Educated unemployment in urban West Africa: Why do educated workers not grade down?*

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Esther Mirjam Girsberger, University of Lausanne & IZA
Romuald Meango, Max Planck Institute, Munich

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Abstract

Unemployment rates in urban West Africa are increasing or inverse U-shaped in education. This is puzzling. Educated workers could just take low-qualified jobs or go into self-employment to escape unemployment. In the first part of this paper, we show that the West African unemployment pattern is robust to different definitions and controls. We provide descriptive evidence on labour market entry and transitions between different sectors and how they vary across education levels. In the second part, we develop a search and matching model with three sectors (public, formal and self-employment), heterogenous agents and an endogenous schooling choice. We calibrate a basic version of the model using data from the 1-2-3-Survey. Preliminary results indicate that productivity differences between the public/formal sector and self-employment are relatively large. However, despite large productivity differences, it is not rejection of self-employment opportunities but the relatively low arrival of these opportunities which explain why educated individuals do not downgrade. Also, we find that differential destruction rates across sectors and education levels contribute considerably to the observed unemployment patterns. In the last part, we want to use these results to analyse alternative education and labour market policies. We aim to understand how decreasing schooling costs, self-employment subsidies, minimum wage laws and the creation of public-sector jobs affect educational attainment, unemployment and worker distribution across sectors.

JEL: E24, E26, J24, J45, J46, J64, O17

Keywords: Unemployment, education, search and matching model, urban West Africa

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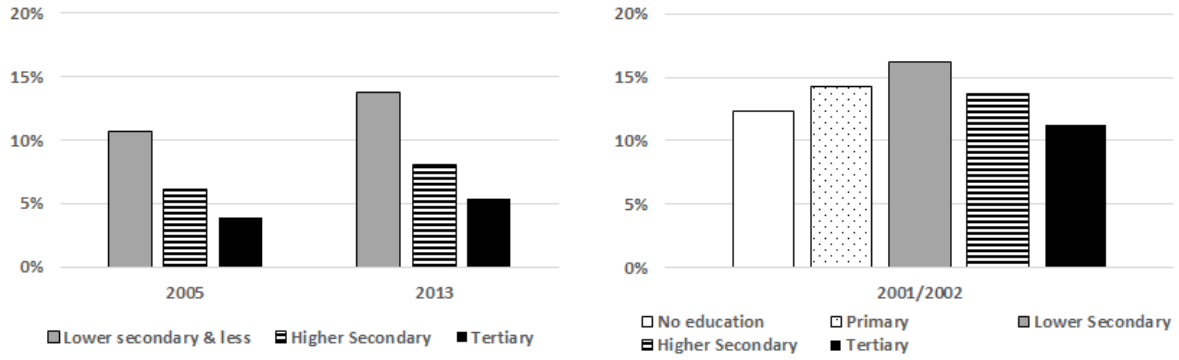
1 Introduction

It is a well-established fact that unemployment rates in (almost all) OECD countries are decreasing in education (see Figure 1, left panel). This is in sharp contrast to the pattern observed in urban West Africa where unemployment rates are inverse U-shaped in education, peaking at lower secondary education (see Figure 1, right panel)[1].



Sources: OECD (left panel). 1-2-3-Survey, 1st phase, 2001/2002; AFRISTAT, DIAL, INS; authors' calculations (right panel).

Figure 1: Unemployment rates of men (25 to 64 years old) in the OECD and urban West Africa by education level

Inverse U-shaped unemployment rates were already reported in the late 1960s and early 1970s for different developing countries such as India, Sri Lanka (Ceylon), Argentina, Colombia, Venezuela, Malaysia, Syria and Sudan (see Turnham (1971) and Fields (1980)). Recent evidence confirms this pattern for many other developing countries (see Galal (2002) for Egypt). Different mechanisms could be at the core of this pattern. First of all, skills required in qualified jobs do not match the skills acquired in secondary and tertiary education. Secondly, labour supply of educated workers exceeds its demand, and wages cannot adjust. Thirdly, better educated workers face longer job search duration.

While these interpretations can rationalise higher unemployment rates of educated workers, they cannot explain why educated workers do not (temporarily) downgrade to lower skilled jobs in order to escape unemployment. Indeed, downgrading or trickle-down effects of unemployment are an important factor in explaining the decreasing unemployment rate by educational attainment observed in the US and other developed countries (see Gautier (2002), Beaudry et al. (2013), Barnichon and Zylberberg (2014)). The contrasting unemployment pattern in West Africa and other developing countries suggests that costs associated with downgrading exceed the income a high-skilled individuals can derive from working in a low-skilled job.

This paper studies unemployment and under-employment patterns in seven West African economic capitals and how they relate to educational attainments. We aim to shed light on the workings of labour markets in developing countries, and identify possible mechanisms which can explain the observed patterns. More specifically, we study education decisions, labour market

[1]For unemployment rates by country and education level, see Figures 6 and 7 in the Appendix.

entry and labour market transitions.

