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Abstract

This paper uses national survey data to estimate up-to-date private rates of return to education in Burkina Faso. Mincer earning regressions are fitted to wage data for women and men, and for public and private sector workers. The main results indicate that rates of return rise by level of education, and the public sector does not compensate female primary education. The findings suggest that current education polices which focus on increasing primary schooling supply be complemented with support for children, especially girls from resource constrained households to reach the secondary and tertiary levels. The estimated returns to education are strongly influenced by sample selection. For both men and women, failing to control for both selection in the wage sector and sector choice leads to biased estimates based on my identification of the selection process.

Keywords: Burkina, Education, Labor

JEL codes: I21, J31

1 Introduction

Schooling levels in Burkina have been historically low with total years of schooling averaging about 0.6 years for men aged 50-54 and 2.6 years among the youngest cohort (Schultz, 2003). Women in the same cohorts received about half of the male schooling level, suggesting a persistent gender gap. For children aged between 7 and 15 years, average enrollment rate is about 31 percent in 1998, with wide disparities between boys and girls, and between rural and urban areas (e.g. UNESCO, 2001; National surveys 1998). Although observed school enrollment rates are related to a number of factors under and beyond the household's control, one can argue that private rate of return to education is one of the key contributing factors. Thus, returns to education are useful for designing education policies.

Previous estimates of returns to education in Burkina have used data which may not have been nationally representative. The estimations by Ram and Singh (1988), which are subsequently reported by Psacharopoulos (Psacharopoulos, 1994), use a sample of 60 rural households surveyed in 1980. The private returns to education are estimated at 9.6 percent. Using a 1982 survey, Psacharopoulos (Psacharopoulos, 1985, 1994) report social rate of returns to education of 20 percent for primary education, 14.9 percent for secondary education and 21.3 percent at the university. To the extent that the samples used were not representative of the entire population, and rates of return to education may be changing over time, the reported rates of return to education may be misleading and of little relevance to policy formulation.

The goal of this paper is to evaluate private returns to education in Burkina Faso, in order to learn whether low returns to education contribute to explain the observed enrollment rates. In connection with the current national education policy which focuses on increasing the supply of primary education services (Ministere de l' Economie et des Finances, 2001), the exercise can generate two main policy implications. First, if rates of returns to education are effectively low on average and households perceive education as investment in their children, enrollment is unlikely to increase as a response to increased supply of education services. Second, if rates of returns are increasing with education level, low income households who lack the resources to support their children to reach higher education levels may not ever enroll them. This is because these households will then face the low segment of the rate of returns. Furthermore, a wide gap in returns to education between men and women will imply that parents are willing to invest more in male than in female education. In either case, increasing the supply of schooling services at the primary level, might not be sufficient to increase school enrollment, especially for poor families and girls in these families, who are the main target of these policies. This paper makes two empirical contribution to the literature on returns to education. Firs, it provides more reliable estimates of rates of return to education for Burkina Faso, a country with low school attendance even by African standards and yet with rare estimates of return to education. Second, the paper attempts to distinguish between the public and the private sectors, an issue which has received less attention by the empirical literature dealing with returns to education in the context of Sub-Saharan Africa.

In this paper, education is treated as a private decision to invest in human capital and the internal rate of return to that private investment is estimated. This approach has been used extensively to examine returns to education in both developed and developing countries[1]. If there is strong evidence indicating that private returns to education are large relative to other investments with similar degrees of risk, then the observed low enrollment rates might be explained by some market failures, which prevent individuals from implementing their privately optimal education investment plans. Such findings may justify public interventions (Schultz, 2003).

The paper uses the 1994 and 1998 waves of the priority survey (PS I and II) conducted by the national statistical agency. The private rates of returns to education are estimated as the coefficients on years of education variables in the logarithmic wage equation that contains controls for post-schooling potential work experience and other individual characteristics (Mincer, 1974). Sample selection bias is controlled in two steps. First, the decision whether to participate in the wage sector is taken into account by using the selection correction approach proposed by Heckman (1979). Second, the Heckman approach is generalized into a two stage selection process, in an attempt to control simultaneously for both self-selection into the wage sector and endogenous choice between the private and the public sectors following an approach proposed by Tunali (1986).

[1]See Schultz (1988) for a review in developing countries.

Robustness of the estimates is checked using semi-parametric methods. The analysis is limited to the wage sector, and therefore does not cover the urban self-employed and most agricultural workers. The main reason for excluding self-employed is because earnings data from this sector also incorporate returns to physical capital and to risk borne by individuals, which are difficult to disentangle from returns to education in the absence of specific information.

The central findings are summarized as follows. Without controlling for choice between private and public sectors, the average gross private returns to education in Burkina are about 9 percent for primary education for men and women, 16.4 percent for women and 14.3 percent for men at the secondary level, and 18.1 percent for women and 23.4 percent for men at the university level. The results are sensitive to controlling for endogenous choice between private and public sectors. After controlling for sector choice, the rate of returns to primary education is almost zero for women. This suggests that based on private wage returns calculations, fewer girls have an incentive to be enrolled than boys, unless the education policy increases girl expectations for reaching g the higher segments of the education system, or the employment prospects for females with primary education improve.

The second section discusses the data and the sample used for estimations. The third section reviews the econometric specifications. The fourth section discusses the results. The fifth section concludes.

2 Data and descriptive statistics

The paper uses data from the two rounds of the Priority Survey (PS), conducted in 1994 and in 1998. The two surveys are similar in the scope of the information collected, the sampling design and the coverage. The number of households interviewed is 8642 in 1994 and 8478 in 1998. Information was collected on household and individual characteristics, employment status and wage received.

The analysis in this paper concerns the working age population, defined to include individuals aged between 15 and 65. The resulting sample for the two years contains 55526 working age individuals, from whom 6.4 percent were wage earners. Monthly wages were calculated for those working in paid labor. Table (1) summarizes descriptive statistics of the variables used in the regressions and selected others, education levels of the workforce is tabulated in table (2) and allocation of the workforce between the private and the public sector is presented in table (3).

