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Education and earnings in urban West Africa ☆

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ABSTRACT

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Using a series of comparable labor force surveys in urban West Africa, we estimate the private returns to education among representative samples of workers in seven economic capitals (Abidjan, Bamako, Cotonou, Dakar, Lome, Niamey and Ouagadougou). The data allow us to provide a unique cross-country comparison using rigorously the same variables and methodology for each country. We tackle the issues of endogenous sector allocation (public, formal private and informal sectors) and endogeneity of the education variable in the earnings functions. We find that the returns to schooling are most often enhanced once an endogenous education variable is accounted for. This effect holds particularly true in the informal sector. In most West African cities of our sample, the public sector gives more value to education, followed by the formal private sector and then the informal sector. We also shed light on convex returns to education in all the cities and sectors, including in informal activity. More generally, a major contribution of this paper is to provide evidence of significant effects of education on individual earnings in the informal sectors of the West African cities, even at high levels of schooling. *Journal of Comparative Economics* **37** (3) (2009) 491–515. IRD, DIAL, France; CEPS/INSTEAD, Luxembourg.

1. Introduction

At a time when all development policies are focused on poverty reduction, it is a paradox that the research community has not taken the full measure of the role that could be played by improving the way urban labor markets work in Sub-Saharan Africa (SSA). This bias can partly be explained by the concentration of pockets of poverty in rural areas. And yet, in labor-abundant countries undergoing rapid urbanization where, for the vast majority, the population – particularly the poor – earns its income from work, the creation of decent work in towns is a major challenge for Africa's future. In SSA, education is often seen as the main policy instrument in the fight against poverty because it may help individuals access better jobs and thus raise their labor earnings. However, in practice, although the value of education is strongly reaffirmed as an intrinsic component of development and of the well-being of populations in SSA (through the Millennium Development Goals, the Education for All initiative, etc.), its economic efficiency, on the contrary, is more contested.

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The dilemma is that the ability to increase the demand for education depends greatly on the families' opinion on how profitable it is on the labor market, i.e. its ability to provide attractive jobs. Yet, the results in the past few years are ambiguous in this respect. The idea of a widening education-job gap is widespread. Unemployment of skilled workers, worsened by the lasting freeze in civil service recruitment and the lack of vitality in the formal private sector, massive unemployment and an education system unsuited to the needs of the informal sector, and more generally the deterioration in the quality of public education under pressure from drastic budget restrictions, are all factors that tend to undermine the value of investment in schooling. Education no longer seems to guard against poverty and social exclusion in SSA.

In this context, it is of key importance to reappraise the economic returns to investing in education in SSA. The analysis of private returns to education originates from standard human capital theory according to which inter-individual earnings differentials result from wage compensations for workers' different levels of human capital endowment. This principle has substantial implications for poor countries because it justifies the existence of income differences between individuals in the labor market. Yet many authors have demonstrated, particularly in an African context, that the traditional theories postulating the leveling of income levels between individuals with identical human capital do not fit when markets are imperfect or segmented. Markets in most African countries are not only imperfect, but the nature of work contracts also interferes significantly in the relationship between human capital and earnings. In particular, it is widely acknowledged that there are four types of labor markets in developing countries, namely rural, public, private formal and informal. These markets each have specific characteristics, such as job seasonality and uncertainty about the level of demand, the nature of contracts and the structure of wages and earnings (Ray, 1998; Hess and Ross, 1997; Schultz, 2004). However, many studies referring to the link between education and labor market outcome in these countries overlook the fact that the existence of different employment segments, especially in the rural and informal sectors, could have major implications as to the role of education in labor market integration. Vijverberg (1995) observes that some types of employment, such as self-employed work, cannot be linked to the individuals' credentials, or to a pay scale of any sort, meaning that education can only play a minor role in explaining individual earnings levels. Bennell (1996) notes that many studies on developing countries are based on data for formal sector employees and do not take into account income in rural and informal sectors where returns to education are probably very low. Glewwe (1996) also reveals that the wage structure in the private sector reflects the impact of education on the workers' productivity more than they do in the public sector.

Taking account of these African specificities, the aim of our study is to reassess the private returns to education in seven major West African cities of the WAEMU[1] (Abidjan, Bamako, Cotonou, Dakar, Lome, Niamey and Ouagadougou) using the unique household *1–2-3 Surveys* on employment and earnings. The cross-sectional data sets gather a total of nearly 100,000 individuals surveyed between 2001 and 2003. Thanks to these comparable series of surveys in French-speaking economic capitals, we broaden the scope and refine the indicators generally used to assess the private returns to education in SSA[2], using exactly the same method for each city. In particular, the data allow us to estimate the determinants of earned income whilst differentiating individuals according to the institutional sector to which they belong (public, private formal and informal). In addition, we compare the returns to vocational versus general education at different levels of the schooling path which is one of the central aspects of education and vocational training literature, i.e. the debate on whether it is general education or vocational training that has the highest returns.[3] Finally, our household survey data enable us to address two persistent econometric problems when one wants to assess the causal impact of education on earnings (Card, 2001). Firstly, we tackle the issue of the possible endogenous sample selectivity biases regarding paid-work participation and sector choices by using appropriate procedures when the first stage choice model has several modalities, namely enter the public, formal private or informal sectors versus non paid-work participation. Secondly, we address the issue of the possible endogeneity of the education variable in the earnings function using different alternative techniques that make use of family background information. To our knowledge, this is the first time that such a comparative investigation of several African countries has been made based on surveys using identical sampling plans and questionnaires. Then, the comparative nature of our data gives our study a unique slant in that the effects of education can be studied in a uniform manner for all the cities.

We find that the returns to schooling are most often enhanced once an endogenous education variable is accounted for. This effect holds particularly true in the informal sector. In most West African cities of our sample, the public sector gives more value to education, followed by the formal private sector and then the informal sector. We also shed light on convex returns to education in all the cities and sectors, including in informal activity. More generally, a major contribution of this paper is to provide evidence of significant effects of education on individual earnings in the informal sectors of the major WAEMU cities, even at high levels of schooling.

The remainder of the paper is set out as follows. Section 2 describes the data and survey design. Section 3 presents the econometric models. Section 4 comments on the findings. Section 5 concludes.

[1] WAEMU: West African Economic and Monetary Union.

[2] Looking at private returns to schooling from earnings functions is of course a partial view of what education can bring. The overall private returns to investing in education involve in fact both the shape of the earnings function in a given employment and the effect of schooling on the probability of getting into that type of employment. Vijverberg (1993) jointly models the entry and earnings effects for women and men in Côte d'Ivoire. In this paper, we do not report the effect of schooling on employment outcomes and focus on earnings returns which are however corrected for endogenous employment choices.

[3] For instance, Bennell (1996) reports some higher rates of returns to vocational education than the rates of return to general education. By contrast, using firm level panel data, Kahyarara and Teal (2006) find mixed evidence of higher returns to vocational education. They argue that most previous studies have suffered from inability to control for endogeneity of education along with time invariant firm attributes.

2. The data

2.1. The 1-2-3 Surveys in West Africa

Our data are taken from an original series of urban household surveys in West Africa, the *1–2-3 Surveys* conducted in seven major WAEMU cities (Abidjan, Bamako, Cotonou, Dakar, Lome, Niamey and Ouagadougou) from 2001 to 2003. The surveys were carried out by the relevant countries' National Statistics Institutes, AFRISTAT and DIAL as part of the PARSTAT Project.[4]

As suggested by its name, the *1–2-3 Survey* is a three-phase survey. The first phase concerns individuals' socio-demographic characteristics (including education and literacy) and labor market integration. The second phase covers the informal sector and its main productive characteristics. The third phase focuses on household consumption and living conditions. The same methodology and virtually identical questionnaires were used in each city, making for totally comparable indicators. Our study uses solely the phase 1 data. For this phase, the theoretical household samples were made up of 2500 households in each of the seven cities, with the exception of Cotonou where the number was raised to 3,000. A full 17,841 households actually answered the questionnaire. This corresponds to 93,213 individuals and 69,565 people aged 10 and over (which is the potential labor force) for whom an individual questionnaire was completed. Full summary statistics of the variables used in the econometric analysis are reported in Table A.1 in Appendix A.

2.2. Descriptive statistics of the samples

Educational attainment was covered by a series of questions[5] put to each household member concerning: school attendance (current or past), the school level reached, the number of completed years of education, the qualifications obtained (differentiating between general and vocational education), the type of school attended in the last year of schooling, and the interviewee's father's level of education and work status.

Summary statistics reported in Table A.1 and Fig. 1 show that the accumulation of education remains low in all seven cities: the average number of years of completed schooling is only about 5 years, and over half of the individuals aged 15 years or over (55%) either never attended school or attended school but did not complete primary cycle. Yet people are only considered to be literate when they have completed primary school. On this basis, we estimate the proportion of literate individuals aged 15 and over in the WAEMU cities in the early 2000s at 45%. Moreover, these literate individuals' level of education was extremely modest since nearly half of them did not go beyond the *collège* (first four-year cycle of secondary education), and less than a quarter completed the second secondary cycle or *lycée* (total of seven years of secondary education), with the possibility of enrolment in higher education. Then, the distribution of individuals aged 15 and over by level of education in each of the cities taken separately is pyramid-shaped with a broad base and a very narrow summit. This is indicative of a high level of illiteracy (at least 44%) and high drop-out rates between and within the cycles.

Although the cities have a common curve, they also display differences. If we look at the base of the schooling pyramid, i.e. the individuals who did not start or complete primary school, Bamako, Niamey and Dakar are found to be the most disadvantaged from this point of view. Approximately 60% of the over-15s in these cities do not have the minimum level of schooling in terms of having completed primary school. Conversely, "only" 45% of the population lacks this basic level in Cotonou and Lome. Ouagadougou and Abidjan are in intermediate positions with respectively 56% and 51% of the population who did not start or complete primary school. Abidjan has the highest proportion (13%) of individuals at the top of the educational pyramid (secondary school completed or higher education), ahead of Cotonou (11%). The other cities post percentages ranging from 7% to 8.5%.

Women are largely disadvantaged by gender in that nearly two-thirds (64%) did not complete primary school (as opposed to 45% of men). This rate rises to 68% in Dakar, Niamey and Bamako. Even in the cities with the longest-standing and most developed schooling (Cotonou and Lome), women remain largely on the fringes: 59% did not complete primary school. When studied by generation, more under-35s (48%) have the minimum level of schooling than their elders aged 35 to 44 (44%) and especially those aged 45 and over (34%). This configuration reflects the steady development of the education system in the African countries. Yet the schooling dynamic is not the same everywhere. At one end of the scale, there are the cities with a long tradition of schooling. At the other end of the spectrum are those where the development of schooling has been stepped up more recently. The first group comprises Lome, Abidjan and Cotonou where, even among the individuals aged 45 to 59, a non-negligible proportion (at least 45%) has the minimum level of schooling. In the second group (Bamako, Niamey and, to a certain extent, Ouagadougou), over 60% of the over-35s do not have the minimum level of schooling. Dakar stands out for its stagnation (at around 60%) in the proportion of individuals without the minimum grounding in education across all generations (15 to 59 years old).

A last point worth mentioning about the educational landscape of the major WAEMU cities is the low weight of vocational education, which never exceeds 2% of the over-15s with the notable exception of Mali where it comes to 6%. This is reflective of an education system in which vocational education and training is left by the wayside.

[4] PARSTAT: *Programme d'appui régional statistique à la surveillance multilatérale*. This program was sponsored by the WAEMU Commission.

[5] See Brilleau, Roubaud and Torelli (2005a,b) for a detailed description of the questionnaires.

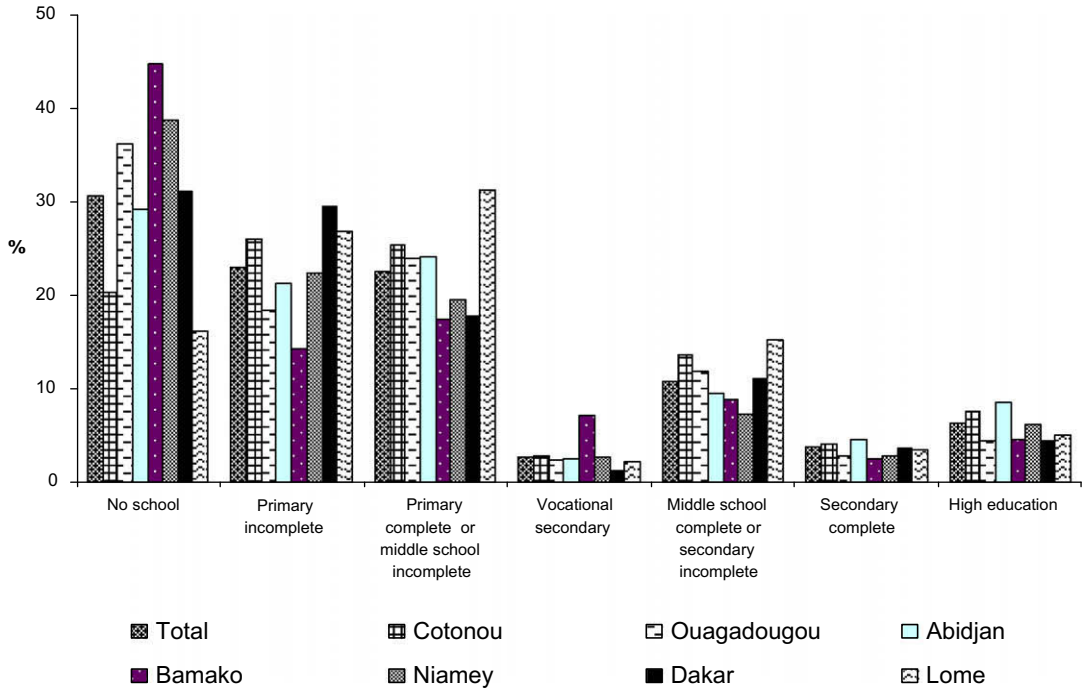

Fig. 1. Distribution of individuals aged 15 and over by education level and city. *Source*: *1–2-3 Surveys*, Phase 1 (Employment), 2001–2002, National Institutes of Statistics, AFRISTAT, DIAL; authors' calculations. * Did not reach the last year of that level of schooling.

Let us now describe the labor market outcome variable in this study, individual earnings. It is not easy to study earnings in an African urban environment since a large majority of workers works in the informal sector where there are no accounts or pay slips and individuals are naturally reticent to disclose their incomes (this is not specific to Africa). The *1–2-3 Surveys* provide an estimate of the total benefits relating to the job (sundry bonuses, paid holidays, housing, benefits in kind, etc.), whether monetary or non-monetary, which are added to the direct income.

