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The Returns to Education in Africa: Some New Estimates

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ABSTRACT *We estimate the rate of return to education for 12 African countries using recent data and a range of methodologies, which we apply consistently across all countries. Our findings confirm that the return to basic education is the lowest (7–10%). The returns to upper secondary and tertiary education are similar to one another (25–30%). Accounting for the risk of joblessness increases these rates of return, particularly for basic education and for women at tertiary level. Our results at the country level suggest that great care should be taken in choosing the appropriate methodology to estimate rates of return.*

1. Introduction

George Psacharopoulos' reviews of the rates of return to education (RORE) across countries and regions have made a hugely influential contribution to the economics of labour and education literature. The main conclusions from this work are well known, and have had a significant impact on education policy; in particular the finding that returns fall by education level (that is, that they are highest for primary and lowest for tertiary education), which has helped to influence a decision to shift (donor) resources from higher to lower levels of education.

Despite the importance of this work, few studies have since attempted similar comparative reviews in the context of Africa. The few exceptions include Appleton (2000), Bennell (1996), Colclough, Kingdon, and Patrinos (2010), and Diagne and Diene (2011), and these all reach conclusions very different to Psacharopoulos' regarding the returns by level of education. In general, they find that the returns to primary education are lower than those at secondary and post-secondary education.

Although useful, such literature reviews are vulnerable to some of the same criticisms directed by Bennell (1996) at Psacharopoulos' work: the studies included are of variable quality and, perhaps more importantly, approaches vary widely across papers in terms of methodology used (short-cut method, Mincer equations, elaborate/full method), control variables included, assumptions around loss of working life, the inclusion of direct costs, and so forth. Averaging returns across such studies is, at best, highly problematic.

To address such concerns, some studies have estimated the returns to education in Africa using a single methodology applied to household (or similar) surveys from a range of different countries. These studies are few, however (Colclough et al., 2010; Schultz, 2004), cover only a handful of countries

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(Burkina Faso, Ghana, Ivory Coast, Kenya, Nigeria, and South Africa), and mostly use data which are now relatively old (the most recent data being from 2003, but others dating back as far as 1987).

The first contribution of the present paper is, therefore, to provide updated estimates of the returns to education in Africa (all data selected for this study are from 2005 or more recent), using a relatively large number of countries (12), and applying a consistent methodology across all surveys. The countries included in this study (with the year of survey data in parentheses) are: Burundi (2006), Egypt (2006), Ghana (2005), Mali (2007), Nigeria (2010), Rwanda (2005), Sudan (2009), South Africa (2010), Tanzania (2008), Togo (2011), Tunisia (2010), and Uganda (2006). Together, these countries account for nearly half (47%) of Africa's population, include some of Africa's key economies, and show a good geographical spread (eastern, western, northern, and southern Africa are represented, as well as Francophone, Anglophone, and Arabic countries). For one country included in the paper (Burundi), these estimates of the return to education are, as far as we are aware, the first ones publicly available. For some others, our estimates provide an important update (for example, Tunisia).

In addition, the paper offers two technical/methodological contributions. First, it estimates the returns to education using a variety of methods, including the short-cut, Mincer, and 'elaborate' methods, as well as a non-parametric approach which does not impose any functional form assumptions. Second, given the high levels of unemployment encountered in many African countries, we adjust our estimates of the wage return to education for the likelihood of being in employment.

The main conclusions of the paper are as follows. Looking at overall patterns in returns to education across all countries, our paper confirms that the return to basic education in Africa is the lowest (7–10%). The returns to upper secondary and tertiary education are found to be very similar to one another, at 25–30 per cent per year of education.

From an aggregate point of view, we find that the different methodologies produce strikingly consistent results. At country level, however, we conclude that the choice of methodology can matter – most likely because the shapes of age-earning profiles vary from country to country – and, therefore, the appropriate functional forms that need to be applied in order to retrieve the true relationship between education and earnings must vary.

Adjusting our estimates for the effect of education on employment outcomes, we find that the rate of return to education increases at all levels, but particularly at the basic education level and women at tertiary level, suggesting that the employment effects of acquiring those levels of education are significant for the groups mentioned. Although the returns to education tend to be highest for women at upper secondary level, they increase with the level of education (and are highest at tertiary level) once the likelihood of being in employment is taken into account.

The remainder of this paper proceeds as follows. Section 2 provides a brief overview of the literature on the returns to education in Africa. Section 3 outlines and discusses the various methodologies used for estimating the returns to education. Section 4 describes the data and provides some descriptive statistics. We present our main findings in Section 5, while Section 6 concludes, with a summary of methodological issues and pointers for future research.

2. Literature Review

Popular wisdom, influenced by the work of Psacharopoulos (1973, 1981, 1985, 1994) and Psacharopoulos and Patrinos (2004a, 2002), has it that the returns to tertiary education in Africa are lower than those at lower levels of education. These findings have very much influenced donor investments in education across the continent, but have been criticised by a number of authors, including Bennell (1996), who questioned the quality of the data and analysis used in these studies, and Schultz (2003), who analysed data from six African countries and found that private returns were actually higher at secondary and post-secondary levels than at primary level. A number of other papers have confirmed this finding (Appleton, 2000; Colclough et al., 2010; Diagne & Diene, 2011).

Table 1 summarises the reviews of the returns to education from each of these studies, by level of education. A number of interesting patterns (or sometimes lack thereof) emerge. First, the average

Table 1. Returns by level of education in Africa, summary of literature reviews

		Secondary		
	Primary	Lower	Upper	Higher
Psacharopoulos (1981)	29.0	22.0		32.0
Psacharopoulos (1985)	45.0	26.0		32.0
Psacharopoulos (1994)	41.3	26.6		27.8
Appleton (2000)	5.0	14.0	16.0	37.0
Psacharopoulos & Patrinos (2004)	37.6	24.6		27.8
Schultz (2004)[a]	8.9	7.5	14.0	22.7
Colclough et al. (2010)[b]	10.7	15.1	15.4	26.0
Diagne & Dienne (2011): 1960–1969	24.2	30.3		29.6
Diagne & Dienne (2011): 1970–1979	25.2	21.0		24.3
Diagne & Dienne (2011): 1980–1989	28.2	31.8		26.0
Diagne & Dienne (2011): 1990-1999	26.0	45.2		22.3
Diagne & Dienne (2011): 2000–2010	13.1	10.0		19.0

Notes: [a]Male wage workers aged 25–34; [b]Male wage workers, all ages.

returns to higher education are high and surprisingly similar across studies, ranging from 22.7 per cent to 37 per cent. This stands in striking contrast to the average returns to secondary and primary education.

At primary level, the reviews range from an average return of 5 per cent (Appleton, 2000) to an incredibly high 45 per cent (Psacharopoulos, 1985). Although the review by Diagne and Dienne, which averages returns by decade, suggests that the returns to primary education may have been falling over time,[1] their study suggests that, on average, the returns to primary education are not too dissimilar from the returns to higher education (roughly 25–30% per year of education).