In table 1, the wage variable is the average monthly wage in CFA Franc expressed in log. Education is measured as the total numbers of years of schooling, which is further decomposed in primary, secondary and tertiary education. There is a maximum of six and seven years at the primary and secondary levels, respectively. Because information on actual number of years spent at the tertiary level was not available, an average of two years was allocated to individuals with some post secondary education. This corresponds to half the time required to complete the bachelor degree at the national university. The post schooling experience is obtained by subtracting years of schooling and age at school entry from the individual current age. Because information on age at school entry was not available, it is assumed that individuals started school at seven, which is the official school entry age in Burkina Faso.

—Insert table 1 about here—-

The average years of education completed is 1.4 for men and .54 years for women. Female wage earners have completed on average 8.86 years of education as compared to 4.05 years for male wage earners. This suggests that education increases women productivity in the wage sector more than it does for men. Moreover, this is suggestive evidence that women working in the wage sector consist of a selected sample, which is not representative of the female population. Finally, one notes that working women have relatively less post schooling potential experience than men. This pattern can be explained by women's relatively higher education attainment, and by younger cohorts of women entering the wage market. It is apparent from table 2 that the private sector is the main provider of wage job to individuals with no formal education, and to those with primary education, especially to female workers. In contrast, less than 18 percent of men and less than 10 percent of women in the public sector have the primary education level. This suggests that at least the completion of primary school is increasingly the minimum requirement to compete for a public job.

—Insert table 2 about here—-

From table 3, the wage sector employs a very small fraction of the working age population.

This small fraction of the labor force employed in the formal wage sector is typical for a developing country and especially for sub-Saharan Africa[2]. The wage sector is dominated by male workers and is concentrated in urban areas. In 1994, 82 percent of wage earners were male and 87 percent resided in urban areas. In 1998, the corresponding figures were 85 and 91 percent. Although the wage sector remained stable (6.4 percent of the working population), this stability results from a relative contraction of the public sector and an expansion of the private sector. The private sector was employing 54.8 percent of the working population in 1998 compared to 46.4 percent in 1994. This reallocation of workers between the two sectors may be attributed to the ongoing economic reforms (Lienert and Modi, 1997).

—Insert table 3 about here—-

Figure 1 presents unconditional wage densities and distribution for four subgroups: male, female, private sector and public sector workers. It is apparent from the figure that wage distribution for public sector workers is higher than that of private sector workers, while men wage is higher than women wage for log wages less than 10.5. That is, unconditional wages for public servants appear to be uniformly higher than those for private sector workers, while only low wage levels (less than CFA 36000) do male worker wages exceed female workers wage.

—Insert figure 1 about here—-

3 Econometric specifications

Three specifications are estimated based upon the Mincerian wage equation. The first specification restricts the sample to wage earners and use ordinary least squares to estimate the wage equations. The second specification controls for endogenous selection into the wage sector but, ignores selection between private and public sectors. Finally, the third specification controls for selection in the wage sector, and allows for endogenous choice between public and private sectors.

[2]For instance Lienert and Modi (1997) using data for 24 Sub-Saharan countries found that the central government employ 1 percent of the population in 1996, and 0.6 percent in Burkina Faso.

3.1 Base specification

The specification of the wage equations uses the human capital framework as developed by Becker (1975) and Mincer (1958; 1974)[3]. Assuming that (i) the only costs of schooling are the forgone earnings and (ii) each individual starts working after completion of school, Mincer (Mincer, 1958) shows that the natural logarithm of wage can be expressed as a function of years of schooling, post schooling experience and its quadratic term. Furthermore, this relationship provides direct measure for returns to schooling through the coefficients of years of schooling in the wage regression. The model can be made more flexible by allowing the slope of the profile to vary over different segments of education. In this paper, three levels of education are considered: the primary, the secondary and the tertiary levels. This basic Mincerian wage equation is written as follows:

$$lnw_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \varepsilon_i \tag{1}$$

Where x_{1i} is a set of variables including the number of years of schooling in each education level, post schooling experience and post schooling experience squared. This simple specification implies a number of simplifying assumptions (Mwabu and Schultz, 2000)[4]. In this paper, the basic Mincer's wage equation is augmented with three variables summarized by x_{i2}. First, a year dummy for 1994 is included to allow for the wage level to change between survey years. The second variable is a residential dummy (rural versus urban), which is intended to control for the wage differential between urban and rural areas. Although one expects a priori wages to be lower in rural areas, it might not necessarily be so, since workers relocation to rural areas is usually associated with some monetary compensation. Since 1991, the Burkinabe economy is being reformed, with potentially different effects on the wage market between rural and urban areas. To account for these potential different effects, the time and the geographic location dummies are interacted[5].

[3]The Mincer earning equation is motivated by two conceptually different frameworks which generate similar estimable functional forms. The first model (Mincer, 1958) is based upon the principle of compensating differences, and the second model (Mincer, 1974) builds on an accounting identity developed by (Becker, 1975). See Heckman, Lochner, and Todd (2003) for a review.

[4]Specifically, all individuals are assumed to have the same access to credit, (ii) correlations between genetic endowment and human capital are assumed to be zero, education is assumed to be measured without errors.

[5]Note that when using the pooled sample, a gender dummy is also included.

3.2 Sample selection

In estimating equation (1), the sample was restricted to wage earners. To the extent that this specific sub-sample is not representative of the entire working age population, the estimates may be biased. There are at least two indications why sample selection may be a concern. First, only a very small proportion of the working wage population is involved in the wage sector. Second, from the descriptive statistics, it appears that women working in the wage sector and the non-working women differ substantially in their education attainment (8.9 years as compared to .55 years) as well for men (6.4 years as compared to 1.4 years). Thus, I attempt to correct for potential selection bias that may affect the OLS estimates, using Heckman approach (Heckman, 1979).

To implement Heckman's sample correction procedure, I specify a participation equation as follows:

$$y_i = \alpha_1 x_i + \alpha_2 z_{1i} + \mu_i \tag{2}$$

Where y is the participation decision, which is 1 if an individual is observed in the labor market, and 0 otherwise, x_i is a set of variables including both x_{1i} and x_{2i}, and z_1 is a set of variables that are believed to influence the participation decision through the reservation wage, without a direct effect on the market wage received. Assuming joint normality of μ_i and ε_i, the joint maximum likelihood estimates of (1) and (2) are consistent and efficient (Greene, 1980).

