higher wages than women; there are positive and declining returns for experience (age); formally employed individuals earn 27.4% more per hour than informally employed individuals; and the more educated an individual is, the higher the individual's wage. Whereas family size is negatively correlated with wages, the number of children in the household is positively correlated with earnings.

In terms of employment, no significant differences are found between literate and illiterate individuals. Regarding other control variables, however, the following relationships are noted: male, older, white and more educated individuals have a greater chance of being employed.

Finally, the results suggest that the impact of literacy on formal employment is positive and significant. A literate individual is 9.7% more likely to be formally employed under a formal contract than is an illiterate individual. Note that the impact of literacy on wages goes beyond formalization. It has been documented that the Brazilian labor market is segmented in that workers in the formal sector earn more than those in the informal sector (e.g., Botelho and Ponczek, 2010). Therefore, one possible means by which literacy might affect individual earnings is by increasing formal employment. However, as discussed above, the wage regressions control for formalization suggesting that the wage increase caused by literacy persists even when holding formalization constant.⁸

3.1 Panel

Cross-sectional estimates lead to coefficients that capture the average effects of literacy on income by comparing the results for literate and illiterate individuals. However, the possible presence of unobservable characteristics related to schooling, income and employability can bias the OLS estimator. Use of longitudinal data permits the elimination of those characteristics that are constant over time. In this study, the availability of information for two periods permits the elimination of fixed effects that affect both literacy status and wages or likelihood of employment.

⁷ As the dependent variable is in the form of natural log, to find the estimated effect of independent variables one should make the following calculation for each of these: $(e^{\text{coefficient}} - 1)$.

⁸ We only observe earnings and the job status (formal or informal) of those individuals who are employed. Therefore, the results on these outcomes have to be interpreted as conditional of being currently employed. As one would not expect that job status (formal or informal) and earnings are orthogonal to employment status, there could be selectivity problems in our regressions. To investigate how severe these problems are, we run a Heckman style sample selection corrections. The point estimates are similar to those found in Pooled OLS separate regressions. However, the estimated variances increase making all coefficients insignificant. It is important to note that since we do not have an excluded instrument in the selection regression (no exclusion restriction), our identification comes from the non-linearity of the Probit in the first stage. Therefore, our identification is very tenuous in this approach. The results are available upon request.

These characteristics are generally identified as skills but involve traits such as talent, ability, persistence, effort, and cultural and family background. Therefore, we use the following specification:

$$y_{it} = \alpha + \beta Lit_{it} + X_{it}'\gamma + \delta_t + \varepsilon_i + u_{it} \quad (2)$$

where y_{it} and Lit_{it} are the same as in equation (1). Because the majority of the control variables used in this study are constant over time, in the regressions that explore the longitudinal format of the data, δ_t and X_{it} only include year dummies and the number of children, respectively. ε_i represents an idiosyncratic individual effect.

Table 3 shows the panel data results using longitudinal data. In column A, we estimate the gains associated with literacy by the random-effects estimator; the results indicate that individuals who become literate experience average wage gains of 62.86 percentage points (p.p.). This result supports the estimates found in cross-sectional regressions. However, when we estimate the impact of literacy by fixed effects (column B), we find a wage effect of approximately 4.44 p.p.. Comparing the results of the fixed- and random-effects estimators, we find that the Hausman test rejects the statistical equivalence between the two, highlighting the effects that fixed, non-observable characteristics have on the bias of cross-sectional estimations, which fail to take these effects into account. In the bottom of table 3, the results of the Hausman test are shown. For all three outcomes, the tests are rejected at 1% of significance level.

As for employment, the fixed-effects estimator confirms that literacy has no impact on the likelihood of employment. Columns C and D show the results of the random- and fixed-effects estimators, respectively. Columns E and F show the results for formal employment. As in the pooled OLS regressions, the results suggest literacy has a significant impact on the likelihood of employment in the formal sector.⁹

⁹ We also allow for clustered standard errors at the household level. The results are qualitatively similar as we have few households with two or more individuals who transitioned from illiterate to literate status. They are available upon request.