Finally, the interpretation of estimates of the return to secondary education is complicated somewhat by the fact that some studies combine lower and upper secondary education and others do not. As with primary education, average returns to secondary education have been estimated to range from a low 7.5–15.4 per cent (Appleton, 2000; Colclough et al., 2010; Diagne & Dienne, 2011, for the decade 2000–2010; Schultz, 2004) to a high 45 per cent (Diagne & Dienne, 2011), while most of the studies by Psacharapoulos place them at around 25 per cent per year of education.

In sum, it is not obvious what conclusions to draw from these studies and, even discarding the Psacharopoulos ones (on the basis of the critique they received from Bennell (1996)), it is not entirely clear that the return to primary education is the lowest. Moreover, these reviews cover studies looking at a range of different countries and using a variety of methodological approaches, which means that they conceal considerable heterogeneity across studies. In some countries the returns are higher at primary level, whereas in others they are highest at tertiary level. Moreover, even within specific countries, the pattern of returns by educational level will vary by study and methodology used.

To illustrate these points further, Table 2 summarises the recent RORE studies we found for the 12 countries included in our paper. Note that no studies could be found for Burundi, so the estimates we present would appear to be the first publicly available for that country. Simply averaging returns across all the studies included in Table 2 (which means that some countries will receive more weight than others because multiple estimates are reported),[2] a pattern of increasing returns by level of education can be observed. On average, the RORE is 4.5 per cent for primary education, 7.1 per cent for lower secondary education, 11.2 per cent for upper secondary education, and 15.3 per cent for tertiary education.

However, some of these averages will be biased by just a few outliers; for example, the return to higher education in South Africa was estimated to be as high as 51 per cent by Keswell and Poswell (2004). Moreover, the pattern of RORE by level of education varies by country. Some studies find that the return to tertiary education is the lowest (for example, Liang, 2002, for Uganda; Salehi-Isfahani,

Table 2. Returns by level of education in 12 African countries, summary of individual studies

Country	Study	Primary	Secondary		Tertiary	Year	Controls	Selection	Years primary
			Lower	Upper					
Egypt[a]	Salehi-Isfahani et al. (2009)	1.5		10.0	7.7	1988	No	No	
Egypt[a]	Salehi-Isfahani et al. (2009)	2.1		16.8	0.3	1998	No	No	
Egypt[a]	Salehi-Isfahani et al. (2009)	0.9		12.1	7.5	2006	No	No	
Egypt[b]	Wahba (2000)	4.7		7.7	14.2	1988	No	No	
Egypt[c]	Said (2007)	3.1	2.1	12.6	8.6	1988	Yes	No	
Egypt[c]	Said (2007)	2.8	3.3	11.5	7.6	1998	Yes	No	
Egypt[c]	Said (2007)	2.7	3.3	11.1	5.0	2006	Yes	No	
Egypt[d]	Herrera & Badr (2011)	2.7	2.2	19.4	3.0	1998	Yes	No	
Egypt[d]	Herrera & Badr (2011)	1.8	3.2	4.5	8.4	2006	Yes	No	
Ghana[e]	Sackey (2008)	3.5	3.8	7.3	11.4	1992	Yes	No	
Ghana[f]	Sackey (2008)	0.4	4.2	7.4	13.2	1999	Yes	No	
Ghana[e]	Sackey (2008)	5.0	4.0	12.3	18.4	1992	Yes	No	
Ghana[f]	Sackey (2008)	1.3	5.6	5.7	18.9	1999	Yes	No	
Ghana[g]	Kingdon & Soderbom (2008)	2.5	0.1	7.0	18.0	1998	Yes	No	
Ghana[h]	Kingdon & Soderbom (2008)	0.7	8.8	0.2	12.8	1998	Yes	No	
Ghana[h]	Colclough et al. (2010)	8.9	8.5	8.8	16.9	1998	No	No	3
Mali[i]	World Bank (2008)	0.3	5.3	14.0	12.2	2006	Yes	No	data-driven
Mali[j]	Kuepie, Nordman, & Roubaud (2009)	5.8	10.4	17.1	13.8	2002	Yes	Yes	data-driven
Nigeria[k]	Okuwa (2004)			1.6	16.7	1995	No	No	N/A
Nigeria[h]	Aromolaran (2004)	2.5	3.9		10.4	1996–1999	Yes	No	data-driven
Nigeria[g]	Aromolaran (2004)	2.4	4.4		12.2	1996–1999	Yes	No	data-driven
Nigeria	Oyelere (2011)	2.5		3.0	8.6	1998	Yes	No	data-driven
Nigeria	Oyelere (2011)	2.7		3.3	8.0	1999	Yes	No	data-driven
Nigeria	Oyelere (2011)	3.7		4.7	13.0	2000	Yes	No	data-driven
Nigeria	Oyelere (2011)	4.2		4.3	14.7	2005	Yes	No	data-driven
Rwanda	Lassibille & Tan (2005)	19.4		29.0	33.3	2001	Yes	Yes	3
South Africa[h]	Colclough et al. (2010)	12.0	21.6	24.4	34.1	2001	No	No	3
South Africa[l]	Keswell & Poswell (2004)	1.0		31.0	51.0	2000	No	No	data-driven
Sudan	Ali (2006)	4.7		0.7	15.0	1996	No	No	

(*continued*)

Table 2. (*Continued*)

Country	Study	Primary	Secondary		Tertiary	Year	Controls	Selection	Years primary
			Lower	Upper					
Tanzania[m]	Mason & Khandker (1997)	7.9		8.8		1991	[unknown]	[unknown]	[unknown]
Tanzania[n]	Colclough et al. (2010)	10.2		12.0	27.3	2003	No	No	3
Togo[j]	Kuepie et al. (2009)	6.4	10.2	21.5	15.4	2002	Yes	Yes	data-driven
Tunisia°	Bonattour (1986)			13.0	27.0	1980	[unknown]	[unknown]	[unknown]
Tunisia[b]	Zouari-Bouattou, Zouari, & Boudraa (2001)	3.7	13.0		26.8	1999	No	No	5
Uganda[p]	Liang (2002)	16.0	24.0	15.0	8.0	1999	No	No	
	Average	4.5	7.1	11.2	15.3				

Notes: 'Controls' refers to whether or not the estimates reported are net of control variables other than age/experience. 'Selection' indicates whether or not the estimates are adjusted for ability/selection bias. 'Years primary' refers to the number of years assumed for the opportunity cost of primary education. Where this column is left empty, the full length of primary education is assumed as an opportunity cost. [a]Urban male wage earners taking nine years of basic education, three years of upper secondary education, and four years of tertiary. [b]Wage workers. [c]Derived from Online Appendix 1; all wage workers. [d]For four-year university degree. [e]Female; income from all economic activity. [f]Male; income from all economic activity. [g]Female wage workers. [h]Male wage workers. [i]Also includes direct costs. [j]Urban only. [k]Lagos only. [l]Full-time wage workers. [m]Method unknown; as quoted in Psacharopoulos and Patrinos (2004). [n]Male. [°]Method unknown; as quoted in Psacharopoulos (1994). [p]Formal wage sector; also includes direct costs.