However, as is the case in all surveys of this kind, measurement errors are greater for non-salaried workers, particularly in the informal sector[6]. Two strategies were adopted in the *1–2-3 Surveys* to at least partially overcome these problems: first, for non-wage earners (self-employed and employers), the interviewers were asked to help them reconstitute their earnings by recapping incomings and outgoings over a reference period to which the interviewee could relate. Following this exercise, non-wage earners' incomes were translated into a monthly sum in the questionnaire. This monthly income (net) was then divided by the number of hours worked per month available from both phases 1 and 2 of the *1–2-3 Surveys* to obtain hourly earnings. Second, the individuals who were unable or unwilling to disclose their exact earnings were asked to give a bracket. Seven brackets were defined by multiples of the minimum wage in force, providing therefore quite thin intervals.

For both the workers who refused to disclose their earnings (on average less than 6% of the sub-samples of income-earners in our econometric analysis) and those who declared only income brackets (on average 50% of our samples), earnings are imputed by an econometric estimation based on an income equation. In a first step, an earnings model is estimated for the employed workers who disclosed their precise earnings based on their observed characteristics. In a second step, the predicted values from this model are imputed. For the individuals with income brackets (which hence constitute the overwhelming proportion of workers with imputed incomes), the procedure of imputation includes a third step: uniform random sampling of the residual is conducted and the results of this sampling is added to the estimated income until the sum obtained comes within the bracket declared by the interviewee. Sensitivity tests of this methodology over alternative techniques have been conducted[7] and have shown that estimates of the earnings equations, in particular the coefficients associated with the education variables, were qualitatively unchanged.

Summary statistics on earnings reveal that the average monthly earned income for individuals aged 15 and over in the WAEMU cities is 63,000 CFA francs (96 euros in 2006).[8] There are some substantial differences between cities (see Table A.1). A worker in Abidjan earns on average 78,000 CFA francs (119 euros) per month whereas a worker in Dakar earns 67,000 CFA francs (102 euros) per month and a worker in Lome earns a mere 35,000 CFA francs (53 euros) per month. The other cities

[6] The informal sector is defined as all production units with no fiscal or statistical identity or without any formal accountancy.

[7] These include first performing regressions on a sub-sample of individuals who declared precise incomes only, and also using the mean of each bracket for individuals who declared their incomes in brackets.

[8] Income in terms of Purchasing Power Parity (PPP). Dakar is the base country.

are in intermediate positions with 49,000 to 59,000 CFA francs. Breakdown by sector also reveals substantial earnings inequalities. For example, public-sector workers earn an average of 145,000 CFA francs (221 euros) per month, which is approximately three and a half times more than informal sector workers who scrape by with just 40,000 CFA francs (61 euros) per month. Formal private sector workers are also winners on the labor market with 122,000 CFA francs per month. This bipolar configuration is found in all the cities studied: high earnings in the public sector, followed closely by the formal private sector (except in Abidjan where public-sector earnings are far higher – one and a half time – than that of the formal private sector), while the informal sector lags far behind these high yields.

3. Econometric models

Our methodological approach consists of estimating different models to evaluate the impact of education in its different forms on individual earnings differentials. The surveys enable us to estimate Mincer-type earnings models taking account of the sample selection effects associated with the individuals' paid-work participation and sector choice. In addition, the data allow us to address the issue of the possible endogeneity of the education variable in the earnings function using different alternative techniques that make use of family background information.

3.1. Earnings equations with sample selectivity

Estimating earnings functions using selected populations raises concerns over possible sample selection biases. Strictly speaking, there are two sources of selectivity involved. One arises from the fact that income-earners are only observed when they work, and not everyone is working. The second comes from the selective decision to engage in public wage employment rather than formal private employment or the informal sector.

We use Heckman's two-step procedure to address the first issue when we estimate a pooled earnings functions over the three identified sectors of employment. In the first stage, probit models of the probability of participation[9] are estimated. We then include the estimated correction terms (inverse Mill's ratios) into the second-stage earnings equations. The inclusion of the correction terms ensures that OLS gives consistent estimates of the augmented earnings functions.[10]

One of the ways to account for sample selectivity related to sector choice is to use a generalization of Heckman's procedure (Lee, 1983) that takes into account the possible effect on earnings of endogenous selection in different sectors. The econometric model is given by:

$$S_j^* = \zeta_j' Z_j + \eta_j \tag{1}$$

and

$$Y_j = \beta_j' X_j + \varepsilon_j. \tag{2}$$

Y_j refers to the earnings associated with sector j (j = 1,2,3 respectively for public employment, private formal employment, informal employment) and S_j^* is a latent variable associated with sector j. Z_j and X_j are vectors of observable characteristics (including education). β_j is a vector of parameters of interest to be estimated. η_j and ε_j are disturbance terms. Since for each individual Y_j is observed only if $S_j^* > 0$, η_j and ε_j are not independent if there exist unobserved characteristics of individuals affecting both sector allocation and earnings. In this case, the OLS estimator of β_j is inconsistent.

In the first stage (1), multinomial logit models are used to compute the correction terms λ_{ij} from the predicted probabilities of individual i being in sector j. The generalized forms of the inverse Mill's ratios are then introduced into the earnings equation for each sector j and yield consistent estimators of β_j. Lee's method has been criticized, for it relies upon a strong assumption regarding the joint distribution of error terms of the equations of interest (see Vijverberg, 1993; Dahl, 2002; Bourguignon, Fournier and Gurgand, 2007). However, the existing alternative methods we tried, such as Dubin and McFadden's or Dahl's, did not appear more efficient given the small size of our sectoral sub-samples.[11] We then choose Lee's correction method which has the advantage of providing an easier interpretation of the correction terms.

Another potential problem is that the multinomial logit may suffer from the Independence of Irrelevant Alternatives assumption (IIA), which in most cases is questionable. We performed Hausman-type tests for each city and sector which massively provided evidence that the IIA assumption was not violated, with the exception of the informal sector in Bamako.[12]

In both Heckman's and Lee's procedure, identification is achieved using exclusion restrictions, i.e. by the inclusion of additional regressors in the first stage selection equations. Let us briefly comment on this identification strategy. In order to pre-

[9] In our case, this category corresponds to the individuals who did not declare positive earnings for the reference month.

[10] The presence of the additional constructed selectivity correction terms renders the standard errors incorrect. They are then bootstrapped to provide asymptotically consistent values.

[11] Indeed, based on Monte-Carlo simulations, Bourguignon et al. (2007) conclude that "Lee's method is adapted to very small samples (...)".

[12] Note that Bourguignon et al. (2007) argue that selection bias correction based on the multinomial logit model is a "reasonable alternative to multinomial normal models when the focus is on estimating an outcome over selected populations rather than on estimating the selection process itself. This seems even true when the IIA hypothesis is severely at odds". Since we are interested in results in the second stage regression, this allows us to be confident regarding the choice of a multinomial logit.

serve as much as possible comparability across countries, we rely on the same exclusion restrictions for each city. However, after considering tests of appropriateness of the exclusion restrictions (see Footnote 14), we have to relax such constraint at the sector level i.e. we use different sets of identifying variables for selection into the informal sector and for selection into the formal sectors (public and private).[13] In the case of the formal sectors, we use six dummies describing the individual's situation toward his/her household head (child, spouse, etc.) together with the household's inverse dependency ratio (number of working individuals divided by the total number of individuals in the household). For the informal sector, only the dependency ratio is excluded from the second step regressions where the individual's situation in the household often appeared significant, contrary to the dependency ratio. We tested the appropriateness of this identification strategy using Wald tests of joint significance of the identifying variables in the first stage and insignificance in the second stage for each sector of all cities (so 21 cases). The tests highlighted the appropriateness of this choice in 19 cases.[14] However, bearing in mind the methodological controversies surrounding the choice of identifying variables in general, we report summary results from uncorrected earnings functions (OLS) as well. This will also help provide comparability with existing studies.

3.2. Endogenous education

It is widely recognized in the literature that using OLS to estimate the returns to education from cross-section data is potentially problematic. The standard concern is that education may be an endogenous variable, i.e. correlated with the residual of the earnings function due to unobserved individual heterogeneity. To address this issue, one commonly uses instrumental variables techniques (IV) which imply finding variables that are uncorrelated with the individuals' unobserved heterogeneity but correlated with their education. The instrumentation is often based on households and demographic characteristics which are assumed uncorrelated to the error term of the earnings equation. These instruments, popular when using developing country data, may capture various genetic and environment influences (Sahn and Alderman, 1988).[15]

Treating the endogeneity of education with IV may lead to downward estimation of the returns to education if schooling is positively correlated with the individuals' unobserved ability. For instance, Belzil and Hansen (2002) find a strong positive correlation between unobserved ability and unobserved taste for schooling, thus leading to substantial upward bias in the OLS estimates of the return to education. However, a more common finding is that estimated returns rise as a result of treating education as an endogenous variable (see e.g. Card, 1999, 2001). Card (1999) has proposed an explanation for this phenomenon that is based on the hypothesis that the returns to schooling are heterogeneously distributed across the population.[16] Other alternative explanations suggest that OLS estimation suffers from the so-called attenuation bias caused by measurement errors in the reported years of schooling.[17] Since there are potentially two effects playing in opposite directions (ability versus attenuation biases), an OLS estimate of the return to education can bias in either way depending on the relative magnitudes of these biases.

In this paper, we tackle the issue of endogeneity using different alternative techniques. Firstly, father's schooling and main occupation are used as instruments and we use a control function (CF) approach (Garen, 1984; Wooldridge, 2002; Söderbom et al., 2006). The method can be described in the following way. We first regress the number of years of completed schooling on the set of instruments. Based on this regression, we estimate the residual $\hat{\lambda}$. In the second stage, we estimate the earnings functions in which $\hat{\lambda}$ is used as a 'control variable' for the unobserved heterogeneity component. This approach produces consistent estimates of the parameters of interest provided standard conditions for identification hold, and provided the instruments are independent of $\hat{\lambda}$ and uncorrelated with the residual of the earnings function.[18] The CF method is

[13] The results of the probits and multinomial logits are not reported to save space but are available on request from the authors.

[14] The exceptions were the formal private sector in Niamey and Dakar, where theappropriateness of theexcluding conditions in the second stage was rejected at the 10% and 1% levels respectively. In these two cases, we then tried to restrict the number of exclusions using as identifying variable only a dummy indicating whether the respondent was the household head (together with the dependency ratio). The test then passed and the results in the second step did not differ from those obtained previously. We hence chose to report the results including the full set of exclusions in order to assure perfect comparability across the countries. For all cities and sectors, Wald tests of joint significance of the instruments in the first stage never rejected the null at the 1% level. Note that the second-stage equation is still identified without excluding conditions for the need of the tests since identification relies then on the distributional assumption of Lee's model (see Bourguignon et al., 2007).

[15] For example, Ashenfelter and Zimmerman (1997) use parental education, Butcher and Case (1994) exploit the presence of any sister within the family, and Card (1995) draws on geographic proximity to a four-year college as instruments.

[16] As is discussed in Card (1999, 2001), the necessary conditions for the IV estimator to yield consistent estimate of the return to schooling in the presence of heterogeneity in the returns are fairly strict. In the case where changes in the instrumental variable affect the entire mapping between unobserved abilities and schooling outcomes, assumptions such as independence or homoskedasticity are violated. In such case, the IV estimates recover a weighted average of marginal returns for the affected subgroups (a "local average treatment effect", or LATE). For example, an IV procedure based on changes in family background variables may lead, for instance, to bigger changes in the education choices of people with relatively high marginal returns to education (considering that opportunity costs of schooling are relatively lower in rich families where family education, for instance, tends to be greater). As suggested in Card (2001), this will tend to produce an over-estimate of the average marginal return to schooling.

[17] Griliches (1977), Angrist and Krueger (1991) and Ashenfelter and Krueger (1994) suggest that the omitted ability biases in the OLS estimates are relatively small, but the downward bias due to measurement errors could be sizeable.

[18] As is discussed in Wooldridge (2002) and Söderbom et al. (2006), however, 2SLS does not require independence between the instruments and the unobserved component of the earnings equation – just zero covariance – unlike the control function approach. Thus, 2SLS is less restrictive than the control function. Nevertheless, with 2SLS, identification is likely to be harder to obtain in practice. Indeed, in the case of flexible forms of education (variables foreach level), the interest of the control function approach over 2SLS is that we only need to add a univariate function in the first stage, rather than instrumenting for several variables corresponding to the various education cycles.

adapted when the earnings-education profile is non-linear in the estimated parameters. Specifically, as discussed by Card (2001), the CF approach is more robust than 2SLS when slope parameters potentially vary with the unobserved factors of the model. In addition, even if all slope parameters are constant, 2SLS is likely to yield relative imprecise parameter estimates when the model is non-linear in the endogenous variable, namely education in our case. As our results will show, the CF approach is worthwhile since the marginal effects of education are found to be non-constant.

Following Blackburn and Neumark (1995), Lam and Schoeni (1993) or Ashenfelter and Zimmerman (1997), we also use family background information differently by introducing it directly into the earnings functions. This is another way to apply the CF procedure. Indeed, individual education could be deemed endogenous if, for instance, the father has contributed to job access for his child or if father's education and/or work status are actually proxies for the individual's unobserved ability. This would be the case if there exists "genetic transmission" of ability or if parents with a lot of education (or with particular jobs) can help their children develop skills that are subsequently rewarded in the labor market. Using IV estimates relies on the assumption that such situations do not arise and that parental education variables can be considered as valid instruments. However, it is unclear whether family background should be used as instrument or as proxy for unobserved ability. In this paper, we shall attempt to use this information in both ways in order to check the sensibility of our results to these different assumptions.

All these different techniques are interesting to perform because the different hypothesis behind them may lead to common features in the results that we shall be able to consider as relatively robust. Thus, even if endogeneity issues are not perfectly corrected, the similarity of results from the different methods should help convincing us of their relative soundness.

4. The impact of education on earnings

We now turn to investigating the effect of education on inter-individual earnings differentials. We proceed in the following way. In the first sub-section, we report results from pooled and sectoral earnings functions and examine summary results obtained with different alternative econometric methodologies, in particular considering selectivity-corrected earnings functions and the education variable as an endogenous regressor. In the second sub-section, we focus on the cross-country comparison using a set of estimates deemed the most reliable for each city and sector. Finally, in the last sub-section, we provide an overview of the marginal returns to different qualifications.