Identification of equations (1) and (2) is achieved here via the use of restriction exclusions analogous to those used in the standard IV approach (Wooldridge, 2002). A valid instrument in the context of this paper, z, must be a determinant of the decision to join the wage sector and have no direct influence on the wage offered or accepted. There are three identifying instruments. The first instrument is household asset, approximated by ownership of real estate. The second instrument is constructed around private business ownership. For families with private business, I use the positive difference between the potential working experience and the business age. Thus, it is unlikely that income received from the wage sector has been used to start the business. The strategy could reduce potential reverse causality which may occur if wage workers use their earnings to start a business. The third instrument is the demand for labor by the private sector, which is measured as the percentage of individuals reporting "employer" in each province as their main occupation[6]. The first two instruments are supposed to determine individual reservation wage, and the third instrument is supposed to lower search costs and improve competitiveness of private job options. Assuming that neither of these variables affect wage market productivity, they may be excluded from the wage equation.

3.3 Selection between private and public wage sectors

A potential concern when the estimation is restricted to equations (1) and (2) is that one ignores potential differences of returns to education between private and public sectors. This concern is related to the debate on the possible existence of non productive rents received by workers who manage to obtain jobs in the governmental sector in developing countries where competitive pressures are weak (e.g. Terrell, 1996; Lienert and Modi, 1997). One could augment equation (1) with a dummy variable indicating the sector (assuming that the main effect is through the constant term) or estimate separate regression for each sector (assuming different constant and slopes). However, such an approach would lead to biased estimates since sector choice is likely to be endogenous (e.g. der Gaag and Vijverberg, 1988).

To correct for potential bias resulting from self-selection between private and public sectors, the Heckman approach is extended to the case where after deciding to enter the wage sector, workers decide whether to work in the private or the public sector[7]. Consider that conditional on entering the wage sector, there are both observed and unobserved factors that determine whether a worker joins the private or the public sector. As with the participation equation, the relationship between the outcome (the observed employment sector) and the determining factors can be expressed in a reduced form as a probabilistic model.

$$s_i = \gamma_1 x_i + \gamma_2 z_{2i} + \nu_i \tag{3}$$

[6] Employer in the survey is defined as an individual, excluding farmers, who hires workers (excluding house workers) for a wage. Note also that this category is excluded from the analysis.

[7] See Tunali (1986) for a comprehensive exposition of the method used, and Stillman (2000) for a more recent application.

where $s = 0, 1$ for the public and the private sectors, respectively, and z_2 is a set of exogenous variables, which must be distinct from z_1 in order to identify (2) from (3). I exploit the proposition that the reservation wage as measured in section— determine the decision to enter the wage sector, but does not affect how worker choose between the private and the public sector. These two instruments are then excluded from private-public sector choice regression (3). Thus, z_2 in regression (3) contains only the ratio of employers to work force in the community and its squared term. With these identifying assumptions, one can use a sector specific wage defined as:

$$lnw_{is} = \beta_{1st} x_{is} + \varepsilon_{is}$$

along with equation (2), and equation (3), to write a full reduced form system of equations allowing for both selection into the wage sector and by sector.

$$y_i = \alpha_1 + \alpha_2 x_i + \alpha_3 z_{1i} + \mu_i \tag{4a}$$

$$s_i = \gamma_1 x_i + \gamma_2 z_{2i} + \nu_i \tag{4b}$$

$$lnw_{i0} = \beta_{10} x_{i0} + \varepsilon_{i0} \tag{4c}$$

$$lnw_{i1} = \beta_{11} x_{i1} + \varepsilon_{i1} \tag{4d}$$

In this model s_i is observed if $y_i = 1$, the wage in the private sector is observed if $y_i = 1$ and $s_i = 1$, and the wage in the public sector is observed if $y_i = 1$ and $s_i = 0$.

Identification of (4) requires that μ_i and ν_i follow a bivariate normal distribution, although no additional restrictions are needed on the other error terms[8]. The model is estimated using a two-step procedure. The first step is a binary response model with sample selection, which jointly estimates (4a) and (4b) using maximum likelihood and controlling for the selected nature of the sample (See Wooldridge, 2002, p.570-571). From the first stage, two Mills ratios are calculated for the participation in the wage sector, and for the choice of private sector, respectively. The second

[8]Note that the covariance $(\varepsilon_{i0}, \varepsilon_{i1})$ cannot be identified since no individual is observed working simultaneously in the two sectors.

step estimates the sector-specific earning functions (4c) and (4d) using OLS and including the Mills ratios as regressors. As with Heckman's approach, the parameters are unbiased, but the variances must be adjusted for statistical inferences to be valid[9].

4 Estimation Results

4.1 Probit estimation of the selection into the wage sector

Estimations of the participation equation using a probit specification are presented in table 4 for women (column 1) and men (column 2). The instruments used have the expected sign, and although only the real estate ownership is significant in women sub-sample, the null hypothesis of the joint non significance of the instruments is rejected at any reasonable level: the computed χ^2 is 77.2 and 489.7 for the women and the men sub-samples, respectively, with degree of freedom of five.

—Insert table 4 about here—-

The probability of wage employment increases with experience at a decreasing rate for both men and women. The probability of being in the wage sector is maximized at age 26 for women, and at age 30 for men. As expected, more years of education are associated with higher probability of entering the wage sector.

Living in the rural areas has a strong negative effect on the probability of being in the wage sector. This is consistent in the context of Burkina, where the wage sector is concentrated in two major cities[10]. The coefficients of the year and rural dummies indicate that for men, the probability of entering the wage sector has increased between 1994 and 1998, while it has decreased in rural areas. This result is consistent with the descriptive statistics contained in table 3. For women, the probability of entering wage sector has decreased in the urban areas between 1994 and 1998, while it has remained stable in the rural areas.

[9]In practice, the bootstrap techniques are used to avoid the difficulties associated with the analytical derivations.

[10]Ouagadougou, the capital city and Bobo-Dioulasso, the second largest city.

4.2 Estimated wage equations

Ordinary least squares (OLS) estimates of the wage earners sub-sample and maximum likelihood estimates (MLE) of the sample selection model are presented in table 5. The OLS estimates are presented in columns (1) to (3) for the whole sample, women and men, and the MLE estimates are presented in columns (4) and (5) for women and men.