Table 3

Fixed effects (FE) and random effects (RE): Results of wage, employment and formal sector estimations

	Hourly wage (log)		Employment		Formal Sector	
	RE	FE	RE	FE	RE	FE
	A	B	C	D	E	F
	coef/se	coef/se	coef/se	coef/se	coef/se	coef/se
Literacy	0.488***	0.043*	0.011***	0.003	0.159***	0.043**
	(0.012)	(0.022)	(0.004)	(0.010)	(0.012)	(0.022)
Number of children in the household	-0.069***	-0.001	-0.010***	-0.003*	-0.011***	-0.005**
	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)
Number of observations	409,814	409,814	463,661	463,661	274,376	274,376
Hausman Test	1175.53***		51.35***		89.31***	

note: *** p<0.01, ** p<0.05, * p<0.1. Year dummy variables included.

3.2 Effects according to population subgroups: wage results

To obtain measurements of the effect sizes for population subgroups, we estimate the impact of literacy on income, employment and formal employment for each of the subsamples segregated by gender, race/ethnicity, age bracket (at the first interview), metropolitan region and employment status (formal or informal). We further segregate these subsamples into smaller ones by dividing and also intersecting them (e.g., white men, women aged between 30 to 35 years of age, etc.). The goal of this approach is to identify the characteristics associated with the increased benefits of becoming literate.

Table 4
 POLS and Panel (fixed effects): Results on wage by broad subgroups.

	POLS		Panel	
	Coefficient	Stand. Errors	Coefficient	Stand.. Errors
By gender				
Men	0.21***	0.02	0.05**	0.03
Women	0.15***	0.03	0.03	0.04
By age				
25 to 40 years old	0.15***	0.03	0.08**	0.04
41 to 60 years old	0.18***	0.02	0.03	0.03
By region				
South/Southeast	0.18***	0.02	0.02	0.03
Northeast	0.27***	0.03	0.09	0.04
By race				
White	0.24***	0.03	0.05	0.04
Non-white	0.19***	0.02	0.04	0.03

note: *** p<0.01, ** p<0.05, * p<0.1

Marginal effects of literacy are displayed. Control variables: year dummies and number of children.

Table 4 s hows the results for the broad subgroups. The first two columns present the coefficients associated with literacy and their standard deviations on the POLS regressions as in equation (1). The last two columns show the results of fixed-effects estimators.

The POLS regressions indicate that literacy has a greater impact on wages among men, residents of the Northeast and whites. There is no statistically significant difference between the two broad age brackets analyzed (25 to 40 and 41 to 60 years of age). The fixed-effects regressions only yield results significantly different from zero for men and for younger individuals. However, no category shows results significantly different from their comparison groups.

Table 5
 POLS and Panel (fixed effects): Selected results on wage by narrow subgroups.

	POLS		Panel	
	Coefficient	Stand. Errors	Coefficient	Stand. Errors
Men				
30 to 34 years old	0.184***	0.05	0.17**	0.07
Formal	0.199***	0.02	0.06**	0.03
Whites				
25 to 29 years old	0.243**	0.09	0.29*	0.15
Formal employment	0.267***	0.04	0.14***	0.05
Informal employment	0.238***	0.06	0.18*	0.09

note: *** p<0.01, ** p<0.05, * p<0.1.

Marginal effects of literacy are displayed. Control variables: year dummies and number of children.

We further divide certain subgroups into narrower ones, creating seven age brackets made up of five-year ranges (25 to 29, 30 to 34, and so on), six metropolitan area subgroups, and groups according to the job status (formal or informal). We also intersected each subgroup with a second one. Combining each category with a second subgroup yielded 132 subgroups¹⁰.

Table 5 shows selected regression results using the narrower subsamples¹¹. We first highlight the results for men between 30 and 34 years of age and men working in the formal sector. These subgroups exhibit significant and sizable effects of literacy on wages in the panel regressions (18.5 and 20 percentage points, respectively). Subsamples of white individuals also demonstrate notable gains with literacy, especially those who are formally employed and are between 25 and 29 years of age.

Overall, the results suggest that certain characteristics are associated with higher returns for attaining literacy. Although our dataset does not allow us to determine the exact mechanisms that generate greater benefits for some subgroups, it is possible to make some conjectures.