4.1. Earnings functions specifications

The earnings regressions use the seven samples of the WAEMU cities separately. The estimates are obtained using the log of hourly rather than monthly earnings to take account of the heterogeneity of working hours in different sectors. Together with education, we account for the individuals' migratory status, marital status, religion, job seniority, potential experience, gender, and dummies for the employment sector in the pooled sector regressions (in reference to the informal sector).[19]

In most studies, log earnings are assumed to be linear or quadratic in years of education. Here, we seek to document the shape of the entire earnings-education profile, and therefore adopt a more flexible approach specifying education as a piecewise linear spline function that allows the strength of the relationship between education and earnings to vary across different parts of the educational distribution. More specifically, we distinguish four levels: primary, secondary 1 (*collège*), secondary 2 (*lycée*), and higher education. The education variables introduced have then the form $s_k(e)$ with e the years of completed schooling in the k levels (k: 1...4):

$$s_1(e) = \begin{cases} e, & e \leq 6, \\ 6, & e > 6, \end{cases} \qquad s_2(e) = \begin{cases} 0, & e \leq 6, \\ e-6, & 6 < e \leq 10, \\ 4, & e > 10. \end{cases}$$

$$s_3(e) = \begin{cases} 0, & e \leq 10, \\ e-10, & 10 < e \leq 13, \\ 3, & e > 13, \end{cases} \qquad s_4(e) = \begin{cases} 0, & e \leq 13, \\ e-13, & e > 13. \end{cases}$$

Pooled earnings functions estimates across sectors using Heckman's two-step approach and endogenous education with the CF method are reported in Table A.2 in Appendix A. The use of a single model to all gainfully employed individuals can only provide the average effect of education on earnings owing to specific effects found in each employment sector. In the case in which these specific effects differ little from one sector to the next, a pooled model suffices to be able to draw conclusions applicable to each of the labor market segments. However, where these effects vary a great deal, it is essential to estimate the returns to education separately for each sector. These estimates corrected for potential endogenous sector selection (using Lee's method) are reported in Tables A.3, A.4 and A.5.[20] To ease reading given the number of countries

[19] See details at the bottom of Table A2 in Appendix A.

[20] We drop the tenure variable from the set of covariates in the sectoral estimates as seniority in the current job makes less sense in the informal sector.

Table 1
Endogeneity tests of education in the earnings functions.

H0: education is exogenous in earnings function	All sectors P-values (*t*-test)	Public sector P-values (*t*-test)	Formal private sector P-values (*t*-test)	Informal sector P-values (*t*-test)
Cotonou	0.00	0.61	0.19	0.00
Ouagadougou	0.00	0.56	0.04	0.02
Abidjan	0.46	0.80	0.60	0.69
Bamako	0.00	0.30	0.00	0.08
Niamey	0.11	0.39	0.70	0.07
Dakar	0.00	0.33	0.06	0.01
Lome	0.06	0.26	0.70	0.04

studied and the set of alternative estimation techniques advocated in Section 3, we also present a synthesis Table A.6 reporting the average marginal returns to schooling[21] using different possible methods. Before turning to the comments on the returns to human capital, let us first discuss the results obtained with the different estimation strategies.

4.1.1. OLS vs. selectivity-corrected earnings functions

Using a pooled population of paid-work participants across the three different sectors, Table A.2 indicates that the selection-correction terms stemming from a probit equation of paid-work participation in the first stage are generally insignificant, with the exception of Abidjan at the 1% level. For the Ivorian economic capital, this means that the mechanism of allocation in the two groups (paid-work participants vs. non-participants) is not random and affects earnings significantly. Paid-work participation is associated with unobserved characteristics that are negatively correlated to earnings. Be sample selectivity not accounted for, OLS estimates would then yield biased estimates of the returns to observed characteristics, notably human capital. The same picture emerges from the sectoral estimates which also report few significant selectivity terms (Abidjan and Lome for the public sector, Cotonou and Abidjan for the informal sector; see Tables A.3-A.5 in Appendix A.)

Söderbom et al. (2006) provide a discussion on whether the control function method can also address sample selectivity issues, which may explain why we obtain few significant Mill's ratios once an endogenous education variable is considered.[22] Their answer is yes provided the instruments are independent of the error term of the selected samples. Table A.6 provides an overview across countries and sectors of what would be the average marginal returns to education with no selectivity correction and an exogenous education variable. Correcting for endogenous sample selection generally refines the estimated returns to education as compared to pure OLS estimates. The bias is the most important in the public sector with a difference of about 3 percentage points on average (a high variability mostly due to estimates for Abidjan and Lome).

4.1.2. Exogenous vs. endogenous education

We now investigate the exogeneity assumption of the education variable in the earnings function following our discussion in Section 3.2. Compared to OLS and selectivity corrected returns, introducing directly the father's characteristics (three dummies for his level of education and three dummies for his work status i.e. self-employed, unskilled wage-employee, and executive or manager), we observe that the returns to education are only marginally modified.[23] In addition, joint F tests of significance show that the father's characteristics are never significant in the earnings functions, with only one exception in the formal private sector of Bamako (P-value 0.025). Overall, such result may cast doubt on the validity of using the father's characteristics as proxies for heterogeneity – or ability – of his children. Alternatively, this may also suggest that individual heterogeneity effects should not be an important concern in these data.

To further examine this issue, we use the father's characteristics as instruments by means of the CF method. Based on the first stage regressions where education is regressed on all exogenous variables, we test for the joint significance of the coefficients of father's characteristics, a necessary condition for consistency of the estimates. For all cities, we can safely reject the hypothesis that these coefficients are jointly zero.[24] From the CF estimates of the returns to schooling, several interesting patterns emerge (Tables A2-A6 in Appendix A).

First, by using the CF, we can directly identify the correlation between the endogenous variable (education) and its unobserved determinants. A significant parameter estimate of the control variable (residuals of the education regression) means that the unexplained variation of the education variable also affects variation in earnings. On the other hand, if the parameter turns to be insignificant then we cannot accept the hypothesis of endogeneity. Table 1 provides an overview of P-values for *t*-tests associated with each control variable in the different specifications:

[21] Assuming that the marginal return to education varies across educational levels, but that it is constant within each cycle, the marginal return to education around the sample's education mean is defined as: $R = \sum_{k=1}^{4} \alpha_k I(\bar{educ} \in C_k)$, with α_k the estimated coefficients of the k education variables corresponding to the four cycles, I(.) the indicator function, $\bar{educ}$ the average years of schooling and the educational groups.

[22] See Footnote 24 for the results of tests of instrumentation.

[23] Similar findings in the literature are reported by Card (1999) who concludes that the bias component in a simple OLS estimator is about the same as, or only slightly bigger than, the bias in the estimator that controls for family background.

[24] Sargan tests on overidentifying restrictions also cannot reject the null at the 10% level that the instruments are valid in 18 cases out of 21. The three cases where validity is not supported concern the formal and informal private sectors of Bamako and the public sector of Niamey, thus suggesting to rather consider uncorrected education returns in those cases. These tests are not reported to save space and available upon request.

For all cities, we cannot reject the hypothesis of exogeneity of education in the public sector.[25] By contrast, the tests reject exogeneity in the informal sector for all cities but Abidjan. In the formal private sector, we obtain mixed results, with rejection of exogeneity in the cases of Ouagadougou, Bamako and Dakar.[26] Note that the case of Abidjan, where the unexplained variation of schooling never affects variation in earnings significantly, stands apart.

Second, in 16 cases out of 21, the results suggest that treating education as an endogenous variable increases the estimated returns. Unsurprisingly given the endogeneity tests reported above, this correction is more sensible in the informal sector, with the exception of Abidjan. This may be reflective of the fact that estimations treating education as exogenous suffer from the so-called attenuation bias caused by measurement errors in the reported years of schooling. Another explanation suggested by Card (1999) is that, in the presence of heterogeneity in marginal returns, one expects an IV-type estimator to capture the marginal responses for a particular subgroup, i.e. those for whom changes in family background have a stronger impact on schooling behaviors (a case of LATE; see Footnote 16). In other words, IV estimates using family background as an exogenous determinant of schooling may often be above the corresponding OLS estimates.

In this paper, when exogeneity of education is rejected, we place more confidence in the IV estimates, at least those using the CF approach, for three reasons. First, as mentioned in Section 3.2, the CF method is more robust than 2SLS when slope parameters vary with unobserved factors (Card, 2001). This may attenuate a potential bias in IV estimates due to heterogeneity in marginal returns. Second, in addition to heterogeneity across individual observables, Card's interpretation of greater IV estimates relies on a case where the instrumental variable would reflect to some extent unobserved ability. Here, this would be the case if, for a given level of education, the father's background would affect educational choice for more able children.[27] Yet, the lack of significance of father's covariates in earnings functions does not provide much support for this assumption. Third, we believe that the self-reported years of schooling are likely to be affected by important measurement errors due to the documented high proportion of school drop-out and class repetition in West Africa (UNESCO/BREDA, 2007). This rather gives support to the use of IV-type estimator, when relevant.

In all the subsequent regression results and tables discussed, we then rely on endogeneity-corrected estimates when exogeneity of education is rejected and our instrumentation is plausible (see Footnote 24). In all other cases, i.e. public sector for all cities and private sectors of Abidjan and Bamako, exogenous education variables are preferred.[28]

4.2. Cross-country sector comparison

4.2.1. General findings

Chow tests for the joint equality of coefficients across sectors show that the decomposition by institutional sector is justified. Indeed, we find highly contrasting configurations. As expected, the models' explanatory power goes in descending order from public, to formal private, then to informal employment, with pseudo R^2 decreasing on average from 0.44, 0.39 to 0.23 respectively. This hierarchy is consistent with the predictions of the standard human capital model, as this is better suited to accounting for the heterogeneity of earnings in the public sector where wages are based on a set scale that takes these criteria (education, experience) explicitly into account. On the other hand, in the informal sector, apart from the probability of greater measurement errors, other factors not taken into account in our equation, such as the amount of physical capital, are likely to have a significant impact on earnings.

To synthesize the results for education, Fig. 2 represents histograms of the marginal returns to education by sector and city at the sample means of education. In six cities out of seven, the public sector is the sector in which education is given the most value, with a marginal return of between 9.4% (in Dakar) and 17.5% (in Cotonou). This reflects, to a great extent, the salary scales for civil servants, which are determined according to diploma and length of service. The modern private sector comes next (except in Niamey where it is the most rewarding) and finally the informal sector, with the exceptions of Lome, where the informal sector gives more value to schooling than the formal private sector (6% versus 5%), and Dakar where the marginal returns across sectors are roughly homogenous.

4.2.2. Convexity of the returns

As pointed out earlier, the results show strong evidence that earnings are non-linear in education, with a convex profile. For all the regressions reported in Tables A2-A5, we can reject the linear model at the 10% level or lower.[29] Convex marginal returns mean that education has a growing impact on remunerations. For instance, in almost all cases, a completed year of schooling in *lycée* (10–13 years) provides a greater return than a year in *collège* (7–9 years). This observation pertains to years in the *collège* compared to the primary cycle, especially in the private sectors. In Fig. 3, we represent the evolution of the pre-

[25] Note that tests for exogeneity based on Hausman test confirm these findings.

[26] Recall that instrumentation for the private sector in Bamako appeared dubious however.

[27] For instance, educated parents could more easily spot able children and encourage them to pursue their studies and/or children with high discount rates (due for instance to low taste for education).

[28] Sample selectivity is still accounted in all cases. Note, however, that using OLS for all sectors and cities does not alter the main findings of the paper.

[29] We investigated whether our findings are sensitive to functional form by considering the effects of modelling the earnings-education profile as second- and third-order polynomials. The quadratic function systematically produced significant squared education coefficients while the cubic form appeared less appropriate to fit the data in the majority of cases.

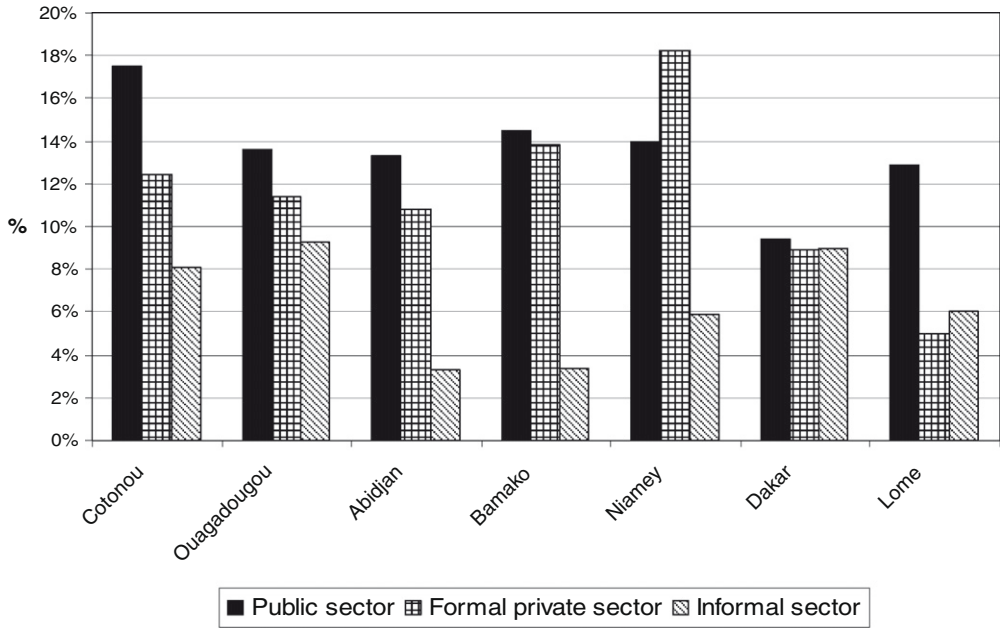

Fig. 2. Marginal returns to education by sector of activity (calculated at the sample mean). *Note*: Estimates are based on results reported in Table A.6. The returns are for an exogenous education variable for the public sector of all cities and for the private sectors of Abidjan and Bamako.

dicted earnings in the different sectors according to the years of completed schooling. For all sectors, we observe that earnings are roughly constant until about the 8th year of education and sharply increase around the 11th year, with small differences depending on the city considered. This rise in earnings happens slightly earlier for informal sector workers (around the 8th year of schooling). These patterns indicate that the convex profile is due to a large extent to the surge of income observed when individuals make the transition from secondary to higher education in the formal sectors while it is mainly due to the completion of the *collège* in the case of informal sector workers.

These results go against the traditional model of human capital accumulation whereby the marginal return to education is assumed to be constant or even decreasing. This convexity has already been highlighted by Schultz (2004) using household surveys for six African countries (Burkina, Côte d'Ivoire, Ghana, Kenya, Nigeria, South Africa) and by Söderbom et al. (2006) from samples of employees in manufacturing firms in Kenya and Tanzania. To our knowledge, so far, this feature of Africa's labor markets had never been documented at a sectoral level using representative samples of urban Africa. This is a meaningful result since it has been advocated that not accounting for the high proportion of workers in the informal sector may lead to over-estimate the returns to primary education while, at the same time, to underestimate the returns to higher education (Bennell, 1996). Here, convexity is revealed for all sectors, including informal activity. In our estimates, the marginal return to primary education is not only lower than those of the secondary and upper levels in all sectors but the return to primary school in the informal sector is also weaker than that of the formal private sector (on average for all the cities, 6.6% versus 7.2% respectively for the informal and private formal sector). Similarly, the average return to a year in *lycée* is greater in the informal sector (18.3%) than that in the formal sectors, both public and private (on average 15.5%). Hence, as Bennell (1996) presupposed, not accounting for earnings in the informal sector would indeed produce an overestimation of returns to primary school, but also possibly an underestimation of returns at higher levels of schooling. [30]

Observing increasing returns to education by levels is important because the idea that primary education is an effective instrument to fight against poverty is based partly on the hypothesis of a concave earnings function, which states that education is more profitable for the first years of schooling. Recommendations for policies aimed at promoting primary education in SSA were drawn up on the basis of this premise among others (Psacharopoulos and Patrinos, 2004). However, different arguments have been put forward in the literature that may explain the emergence of convexity in the returns to schooling (Bennell, 1996, 2002; Schultz, 2004). One refers to the overexpansion of primary education which may have lowered returns to primary relative to higher levels. Another is the decline over time in primary school quality which is likely to affect the return estimates (Behrman, Ross and Sabot, 2008). Slowdown in formal sector growth has also been mentioned, which may have reduced the demand for educated labor and perhaps affected the less educated individuals more strongly.