—Insert table 5 about here—-

To begin, the OLS estimates of years of education and post schooling experience are significant at the one percent level, and the model explains more than 50 percent of the variations in monthly wages, indicating that the Mincerian specification provides a good fit for the data. The results are consistent with most of the previous OLS estimates of the Mincer equation in other developing country samples (e.g. Kugler and Psacharopoulos, 1989; Mwabu and Schultz, 2000; Siphambe, 2000). However, an examination of the coefficients of the Mills ratio in columns (4) and (5) (all significant at the one percent level) indicate that entry in the wage sector introduces sample selection. Thus, the OLS estimates are biased and the MLE estimates are preferred. Consequently, the discussion focuses on the MLE estimates, and I will turn later to the potential bias of the OLS estimates.

From columns (4) and (5), the implied rate of return to education at the primary education level is 9 percent for both men and women. At the secondary and tertiary levels, the returns are 14.3 and 13.2 percent for men, and 16.4 and 9.8 percent for women, respectively[11]. Thus, men in the wage sector are better compensated than women for an additional year of primary and tertiary education, while women are better compensated at the secondary education level.

The OLS estimates imply rates of return to education of 9.9 percent for the primary education, 16.4 percent for the secondary education and 11.4 percent for the tertiary education. The implied rates of returns are higher for women than for men at the primary and secondary education levels; 12.3 and 11.5 percent for women, as compared to 9.8 and 15.3 for men (columns 2 and 3). Thus, compared to the more consistent MLE estimates, the OLS estimates are upward biased for primary and secondary education, and downward biased for tertiary education, and differentially in favor

[11] The implied rate of return at the tertiary level is: $\left[exp(\beta) - 1\right]/2$.

of women.

Turning to the other covariates, the linear and quadratic terms of the post schooling experience are statistically significant, with positive and negative signs as expected. The estimates indicate that wages peak at 42 and at 33 years of experience for men and women, respectively. After controlling for sample selection, living in rural area has a positive and significant effect on women's wage, while the effect on men wage is positive but not significant. This may be reflecting compensation that workers receive (especially in the public sector) receive for relocating to rural areas. The year-dummy coefficient suggests that average men wage increased between 1994 and 1998, while for women the wage decreased. This suggests that the adjustment process may have differentiated gender effects in the wage sector.

4.3 Returns to education in public and private sectors

Single estimation results using the full reduced form (4) are presented in table 6. The regression results are presented by gender for each sector. The point estimates of returns to education are significant at the 5 percent level across the six regressions, except for primary education in the public sector[12]. After controlling the sector choice, the Mills ratio for the participation in the labor market is insignificant except for a negative effect for women in the private sector.

—Insert table 6 about here—-

Consistent with the results presented in previous subsections, returns to education rise as education level increases. For men, an additional year of primary education is estimated to increase wage by 8.8 percent and 9.0 percent in the public and in the private sectors, respectively. Compensation for secondary education is 14.1 percent in the public sector and 11.2 in the private sector. Higher education is better compensated by the private sector, 27.2 percent as compared to 8.4 percent in the public sector. For women, the rate of returns at the primary education level are .3 percent in the public sector and 3.4 percent in the private sector, but statistically not different from zero. The returns to secondary education are 10 percent in the public sector and 14.2 percent in the private sector, while the corresponding figures for higher education are 10.6 percent and 8 percent.

[12]Statistical inference obtained from bootstrap, which consisted of 500 replications.

The wage rate was increasing in the private sector and in the cities for men. For women wage gains were only significant in the public sector. Thus, it appears that the improvement in the private sector may be benefiting more to men than to women. Moreover, the benefits seem to have been concentrated in urban areas.

Disaggregating across sectors generates two results. First, return to primary education is almost zero for women. Thus, whenever expected schooling is less than secondary education, the implied expected rate of return may discourage female enrollment. Second, the private and the public sectors have different compensation systems for men and women. Women with primary and secondary education are relatively better compensated by the private sector than by the public sector, while the public sector compensates more women with higher education. For men, primary and higher educations are better compensated by the private sector, while the public sector compensates better secondary education. Overall, compared to the private sector, the public sector is paying workers with secondary education more than the private sector, and compensating those with higher education less. To some extent, this reflects long term policy goal in Burkina, which sought to limit wage gap among public servants (Zagre, 1994).

4.4 Robustness check

Joint normality of the error terms and correct specification are both critical for the MLE estimates in table 5 and the estimates in table 6 to be consistent (e.g. Ahn and Powell, 1993; Das, Newey, and Vella, 2003). Alternatively, semi-parametric version of the sample selection model can be used to obtain estimates, which are robust to violation of the joint normality assumption and to miss-specification of the selection process (e.g. Ahn and Powell, 1993; Das, Newey, and Vella, 2003; Schafgans, 1998, 2000). In particular, one might use a non-parametric specification for the selection probability and allow the selection term to enter the wage equation non-parametrically (Das, Newey, and Vella, 2003).

In this section, I re-estimate the selection probability using the non-parametric estimation method developed in Racine and Li (2003), which admits both discrete and continuous covariates. More formally, the probability of being selected in the wage sector conditional on the variables x

and z described above ($E\left[particip|x, z1\right]$) is estimated free of distributional and functional form assumptions. Racine and Li (2003) show that the proposed estimator has rate of convergence which depends only on the number of continuous variables involved, and it accommodates the interactions among discrete and continuous variables.

With the estimated probability of participation, a selection term can be constructed as $\pi_1 = Pr[particip = 1]^{-1}$, which is used in the second step to correct the selection bias (Robinson, 1989). The framework is extended to the choice between private and public sectors. The probability of being selected in the private sector conditional on the variables x, z_2, and π_1 is estimated non-parametrically using the same methods discussed above. The selection terms are then constructed as $\pi_2 = Pr[private = 1]^{-1}$ for private sector workers and $\pi_2 = Pr[private = 0]^{-1}$ for public sector workers.