The more pronounced literacy effects for subgroups of men and white individuals may be associated with the types of occupational transitions enabled by these subgroups becoming literate. After becoming literate, men are more likely to move from the construction-related workforce to the manufacturing industry or other services, which usually pay higher wages. On the other hand, women with low levels of schooling usually work in housekeeping positions or in the retail sector. Unlike men, it is unlikely that women will move to other sectors or activities that pay higher wages

¹⁰ Intersecting gender and race creates 4 subgroups; gender and age, 14; gender and metropolitan region, 12; and so on.

¹¹ The results of all regressions are available upon request.

after becoming literate. The same process occurs for non-white individuals who are usually trapped in low-paying jobs even after becoming literate.¹²

3.3 Effects by population subgroups: employment and formal sector results

Table 6 shows the results for employment by subgroups. Note that no significant results are found. It is also important to note that by comparing interviews one year apart, we are capturing the short-term impact of literacy on labor outcomes. In the case of employment, individuals may increase their reservation wage after becoming literate. In this case, the demand curve for these workers can shift upward, but the supply curve can shift as well, which could explain the increase in wages but not in employment.

Table 6
POLs and Panel (fixed effects): Selected results on employment by broad subgroups.

	POLs		Panel	
	Coefficient	Stand. Errors	Coefficient	Stand. Errors
By gender				
Men	0.005	0.004	0.005	0.018
Women	0.003	0.006	-0.002	0.018
By age				
25 to 40 years old	0.003	0.007	0.007	0.017
41 to 60 years old	0.002	0.003	0.001	0.012
By region				
South/Southeast	0.003	0.004	-0.002	0.012
Northeast	0.006	0.007	0.013	0.018
By race				
White	0.008	0.006	0.005	0.018
Non-white	0.003	0.005	0.002	0.013

note: *** p<0.01, ** p<0.05, * p<0.1.

Marginal effects of literacy are displayed. Control variables: year dummies and number of children.

Finally, Table 7 shows the results for formal employment. Although no significant results are found among the major groups, several significant results are found among subgroups.

¹² Men with a low level of education are widely distributed among sectors (13 total) with high numbers in the sectors of construction (31%), commerce (19%) and manufacturing (10%). Among women with low education, 52% are employed in domestic activities and 13% in commerce with the remainder distributed among the other eleven groups (PNAD 2008/IBGE).

Table 7
 POLS and Panel (fixed effects): Selected results on formal employment by broad subgroups.

	POLS		Panel	
	Coefficient	Stand. Errors	Coefficient	Stand. Errors
By gender				
Men	0.09***	0.01	0.04	0.02
Women	0.06***	0.02	0.06	0.04
By age				
25 to 40 years old	0.103***	0.02	0.043	0.04
41 to 60 years old	0.075***	0.01	0.044	0.03
By region				
South/Southeast	0.076***	0.01	0.032	0.03
Northeast	0.096***	0.02	0.071**	0.04
By race				
White	0.050***	0.02	0.053	0.04
Non-white	0.097***	0.01	0.037	0.03

note: *** p<0.01, ** p<0.05, * p<0.1

Marginal effects of literacy are displayed. Control variables: year dummies and number of children.

Women between 40 and 44 years of age (23 p.p.) are more likely to obtain formal employment when they become literate. Among whites, those who are younger (25 to 29 years of age) increase their chances of formal employment by approximately 22 p.p. when they become literate. Among non-whites, the results are significant among individuals aged 35 to 39 years of age (16 p.p.) and 45 to 49 years of age (14 p.p.).

Table 8
Panel fixed effects and POLS: Selected results of formal sector by narrow subgroups.

	POLS		Panel	
	Coefficient	Stand. Errors	Coefficient	Stand. Errors
Woman				
40 to 44 years old	0.04	0.05	0.23*	0.14
Whites				
25 to 29 years old	0.17**	0.07	0.22*	0.12
Non-whites				
35 to 39 years old	0.18***	0.04	0.16***	0.06
45 to 49 years old	0.08***	0.03	0.14*	0.08
35 to 39 years old	0.12***	0.03	0.29***	0.05

note: *** p<0.01, ** p<0.05, * p<0.1.