[30] Note, however, that these cross-country averages mask some country specificities.

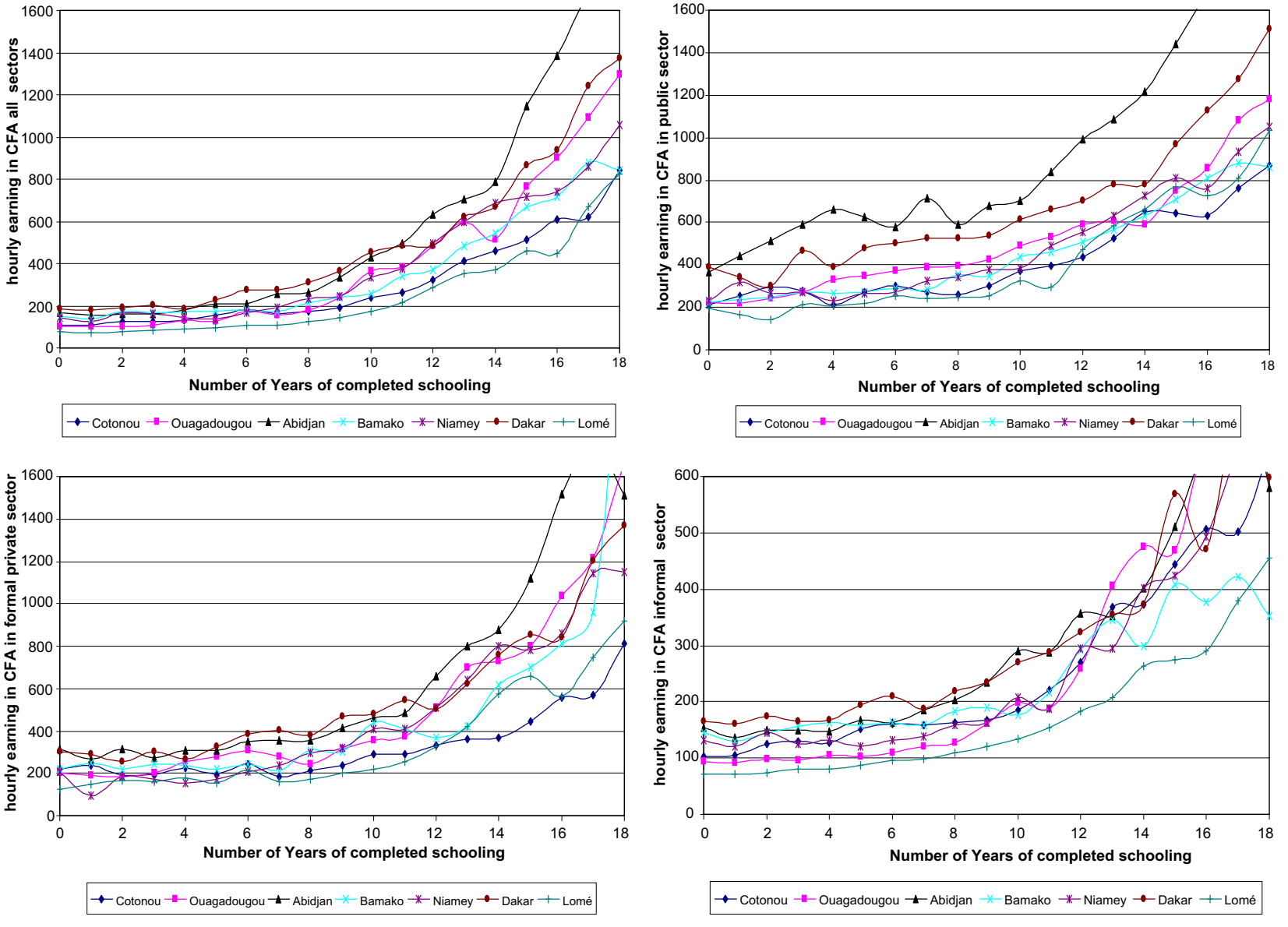

Fig. 3. Predicted earnings.

4.2.3. Differentiated returns between genders and cohorts

By estimating the magnitude of the returns to schooling using pooled samples of males and females individuals aged 15 and over, we rely on two important, and potentially restrictive, assumptions.

Firstly, by pooling the data across genders, we constraint the returns to individual characteristics to be identical for males and females. This might be a problem as women often have less continuous work participation than men, especially in Africa, and as a result may value their human capital differently in the labor market (Nordman and Roubaud, 2009).

We then check whether the rewards for human capital differ across gender by estimating earnings functions with a set of interactions with the gender dummy in such a way as to make the specification equivalent to separate earnings functions. In Table A.7, to save space, we only report the interactions with education and potential experience together with F-tests of joint significance of the interacted terms for each sectoral regression.

For education, in all cities, we cannot reject the hypothesis that the crossed education-gender effects are jointly zero in the public sector. For the private formal sector, this result holds true, except for Abidjan, though the crossed terms there are only jointly significant at the 10% level. For the informal sector, the tests also mostly reject heterogeneity in returns, with the exceptions of Niamey (at the 5% level) and Lome (at 10% level). Hence, these estimates give mostly support to the pooling assumption.[31] Turning to the effects of potential experience, the results of the tests are mostly in favor of the pooling assumption as well, except in the informal sector where we reject the hypothesis that the crossed experience-gender effects are jointly zero in three cases (Ouagadougou, Abidjan and Dakar). In those cases, females' experience-earnings profiles are flatter than those of men who mostly have a concave experience-earnings profile, especially in the informal sector. A flatter profile may be reflective of greater measurement error in women's potential experience due to their more discontinuous labor force attachment.[32]

Overall, while the absence of gender differentiation in the returns to human capital in the public sector is not so surprising given that earnings are set there from formal wage scales irrespective of sex, these mixed results in the private sectors may be more unexpected. For instance, Schultz (2002) provides a discussion on gender differences in returns to schooling in developing countries and concludes that the balance of evidence indicates that these estimates tend to be somewhat higher for women than for men.[33] Such evidence for Africa include studies of Vijverberg (1993) for Côte d'Ivoire, Glick and Sahn (1997) and Siphambe and Thokweng-Bakwena (2001), respectively for the public sector of Guinea and Botswana, and more recently Nordman and Roubaud (2009) for Madagascar. Mixed evidence of greater education returns for females have been found by Appleton, Hoddinott and Krishnan (1999) for Côte d'Ivoire, Ethiopia and Uganda. By contrast, higher returns to education for men are obtained by Cohen and House (1993) for the formal sector in Sudan.

In our cases on West Africa, two explanations of the similar education returns across gender come to mind: firstly, our samples are representative of urban areas where gender differentiation in the labor market is probably less prominent than in rural regions. Secondly, decreasing marginal returns to schooling across education levels had been advanced to explain the observed greater returns to education for women (Schultz, 2002), since women tended to have less education than men on average[34], and returns were often observed to be higher at lower levels of schooling. However, the convexity of the marginal returns evidenced here has now probably a counterbalancing effect.

Another issue of concern is whether we should consider young and old workers in the same regressions, or more generally individuals belonging to different age cohorts. This is potentially problematic if these two categories receive different rewards for their observed characteristics due to differentiated labor market conditions at the time they got their job. Pooling these individuals implies that there is no cohort effect in the return to human capital. As this assumption does not necessarily hold, we relax it by estimating earnings functions with crossed effects using a dummy indicating whether the individual is above 30 years old (old). We perform a F-test of joint significance of the crossed education-old coefficients and report summary results in Table A.8.

For the public sector, the tests never reject the hypothesis that the crossed terms of education are jointly zero while, for the private formal sector, rejection is obtained for Dakar and Lome. For the informal sector, only Dakar exhibits different education-earnings profiles for young and "old" workers. Then, the pooling assumption across these two cohorts does not seem to be a so strong hypothesis, at least for education.

However, from Table A.8, it is easy to compute the returns to education by level for young and old workers in the informal sector where samples are large enough. We observe that the returns to a year in *lycée* and in higher education are always greater for young individuals in the cases of Abidjan, Bamako, Dakar and Lome and, to a lesser extent because for higher edu-

[31] Among the few cases where education is differently and significantly rewarded across gender, Abidjan reports greater return to higher education for females in the private formal sector. Similar pattern is observed for the informal sectors of Cotonou and Lome. Likewise, women benefit from a higher return to primary schooling in the private formal sector of Bamako. By contrast, the return to a year in *collège* is greater for men in the informal sectors of Abidjan and Niamey.

[32] If actual measures of experience were available in our data, this would not necessarily solve the issue of biased returns to experience. Indeed, using actual in lieu of potential experience is likely to introduce another bias since actual measures are more prone to reflect preference for work, then possibly ability.

[33] See also Dougherty (2003) for explanations of this documented stylized fact.

[34] This is still the case here as, on average across all the cities in our data, female paid-work participants have 4.0 years of schooling while their male counterparts benefit from 6.2 years.

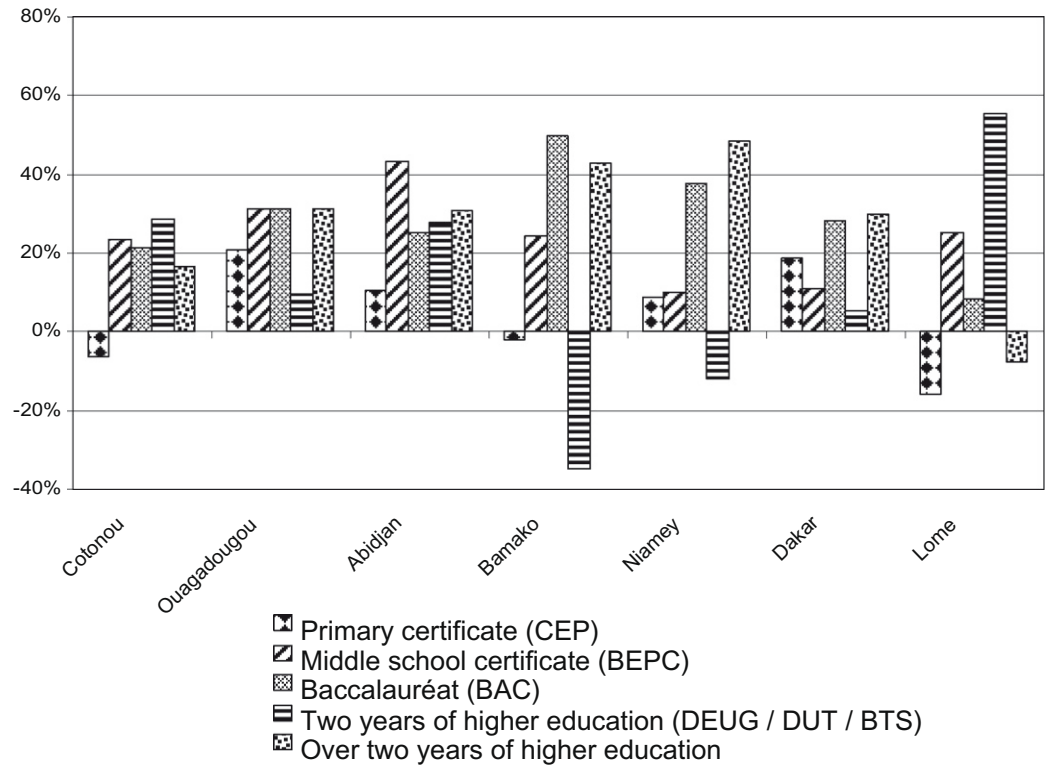

Fig. 4. Marginal returns to qualifications in the public sector.

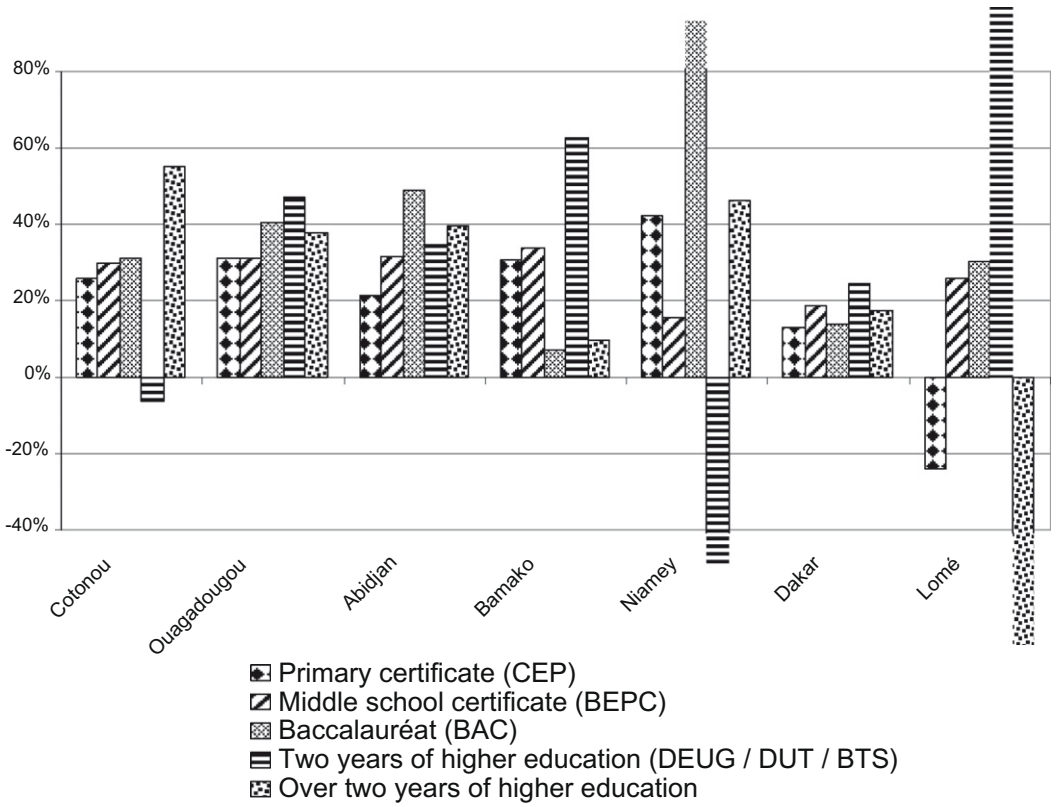

Fig. 5. Marginal returns to qualifications in the formal private sector.