In estimating the earning functions, the selection terms are allowed to enter the wage regression non-parametrically. More formally, the wage equation for the selected sample is estimated as follows:

$$lnw_i = \beta_1 x_i + g(\pi_{1i}) + \varepsilon_i \tag{5}$$

Where the variables x_i have been described before, and g is an unknown function, which is assumed to be smooth in π_1 [13]. Consistently estimating β requires that the contaminating effects of $g(.)$ be removed first. Following Ahn and Powell (1993) and Yatchew (1999), I use differencing method to remove the non-parametric effects. In other words the data are rearranged in ascending order using π_1, and then differentiated to get[14]:

$$\Delta lnw_i = \Delta g(\pi_{1i}) + \beta \Delta x_i + \Delta \varepsilon_i \tag{6}$$

Under the assumptions about g (in particular that π_1 which are close will have corresponding values of g which are close), the first term at the RHS vanishes as n goes to infinity ($plim\left[g(\pi_{1i}) - g(\pi_{1i-1})\right] = 0$), so that the parameters β can be consistently estimated by applying OLS on the following re-

[13] Note that the constant is subsumed in the function g.

[14] Alternatively one could use Robinson (1988)'estimator.

gression.

$$\Delta lnw_i = \beta \Delta x_i + \Delta \varepsilon_i \tag{7}$$

Following Yatchew (1999) higher differencing allows efficiency gains. Accordingly, I use third order differences with optimal weights given in Yatchew (1999, p.19).

Semi-parametric estimations of the wage equations, are reported in table 7. The estimates in columns (1) and (4) are comparable to the MLE estimates in table 5 and the results reported in columns (2), (3), (5) and (6) are comparable should be compared to those in table 6.

The results in columns (1) and (4) ignore the choice between private and public sectors. The estimated rates of returns for men are 10.5 percent for primary education, 14.8 percent for secondary education, and 12.8 percent for tertiary education. These are comparable to MLE estimates[15]. Using semi-parametric methods, estimated rates of returns to female primary and secondary education are 17.4 and 20.1 percent, and are substantially higher than that implied by MLE; 9.3 percent and to 9.1 percent, respectively.

——Insert table 7 about here———

Estimations which account for sector choice are presented columns (2) and (3) for women, and in columns (5) and (6) for men. For women, returns to primary and secondary education are higher in the private sector than in the public sector, contrasting with the parametric estimates, where returns to primary education are insignificant in both sectors and returns to secondary education are higher in the public sector. Post secondary education generates significant returns only in the public sector. For men, returns to education are found to be higher in the private sector across all segments of education, while the returns to secondary education were found higher in the public sector with the parametric methods. Other than that the parametric and the semi-parametric methods lead to similar qualitative conclusions.

Overall, most of the qualitative conclusions using the parametric methods are preserved for men. For women, the noticeable change is the positive and significant returns to primary education

[15] For men, the implied rates of returns by MLE method are 9.3 percent for primary education, 14.3 for secondary education, and 13.1 percent for tertiary education.

in the private sector. Moreover, in terms of magnitude, the parameters are more stable across estimation methods for men than for women. This suggests that violation of the joint normality assumption, or miss-characterization of the sample selection process is more likely to affect more women results than the men results. However, this conclusion must be interpreted with caution because of the small size of the female sample[16].

To provide further insights in the differences in returns to education between men and women, the predicted log wage is presented in figure 2. The earning functions have been fitted using partial linear regressions [17]. The specification maintains a quadratic relationship between log wage and post-schooling experience but does not impose any functional form between log wage and education. Formally, the relationship may be expressed as $lnw_i = g(ed_i) + \beta x_i + \epsilon_i$, where ed is years of education, x is a set of variables containing post schooling experience and the inverse mills ratios. In other words, the method partials out the effects of the other covariates and then use non-parametric method to fit the relationship flexibly between log wage and education.

——-insert figure 2 about here ———-

The figure indicates that the relationship between log wage and education is not constant nor linear. From figure(2), a minimum of four years of education are needed for women before any positive effect on wage is apparent. After this critical level, there is a downturn between five and seven years, but the wage premium is thereafter increasing with education. In contrast to women, there is no apparent critical education level for men. It is informative to note that the four years of education are far above the expected years of education for women which correspond to .55 year. Thus, policy seeking to increase girl enrollment should be designed so that most girls stay in school at least for four years.

[16]Note that Schafgans (2000, 1998) reaches to similar conclusions in Malaysia with relatively larger female sample. He found that semi-parametric estimates of the wage equation differed from MLE estimates for women but not for men. The sample he used, included more than 1200 women with positive wage. Thus, his conclusions are less subject to small sample size bias.

[17]Because of the limited size of the women sample, separated sector-specific regressions are not estimated.

5 conclusions

The aim of this paper was to explore whether private returns to education could explain the observed trends in school enrollment over the past decades, which have been very low. To examine this question, two nationally representative surveys were used to estimate wage equations with sample selection corrected at two levels, the participation in the wage sector, and the choice between private and public sectors.

Rates of returns to education are found to differ substantially between men and women, and between the private and public sectors. Specifically, rate of returns to primary education in the public sector were found to be very small for men and almost zero for women. Moreover, the graphical analysis suggests that earning profiles are non-convex in education, and the non-convexities appear to be more pronounced for women than men. The findings are informative for education policy purpose. The relatively high returns to secondary and tertiary education would provide parents with enough incentives to enroll their children at secondary and at tertiary level. Hence, primary education is only useful as long as the child is able to complete at least secondary school. As a consequence, parents will enroll their children if opportunity and direct schooling costs up to the completion of at least secondary school are affordable. Particularly girls are unlikely to be enrolled unless parents expect them to stay in school for at least four years, which corresponds to about seven times the average women years of education.

In combination with the imperfections in credit markets, these non-convexities imply reduced incentives for low-income households to invest in education since the prospects for crossing the minimal education level are limited. This might limit social mobility over time since education level depends to a great extent on initial conditions. This suggests that education policies which focus on increasing the supply of primary education should be complemented with policies which improve employment prospects for primary school graduates. From this perspective, an encouraging note is the expansion of the private sector, which is found in this study to generate relatively higher returns to both male and female primary education.