Tunali, and Assaad, 2009, for Egypt). There may also be some methodological issues at play (consider, for instance, the variance in the returns to education for Egypt and South Africa across the studies cited), as well as some time/cohort effects (for example, we observe significant changes in the returns to education across time in some studies for Egypt, Ghana, and Nigeria). Finally, note that the averages will not necessarily be calculated over the same countries (for example, missing returns to primary education in the case of some studies for Nigeria and Tunisia, and to tertiary education in one study for Tanzania).

In sum, the literature shows a wide spread of estimates, which vary across countries, but also within country depending on the methodology used as well as the year of study. This demonstrates the need for a more consistent approach in estimating the returns to education across countries. It also raises the suspicion that methodological choices can make large differences to RORE estimates. In this paper, we try and apply a consistent methodology across all 12 countries we investigate. Moreover, we use a variety of methodologies and study how the results and conclusions alter depending on the approach taken. In the next section, we describe the methodologies we apply in more detail.

3. Methodology

A number of methods exist to estimate the returns to education, most of which have been discussed in Psacharopoulos (1981). These include: the (very commonly used) Mincer-type estimation; the 'elaborate' method, which relies on calculating the net present value of the difference in earning streams between individuals with different educational attainment; and a 'short-cut' method, which requires only limited information, but is rarely applied nowadays because individual-level datasets have become more widely available in most countries. All these methods rely on strict functional form assumptions, and more recent literature has sought to relax these using non-linear and non-parametric approaches (for example, Heckman, Lochner, and Todd, 2008). In this section, we describe the various methods we apply to our data to estimate the rate of return to education in Africa.

Some Initial, Cross-Cutting Definitions and Assumptions

There are some definitions and assumptions we will apply throughout the analysis, regardless of the method applied, and we discuss these up front.

Where possible, we use earnings rather than wages. This choice of dependent variable is not entirely innocuous: wages are the pay per unit of time, whereas earnings are wages multiplied by the time worked. Because education might be expected to have an effect on employment as well as on wages (see discussion later on in this section), the return to education using earnings tends to be higher than the return using wages (Karasiotou, 2003). Details about the exact variables we used from each survey to construct our earnings variables can be found in Online Appendix A. In most cases, our analysis includes wage earners as well as the self-employed (with the exception of Uganda and Tunisia).[3]

We also apply a few age restrictions. We include individuals as soon as they are of compulsory schooling age (this is either six or seven, depending on the country; Table 3) and we assume individuals retire at the age of 60 in all countries, and so we exclude anyone aged 60 or over.[4]

We look at three levels of education: basic education (primary combined with lower secondary), upper secondary,[5] and tertiary. The motivation for combining primary and lower secondary is that, in most of the countries studied, this covers compulsory education (with the exception of Tanzania and Uganda). The country's education system is followed as closely as possible, and the length of each education cycle we use is as summarised in Table 3. In the case of tertiary education, the duration of bachelor courses in certain countries ranges between three and six years. We always choose the lower figure.[6]

Throughout the paper, we assume that the only cost of education is the opportunity cost (that is, the earnings foregone while studying). Although this simplifying assumption reduces the realism of our estimates somewhat, it is worth pointing out that: most RORE students do not include the direct costs

Table 3. Compulsory schooling age and length of studies by educational level

		Length of education cycle (years)			
		Basic			Tertiary
Country	Starting age	Primary	Lower secondary	Upper secondary	(Bachelor)
Burundi	7	6	4	3	4
Egypt	6	6	3	3	4–6
Ghana	6	6	3	4	4
Mali	7	6	3	3	3
Nigeria	6	6	3	3	4
Rwanda	7	6	3	3	4
South Africa	7	7	2	3	3–4
Sudan	6	8		3	4
Tanzania	7	7	4	2	3–5
Togo	6	6	4	3	3
Tunisia	6	6	3	4	3
Uganda	6	7	4	2	3–5

Notes: Shaded area indicates compulsory education.
Source: UNESCO ISCED 1997 Mappings for education. http://www.uis.unesco.org/Education/ISCEDMappings/Pages/default.aspx

of education (fees, the cost of books, uniforms, transport, and so forth); the opportunity cost is by far the largest cost of investing in education;[7] and although we do not include such direct costs, neither do we include scholarships, grants, and so forth, which would partly offset them. Overall, therefore, we do not think this assumption to be a major limitation of our work.[8]

The opportunity cost of education depends on the years of foregone earnings. The assumptions we make around the length of each educational cycle have already been discussed. However, one additional point merits further discussion, and that is the assumption around the opportunity cost of primary/basic education. A mixture of assumptions has been made in the literature. Psacharopoulos (1994, p 1326) argues that primary school children do not forego earnings during the entire length of their studies, and so he believes that 'it is a mistake to mechanically assign them six years of foregone earnings as part of the cost of their education', and suggests assigning 'one, two, or three years of foregone earnings to primary school graduates'. This is an important point, because the return to primary education will be very sensitive to such assumptions: a coefficient of 36 per cent in an augmented Mincer regression will result in a very different return to education depending upon whether we assume three or six years of foregone earnings. Taking Table 2 as our reference, a three-year opportunity cost rule is followed by a number of authors (for example, Colclough et al., 2010; Lassibille & Tan, 2005); however, most of the papers included in Table 2 assume the full length of primary schooling as the opportunity cost, a choice supported by Bennell (1996, p 191):

> in predominantly rural societies where children make vital, non-marginal contributions to farm and non-farm production, it is incorrect to assume that the opportunity cost of primary education in terms of output foregone is zero and minimal. […] This failure to account properly for opportunity costs has undoubtedly led to a very serious overestimation of ROREs to primary education.[9]

In reality, primary school completion will vary from country to country. Amongst the countries included in our sample, primary school completion rates approach 100 per cent in Egypt, Ghana, and Tunisia (Table 4). In these countries, it may not make much sense to talk of an opportunity cost for and, therefore, of a return to primary education when, in practice, there is no alternative investment.[10]

Table 4. Primary school completion rates, 2005–2012

	2005	2006	2007	2008	2009	2010	2011	2012
Burundi	36.8		41.9	45.1	52.4	56.1	62.1	
Egypt	96.8	92.0	95.8		98.5	101.0	98.5	
Ghana	74.6	71.4	77.9	84.4	86.7		94.0	99.1
Mali	40.6	45.6	48.4	50.8	52.1	54.8	55.4	
Nigeria	82.9	91.1	81.1	70.0	71.3	74.4		
Rwanda				51.2	68.0	69.6		
South Africa								
Sudan				51.0	57.9			
Tanzania	55.3	72.7	83.2		103.0	89.9		81.2
Togo	75.6	75.5		68.5	68.2	73.7	76.6	
Tunisia	101.9		103.1	93.7	91.2			
Uganda	57.5		53.6	58.4	58.5	57.2	54.9	

Source: UNESCO Institute for Statistics. http://data.uis.unesco.org/

In the other nine countries included in our study, however, the primary school completion rate is very far from 100 per cent, and so still has a very real opportunity cost. Individuals without primary education may nevertheless have completed at least a few years of primary education, and so it would not be correct to attribute the full length of primary education as an opportunity cost either. This is why some authors of the studies included in Table 2 let the opportunity cost be dictated by the data itself (that is, the number of years of schooling of individuals without primary education). This is also the approach we will be taking in our study. On average, individuals who have not completed basic education have approximately 1.5 years of education (calculations not shown, but available upon request). In practice (and for each country separately), the opportunity cost is obtained by simply subtracting the average number of years of education obtained by those without basic education (rounded to the nearest year[11]) from that country's length of basic schooling. For example, in the case of Burundi, basic education lasts 10 years, but those without basic education have, on average, completed 2.3 years of schooling, which gives two, rounded to the nearest year. So, in this case the opportunity cost of basic education is assumed to be $10 - 2 = 8$ years of foregone earnings.