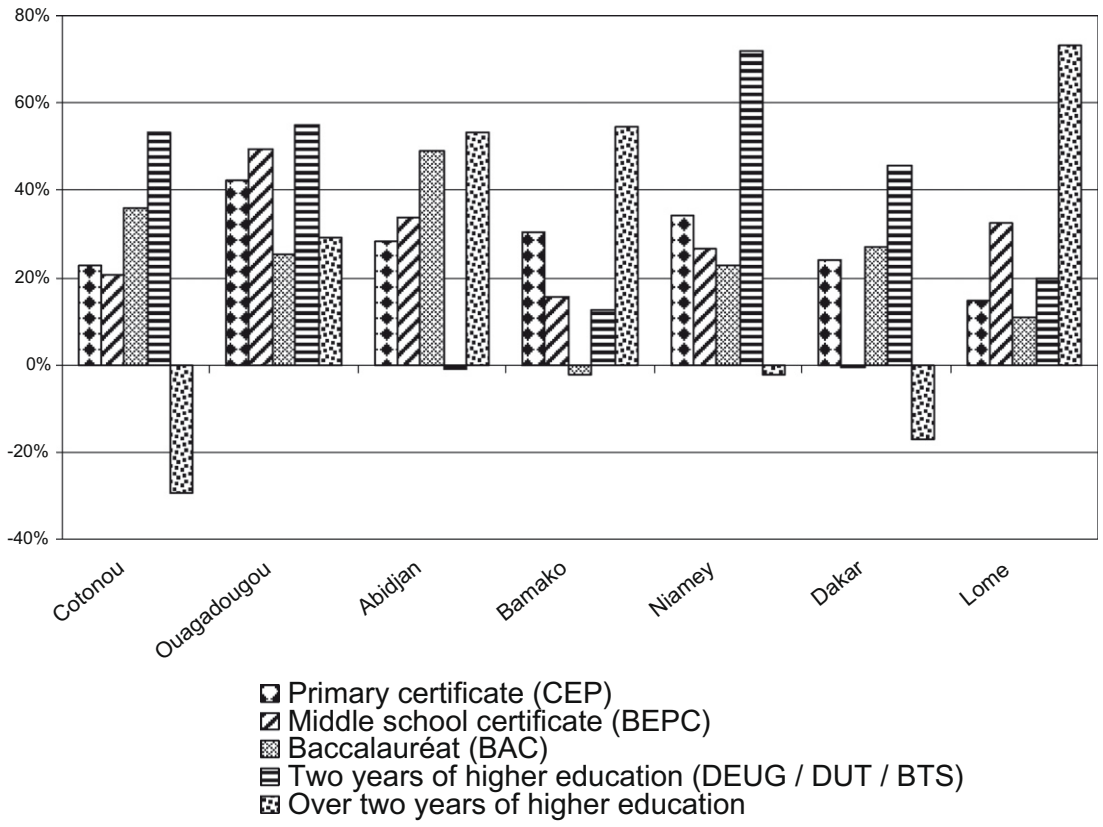

Fig. 6. Marginal returns to qualifications in the informal sector.

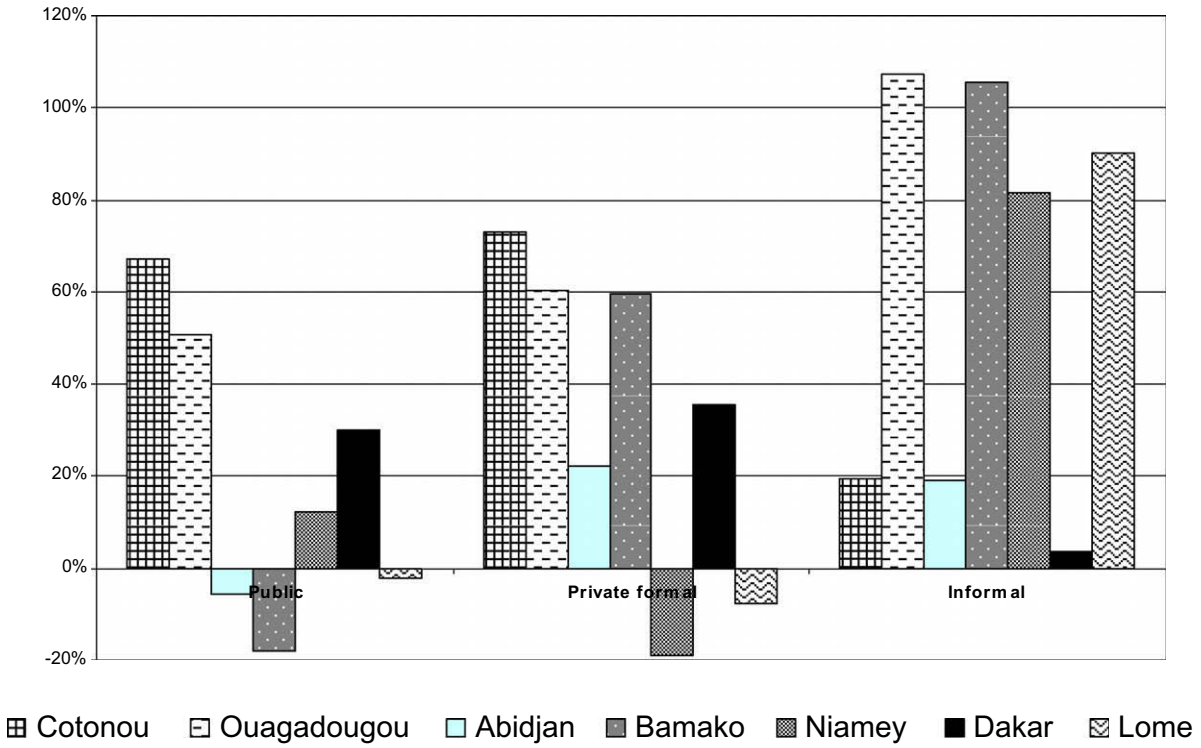

Fig. 7. Marginal returns to the vocational certificate (BEP*) compared to the *Baccalauréat*. *Note*: **Brevet d'Études Professionnelles*.

cation only, in the cases of Cotonou, Ouagadougou and Niamey. By contrast, in all cities except Ouagadougou, the return to a year in *collège* is greater for old workers. This indicates that the convex earnings-education profile previously observed is more acute for young workers than for their elder counterparts. Hence, in most cities, the existence of increasing returns by level of education concerns mainly the youngest generation of workers. However, note that this pattern is less clear in the formal sectors.

4.3. Returns to qualifications

The fact that the earnings function is convex prompted us to make more detailed analyses, measuring the returns to different levels of qualification and not just to average years. To do so, we estimate the marginal returns to holding a diploma, thus accounting for the quality of the school career. In the private sectors, we control for the endogeneity of schooling (except for Abidjan and Bamako) using the CF method. [35]

Returns to qualifications can be studied in at least two ways. One way is to directly consider the regression model coefficients. In this case, the coefficient associated with each qualification dummy is interpreted as the rate of increase in earnings between individuals with no qualifications (the reference) and individuals with the qualification considered. Another way is to calculate the marginal returns obtained by subtracting from the considered qualification's coefficient (qualification *d*) the value of the coefficient for the qualification immediately below it (qualification *d*-1). For example, the marginal return to a *baccalauréat* plus two years of higher education (BAC + 2) is the difference between the coefficient for the BAC + 2 and the coefficient for just the *baccalauréat* alone. The return to a primary certificate (CEP) is the difference compared to the "no diploma" category, that of the middle school certificate (BEPC) compared to the CEP, that of the BAC compared to the BEPC, etc. The marginal returns hence correspond to the increases in earnings generated by the acquisition of the successive qualifications. In this paper, we rely on the marginal returns since they measure the additional value of each qualification rather than the value compared with "no qualifications", which can almost always only ever be positive.

The various sectoral earnings functions are not presented for reason of space.[36] Instead, we report histograms of the marginal returns to the various qualifications for each sector in Figs. 4–7. Not surprisingly, the effect of each qualification on earnings is positive overall with a huge quantitative leap for secondary and higher education, as already shown. The most striking result is that, depending on the capitals, a certain number of diplomas do not have positive intrinsic marginal returns. This situation either reflects the inadequacy of the training considered with respect to the labor market, or the fact that certain diplomas do not in fact target the labor market but are solely aimed at giving access to higher levels of education. Although the latter hypothesis can be put forward to explain the low marginal profitability of a few diplomas in the public sector (like the short higher education courses in Bamako, Niamey, Ouagadougou, and Dakar, Fig. 4), the fact that for a large number of diplomas additional earnings are nil or negative in the formal private sector (Fig. 5) suggests, as we stressed in the introduction, that many of the training schemes do not correspond to the needs of the labor market in this sector.

None of the capitals escapes from this lack of connection between the level of training revealed by the diploma and the remuneration obtained on the formal private labor market. In the informal sector (Fig. 6), the marginal earnings seem to be more coherent with the level of training acquired than in the formal private sector (but less than in the public sector). This result goes against the idea that the informal sector does not enhance the value of educational capital. Furthermore, the profitability of education in the informal sector is illustrated in a spectacular way by the income premium received by individuals when they have a vocational diploma (in particular the BEP, Fig. 7), in a sector where the returns to vocational training very often exceed those that the same diploma can procure in the formal private sector. Moreover, vocational education qualifications are often found to be more profitable than general education qualifications when compared with the number of years required to obtain them. For example, although it generally takes one year less to obtain the vocational certificate (BEP, on average 11.6 years) than to obtain the *baccalauréat (*on average 13.0 years*)*, the BEP is most often more profitable than the *baccalauréat*, especially in the informal sector (Fig. 7). The returns to the BEP are even found to be significantly over 40% higher than the returns to the *baccalauréat* in the formal private sector of Cotonou, and in the informal sectors of Ouagadougou, Bamako, Niamey and Lome. The same result holds true if we compare the premium for obtaining the CAP (vocational certificate equivalent to completed primary school) versus the BEPC (general certificate of completed primary education).

5. Conclusion

Using a series of comparable labor force surveys in urban West Africa, we estimate the private returns to education among representative samples of workers in seven economic capitals. The data we use allow us to provide a unique cross-country comparison using rigorously the same variables and methodology for each city.

[35] Note that we do not include a continuous variable of education together with the dummies for diplomas as the estimated effects would then be more difficult to interpret. Our purpose is then to account both for the quantity and quality of schooling attainment, and not only for the potential filter effects that might be attached to obtaining a diploma (Arrow, 1973; Spence, 1973).

[36] We neglect the potential cohort effects in the regressions for the sake of simplicity.

Our study tackles two recurrent econometric issues when one wants to assess the effect of education on individual earnings. First, we address the issue of endogenous sector allocation (public, formal private and informal sectors) in the earnings functions estimates and provide evidence that correcting for this sample selectivity refines the returns to education in all cities and sectors. Second, in most cities, the assumption of exogeneity of the education variable can be rejected, except in the public sector. Then, using the workers' family background as an instrument for education, we find that the returns to schooling are most often enhanced once endogeneity is accounted for. This effect holds particularly true in the informal sector.

In most West African cities, the public sector gives more value to education, followed by the formal private sector and then the informal sector. However, there are noticeable exceptions stressing for instance that, in Lome, the informal sector rewards schooling at least as well as the formal private sector and that, in Dakar, average returns to education are relatively homogenous across sectors of employment.

Yet, whereas traditional theories assume constant or concave marginal returns to education, which ensure immediate, high profitability from the first years of schooling, the West African data from the *1–2-3 Surveys* help bring to light convex returns in all sectors, including in informal activity. This finding, then, casts doubts on the suitability of estimating average marginal returns and calls for disaggregated estimates at each level of the educational path. We provide evidence that the convex profile is due to a large extent to the surge of income observed when individuals make the transition from secondary to higher education in the formal sectors while it is mainly due to the completion of the first secondary cycle in the case of informal sector workers. In addition, in the cases of Abidjan, Bamako, Dakar and Lome, the convex earnings-education profile observed is more acute for young workers than for their elder counterparts, especially in the informal sector. More generally, this is a major contribution of this study to show that education, even at high levels, provides a substantial growth in earnings in informal work in most of the cities studied.[37] To our knowledge, so far, these features of Africa's labor markets had never been documented at a sectoral level using representative samples of urban areas.

Possible policy implications of our findings are worth discussing. Convexity of the returns to schooling means that stimulating access to primary education is only effective in reducing poverty if individuals concerned by this type of initiative can continue their studies in order to take full advantage of the high marginal returns related with long studies. However, this poses the delicate question of managing the flows of students leaving the general secondary and higher education cycles, which could certainly benefit from an in-depth review on the (too) general content of the schooling programs, in order to readapt them to the labor market needs. In the meantime, in order to increase the returns to low levels of schooling, improving primary school quality should certainly remain on top of any education's political agenda.

However, as mentioned in introduction, West African cities are characterized by increasing unemployment, especially among educated workers. For instance, there is an explosion in the numbers of highly qualified young people who are unable to find jobs to fit their skills in the formal sector. This mismatch between (increasing) investment in schooling and actual labor market opportunities is a major challenge faced by policy makers. Would then an increase in education generate its own demand? Or would more educated people simply add to the pool of disenfranchised and disillusioned workers, whose only hope is to migrate and find employment somewhere else? For years, the existence of significant rents in the formal labor sector (especially in the dominant public sector) are known to be so high that it is rational for individuals to "queue" and to discount the returns to be accrued in the informal sector.

If our findings help in adding more insight into the question of where specific bottlenecks arise on the labor demand side, they also provide evidence of the existence of significant returns to education in the informal sector that may counterbalance the incentive for job queuing. More specifically, if schooling helps workers in the informal sector to be more productive (probably thanks to innovation and adaptability), then the household and government investments made for their education are not in vain. Given that the informal sector has created over 80% of urban jobs in West Africa in recent years, concentrating public investments in employment in this sector with really attractive policies for the most qualified people could be, at least in the short term, a serious alternative to the lack of employment observed in the formal sectors. Such a policy, coupled with continued support to primary school quality and post-primary education, could also pay off in the medium to long term by generating the accumulation required for the modern economy to take off in the African cities.

Appendix A.

(See Tables A1-A8).

[37] Of course, the informal sector's heterogeneity in this respect deserves consideration, notably the possible co-existence of different employment segments within the informal activity with own specific features. We leave this for future research.

Table A.1
Summary Statistics of the Samples of Paid-Work Participants.