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Table 1: Descriptive statistics of variables used in the estimations

	Mean	St. dev	Min	Max
Female wage earners (n=620)				
Log wage	10.59	1.06	7.82	13.65
Post sch. exp.	17.04	8.97	0.00	56.00
Years of education	8.86	4.59	0.00	15.00
Primary	5.07	2.09	0.00	6.00
Secondary	3.55	2.75	0.00	7.00
Tertiary	0.24	0.65	0.00	2.00
Rural dummy	0.09	0.28	0.00	1.00
Year dummy (1998)	0.48	0.50	0.00	1.00
Year-rural dummy	0.05	0.21	0.00	1.00
Real estate	0.28	0.26	0.00	1.00
Fam. bus. age	0.38	2.31	0.00	25.00
Labor demand in private sector	21.44	14.83	0.00	36.00
Male wage earners (2922)				
Log wage	10.68	0.89	7.82	13.86
Post sch. exp.	20.88	10.39	0.00	58.00
Years of education	4.05	2.69	0.00	6.00
Primary	2.50	2.89	0.00	7.00
Secondary	0.21	0.61	0.00	2.00
Tertiary	0.12	0.33	0.00	1.00
Rural dummy	0.48	0.50	0.00	1.00
Year dummy (1998)	0.07	0.25	0.00	1.00
Year-rural dummy	0.71	0.64	0.00	4.00
Real estate	0.31	0.22	0.00	1.00
Fam. bus. age	0.06	0.57	0.00	15.21
Labor demand in private sector	20.80	15.14	0.00	36.00
Working age women (n=26762)				
Post sch. exp.	25.24	13.32	0.00	58.00
Years of education	0.54	2.04	0.00	15.00
Primary	0.42	1.45	0.00	6.00
Secondary	0.11	0.76	0.00	7.00
Tertiary	0.01	0.11	0.00	2.00
Rural dummy	0.85	0.36	0.00	1.00
Year dummy (1998)	0.46	0.50	0.00	1.00
Year-rural dummy	0.38	0.49	0.00	1.00
Real estate	0.51	0.33	0.00	1.00
Fam. bus. age	0.79	3.85	0.00	60.00
Labor demand in private sector	2.88	8.53	0.00	36.00
Working age men (n=28764)				
Post sch. exp.	24.58	14.09	0.00	58.00
Years of education	1.40	3.21	0.00	15.00
Primary	1.04	2.15	0.00	6.00
Secondary	0.33	1.32	0.00	7.00
Tertiary	0.02	0.22	0.00	2.00
Rural dummy	0.77	0.42	0.00	1.00
Year dummy (1998)	0.50	0.50	0.00	1.00
Year-rural dummy	0.39	0.49	0.00	1.00
Real estate	0.68	0.40	0.00	1.00
Fam. bus. age	0.86	4.01	0.00	58.00
Labor demand in private sector	4.75	10.89	0.00	36.00

Table 2: Workers distribution across education levels

		All persons 15-65	Private wage	Public wage
Males				
	No schooling	79.56	41.31	15.17
	Any primary	13.18	27.56	17.81
	Any secondary	6.03	25.38	51.57
	Any tertiary	1.22	5.75	15.46
	Total	100 (28546)	100 (1513)	100 (1404)
	Row total	100.00	51.87	48.13
Females				
	No schooling	91.76	24.73	2.71
	Any primary	5.53	24.37	9.04
	Any secondary	2.40	41.22	74.40
	Any tertiary	0.32	9.68	13.86
	Total	100 (26533)	100 (279)	100 (332)
	Row total	100.00	45.66	54.34

Table 3: Workers allocation between private and public sectors

		Urban		Rural		Pooled
Employment status		Men	Women	Men	Women	sample
1994						
Wage earners, from whom		36.64	13.22	1.74	0.27	6.37
	Public sector	*49.63*	*56.30*	*71.73*	*75.90*	*53.64*
	Private sector	*50.37*	*43.70*	*28.27*	*24.10*	*46.38*
Self employed		63.36	86.78	98.26	99.73	93.63
N. obs		3314	2043	11077	10272	26706
1998						
Wage earners, from whom		42.41	14.66	1.67	0.27	6.38
	Public sector	*40.09*	*49.66*	*78.57*	*61.54*	*45.16*
	Private sector	*59.91*	*50.34*	*21.43*	*38.46*	*54.84*
Self employed		57.59	85.34	98.33	99.73	93.62
N. obs		3243	2019	11130	12428	28820

Table 4: Participation in wage market

	(2)	(3)
	Women	Men
Post schooling experience	0.0365	0.09001
	[3.77]***	[17.11]***
psexp squared	-0.0706	-0.145
	[3.77]***	[15.53]***
Primary schooling, 1-6	0.169	0.127
	[12.44]***	[18.09]***
Secondary schooling, 1-7	0.352	0.282
	[18.16]***	[25.94]***
Post secondary, 2	0.199	0.244
	[1.93]*	[4.49]***
Rural dummy, rural =1	-0.992	-1.244
	[8.59]***	[23.18]***
Year dummy, 1994=1	-0.0152	-0.275
	[0.19]	[6.17]***
Year rural	0.139	0.288
	[0.97]	[4.26]***
Identifying instruments		
Real estate	-0.409	-0.447
	[6.13]***	[12.98]***
labor demand in private sector	0.0158	0.01803
	[1.11]	[2.34]**
labor d. squared	-0.00629	0.0115
	[0.15]	[0.52]
Family business	-0.0163	-0.0311
	[0.61]	[2.82]***
Family b. squared	-0.0137	0.0649
	[0.10]	[1.82]*
Constant	-2.261	-1.967
	[14.90]***	[23.11]***
Observations	26766	28789
Instruments ($\chi^2(5)$)	77.23	489.66

Absolute value of z statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Estimated wage equations

	(1)	(2)	(3)	(4)	(5)
		OLS		MLE	
	Pooled sample	Women	Men	Women	Men
Post schooling experience	0.0990	0.1175	0.0954	0.1122	0.0919
	[25.19]***	[11.76]***	[22.21]***	[11.13]***	[19.36]***
psexp squared	-0.1277	-0.1895	-0.1188	-0.1781	-0.1126
	[15.85]***	[8.22]***	[13.81]***	[7.71]***	[12.09]***
Primary schooling, 1-6	0.0992	0.1231	0.0982	0.0932	0.0921
	[17.86]***	[7.54]***	[16.85]***	[4.80]***	[13.56]***
Secondary schooling, 1-7	0.1645	0.2066	0.1529	0.1638	0.1429
	[28.64]***	[15.00]***	[24.30]***	[7.95]***	[16.80]***
Post secondary, 2	0.2061	0.1566	0.2254	0.1808	0.2339
	[9.85]***	[3.25]***	[9.79]***	[3.65]***	[9.93]***
Rural dummy, rural =1	-0.0086	0.1783	-0.0345	0.3408	0.0320
	[0.18]	[1.27]	[0.67]	[2.25]**	[0.50]
Year dummy, 1994=1	-0.0292	0.0078	-0.0458	0.0102	-0.0439
	[1.26]	[0.13]	[1.83]*	[0.18]	[1.76]*
Yeard-rural	0.0377	0.1893	0.0358	0.1836	0.0397
	[0.56]	[0.98]	[0.50]	[0.96]	[0.56]
Male	0.2059				
	[7.11]***				
λ				-0.3736	-0.4586
				[11.00]***	[33.57]***
Constant	8.2685	7.8853	8.5416	8.4041	8.6802
	[142.49]***	[62.24]***	[146.02]***	[37.49]***	[88.40]***
Observations	3571	624	2947	26766	28789
R-squared	0.52	0.6	0.51		