With these common definitions and assumptions clarified, we now turn to a more detailed description of each one of the estimation methods we apply to our data.

Method 1: The 'Short-Cut' Method

The first method we apply to the data is the so-called 'short-cut' method (Psacharopoulos & Patrinos, 2004). This is by far the easiest and least data-intensive method (it does not require individual-level data), but it is also the one with the most restrictive assumptions about the shape of the age-earnings profile. It is applied using the following formula:

$$RORE_S = \frac{\bar{E}_S - \bar{E}_{S-1}}{Y_S \bar{E}_{S-1}}, \tag{1}$$

where S and S–1 represent the levels of schooling being compared (for example, basic versus none, or tertiary versus upper secondary); $\bar{E}$ are the average earnings of those with education level S and S–1, respectively; and Y represents the years of schooling it takes to obtain education level S. The denominator $Y\bar{E}$ is therefore the opportunity cost of obtaining a certain qualification (for example, someone studying for a tertiary qualification will give up three years (or more) of income equivalent to what someone with only upper secondary education would have earned[12]). Although simple and not in the least data intensive, the method has clear drawbacks in that it assumes flat age-earning profiles and no discounting of earnings that occur later in life.

Method 2: Simple Earnings Function/Mincerian Method

Our second approach consists of applying the earnings function/Mincerian method (Mincer, 1958, 1974). More specifically, we use the 'augmented' version of the Mincer model (that is, with dummies for educational levels rather than years of schooling):

$$\log(E) = \beta_0 + \beta_1 S + \beta_3 A + \beta_4 A^2 + \varepsilon. \quad (2)$$

As before, E represents earnings. S is a dummy variable equal to one when the individual possesses the corresponding level of education (the reference category being education level S–1). Instead of potential experience (as in the classical Mincer model), we use age (A); the primary reason being that, because of drop-out, grade repetition, and so forth, Mincer's traditional calculation of potential experience as age minus years of schooling minus the school starting age makes less sense in the context of Africa. In practice, using age instead of potential experience means that our estimates of the rate of return to education are likely to be biased downward somewhat (Chiswick, 1997).

The coefficient on the education dummy represents the return to obtaining the qualification, and can be easily converted to an annual return by dividing by the number of years of foregone earnings.[13] As a reminder, we use the values report in Table 3 for upper secondary and tertiary education. For basic education, we use the values of Table 3 minus the average number of years of education obtained by those who have not attained basic education (rounded to the nearest integer).

Many authors will add additional explanatory variables to the right-hand side of Equation (2). In line with Becker (1964), Psacharopoulos (1994, p 1326) argues that 'works that have included too many variables in the fitted earnings function, other than human capital variables [are] artificially biasing downwards the returns to education'. This is particularly the case when variables included can be argued to be endogenous (for example, sector of employment, marital status, number of children, region of residence, and so forth).[14] We support and follow this advice also because it makes our Mincer estimates more consistent with those obtained with the other methods used in this paper (neither of which control for other factors). Another reason for adopting this approach is that it makes it easier to apply a consistent methodology across different countries and surveys.

Finally, note that, instead of estimating all education coefficients simultaneously in one equation, we run three different regressions for basic, upper secondary, and tertiary education on the appropriate age ranges for each level of education only.[15] This somewhat relaxes the assumption of separability between schooling and experience/age (that is, that age-earning profiles are parallel for different levels of education). The latter assumption has been one of the main criticisms aimed at the Mincer model by Heckman et al. (2008), who argue that this restrictive functional form assumption may have held at the time when Mincer analysed earnings data for the United States, but that it no longer fits the current data. To relax this assumption fully, the authors propose a non-parametric estimation method based on local linear regression. Using this method, they find that the pattern of returns to education in the United States is radically different from that obtained with estimates sticking to the traditional assumptions of the Mincer model. We apply this approach to our African data as part of the next, and final, methodology.

Method 3: 'Elaborate' Method

The elaborate method consists in calculating the discount rate (r) that equates a stream of benefits (in this case, the additional earnings resulting from more education) to the stream of costs (the earnings lost as a result of taking time out of the labour market to pursue one's studies). Technically, the return is found by solving for r in the following equation:

$$\sum_{t=1}^{n} \frac{(E_S - E_{S-1})_t}{(1+r)^t} = \sum_{t=1}^{Y_S} (E_{s-1})_t (1+r)^t, \quad (3)$$

where, as before, E represents earnings, S the level of education for which the returns are being estimated, and S–1 the level immediately below. The left-hand side represents the discounted benefit stream of obtaining that level of education (that is, the discounted difference in earnings between this level of education and the one immediately below, $E_s - E_{s-1}$), and the right-hand side denotes the opportunity cost of this education (earnings of those with an education level immediately below summed over the Y_s years of schooling it takes to obtain E_s).

Solving for r first requires the construction of detailed age-earning profiles for each level of education. There are a number of ways in which this can be done. Ideally, we would simply calculate average earnings by year of age and education. Compared to the Mincer and short-cut methods described previously, this approach is relatively data intensive and, in nearly all the countries we study, results in some empty cell sizes as well as saw-toothed age-earning profiles. The saw-tooth patterns are a problem in particular because, if they occur early on in the age-earning profile, they can have a large effect on the estimated returns to education. These 'raw' data were therefore found to be unusable without the application of a smoothing procedure. We tested two such techniques.

- *Method 3a: elaborate method (smoothed).* The original smoothing method suggested by Psacharopoulos (1981) consists of estimating simple earnings equations for each level of education,

$$\log(E_S) = \beta_0 + \beta_1 A + \beta_2 A^2 + \varepsilon, \tag{4}$$

and drawing on the estimated coefficients to predict well-behaved age-earning profiles, which are subsequently used to derive a value for r, as before. As with the Mincer and short-cut methods, however, this approach imposes strict functional form assumptions onto the data. As already mentioned, more recent literature (for example, Heckman et al., 2008) has attempted to relax such restrictive assumptions by using non-parametric estimation techniques. We attempt a similar approach with our next, and final, method.