Marginal effects of literacy are displayed. Control variables: year dummies and number of children.

Note that significant effects are found among older individuals, whites and women, which may be associated with a higher proportion of illiterate workers among informal occupations in these groups. These workers can increase their chances of finding formal employment by becoming literate.

3.4 Transition vs. non-transition

The consistency of these estimations relies on the assumption that unobservable characteristics that vary over time must not be correlated with literacy and the labor outcome variables. Individuals who become literate may decide to attend a literacy program because they have become unemployed or experienced a decrease in income. In this case, these individuals' wages would increase regardless of whether or not they became literate via regression to the mean. The literature refers to this phenomenon as *Ashenfelter's dip*¹³, and it leads to inconsistent estimations of the effects of literacy on the relevant variables, particularly on wages.

To investigate whether this potential problem interferes with our estimations, we compare wages, employment, formalization and socio-demographic characteristics — all as stated in the first interview — across illiterate individuals who either later transitioned or did not transition to literacy.

¹³ For additional information, see Ashenfelter and Card (1985).

As illustrated in Table 9, only 25% of the illiterates transitioned to literate one year after the first interview. Both groups have similar levels of employment (91.31% vs. 90.61%) and formal sector jobs (63.26% vs. 64.67%). The proportion of whites is also similar between the two groups (32.19% vs. 34.07%). On the other hand, the group that became literate is younger and includes more men than the group of individuals who remained illiterate.

There is a difference in wages between illiterate individuals who later transition to literacy and those who do not transition: namely, mean hourly wages of R\$2.24 as compared to R\$2.01. Because the transitioned individuals have marginally higher initial wages, we dismiss the possibility that this problem is associated with an influence of *Ashenfelter's dip*. On the other hand, taking wage as a productivity indicator, the higher income of transitioned individuals might suggest that the decision to become literate occurs among apparently more productive individuals. It remains to be determined if those who were previously more productive derive a greater impact from literacy; our estimation cannot be interpreted as the average effect of transition across all illiterate populations (average treatment effect), but rather it represents the effect on those who chose to become literate (treatment on the treated effect).¹⁴

Table 9
Characteristics of transitioned and non-transitioned individuals at the first interview

	t: Illiterates	
	t+1: illiterates	t+1: literates
Number of observations	4,836	1,633
%	74.76	25.24
Average hourly wage	2.01	2.24
Employed %	91.31	90.61
Formal employment %	63.26	64.67
Men %	39.45	45.25
Whites %	32.19	34.07
Age group %		
25 to 35 years old	15.49	18.98
36 to 45 years old	24.01	28.17
45 to 60 years old	60.50	52.85

¹⁴ For additional information, see Angrist (2004).

4 Final Remarks

Many countries throughout the world have expressed great concern regarding their populations' educational needs. This concern includes recognition of a need for equalizing opportunities for access to education so that individuals may develop sufficient human capital to generate the minimum income necessary to attain satisfactory living standards. Initiatives have been developed around the globe to provide basic reading and writing skills to youths and adults who are not functionally literate. Several international studies have examined the relationship between literacy and wages. Their findings suggest that literacy is an important means of achieving wage gains among illiterate populations.

This paper shows that among individuals who became literate in this sample of the Brazilian population, the average return on income was 4.4 percentage points. We emphasize that the gains occurred mainly among population groups with higher wage differentials between literate and illiterate people - men, whites and younger adults. Formal work status follows the same trend: those subgroups with smaller proportions of formal illiterate workers are more likely to obtain formal work after becoming literate (i.e., blacks, women and older people). These important results can contribute to public policy decisions regarding adult literacy.

Note that despite the availability of information on a single individual for more than one period, this study only observes the effect of literacy over one year, a period that may not be sufficient to capture all of the positive and cumulative effects that literacy can generate in terms of income, employment and citizenship. Thus, literacy among adults is expected to generate benefits beyond those found in this study. These results reaffirm that universal literacy is an important starting point to not only increase the income-generating ability of underprivileged members of society but also to increase their well being.

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