Absolute value of t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Estimated wage equations with endogenous sector choice

	(1)	(2)	(3)	(4)
	Women		Men	
	Public Sector	Private Sector	Public Sector	Private Sector
Post schooling experience	0.0592	0.112	0.0859	0.0805
	[4.26]***	[5.38]***	[14.39]***	[8.51]***
Post sch. exp. squared	-0.0720	-0.171	-0.108	-0.105
	[2.12]**	[4.25]***	[9.22]***	[6.78]***
Primary schooling, 1-6	0.00327	0.0336	0.0883	0.0902
	[0.09]	[0.85]	[7.94]***	[7.85]***
Secondary schooling, 1-7	0.100	0.142	0.141	0.112
	[2.94]***	[2.56]**	[11.50]***	[6.80]***
Post secondary, 2	0.193	0.148	0.159	0.445
	[4.49]***	[1.47]	[7.39]***	[9.63]***
Rural dummy, rural =1	-0.176	1.133	-0.000488	-0.599
	[1.11]	[3.51]***	[0.00]	[3.37]***
Year dummy, 1994=1	-0.0995	0.0848	0.0247	-0.186
	[1.82]*	[0.81]	[0.76]	[4.39]***
Yeard-rural	0.139	-0.064	-0.079	0.356
	[0.92]	[0.16]	[1.24]	[2.44]**
Mills wage sector	-0.111	-0.643	0.060	-0.015
	[0.77]	[2.99]***	[0.75]	[0.16]
Mills sector	-0.216	-0.131	-0.106	0.148
	[1.36]	[0.48]	[1.19]	[1.14]
Constant	9.801	9.025	8.771	8.673
	[19.57]***	[15.70]***	[50.25]***	[45.97]***
Observations	337	283	1407	1515
R-squared	0.48	0.66	0.48	0.45

Absolute value of t statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Estimated wage equations: Semi-parametric methods

	(1)	(2)	(3)	(4)	(5)	(6)
		Women			Men	
	Both sect.	Private	Public	Both sect.	Private	Public
Post sch. exp.	0.112	0.126	0.051	0.096	0.088	0.078
	[11.29]***	[8.51]***	[4.19]***	[21.98]***	[13.96]***	[15.62]***
Post sch. exp. Squared	-0.184	-0.206	-0.053	-0.121	-0.115	-0.100
	[8.20]***	[6.65]***	[1.62]	[13.84]***	[9.61]***	[9.51]***
Primary schooling, 1-6	0.174	0.144	-0.003	0.105	0.097	0.060
	[9.29]***	[6.02]***	[0.12]	[16.19]***	[11.36]***	[7.86]***
Secondary schooling, 1-7	0.201	0.248	0.106	0.148	0.130	0.113
	[12.98]***	[9.64]***	[7.58]***	[23.38]***	[12.05]***	[16.55]***
Post secondary, 2	0.167	0.085	0.199	0.229	0.436	0.191
	[3.54]***	[0.88]	[5.26]***	[10.09]***	[9.59]***	[9.66]***
Rural	-0.008	0.224	-0.251	-0.068	-0.556	-0.023
	[0.06]	[0.83]	[2.15]**	[1.21]	[4.69]***	[0.49]
Year 1994	-0.016	0.061	-0.131	-0.033	-0.162	0.001
	[0.28]	[0.63]	[2.59]**	[1.31]	[4.44]***	[0.03]
Rural*1994	0.138	0.127	0.117	0.069	0.382	-0.031
	[0.74]	[0.34]	[0.77]	[0.96]	[2.60]***	[0.51]
Constant	0.002	0.010	-0.002	0.000	0.000	0.002
	[0.08]	[0.21]	[0.08]	[0.04]	[0.02]	[0.17]
Observations	615	278	332	2917	1510	1402

Absolute value of t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1: Empirical Wage Density and Distribution Functions (Unconditional)