Observations (individuals with positive earnings)	Cotonou (Benin) 4398		Ouagadougou (Burkina Faso) 4211		Abidjan (Côte d'Ivoire) 4262		Bamako (Mali) 4032		Niamey (Niger) 3601		Dakar (Senegal) 5434		Lome (Togo) 3916	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Hourly earnings in PPA	0.29	0.47	0.29	0.71	0.49	0.98	0.36	1.00	0.36	0.90	0.44	1.11	0.22	0.47
Log hourly earnings in public sector	-0.77	0.81	-0.70	0.77	0.00	0.72	-0.66	0.74	-0.75	0.81	-0.42	0.74	-0.96	0.89
Log hourly earnings in formal private	-1.17	0.82	-1.01	0.92	-0.72	0.96	-1.23	1.09	-1.13	1.09	-0.89	0.89	-1.40	1.04
Log hourly earnings in informal sec.	-2.04	0.93	-2.36	1.01	-1.81	0.97	-1.95	1.05	-2.03	0.98	-1.75	0.96	-2.40	0.99
Dummy for woman	0.52		0.41		0.44		0.44		0.36		0.43		0.52	
Age in years	35.92	11.58	34.98	12.23	33.32	10.69	35.00	12.44	36.90	12.26	35.08	12.44	33.89	11.01
Dummy for above 30 years old	0.61		0.58		0.53		0.59		0.66		0.57		0.56	
Dummy for being native	0.45		0.41		0.28		0.43		0.36		0.58		0.40	
Dummy for urban migrant	0.27		0.36		0.43		0.31		0.28		0.25		0.35	
Dummy for rural migrant	0.19		0.12		0.07		0.18		0.25		0.11		0.12	
Dummy for foreign migrant	0.10		0.10		0.21		0.07		0.10		0.03		0.14	
Dummy for monogamous married	0.55		0.50		0.44		0.48		0.52		0.38		0.47	
Dummy for polygamous married	0.16		0.14		0.04		0.20		0.15		0.15		0.13	
Dummy for free union	0.02		0.02		0.07		0.00		0.00		0.00		0.03	
Dummy for single	0.21		0.29		0.38		0.28		0.25		0.40		0.28	
Dummy for divorced	0.03		0.01		0.03		0.01		0.03		0.04		0.06	
Dummy for widowed	0.03		0.04		0.03		0.02		0.04		0.03		0.04	
Dummy for Christian	0.81		0.42		0.45		0.03		0.03		0.07		0.52	
Dummy for Muslim	0.10		0.57		0.43		0.96		0.97		0.93		0.11	
Dummy for other religion	0.09		0.01		0.12		0.01		0.00		0.00		0.37	
Completed years of education	5.92	5.14	4.47	5.10	5.30	5.21	4.13	5.16	4.80	5.52	4.75	4.90	6.09	4.59
Dummy for no schooling	0.55		0.62		0.57		0.67		0.65		0.67		0.48	
Dummy for primary certificate (CEP)	0.22		0.18		0.20		0.14		0.14		0.14		0.30	
Dummy for middle school cert. (BEPC)	0.10		0.09		0.07		0.04		0.05		0.09		0.12	
Dummy for occupational proficiency certificate (CAP)	0.02		0.02		0.01		0.03		0.02		0.01		0.01	
Dummy for vocational certificate (BEP)	0.00		0.01		0.01		0.05		0.02		0.01		0.01	
Dummy for *baccalauréat* (BAC)	0.02		0.02		0.03		0.01		0.02		0.03		0.02	
Dummy for two years of higher education (DEUG/DUT/BTS)	0.01		0.01		0.03		0.01		0.01		0.01		0.01	
Dummy for over two years of higher ed.	0.05		0.04		0.05		0.04		0.06		0.03		0.03	
Potential experience in years (age-education-6)	23.99	12.50	24.50	13.82	22.04	11.50	24.88	13.14	26.18	14.35	24.26	13.35	21.82	12.16
Seniority in the current job in years	8.13	8.34	6.68	7.48	6.32	6.73	8.04	8.20	8.71	8.61	9.96	8.23	6.12	7.32
Dummy for father executive or manager	0.12		0.06		0.10		0.12		0.08		0.09		0.10	
Dummy for father wage-employee	0.16		0.15		0.16		0.11		0.13		0.22		0.19	
Dummy for father self-employed	0.48		0.53		0.56		0.55		0.53		0.39		0.50	

(*continued on next page*)

Table A.1 (*continued*)

Observations (individuals with positive earnings)	Cotonou (Benin) 4398		Ouagadougou (Burkina Faso) 4211		Abidjan (Côte d'Ivoire) 4262		Bamako (Mali) 4032		Niamey (Niger) 3601		Dakar (Senegal) 5434		Lome (Togo) 3916	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dummy for father with no schooling	0.52		0.79		0.65		0.64		0.79		0.44		0.45	
Dummy for father with 1–5 years of ed.	0.21		0.07		0.19		0.14		0.07		0.03		0.21	
Dummy for father with 6–9 years of ed.	0.15		0.05		0.07		0.04		0.04		0.07		0.16	
Dummy for father with 10–25 y. of ed.	0.13		0.05		0.07		0.07		0.05		0.06		0.12	
Dummy for household head	0.51		0.44		0.49		0.43		0.54		0.29		0.52	
Dummy for head's spouse	0.28		0.26		0.18		0.28		0.20		0.14		0.23	
Dummy for head's child	0.12		0.17		0.10		0.14		0.16		0.28		0.12	
Dummy for head's parent (father/ mother)	0.00		0.01		0.00		0.01		0.01		0.01		0.00	
Dummy for head's other parent	0.07		0.11		0.16		0.09		0.08		0.24		0.10	
Dummy for head's not parent person	0.01		0.01		0.04		0.01		0.01		0.02		0.02	
Dummy for head's domestic	0.02		0.01		0.03		0.04		0.01		0.02		0.02	
Inverse dependency ratio (working indiv. / indiv. in the household)	1.41	1.33	1.03	0.88	1.28	1.13	0.93	0.85	0.94	1.04	1.09	1.13	1.39	1.05
Dummy for working in the public sector	0.10		0.15		0.08		0.11		0.18		0.09		0.09	
Dummy for working in the formal private sector	0.12		0.08		0.21		0.11		0.13		0.18		0.08	
Dummy for working in the informal sector	0.78		0.77		0.72		0.78		0.69		0.73		0.83	

Source: 1-2-3 Surveys, Phase 1 (2001–2002), National Institutes of Statistics, AFRISTAT, DIAL; authors' calculations. The figures are weighted by the sampling ratio of the surveys.

Table A.2
Earnings functions with endogenous education and selectivity correction (all sectors). Dependent variable: log of hourly earnings.

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Education							
0–6 years (*Primaire*)	0.080***	0.103***	0.037***	0.058***	0.052***	0.092***	0.064***
	(9.24)	(9.66)	(3.44)	(5.34)	(4.23)	(9.00)	(4.82)
7–9 years (*Collège*)	0.077***	0.182***	0.112***	0.104***	0.158***	0.106***	0.102***
	(5.42)	(11.55)	(6.92)	(4.78)	(7.44)	(6.92)	(5.80)
10–13 years (*Lycée*)	0.174***	0.201***	0.187***	0.171***	0.182***	0.134***	0.215***
	(7.98)	(8.76)	(7.62)	(6.13)	(6.21)	(5.85)	(8.41)
+13 years (Higher education)	0.141***	0.157***	0.166***	0.138***	0.103***	0.166***	0.154***
	(8.46)	(8.42)	(7.99)	(6.44)	(6.23)	(8.80)	(4.90)
Potential experience	0.011*	0.044***	0.014**	0.029***	0.028***	0.033***	0.025***
	(1.78)	(7.73)	(2.31)	(5.10)	(4.47)	(5.65)	(3.80)
(Potential experience)^2/100	−0.008	−0.052***	−0.002	−0.036***	−0.030***	−0.040***	−0.030***
	(0.81)	(6.34)	(0.22)	(4.33)	(3.44)	(4.59)	(2.79)
Seniority in current job	0.024***	0.030***	0.027***	0.025***	0.030***	0.028***	0.032***
	(4.87)	(5.82)	(4.76)	(5.03)	(5.60)	(5.65)	(5.76)
(Seniority in current job) ^{2}/100	−0.040**	−0.040**	−0.058***	−0.033**	−0.047***	−0.041***	−0.053***
	(2.43)	(2.49)	(2.94)	(2.23)	(2.88)	(2.96)	(2.83)

Table A.2 (*continued*)

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Woman	−0.330***	−0.210***	−0.325***	−0.190***	−0.249***	−0.264***	−0.229***
	(8.92)	(5.20)	(7.48)	(3.49)	(4.81)	(6.69)	(4.42)
Public sector	0.383***	0.640***	0.675***	0.281***	0.420***	0.469***	0.610***
	(9.13)	(15.83)	(14.24)	(5.75)	(9.41)	(11.14)	(10.99)
Formal private sector	0.229***	0.591***	0.476***	0.229***	0.397***	0.407***	0.418***
	(5.64)	(13.16)	(15.03)	(4.59)	(8.49)	(11.83)	(7.39)
Corrections							
Control variable (residuals of education regression)	−0.028***	−0.038***	−0.007	−0.030***	−0.015	−0.037***	−0.023*
	(3.81)	(4.79)	(0.74)	(3.70)	(1.60)	(4.02)	(1.90)
Inverse Mills ratio	−0.092	0.055	−0.240***	0.058	0.035	0.004	−0.026
	(1.49)	(1.03)	(3.86)	(1.06)	(0.58)	(0.07)	(0.36)
Constant	−2.296***	−3.214***	−2.023***	−2.480***	−2.759***	−2.506***	−2.967***
	(21.30)	(28.63)	(19.41)	(23.18)	(20.51)	(20.02)	(24.76)
Observations	4184	3665	4011	3821	3069	4364	3496
Pseudo R-squared	0.41	0.55	0.51	0.38	0.46	0.42	0.38

Note: The additional explanatory variables in the models are migratory status (dummies for rural, urban or foreign migrants), marital status (dummies for single, monogamous married, polygamous married, widowed, free union, divorced) and dummies for religion (Muslim, Christian). The inverse Mill's ratio is derived from a probit estimation of labor market participation for each city (with, as dependent variable, a dummy variable of strictly positive income) comprising age and its squared, gender, years of education, migratory status, marital status, religion and one identifying variable namely the dependency ratio. The Student statistics are given in parenthesis. Standard errors are bootstrapped with 500 replications. The reference category is a male working in the informal sector.

* indicates that the coefficient is significant at the 10% level.

** idem, 5% level.

*** idem, 1% level

Table A.3
Earnings functions with endogenous education and selectivity correction in the public sector. Dependent variable: log of hourly earnings.

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Education							
0–6 years (*Primaire*)	0.063	0.095***	0.090**	0.085**	0.031	0.069*	−0.016
	(1.44)	(3.08)	(1.97)	(2.32)	(1.10)	(1.72)	(0.21)
7–9 years (*Collège*)	0.125**	0.139***	−0.048	0.131***	0.127***	0.034	−0.024
	(2.28)	(3.51)	(0.81)	(2.58)	(3.42)	(0.74)	(0.35)
10–13 years (*Lycée*)	0.182***	0.141***	0.138**	0.157***	0.148***	0.112**	0.094
	(3.56)	(3.86)	(2.43)	(3.50)	(3.91)	(2.41)	(1.21)
+13 years (Higher education)	0.141***	0.124***	0.099***	0.135***	0.094***	0.127***	0.075*
	(3.76)	(5.75)	(2.80)	(5.33)	(4.37)	(3.89)	(1.82)
Potential experience	0.041	0.058***	−0.012	0.069***	0.058***	0.015	−0.022
	(1.33)	(3.50)	(0.45)	(3.59)	(5.36)	(0.59)	(0.62)
(Potential experience)^2/100	−0.017	−0.063**	0.064	−0.091***	−0.078***	0.007	0.062
	(0.31)	(2.25)	(1.25)	(2.76)	(4.39)	(0.18)	(1.04)
Woman	−0.003	−0.058	−0.017	−0.072	−0.081	−0.105	0.281*
	(0.03)	(0.97)	(0.20)	(1.07)	(1.37)	(1.19)	(1.88)
Corrections							
Control variable (residuals of education regression)	−0.008	−0.007	−0.006	−0.015	0.011	−0.015	0.033
	(0.51)	(0.59)	(0.26)	(1.04)	(0.86)	(0.97)	(1.13)
Inverse Mills ratio	−0.100	0.003	0.493**	−0.184	0.016	0.249	0.711*
	(0.29)	(0.01)	(2.42)	(1.03)	(0.12)	(0.92)	(1.88)
Constant	−2.679**	−2.716***	−0.176	−3.235***	−2.427***	−1.089	0.253
	(2.00)	(3.95)	(0.21)	(4.77)	(5.79)	(1.09)	(0.18)
Observations	411	595	306	459	597	483	313
Pseudo R-squared	0.46	0.53	0.44	0.38	0.47	0.38	0.45

Note: The additional explanatory variables in the models are migratory status, marital status and religion. The Lee ratio is derived from a multinomial logit model of sector choices (with, as reference category, non-paid-work participation) comprising age and its squared, gender, years of education, migratory status, marital status, religion and identifying variables namely dummies on how the individual is related to the head of household and the dependency ratio. The Student statistics are given in parenthesis. The standard errors are bootstrapped with 500 replications.

* indicates that the coefficient is significant at the 10% level.

** idem, 5% level.

*** idem, 1% level.

Table A.4
Earnings functions with endogenous education and selectivity correction in the formal private sector. Dependent variable: log of hourly earnings.

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Education							
0–6 years (*Primaire*)	0.057	0.127***	0.040*	0.101***	0.094***	0.084***	0.070
	(1.57)	(3.86)	(1.72)	(2.88)	(2.61)	(3.58)	(1.17)
7–9 years (*Collège*)	0.139***	0.114***	0.116***	0.184***	0.182***	0.089***	0.050
	(3.93)	(2.66)	(4.32)	(3.38)	(3.51)	(3.39)	(0.91)
10–13 years (*Lycée*)	0.124**	0.247***	0.218***	0.113	0.171**	0.141***	0.260***
	(2.54)	(4.79)	(5.84)	(1.45)	(2.52)	(4.18)	(3.55)
+13 years (*Higher education*)	0.175***	0.205***	0.214***	0.261***	0.115**	0.169***	0.184***
	(6.06)	(3.66)	(6.83)	(5.44)	(2.41)	(5.94)	(3.17)
Potential experience	0.019	0.042**	0.040***	0.020	0.053***	0.032**	0.041*
	(1.51)	(1.97)	(3.26)	(0.98)	(3.05)	(2.39)	(1.76)
(Potential experience)^2/100	0.011	−0.036	−0.027	0.012	−0.045	−0.022	−0.026
	(0.50)	(1.06)	(1.26)	(0.34)	(1.48)	(1.04)	(0.62)
Woman	−0.039	−0.016	−0.083	0.036	−0.422**	−0.058	0.031
	0.057	0.127***	0.040*	0.101***	0.094***	0.084***	0.070
Corrections							
Control variable (residuals of education regression)	−0.021	−0.042**	−0.008	−0.068***	0.009	−0.029*	0.015
	(1.31)	(2.07)	(0.53)	(2.98)	(0.39)	(1.88)	(0.39)
Inverse Mills ratio	−0.093	0.050	0.070	0.345	−0.328	0.203	−0.122
	(0.56)	(0.21)	(0.62)	(1.18)	(1.38)	(1.04)	(0.44)
Constant	−2.362***	−2.708***	−1.930***	−2.081***	−3.491***	−1.778***	−3.186***
	(4.64)	(3.30)	(5.77)	(3.02)	(5.48)	(3.39)	(3.75)
Observations	529	346	854	455	414	957	307
Pseudo R-squared	0.36	0.48	0.46	0.32	0.46	0.32	0.35

Note: The additional explanatory variables in the models are migratory status, marital status and religion. The Lee ratio is derived from a multinomial logit model of sector choices (with, as reference category, non-paid-work participation) comprising age and its squared, gender, years of education, migratory status, marital status, religion and identifying variables namely dummies on how the individual is related to the head of household and the dependency ratio. The Student statistics are given in parenthesis. The standard errors are bootstrapped with 500 replications.
* indicates that the coefficient is significant at the 10% level.
** idem, 5% level.
*** idem, 1% level.