- *Method 3b: elaborate method (non-linear)*. In our final approach, we use locally-weighted linear regression to estimate the age-earning profiles.[16] This non-parametric regression technique does not impose a global function onto the data, but instead fits simple models to local subsets of the data. In practice, this method results in the same number of empty cells as when we calculate simple average earnings by age and education. However, because the estimated age-earning profiles have been smoothed, filling the empty cells using simple linear trends is much less sensitive to choices about which information is used to predict the trends.[17] One should nevertheless be aware that data restrictions in most African countries are still such that non-parametric regression techniques like this one cannot be used for estimating the returns to education without having to make additional assumptions about how to address missing data caused by low sample sizes.

Accounting for the Risk of Joblessness

Given that education has an impact on both earnings and the likelihood of employment, it is surprising that very few estimates in the literature have factored in the risk of joblessness in estimating the returns to education. In countries with low rates of joblessness, this is perhaps understandable, but in Africa, where the level of joblessness can reach nearly three-quarters of the working age population (see Section 4), this would seem a major omission. One contribution of this paper is that we adjust the estimates of the return to education by the risk of joblessness. In practice, we calculate the adjusted internal rate of return by generating age-'expected' earnings profiles. For example, in the case of Method 3a, we predict age-earning profiles as before, using Equation (4). In addition, we simulate age-employment profiles using the coefficients from a logit regression of the following form:

$$J_S = \beta_0 + \beta_1 A + \beta_2 A^2 + \varepsilon, \tag{5}$$

where J_S is a dummy variable equal to one when an individual with schooling level S is in employment, and zero otherwise. At each age, we then weight the predicted earnings previously obtained by the predicted likelihood of being in employment at that age in order to derive an age-expected earnings profile. We do this separately for all levels of education. In the case of Method 3b, we use non-linear regression to derive the employment profiles, and multiply these by the earnings profiles constructed using the same (non-linear) method.

Psacharopoulos (1981, p 332) argues that youth unemployment is mostly a reflection of the job search process and, therefore, a temporary phenomenon. He argues that 'it would be a mistake to reduce a whole age-earnings profile by the average rate of unemployment that mainly refers to young people'. This statement is not in contradiction with what we attempt here. Indeed, the age-employment profiles we build specifically allow for changing employment patterns over the lifetime. What Psacharopoulos refers to is an implicit assumption that unemployment as measured in the early years after graduation will persist throughout the lifetime of workers. This is clearly incorrect, and not at all what we attempt to do here.

Ability Bias

Much of the recent literature on returns to education has been dedicated to tackling ability bias in estimating the return to schooling. As early as 1945, Noyes (1945) and Friedman and Kuznets (1945) suggested that observed differences in earnings between education groups are likely to reflect inherent ability differences rather than true productivity differentials. Such correlation between schooling and earnings would lead to an upwards bias in the effect of education on earnings estimated through OLS.

A standard solution to this problem is instrumental variables (IV) estimation, and a large literature has developed using instruments such as the minimum school leaving age, the geographic proximity of schools, and so forth. Generally, this literature has found that OLS under- rather than overestimates the return to schooling. One potential explanation for this finding, advanced by Card (2001), is that these estimates are frequently obtained using structural changes in schooling systems (for example, a raising of the school-leaving age) which affect more marginal students for whom the return to schooling might be higher.

In this paper, we do not attempt to tackle the issue of ability bias. Although instrumental variables methods have proved useful in trying to establish the causal effect of schooling on earnings, they suffer from the same drawbacks as outlined above for the Mincer equation (Heckman, Lochner, & Todd, 2005). In addition, according to Heckman et al. (2008, p 12), 'The functional form assumptions implied by Mincer-based estimation of the internal rate of return lead to […] biases much larger than those commonly discussed as attributable to selection or ability bias'.

4. Data

We now turn to a description of the data we use to estimate the returns to education in Africa. We selected a number of household and labour force surveys dating back no further than 2005.[18] The countries covered include: Burundi, Egypt, Ghana, Mali, Nigeria, Rwanda, Sudan, South Africa, Tanzania, Togo, Tunisia, and Uganda. Some basic information on educational attainment and labour market outcomes is provided in Table 5, which points to a number of important observations.

First, sample sizes can be small, particularly for higher levels of education. The proportion of the working age population with upper secondary qualifications ranges from 1.1 per cent in Sudan to 40.9 per cent in Tunisia;[19] the proportion with tertiary education ranges from 0.8 per cent in Rwanda and Tanzania to 14.2 per cent in Tunisia. This makes estimating the return to these levels of education challenging and is likely to lead to volatility in the estimates obtained, depending on how the sample is specified; an issue rarely highlighted in the literature.

Table 5. Descriptive statistics

	Burundi	Egypt	Ghana	Mali	Nigeria	Rwanda	South Africa	Sudan	Tanzania	Togo	Tunisia	Uganda
	2006	2006	2005	2007	2010	2005	2010	2009	2011	2011	2010	2006
Population												
Number of observations	6,646	37,140	37,128	16,350	23,212	34,461	342,470	33,660	20,559	29,781	549,015	43,097
Working-age population (%)	73.8	61.3	53.5	44.3	58.5	52.9	61.4	47.6	50.5	51.9	66.4	44.2
Education												
No education	2,333	6,819	11,380	5,844	4,436	11,645	32,023	13,031	2,990	7,050	53,915	10,177
% of working-age population	46.2	31.7	54.6	83.1	30.3	70.9	13.6	84.8	29.7	42.0	13.5	54.1
Basic	1,525	4,777	5,420	936	4,206	4,388	104,685	1,832	6,996	6,342	109,628	5,306
% of working-age population	32.0	20.6	30.3	11.0	31.5	23.6	50.4	8.5	64.8	46.1	30.8	27.8
Upper secondary	321	7,286	1,344	248	3,123	529	46,649	214	468	458	142,907	1,332
% of working-age population	6.8	30.8	7.0	2.5	24.8	2.4	25.2	1.1	3.4	3.5	40.9	6.8
Tertiary	443	2,964	628	175	609	220	18,010	228	146	571	41,276	298
% of working-age population	9.6	12.4	3.3	1.6	5.2	0.8	9.8	0.9	0.8	4.9	14.2	1.6
Employment status by education												
No education												
Inactive (%)	17.2	32.8	26.1	15.8	23.4	21.7	56.4	53.6	11.4	20.2	69.0	13.0
Unemployed (%)	14.5	0.7	2.5	6.6	0.9	0.6	10.2	20.3	0.8	10.7	2.0	1.1
Employed (%)	68.4	66.5	71.4	77.5	75.7	77.7	33.4	26.2	87.9	69.1	29.0	85.9
Basic												
Inactive (%)	46.3	54.8	27.3	41.0	38.7	33.8	54.7	43.1	20.2	36.0	42.4	22.3
Unemployed (%)	13.0	1.0	3.9	14.9	1.4	1.6	14.0	10.5	1.6	12.5	5.4	2.1
Employed (%)	40.7	44.2	68.8	44.2	60.0	64.5	31.3	46.4	78.2	51.5	52.2	75.6
Upper secondary												
Inactive (%)	49.5	35.5	38.7	22.9	38.0	17.8	30.9	28.9	36.1	40.7	51.7	28.4
Unemployed (%)	11.7	7.6	8.2	19.5	5.9	10.8	18.6	9.2	3.3	8.4	6.7	3.6
Employed (%)	38.8	56.9	53.0	57.7	56.1	71.4	50.6	61.9	60.7	50.9	41.7	68.0
Tertiary												
Inactive (%)	32.0	19.2	9.6	26.4	18.3	25.9	11.4	18.7	40.2	37.9	31.3	39.2
Unemployed (%)	10.0	12.4	8.1	12.8	9.4	9.6	8.3	8.4	6.5	9.2	15.8	6.7
Employed (%)	58.0	68.4	82.3	60.8	72.3	64.5	80.3	72.9	53.3	52.9	52.9	54.1
Earnings by education (upper secondary=100)												
Basic	66	68	65	54	77	13	57	95	33	75	65	38
Upper secondary	100	100	100	100	100	100	100	100	100	100	100	100
Tertiary	187	188	200	144	208	279	182	185	258	150	173	264