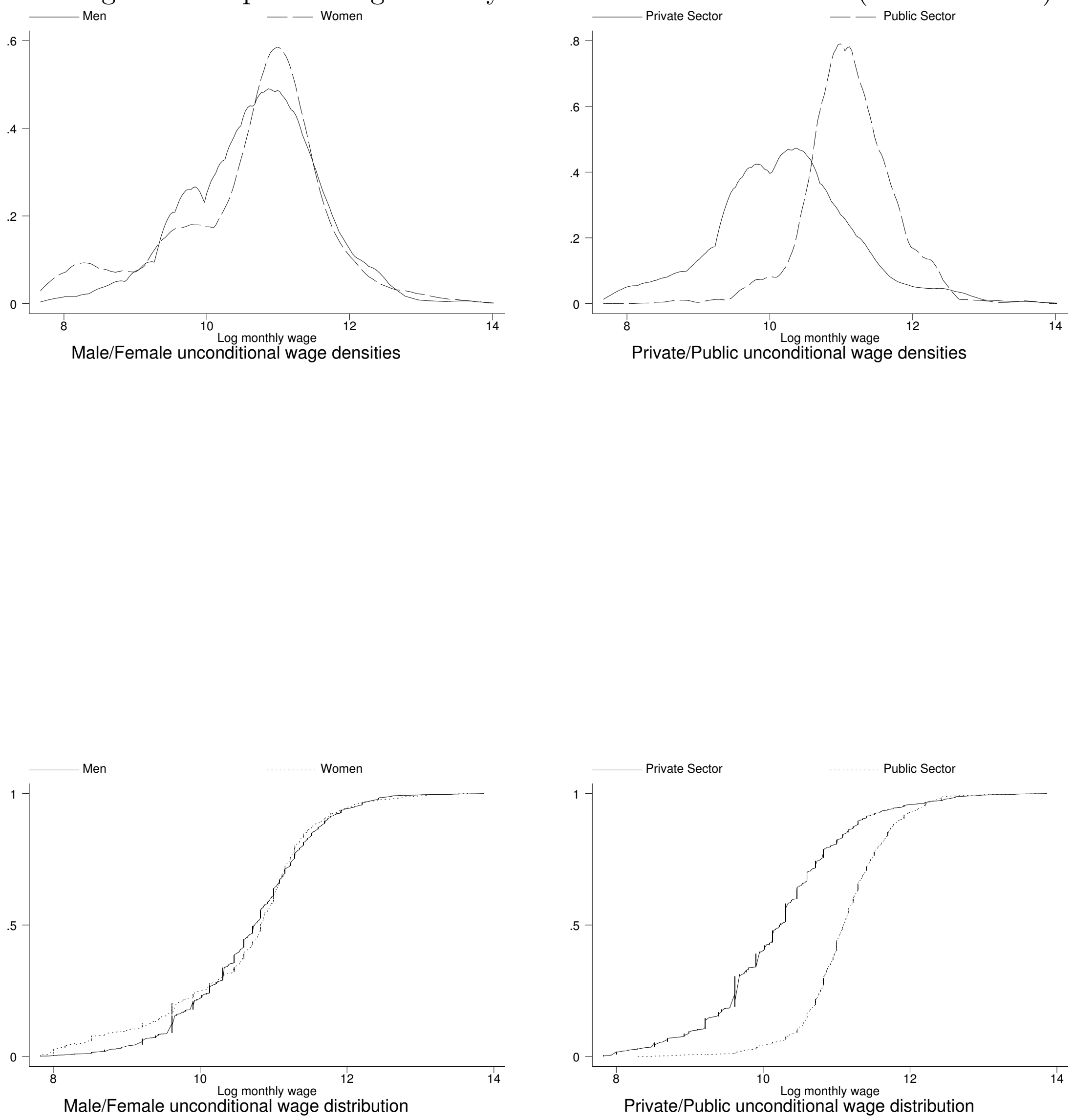

Figure 2: Wage increments

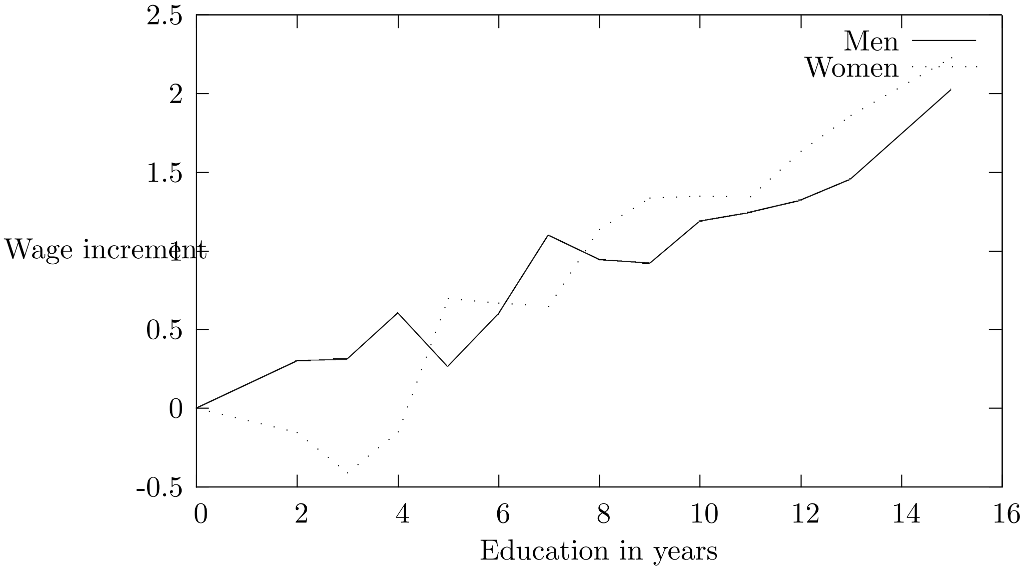

Table 8: Determinants of sector choice

	(1)	(2)
	Women	Men
Post schooling experience	-0.0991	-0.0662
	[3.20]***	[6.35]***
Post. sch. sxp. squared	0.162	0.0695
	[2.24]**	[3.75]***
Primary schooling, 1-6	-0.118	-0.0139
	[1.22]	[0.92]
Secondary schooling, 1-7	-0.132	-0.101
	[1.22]	[5.44]***
Post secondary, 2	0.150	0.00816
	[1.34]	[0.16]
Rural dummy, rural =1	-0.254	-1.194
	[0.58]	[9.79]***
Year dummy, 1994=1	-0.207	-0.397
	[1.45]	[6.19]***
Year/Rural	-0.461	0.354
	[1.13]	[2.42]**
labor demand in private sector	0.0979	0.0342
	[3.55]***	[3.05]***
labor d. squared	-0.239	-0.0535
	[3.05]***	[1.69]*
Constant	1.406	0.684
	[1.02]	[2.99]***
Participation equation		
Post schooling experience	0.0340	0.0951
	[3.50]***	[18.40]***
Post. sch. exp. squared	-0.0688	-0.154
	[3.66]***	[16.69]***
Primary schooling, 1-6	0.173	0.129
	[12.81]***	[18.71]***
Secondary schooling, 1-7	0.342	0.286
	[17.63]***	[26.65]***
Post secondary, 2	0.167	0.191
	[1.59]	[3.57]***
Rural dummy, rural =1	-1.152	-1.601
	[10.95]***	[33.87]***
Year dummy, 1994=1	0.109	-0.0792
	[1.63]	[2.23]**
Year/Rural	0.003	0.112
	[0.02]	[1.76]*
Real estate	-0.845	-0.525
	[7.48]***	[10.58]***
Family bus. age	-0.0335	-0.0320
	[1.40]	[3.01]***
Family bus. Age squared	0.0223	0.0649
	[0.22]	[1.86]*
Constant	-2.040	-1.713
	[14.45]***	[22.09]***
ρ	0.340	0.919
	[0.68]	[7.47]***
Observations	26762	28764

Absolute value of z statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%