Table A.5
Earnings functions with endogenous education and selectivity correction in the informal sector. Dependent variable: log of hourly earnings.

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Education							
0–6 years (*Primaire*)	0.081***	0.093***	0.029*	0.050***	0.059***	0.090***	0.060***
	(7.66)	(6.26)	(1.88)	(3.92)	(3.36)	(7.26)	(3.96)
7–9 years (*Collège*)	0.073***	0.167***	0.122***	0.067**	0.138***	0.093***	0.110***
	(4.54)	(6.67)	(4.64)	(2.55)	(4.07)	(3.99)	(5.49)
10–13 years (*Lycée*)	0.205***	0.231***	0.122***	0.184***	0.208***	0.130***	0.196***
	(5.43)	(4.63)	(2.74)	(3.75)	(3.44)	(2.88)	(5.13)
+13 years (*Higher education*)	0.144***	0.194***	0.225***	0.036	0.141**	0.151**	0.144**
	(3.40)	(3.54)	(4.10)	(0.49)	(2.44)	(2.31)	(2.39)
Potential experience	0.012*	0.046***	0.022***	0.031***	0.023***	0.044***	0.030***
	(1.93)	(7.47)	(3.00)	(5.32)	(3.15)	(7.78)	(4.80)
(Potential experience)^2/100	−0.008	−0.048***	−0.011	−0.034***	−0.015	−0.051***	−0.031***
	(0.89)	(5.69)	(1.01)	(4.24)	(1.49)	(6.43)	(3.24)
Woman	−0.442***	−0.310***	−0.491***	−0.254***	−0.269***	−0.320***	−0.331***
	(10.09)	(5.49)	(8.57)	(4.34)	(4.27)	(7.82)	(5.86)
Corrections							
Control variable (residuals of education regression)	−0.031***	−0.032**	0.006	−0.020*	−0.029*	−0.033***	−0.027**
	(3.43)	(2.38)	(0.39)	(1.74)	(1.80)	(2.67)	(2.01)
Inverse Mills ratio	0.125*	−0.049	0.233***	−0.062	0.054	−0.018	0.047
	(1.77)	(0.72)	(3.08)	(1.06)	(0.78)	(0.29)	(0.59)
Constant	−2.101***	−2.995***	−1.778***	−2.256***	−2.483***	−2.386***	−2.811***
	(17.60)	(21.99)	(13.61)	(17.81)	(13.96)	(19.14)	(20.07)

Table A.5 (*continued*)

	Cotonou (Benin) (1)	Ouagadougou (Burkina Faso) (2)	Abidjan (Côte d'Ivoire) (3)	Bamako (Mali) (4)	Niamey (Niger) (5)	Dakar (Senegal) (6)	Lome (Togo) (7)
Observations	3250	2771	2859	2929	2233	3423	2930
Pseudo R-squared	0.26	0.31	0.25	0.24	0.17	0.20	0.22

Note: The additional explanatory variables in the models are migratory status, marital status, how the individual is related to the head of household (dummies for head of household, spouse, son/daughter, father/mother, other relatives) and religion. The Lee ratio is derived from a multinomial logit model of sector choices (with, as reference category, non-paid-work participation) comprising age and its squared, gender, years of education, migratory status, marital status, how the individual is related to the head of household, religion and one identifying variable namely the dependency ratio. The Student statistics are given in parenthesis. The standard errors are bootstrapped with 500 replications.

* indicates that the coefficient is significant at the 10% level.

** idem, 5% level.

*** idem, 1% level.

Table A.6

Marginal returns to education using alternative estimation techniques (computed at the sample mean using the piecewise linear spline earnings function in Tables A.2–A.5).

	Cotonou (Benin)	Ouagadougou (Burkina Faso)	Abidjan (Côte d'Ivoire)	Bamako (Mali)	Niamey (Niger)	Dakar (Senegal)	Lome (Togo)
All sectors							
OLS	0.058***	0.069***	0.033***	0.033***	0.038***	0.059***	0.044***
Selectivity corrected (Lee's method)	0.059***	0.070***	0.031***	0.033***	0.039***	0.059***	0.045***
Selectivity corrected + father's characteristics	0.053***	0.065***	0.031***	0.029***	0.035***	0.056***	0.041***
Selectivity corrected + Control Function (CF)	0.080***	0.103***	0.037***	0.058***	0.052***	0.092***	0.064***
Observations	*4184*	*3665*	*4011*	*3821*	*3069*	*4364*	*3496*
Public sector							
OLS	0.163***	0.136***	0.206***	0.114***	0.142***	0.118***	0.245***
Selectivity corrected (Lee's method)	0.175***	0.136***	0.133**	0.145***	0.140***	0.094**	0.129*
Selectivity corrected + father's characteristics	0.178***	0.137***	0.144***	0.154***	0.139***	0.093**	0.120*
Selectivity corrected + Control Function (CF)	0.182***	0.141***	0.138**	0.157***	0.127***	0.112**	0.094
Observations	*411*	*595*	*306*	*459*	*597*	*483*	*313*
Formal private sector							
OLS	0.104**	0.075**	0.112***	0.143***	0.181***	0.077***	0.056
Selectivity corrected (Lee's method)	0.111**	0.065*	0.108***	0.138***	0.191***	0.065***	0.063
Selectivity corrected + father's characteristics	0.099**	0.069*	0.107***	0.115**	0.195***	0.063***	0.064
Selectivity corrected + Control Function (CF)	0.124***	0.114***	0.116***	0.184***	0.182***	0.089***	0.050
Observations	*529*	*346*	*854*	*455*	*414*	*957*	*307*
Informal sector							
OLS	0.054***	0.067***	0.030***	0.035***	0.034***	0.062***	0.035***
Selectivity corrected (Lee's method)	0.057***	0.066***	0.033***	0.034***	0.035***	0.061***	0.037***
Selectivity corrected + father's characteristics	0.052***	0.061***	0.034***	0.030***	0.032***	0.059***	0.033***
Selectivity corrected + Control Function (CF)	0.081***	0.093***	0.029*	0.050***	0.059***	0.090***	0.060***
Observations	*3250*	*2771*	*2859*	*2931*	*2233*	*3423*	*2930*

Note: Earnings functions include the set of characteristics reported in Tables A2-A5.

* indicates education coefficients significant at the 10% level.

** idem, 5% level.

*** idem, 1% level.

Table A.7
Tests of crossed effects of being female with human capital dependent variable: log of hourly earnings.

	Cotonou (Benin)		Ouagadougou (Burkina Faso)		Abidjan (Côte d'Ivoire)		Bamako (Mali)		Niamey (Niger)		Dakar (Senegal)		Lome (Togo)	
	X	X*Female	X	X*Female	X	X*Female	X	X*Female	X	X*Female	X	X*Female	X	X*Female
Public sector														
0–6 education years (*Primaire*)	0.070	−0.092	0.077**	0.061	0.082	0.198	0.078**	−0.061	0.050**	−0.073	0.027	0.071	0.015	−0.030
	(1.53)	(0.49)	(2.46)	(1.34)	(1.53)	(1.20)	(2.06)	(0.89)	(1.98)	(1.06)	(0.67)	(1.41)	(0.15)	(0.10)
7–9 education years (*Collège*)	0.096	0.075	0.139***	0.014	−0.023	−0.090	0.139**	−0.034	0.146***	−0.012	−0.013	0.045	0.021	−0.101
	(1.60)	(0.76)	(3.34)	(0.30)	(0.37)	(0.52)	(2.13)	(0.44)	(3.24)	(0.16)	(0.27)	(0.90)	(0.28)	(1.09)
10–13 education years (*Lycée*)	0.191***	−0.047	0.115***	0.062	0.118*	0.139	0.128***	0.080	0.146***	0.053	0.108**	−0.081	0.100	0.007
	(3.38)	(0.52)	(2.66)	(1.21)	(1.80)	(1.40)	(2.79)	(1.01)	(3.43)	(0.83)	(2.28)	(1.30)	(1.15)	(0.06)
+13 education years (Higher levels)	0.121***	0.006	0.124***	0.007	0.105***	−0.025	0.134***	−0.038	0.112***	−0.050	0.112***	−0.016	0.119***	−0.045
	(3.27)	(0.10)	(5.42)	(0.24)	(3.01)	(0.48)	(5.63)	(0.75)	(5.86)	(1.35)	(3.88)	(0.26)	(2.73)	(0.63)
Potential experience	0.048	−0.050	0.066***	−0.014	−0.003	−0.029	0.075***	−0.014	0.056***	−0.019	0.016	−0.042*	−0.025	−0.033
	(1.47)	(1.13)	(3.32)	(0.65)	(0.11)	(0.61)	(3.47)	(0.44)	(3.94)	(0.78)	(0.59)	(1.75)	(0.61)	(0.70)
(Potential experience)^2/100	−0.031	0.113	−0.079**	0.036	0.048	0.083	−0.098***	0.020	−0.073***	0.057	−0.000	0.099**	0.071	0.052
	(0.51)	(1.08)	(2.24)	(0.86)	(0.82)	(0.70)	(2.66)	(0.30)	(3.37)	(0.97)	(0.01)	(2.16)	(1.05)	(0.57)
Joint F-test of nullity of crossed coefficients (value)														
Education	0.83		6.68		3.12		2.37		3.60		7.08		2.80	
Experience	1.28		1.08		0.60		0.50		1.09		5.45*		0.61	
Formal private sector														
0–6 education years (*Primaire*)	0.032	0.092	0.119***	0.077	0.041**	−0.006	0.008	0.204**	0.084**	0.084	0.083***	0.020	0.076	−0.022
	(0.75)	(1.33)	(3.36)	(0.58)	(2.18)	(0.13)	(0.24)	(2.47)	(2.22)	(0.88)	(3.42)	(0.52)	(1.29)	(0.11)
7–9 education years (*Collège*)	0.131***	−0.020	0.133***	−0.087	0.098***	0.073	0.182***	−0.198	0.158**	0.047	0.078***	0.055	0.052	0.014
	(3.34)	(0.26)	(3.11)	(1.04)	(3.74)	(1.38)	(2.99)	(1.59)	(2.51)	(0.49)	(2.70)	(1.07)	(0.87)	(0.08)
10–13 education years (*Lycée*)	0.129**	−0.039	0.261***	0.009	0.210***	−0.035	0.025	0.074	0.223***	−0.254*	0.168***	−0.112	0.223***	0.190
	(2.21)	(0.45)	(4.37)	(0.08)	(4.94)	(0.42)	(0.29)	(0.53)	(2.71)	(1.65)	(4.45)	(1.41)	(2.64)	(1.21)
+13 education years (Higher levels)	0.188***	−0.053	0.233***	−0.071	0.192***	0.135*	0.191***	0.098	0.072	0.201	0.182***	−0.011	0.213***	−0.143
	(6.23)	(0.94)	(4.09)	(0.66)	(6.27)	(1.72)	(3.88)	(0.63)	(1.53)	(1.62)	(5.37)	(0.22)	(3.61)	(0.74)
Potential experience	0.020	−0.021	0.033	0.047	0.056***	−0.033	0.012	0.064*	0.056***	0.008	0.032**	0.011	0.038	0.032
	(1.43)	(0.71)	(1.54)	(1.07)	(3.96)	(1.48)	(0.46)	(1.67)	(2.79)	(0.23)	(2.24)	(0.51)	(1.36)	(0.30)
(Potential experience)^2/100	0.007	0.055	−0.024	−0.099	−0.052**	0.058	0.024	−0.107	−0.046	−0.040	−0.023	−0.037	−0.021	−0.130
	(0.28)	(0.88)	(0.70)	(0.95)	(2.09)	(1.18)	(0.56)	(1.55)	(1.36)	(0.48)	(1.02)	(0.93)	(0.42)	(0.43)

Joint F-test of nullity of crossed coefficients (value)														
Education	4.66		2.63		7.79*		7.27		4.50		3.26		2.35	
Experience	0.99		1.34		2.59		2.81		0.44		2.19		0.31	
Informal sector														
0–6 education years (*Primaire*)	0.094***	−0.019	0.101***	−0.020	0.030**	0.007	0.041***	−0.014	0.062***	−0.012	0.087***	0.006	0.064***	0.004
	(6.12)	(1.11)	(6.21)	(1.16)	(2.52)	(0.42)	(2.77)	(0.65)	(3.41)	(0.57)	(5.70)	(0.36)	(2.83)	(0.18)
7–9 education years (*Collège*)	0.083***	−0.008	0.145***	0.075	0.168***	−0.073*	0.036	0.038	0.101***	0.072	0.088***	0.017	0.147***	−0.067**
	(3.66)	(0.26)	(4.93)	(1.64)	(5.89)	(1.72)	(1.05)	(0.73)	(2.66)	(1.12)	(3.31)	(0.47)	(6.16)	(2.15)
10–13 education years (*Lycée*)	0.225***	−0.082	0.259***	−0.049	0.105*	0.097	0.191***	−0.067	0.176***	0.224*	0.188***	−0.133	0.198***	0.010
	(5.15)	(1.00)	(4.41)	(0.42)	(1.84)	(0.91)	(2.90)	(0.72)	(2.75)	(1.78)	(3.42)	(1.40)	(4.62)	(0.12)
+13 education years (Higher levels)	0.118***	0.222*	0.170***	0.120	0.276***	−0.201	0.025	−0.055	0.159**	−0.041	0.126*	0.076	0.122*	0.263*
	(2.65)	(1.81)	(2.96)	(0.95)	(4.39)	(1.45)	(0.33)	(0.28)	(2.55)	(0.19)	(1.95)	(0.38)	(1.83)	(1.76)
Potential experience	0.010	−0.001	0.059***	−0.025**	0.036***	−0.029**	0.038***	0.003	0.019**	0.016	0.054***	−0.019*	0.031***	−0.007
	(1.13)	(0.09)	(7.36)	(2.16)	(4.24)	(2.42)	(4.46)	(0.26)	(2.28)	(1.19)	(6.51)	(1.84)	(3.53)	(0.58)
(Potential experience)^2/100	0.000	−0.008	−0.062***	0.027*	−0.028**	0.036*	−0.038***	−0.019	−0.008	−0.025	−0.060***	0.018	−0.026*	−0.002
	(0.03)	(0.47)	(5.62)	(1.79)	(2.10)	(1.90)	(3.63)	(1.14)	(0.78)	(1.40)	(5.40)	(1.27)	(1.83)	(0.11)
Joint F-test of nullity of crossed coefficients (value)														
Education	5.86		4.86		6.32		1.16		11.04**		2.26		8.88*	
Experience	3.78		5.27*		6.98**		9.18***		2.18		5.17*		3.61	

Note: Other explanatory variables present in the regressions are reported in Tables A2-A5 and also include their crossed terms. The earnings functions are regressed with an exogenous education variable for the public sector of all cities and for the private sectors of Abidjan and Bamako. The Control Function (CF) method is then used for the private formal and informal sectors of Cotonou, Ouagadougou, Niamey, Dakar and Lome. Discussion and tests on the endogeneity of the education variable in the earnings functions are in Section 4.2. The standard errors are bootstrapped with 500 replications.