Notes: All number of observations unweighted. All proportions weighted. Working-age population is the proportion of the survey sample that is of working age (that is, aged 15–59). Inactive (neither in employment nor looking or available to work) + unemployed (out of work, but looking and available) + employed (in paid employment at least one hour per week) = 100 per cent of working-age population. Education proportions do not add to 100 per cent since only academic upper secondary education has been included.

Second, Table 5 shows that there is a complex relationship between educational attainment and employment outcomes, which varies significantly from country to country. In only one country analysed does employment increase with educational attainment. And, although the employment rate (that is, employment-to-population ratio) is highest for those with tertiary qualifications in Egypt, Ghana, Sudan, South Africa, and Tunisia, it is lowest for those with tertiary qualifications in Rwanda, Tanzania, and Uganda. In many countries, those with no qualifications have the highest employment rates (Burundi, Mali, Nigeria, Rwanda, Tanzania, Togo, and Uganda). Generally, those with basic and upper secondary qualifications have the lowest employment rates; although, once again, the pattern is not uniform. This variability in employment rates as well as the generally high levels of joblessness (inactivity plus unemployment) suggest that accounting for the effect of education on employment will have a crucial impact on the estimates of returns to education in Africa, the direction of which will vary from country to country.

Finally, the table shows the average earnings of those with basic and tertiary qualifications in proportion to the earnings of those with upper secondary schooling (index=100 for the latter). On average, across all countries, the earnings of university graduates are twice as high as those of individuals with upper secondary qualifications, and individuals with basic education only earn around 60 per cent of what those with upper secondary qualifications earn.

Table 6 presents some descriptive statistics by gender. In nearly all countries (with the exception of South Africa) men have higher educational attainment than women. In all countries, men have both a higher probability of being employed and higher earnings when in employment. On average, men are 40 per cent more likely to be in employment, and their earnings are twice as high as those of women. Some interesting differences arise across countries. For instance, while employment rates are similar for women and men in Rwanda, once in employment men earn 3.7 times more. By contrast, in Tunisia, women are only half as likely as men to be employed but, once in employment, their earnings are only marginally lower.

5. Results

Table 7 presents the returns to education in the 12 African countries considered, by level of education and method employed. Starting with the overall patterns across all countries, we find that the return to basic education is the lowest across all methodologies applied. Overall, it ranges between 7 and 10 per cent. The returns to upper secondary and tertiary education are in the same ballpark as each other, ranging between 25 and 30 per cent on average.

These estimates are higher than the average obtained from the literature review of the same countries presented in Table 2, but this is partly because Egypt and Nigeria (two countries with lower than average returns) were over-represented in Table 2 and therefore biased the results down. Our estimates of the return to higher education are certainly in line with the wider reviews summarised in Table 1 (which ranged from 22.7% to 37%). Our estimates for primary education are at the low end, but in line with the more recent studies (for example, Colclough et al., 2010; Diagne & Dienne, 2011, for the period 2000-2010).[20] Finally, while the estimates of the return to upper secondary education presented in Table 1 varied widely, our own estimates are about average compared to those obtained elsewhere in the literature.

Another key finding to emerge from Table 7 is that, at the global level, the estimates obtained by the different methods are surprisingly in line with one another. At the country level, however, returns can vary depending on the methodology used.[21] Sometimes, the range of estimates can be quite wide (for example, a return of 12% for tertiary education in Nigeria using the 'elaborate' Method 3a (smoothed), but 27% using the short-cut method; or a return of 20% to upper secondary education using the Mincer method in Mali, but 59% using 'elaborate' Method 3b (non-linear)). The likely cause of this disparity in estimates is differences in the shape of the age-earning profiles by levels of education (and hence in the appropriate functional form to be adopted). This suggests that studies looking at rates of return at an individual country level should carefully examine the shape of the age-earning profiles and apply the most suitable methodology and functional form given the quality of the available data.

Table 6. Descriptive statistics, by gender

	Burundi	Egypt	Ghana	Mali	Nigeria	Rwanda	South Africa	Soudan	Tanzania	Togo	Tunisia	Uganda
	2006	2006	2005	2007	2010	2005	2010	2009	2011	2011	2010	2006
EDUCATION												
Men												
No education (%)	46.4	24.3	46.6	76.7	22.5	67.7	13.6	78.5	26.3	27.9	6.4	48.0
Basic (%)	32.1	23.5	34.5	15.4	34.2	26.0	50.2	13.3	67.0	54.2	32.7	31.0
Upper secondary (%)	5.6	32.9	9.3	3.5	28.2	2.8	25.3	1.8	4.2	5.5	45.3	8.7
Tertiary (%)	11.2	14.3	5.3	2.7	7.0	1.1	9.5	1.6	1.1	8.0	14.8	2.0
Women												
No education (%)	45.9	39.0	61.8	88.4	37.3	73.6	13.6	90.3	32.9	55.0	20.5	59.8
Basic (%)	31.9	17.8	26.6	7.3	29.2	21.6	50.6	4.2	62.7	38.7	28.9	24.7
Upper secondary (%)	8.1	28.8	5.0	1.6	21.8	2.1	25.1	0.5	2.7	1.7	36.5	5.1
Tertiary (%)	7.8	10.6	1.6	0.7	3.7	0.5	10.0	0.4	0.5	1.9	13.6	1.1
EMPLOYMENT STATUS												
Men												
Inactive (%)	23.4	20.4	27.0	13.7	28.0	22.9	37.3	49.0	17.7	29.0	23.8	19.5
Unemployed (%)	9.7	4.2	3.5	7.3	3.4	1.6	14.6	18.3	1.4	10.4	8.6	1.6
Employed (%)	66.9	75.4	69.5	79.0	68.6	75.5	48.1	32.7	81.0	60.6	67.6	78.9
Women												
Inactive (%)	38.6	52.8	29.2	23.6	35.9	25.8	51.3	54.9	20.6	30.0	72.0	22.5
Unemployed (%)	17.8	5.1	3.6	8.4	2.6	0.9	13.6	19.7	1.5	12.0	5.4	1.9
Employed (%)	43.6	42.2	67.2	68.0	61.6	73.3	35.2	25.5	77.9	58.0	22.6	75.7
EARNINGS												
Female-to-male ratio	1.4	2.0	1.8	2.2	1.8	3.7	1.2	2.0	2.5	1.3	1.1	3.2

Table 7. Returns to education, by country, method, and level of education

	Method 1: short-cut			Method 2: Mincer			Method 3a: elaborate method (smoothed)			Method 3b: elaborate method (non-linear)		
Country	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)
Burundi	10	17	21	7	14	24	11	18	28	11	16	39
Egypt	10	16	22	1	3	8	0	5	9	4	5	9
Ghana	13	13	25	8	15	20	10	12	28	11	13	31
Mali	11	25	15	12	20	15	11	40	13	11	59	7
Nigeria	5	10	27	7	14	24	6	12	12	4	16	16
Rwanda	11	37	43	8	42	39	15	45	33	20	54	33
South Africa	6	25	27	8	29	29	6	23	28	5	21	29
Sudan	14	2	21	10	7	21	10	20	15	10	15	16
Tanzania	20	88	51	5	100	51	8	66	39	8	59	41
Togo	2	11	17	7	17	22	8	13	41	8	18	29
Tunisia	2	13	24	3	12	27	[a]	9	30	−3	10	27
Uganda	13	78	61	7	40	29	8	31	27	8	30	30
Average	10	28	30	7	26	26	8[b]	25	25	8	26	25

Notes: [a]No solution found for the internal rate of return for primary education in Tunisia. [b]Average obtained on 11 countries, excluding Tunisia.

A final (and perhaps obvious) comment to make is that rates of return vary considerably across countries. They appear to be lowest in Egypt, Nigeria, Tunisia, and Sudan, whereas the highest returns can be found in Rwanda, Uganda, and Tanzania.

Employment-Adjusted Estimates of the Return to Education

In Table 8, we adjust the estimates obtained through the elaborate methods (3a and 3b) for the risk of joblessness. On average, the returns to education increase when we do this, particularly at the basic level, where they rise to 10–17 per cent overall. This is because the probability of unemployment decreases with the level of education possessed. The employment-adjusted returns to upper secondary and tertiary education both increase, but much less so, and they remain in the same ballpark as one another (26–32%). The employment effect of education is not identical across all countries, however. In particular, we observe some falls in the returns to upper secondary and tertiary education in countries like Mali, Rwanda, Tanzania, and Uganda. This reflects the ambivalent effect of education across African countries, discussed in the previous section, and suggests that accounting for employment effect when calculating the rate of return in Africa is critical.

Estimates of the Rate of Return to Education by Gender

Finally, we estimate the returns to education by gender using the short-cut, Mincer, and elaborate (3a (smoothed)) methods, as well as the latter adjusted for the risk of unemployment and inactivity. The results (presented in Table 9) show how the return to education is nearly always higher for women than men, and this result holds across nearly all countries considered. Another interesting finding from Table 9 is that the return to education for men increases with educational level (7%, 24%, and 27% for basic, upper secondary, and tertiary education, respectively), while for women it tends to be highest for upper secondary education (9%, 62%, and 30%, respectively). However, once we adjust for the risk of joblessness, the return to tertiary education is also highest for women, suggesting that tertiary education has a particularly large employment effect for women in Africa. Indeed, this was a point already made by Psacharopoulos (1985): 'The rate of return differential in favour of women may be an underestimate because the rate of return to investment in women's education, as commonly calculated, does not take into account the increased probability of more educated women participating in the labour force'. Once again, however, it is important to note that, when we dig below the aggregate level, there is significant heterogeneity at the country level in terms of the impact of employment

Table 8. Returns to education, by country and level of education, adjusted for the risk of joblessness

	Method 3a: elaborate method (smoothed)			Method 3b: elaborate method (non-linear)		
	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)
Burundi	11	17	43	11	17	42
Egypt	2	11	14	0	10	12
Ghana	18	16	56	13	13	41
Mali	12	23	14	11	50	9
Nigeria	9	13	15	6	17	17
Rwanda	20	65	29	22	54	34
South Africa	46	90	70	8	27	43
Sudan	26	48	24	13	22	21
Tanzania	11	35	38	12	43	42
Togo	20	19	41	11	19	33
Tunisia	19	11	26	3	12	28
Uganda	10	22	19	10	24	25
Average	17	31	32	10	26	29

Table 9. Returns to education, by gender

	Method 1: short-cut			Method 2: Mincer			Method 3a: elaborate method (smoothed)			Method 3a: (employment adjusted) elaborate method (smoothed)		
	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)	Basic (%)	Upper secondary (%)	Tertiary (%)
PANEL A – MEN												
Burundi	8	12	26	7	8	27	12	13	36	11	11	48
Egypt	14	13	21	8	15	17	0	5	10	2	8	13
Ghana	3	6	22	1	2	10	11	9	30	18	12	56
Mali	6	22	17	6	14	22	6	22	31	6	16	13
Nigeria	5	6	27	5	9	26	3	10	14	4	9	16
Rwanda	21	136	41	7	40	31	14	43	26	18	74	20
South Africa	9	2	25	6	5	28	8	24	26	51	86	66
Sudan	5	21	19	8	24	20	7	21	14	23	55	19
Tanzania	20	59	55	5	73	50	9	63	38	12	35	27
Togo	1	7	20	4	10	25	6	10	48	16	16	32
Tunisia	1	12	24	3	11	27	−10	10	28	31	10	20
Uganda	12	57	35	5	38	28	6	25	25	9	18	18
Average	9	29	28	5	21	26	6	21	27	17	29	29
PANEL B – WOMEN												
Burundi	12	29	11	7	29	18	10	28	21	9	25	39
Egypt	13	23	36	9	26	28	1	11	9	[a]	21	18
Ghana	10	135	22	0	7	5	9	21	27	15	21	56
Mali	15	35	6	14	45	0	10	91	−5	11	57	16
Nigeria	2	12	23	5	14	20	5	10	11	10	12	15
Rwanda	38	727	50	10	62	57	18	47	42	23	57	49
South Africa	14	−6	57	10	10	36	5	25	29	50	112	75
Sudan	7	33	24	8	37	26	12	22	16	28	37	44
Tanzania	15	158	39	3	153	51	5	68	47	6	34	63
Togo	2	25	7	6	39	11	7	19	26	17	21	113
Tunisia	1	15	26	1	13	28	[a]	10	32	17	12	39
Uganda	5	141	193	7	53	36	7	60	34	9	39	25
Average	11	111	41	7	41	26	8[b]	34	24	18[b]	37	46

Notes: [a]No solution found for the internal rate of return. [b]Average obtained based on 11 countries, excluding Tunisia.

probabilities. In some countries, and particularly at upper secondary level, the return to education for women decreases once employment probabilities are factored in.