* indicates education coefficients significant at the 10% level.

** idem, 5% level.

*** idem, 1% level.

Table A.8
Tests of Crossed Effects of Cohorts with Education Dependent variable: log of hourly earnings.

	Cotonou (Benin)		Ouagadougou (Burkina Faso)		Abidjan (Côte d'Ivoire)		Bamako (Mali)		Niamey (Niger)		Dakar (Senegal)		Lome (Togo)	
	X	X·Old	X	X·Old	X	X·Old	X	X·Old	X	X·Old	X	X·Old	X	X·Old
Public sector														
0–6 education years (*Primaire*)	0.092	−0.044	0.117*	−0.009	0.062	0.018	−0.014	0.115	0.060	−0.019	0.088*	−0.042	0.163	−0.146
	(0.20)	(0.09)	(1.70)	(0.13)	(0.20)	(0.06)	(0.17)	(1.27)	(1.03)	(0.29)	(1.82)	(0.74)	(0.37)	(0.33)
7–9 education years (*Collège*)	0.040	0.078	0.143*	0.014	0.135	−0.238	0.206*	−0.128	0.125	0.009	−0.112	0.160**	−0.051	0.106
	(0.33)	(0.68)	(1.85)	(0.20)	(0.62)	(1.08)	(1.89)	(1.13)	(1.49)	(0.10)	(1.48)	(2.21)	(0.26)	(0.53)
10–13 education years (*Lycée*)	0.108	0.074	0.188**	−0.053	0.064	0.050	0.027	0.120	0.192***	−0.045	0.276***	−0.209**	0.038	0.132
	(0.90)	(0.58)	(2.52)	(0.75)	(0.15)	(0.12)	(0.21)	(0.95)	(2.91)	(0.59)	(2.79)	(2.02)	(0.17)	(0.58)
+13 education years (Higher levels)	0.102	0.025	0.183***	−0.077	0.112	−0.030	0.205*	−0.089	−0.013	0.133*	0.154	−0.034	0.040	0.079
	(0.77)	(0.21)	(2.66)	(1.10)	(0.52)	(0.14)	(1.80)	(0.77)	(0.19)	(1.87)	(1.61)	(0.36)	(0.21)	(0.39)
Joint F-test of nullity of crossed education coefficients (value)	1.74		3.28		2.34		2.59		3.65		6.55		2.43	
Formal private sector														
0–6 education years (*Primaire*)	0.106	−0.062	0.109	0.019	0.011	0.029	0.066	−0.045	0.133**	−0.064	0.105***	−0.022	−0.046	0.196*
	(1.38)	(0.73)	(1.61)	(0.29)	(0.32)	(0.73)	(1.11)	(0.67)	(2.11)	(1.00)	(3.33)	(0.66)	(0.51)	(1.84)
7–9 education years (*Collège*)	0.167***	−0.050	0.091*	0.062	0.084**	0.023	0.216*	−0.085	0.157**	0.034	0.019	0.109**	−0.010	0.112
	(2.83)	(0.70)	(1.67)	(0.92)	(2.09)	(0.48)	(1.82)	(0.63)	(2.09)	(0.36)	(0.47)	(2.42)	(0.11)	(1.14)
10–13 education years (*Lycée*)	0.063	0.103	0.273***	−0.063	0.261***	−0.072	0.072	−0.018	0.065	0.111	0.121*	0.025	0.493***	−0.291**
	(0.64)	(0.98)	(2.67)	(0.52)	(4.06)	(0.95)	(0.54)	(0.12)	(0.63)	(0.83)	(1.81)	(0.33)	(3.72)	(2.17)
+13 education years (Higher levels)	0.172**	−0.003	0.174	0.019	0.129	0.098	0.393***	−0.197	0.216**	−0.112	0.174***	−0.017	−0.122	0.358*
	(2.10)	(0.04)	(1.43)	(0.15)	(1.58)	(1.13)	(3.13)	(1.46)	(2.20)	(1.03)	(2.79)	(0.26)	(0.60)	(1.75)
Joint F-test of nullity of crossed education coefficients (value)	2.56		1.24		2.18		5.23		2.69		10.63**		11.15**	
Informal sector														
0–6 education years (*Primaire*)	0.090***	−0.014	0.113***	−0.026	0.033***	0.010	0.026*	0.017	0.078***	−0.029	0.114***	−0.045***	0.063***	0.001
	(6.44)	(0.86)	(6.88)	(1.37)	(2.72)	(0.54)	(1.66)	(0.82)	(3.67)	(1.22)	(7.85)	(2.91)	(3.68)	(0.06)
7–9 education years (*Collège*)	0.073***	0.006	0.203***	−0.034	0.116***	0.020	0.047	0.007	0.119**	0.059	0.098***	0.012	0.103***	0.035
	(3.03)	(0.20)	(7.11)	(0.69)	(3.66)	(0.46)	(1.20)	(0.13)	(2.55)	(1.01)	(3.06)	(0.29)	(4.33)	(1.05)
10–13 education years (*Lycée*)	0.195***	−0.001	0.203***	0.045	0.178**	−0.097	0.184***	−0.045	0.205**	0.023	0.187***	−0.128	0.239***	−0.074
	(2.79)	(0.01)	(3.46)	(0.45)	(2.57)	(1.00)	(2.61)	(0.48)	(2.36)	(0.19)	(2.66)	(1.36)	(4.96)	(1.03)
+13 education years (Higher levels)	0.284***	−0.161	0.256***	−0.099	0.293***	−0.133	0.103	−0.138	0.162	−0.040	0.304*	−0.162	0.286***	−0.185
	(3.02)	(1.56)	(3.26)	(0.90)	(3.92)	(1.17)	(0.85)	(0.96)	(0.96)	(0.22)	(1.72)	(0.86)	(3.14)	(1.49)
Joint F-test of nullity of crossed education coefficients (value)	4.17		4.10		6.13		3.31		2.80		13.77***		7.06	

Note: Old is a dummy variable indicating whether the individual is above 30 years old. Other explanatory variables present in the regressions are reported in Tables A2-A5 together with their crossed terms. The earnings functions are regressed with an exogenous education variable for the public sector of all cities and for the private sectors of Abidjan and Bamako. The Control Function (CF) method is then used for the private formal and informal sectors of Cotonou, Ouagadougou, Niamey, Dakar and Lome. Discussion and tests on the endogeneity of the education variable in the earnings functions are in Section 4.2. The standard errors are bootstrapped with 500 replications.

* indicates education coefficients significant at the 10% level.

** idem, 5% level.

*** idem, 1% level.

References

Angrist, J.D., Krueger, A.B., 1991. Does compulsory school attendance affect schooling and earnings. Quarterly Journal of Economics 106, 979–1014.
Appleton, S., Hoddinott, J., Krishnan, P., 1999. The gender wage gap in three african countries. Economic Development and Cultural Change 47 (2), 289–312.
Arrow, K.J., 1973. Higher education as a filter. Journal of Public Economics 2, 193–216.
Ashenfelter, O., Krueger, A.B., 1994. Estimates of economic return to schooling for a new sample of twins. Quarterly Journal of Economics 113, 253–284.
Ashenfelter, O., Zimmerman, D., 1997. Estimating of return to schooling from sibling data: fathers, sons and brothers. Review of Economics and Statistics 79, 1–9.
Behrman, J.R., Ross, D., Sabot, R., 2008. Improving quality versus increasing quantity of schooling: estimates of rates of return from rural Pakistan. Journal of Development Economics 85, 94–104.
Belzil, C., Hansen, J., 2002. Unobserved ability and the return to schooling. Econometrica 70, 2075–2091.
Bennell, P., 1996. Rates of return on education: Does the conventional pattern prevail in sub-saharan Africa? World Development 24 (1), 183–199.
Bennell, P., 2002. Hitting the target: doubling primary school enrolments in sub-Saharan Africa by 2015. World Development 30 (7), 1179–1194.
Blackburn, M., Neumark, D., 1995. Are OLS estimates of the return to schooling biased downward? Another look. Review of Economics and Statistics 77, 217–229.
Bourguignon, F., Fournier, M., Gurgand, M., 2007. Selection bias corrections based on the multinomial logit model: Monte-Carlo comparisons. Journal of Economic Surveys 21 (1), 174–205.
Brilleau, A., Ouedraogo, E., Roubaud, F., 2005a. L'enquête 1–2-3 dans les principales agglomérations de l'UEMOA: La consolidation d'une méthode. Stateco 99, 15–19.
Brilleau, A., Roubaud, F., Torelli, C., 2005. L'emploi, le chômage et les conditions d'activité, enquête 1-2-3 Phase 1. Stateco 99, 43-64. DIAL working paper, DT/2004/06: www.dial.prd.fr/dial_publications/PDF/Doc_travail/2004-06.pdf.
Butcher, K.F., Case, A., 1994. The effects of sibling composition on women's education and earnings. Quarterly Journal of Economics 109, 443–450.
Card, D., 1995. Using geographic variation in college proximity to estimate the return to schooling. In: Christofides, L.N., Grant, E.K., Swidinsky, R. (Eds.), Aspects of Labour Market Behavior: Essays in Honor of John Vanderkamp. University of Toronto, Canada, pp. 201–222.
Card, D. 1999. The causal effect of education on earnings. In: Ashenfelter, O., Card, D. (Eds.), Handbook of Labor Economics, Chapter 30, 1801-1863.
Card, D., 2001. Estimating the return to schooling: Progress on some persistent econometric problems. Econometrica 69, 1127–1160.
Cohen, B., House, W.J., 1993. Women's urban labour market status in developing countries: How well do they fare in Khartoum, Sudan? Journal of Development Studies 29 (3), 461–483.
Dahl, G., 2002. Mobility and the returns to education: Testing a Roy model with multiple markets. Econometrica 70, 2367–2420.
Dougherty, C. 2003. Why is the rate of return to schooling higher for women than for men? Centre for Economic Performance Discussion Paper, no. 581 (August).
Garen, J., 1984. The returns to schooling: A selectivity bias approach with a continuous choice variable. Econometrica 52, 1199–1218.
Glewwe, P., 1996. The relevance of standard estimates of rates of return to schooling for education policy: A critical assessment. Journal of Development Economics 51, 267–290.
Glick, P., Sahn, D.E., 1997. Gender and education impacts on employment and earnings in West Africa: Evidence from Guinea. Economic Development and Cultural Change 45 (4), 793–823.
Griliches, Z., 1977. Estimating the returns to schooling: Some econometric problems. Econometrica 45, 1–22.
Hess, P., Ross, C., 1997. Economic Development: Theories. Dryden Press/Harcourt Brace Publishers, Evidence and Policies, Fortworth.
Kahyarara, G., Teal, F., 2006. To train or to educate? Evidence from Tanzania. GPRG-WPS-051, Global Poverty Research Group.
Lam, D., Schoeni, R.F., 1993. Effects of family background on earnings and returns to schooling: Evidence from Brazil. Journal of Political Economy 1001, 710–740.
Lee, L.-F., 1983. Generalized econometric models with selectivity. Econometrica 51 (2), 507–512.
Nordman, C.J., Roubaud, F., 2009. Reassessing the gender wage gap in Madagascar: Does labor force attachment really matter? Economic Development and Cultural Change, forthcoming.
Psacharopoulos, G., Patrinos, H.A., 2004. Returns to investment in education: A further update. Education Economics 12 (2), 111–134.
Ray, D., 1998. Development Economics. Princeton University Press, New Jersey.
Sahn, D.E., Alderman, H., 1988. The effects of human capital on wages and the determinants of labor supply in a developing country. Journal of Development Economics 29, 157–183.
Schultz, T.P., 2002. Why governments should invest more to educate girls. World Development 30 (2), 207–225.
Schultz, T.P., 2004. Evidence of returns to schooling in Africa from household surveys: Monitoring and restructuring the market for education. Journal of African Economies 13 (AERC Supplement), ii95–ii148.
Siphambe, H.K., Thokweng-Bakwena, M., 2001. The wage gap between men and women in Botswana's formal labour market. Journal of African Economies 10 (2), 127–142.
Söderbom, M., Teal, F., Wambugu, A., Kahyarara, G., 2006. Dynamics of returns to education in kenyan and tanzanian manufacturing. Oxford Bulletin of Economics and Statistics 68 (3), 261–288.
Spence, M., 1973. Job market signaling. Quarterly Journal of Economics 87, 355–375.
UEMOA, 2004a. L'emploi, le chômage et les conditions d'activité dans les principales agglomérations de sept Etats membres de l'UEMOA. Principaux résultats de l'enquête 1-2-3 2001-2002, Ouagadougou, December.
UEMOA, 2004b. Le secteur informel dans les principales agglomérations de sept Etats membres de l'UEMOA: Performances, insertion, perspectives. Principaux résultats de l'enquête 1-2-3 2001-2002, Ouagadougou, December.
UNESCO/BREDA, 2007. Education for All in Africa 2007: Top Priorities for Integrated Sector-Wide Policies, Dakar+7, ISBN. 978-92-9091-095-4, Pôle de Dakar.
Vijverberg, W.P., 1993. Educational investments and returns for women and men in Côte d'Ivoire. Journal of Human Resources 28 (4), 933–974.
Vijverberg, W.P., 1995. Returns to schooling in non-farm self-employment: An econometric case study of Ghana. World Development 23 (7), 1215–1227.
Wooldridge, J.M., 2002. Unobserved heterogeneity and estimation of average partial effects. Michigan State University Working Paper.