The finding that women have higher returns on average than men is not new in the context of Africa (Psacharopoulos & Patrinos, 2004), and has been put down by some authors to the fact that women have less education on average than men, which, combined with decreasing marginal returns to education, means that their returns are higher on average (Schultz, 2002). The debate on why returns might be higher for women has not been entirely settled, however, either in Africa or elsewhere. Other explanations put forward include the possibility that ability bias in educational attainment is greater in the case of women (so that the return is on average greater for educated women than for non-educated women), or that education not only increases productivity and skills but also reduces the gap in male and female earnings, attributable to factors such as discrimination, tastes, and circumstances (Dougherty, 2005).

Conclusion

In this paper, we have estimated the return to education for 12 African countries using recent data and a variety of methods. This exercise has highlighted a few methodological issues, which are worth summarising in the hope that they might be addressed in future research on the return to education in Africa.

One key conclusion of our paper was that estimates can vary significantly at the country level, depending on the methodology employed. We speculated that this was related to the different functional form assumptions that the various methods make, and which fit the data better or worse depending on the shape of the country's age-earning profiles. We therefore recommend that future RORE studies carefully analyse these age-earning profiles before deciding on a functional form and method.

Our paper also highlights the importance of considering the employment effect of education in countries where the level of joblessness is high, particularly when estimating rates of return to primary/basic education, and those for women.

Another key issue highlighted was the need to estimate carefully the costs of education. In this paper, we focused on the issue of opportunity costs and, in particular, the true opportunity cost of primary/basic education. To the extent possible, researchers should try and estimate the opportunity cost as closely as possible, but this will often depend on the quality of data available.

Another aspect of the cost debate, ignored in this paper but which would somewhat increase the realism and the policy-relevance of the RORE estimates, is to include the direct costs of education. These are ignored in most studies on rates of return in Africa because of data limitations. Adding some basic education expenditure questions to household surveys would somewhat remedy this problem.

Finally, despite great progress in the collection of micro-data, household and labour force surveys in Africa continue to be scarce, repeated infrequently and at large time intervals, often remain unavailable to most researchers, and are poorly documented. Although the existence of micro-data means that estimations of ROREs through the short-cut method are very much a thing of the past, sample sizes (particularly at higher levels of education and in countries with low educational attainment) remain a major stumbling block to the application of more sophisticated methods than the Mincer regression.

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Notes

1. This pattern, described by Diagne and Dienne (2011), should not be taken at face value, however, because each decade will cover a different set of countries. In addition, the methodologies used across the studies will vary.
2. If, instead, equal weights are given to each country by averaging country means, the equivalent returns are: 7 per cent for primary education; 11.1 per cent for lower secondary education; 14.1 per cent for upper secondary education; and 19.6 per cent for tertiary education.
3. Our measure of earnings will depend on the survey employed, but we have tried to focus on earnings from the primary occupation where possible, excluding benefits. Also note that, in order to avoid estimation problems induced by outlier values, we trim our dataset by removing the top and bottom percentile of earnings. In the case of Burundi, we are not sure whether the self-employed are included in our data.
4. With the exception of Mali (58), our Internet searches suggest that the retirement age is 60 in all other countries. In practice, of course, the level of education itself could affect the length of working life. This is an aspect we do not attempt to address. However, as pointed out by Heckman et al. (2008), because these earnings occur late in the lifecycle, they are heavily discounted in the rate of return calculation and, therefore, bear little influence on the estimates.
5. In addition, we aim to focus on academic upper secondary education only in order to generate a credible control group of individuals with the potential of progressing to tertiary education.
6. In practice, we include in the tertiary category anyone with a qualification higher than upper secondary. This is in order to maximise the sample sizes for estimation, although it means that the tertiary category will be highly heterogeneous and will include individuals with short diplomas as well as people with PhDs.
7. For instance, recent estimates for OECD countries suggest that, for men, direct costs represent around 7 per cent of the overall estimated costs of obtaining an upper secondary (or post-secondary non-tertiary) education and 22 per cent of the overall cost of obtaining a tertiary education; the remainder being made up by foregone earnings (OECD, 2012).
8. In addition, education may bring psychological costs as well as resulting in a higher tax rate (Heckman et al., 2008). Both these aspects are ignored in the present paper, as they are in most other empirical research on the returns to education.
9. Appleton (2000) reverses this argument in the case of tertiary education. He argues that, in most studies, the coefficient for higher education may be overestimated since it is based on the assumption that university education lasts only three years, when in practice students may take much longer to finish their courses.
10. In the case of Tunisia and Egypt, we face the additional problem that employment questions in the survey are not asked to those younger than 15. Although we present returns to basic education for these countries, it is important to bear in mind that the estimated opportunity costs for basic education in these countries will rely on extrapolation and functional form assumptions.
11. The rounding is necessary for the full/elaborate method because rows correspond to entire years and cannot be further broken down. In order to be consistent across methodologies, we also use rounded years of opportunity costs for the Mincer and short-cut methods.
12. Note that Psacharaopoulos and Patrinos (2004b) assume that someone with a tertiary qualification will forego income equivalent to what someone with that same level of education would have earned. If education adds to productivity and increases wages, then this assumption seems incorrect. It would also bias downwards estimates of the return to education, as it artificially inflates the opportunity cost.
13. Halvorsen and Palmquist (1980) and Kennedy (1981) point out that, in semilog models in which discrete variables are used as regressors, the percentage change in the level of the dependent variable is not equal to the coefficient of the dummy multiplied by 100, as is the case of continuous variables. Instead, the appropriate measure for the proportional effect on the outcome variable is $\exp(\beta)-1$. It is this adjusted coefficient that we will divide by the number of years of education in order to obtain an estimate of the annual return.
14. Pereira and Martins (2004) address this issue in detail. They show why considering a number of education-dependent covariates in a wage equation decreases the coefficient of education in that equation and argue for the use of a simple specification of the Mincer equation for the study of the total returns to education.
15. In practice, this means we estimate Equation (2) three times: once comparing basic to no education; then comparing upper secondary to basic; and, finally, comparing tertiary to upper secondary. Each time, this also means that the age group considered (and therefore the sample) will be slightly different. In the first case, we include individuals aged 10–60; in the second those aged 15–60; and, in the last case, those aged 18–60.
16. In practice, we use the lowess function in Stata.
17. In practice, we use the TREND function in Excel using either the 10 next cells (if age < 50) or the 10 previous cells (if age > 50) to predict the trend.
18. Online Appendix B provides a list of the exact data sources used.
19. In many African countries, nearly all those with upper secondary qualifications go on to tertiary education. So, in some of the samples looked at, there are more observations with tertiary education than with upper secondary education.
20. Indeed, our data are more recent than in many other studies, and so there may be temporal effects at play. In particular, in the case of basic education, the move towards universal primary education may have eroded the returns to that level of education even more.
21. Confirming Bennell's (1996, p 194) observation that 'RORE estimates can diverge significantly between the full and short-cut methodologies'.

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