In a first part of the paper we provide descriptive empirical evidence on unemployment patterns. We show that the West African unemployment pattern is robust to different controls. We then investigate labour market entry, transition and employment perspectives for the future. Our findings reveal that education indeed increases the probability of employment in the public and the private-formal sector, the two sectors which pay the highest incomes. As for labour market transitions, education only plays a marginal role. The public sector and self-employment exhibit low out-transition, independent of an individual's education level. This finding suggests that downgrading into self-employment could result in a lock-in, something which educated individuals tend to avoid. On the other hand, our results on employment perspectives show that most self-employed individuals do not envisage a job (or sector) change and surprisingly, a majority of employees in the private-formal or private-informal sector would want to become self-employed.

In a second part of the paper, we develop a search- and matching model with multiple sectors and an endogenous schooling decision. The model is based on the multi-sector search- and matching framework developed by Albrecht et al. (2011), Meghir et al. (2015) and Albrecht et al. (2015), and includes an endogenous schooling choice as in Flinn and Mullins (2015). The model features heterogeneous individuals, which first make a costly education decision before entering the labour market. The labour market consists of a public sector, firms in a private sector and the possibility of self-employment. We will then estimate the model using the 1-2-3 Survey data on West African capitals. The estimated parameters are then used for analysing the effect of different education and labour market policies. Namely, we want to understand how decreasing schooling costs, self-employment subsidies (rather than unemployment insurance), minimum wage laws and the creation of public-sector jobs affect educational attainment, unemployment and worker distribution across sectors.

The remaining part of this paper is structured as follows. Section 2 presents the data and descriptive evidence. Section 3 presents preliminary estimation results. Section 4 develops a search- and matching framework with different sectors and an endogenous schooling decision. In Section 5 we will estimate this model to recover the underlying structural parameters, which we then will use to evaluate alternative education and labour market policies (Section 6). Section 7 concludes.

2 Data and descriptive evidence

2.1 Data

The data set used in this paper is drawn from the first phase of the 1-2-3-Survey (see Brilleau et al. (2005)) conducted in 2001 and 2002 in the economic capitals of the members of the West African Economic and Monetary Union (UEMOA). These include Benin (Lomé), Burkina Faso (Ouagadougou), Côte d'Ivoire (Abidjan), Mali (Bamako), Niger (Niamey), Senegal (Dakar) and Togo (Cotonou). The 1-2-3-Survey is a household survey with approximately 7,500 to 14,000

individual observations per country. It contains information on socio-demographic characteristics, current labour market status, part of the employment history (max. last two spells), actual income, income aspiration, reservation wage and employment perspectives. Some sample statistics of individuals aged 10 and above are summarised in Table 1.

	Benin	Burkina	C-Ivoire	Mali	Niger	Senegal	Togo	Total
Summary statistics								
Observations	8,967	10,295	8,682	9,061	10,141	14,871	7,548	69,565
Age	29.6	28.3	27.9	29.1	28.4	29.4	28.6	28.8
Women (%)	51.9%	49.9%	50.7%	50.7%	51.6%	52.4%	52.4%	51.4%
Born in capital (%)	50.6%	44.8%	37.5%	50.4%	50.4%	63.6%	40.9%	49.8%
Labour market status and earnings								
Students (% of sample)	32.6%	40.2%	31.4%	46.7%	38.7%	32.8%	33.2%	36.0%
Employed students (% of students)	4.2%	5.7%	5.6%	12.7%	9.4%	6.2%	18.1%	8.6%
Labour force (% of sample)	63.1%	62.2%	67.1%	55.5%	54.6%	53.9%	69.5%	60.0%
Unemployment (% of labour force)	6.0%	20.1%	15.5%	10.7%	22.1%	20.0%	9.4%	15.3%
Monthly earnings (CFA)	44,700	40,300	70,000	62,600	41,000	55,300	27,300	48,400
Educational attainment (excl. current students)								
No schooling (%)	27.4%	45.2%	37.4%	55.5%	47.8%	38.5%	22.5%	39.7%
Education (years)/schooling	8.76	8.46	9.00	9.92	8.63	8.23	8.27	8.66

Table 1: Sample characteristics (age 10 and above)

We find that the population in the seven economic capitals is relatively similar in terms of age and gender composition. Larger differences emerge in terms of the share of natives (from 38% in Abidjan to 64% in Dakar), school attendence (high schooling rates of more than 70% in Cotonou and Lomé), and the share of the population in the labour force (from 54% in Dakar and Niamey to 70% in Cotonou). Unemployment rates also vary from 6% in Lomé to more than 20% in Ouagadougou, Niamey and Dakar.

Around 40% of the individuals in urban West Africa have never gone to school. Those who have ever attended school, have been in education for around 8 to 9 years, which corresponds to having something between primary (6 years) and lower secondary education (10 years). Two factors contribute to the relatively low educational attainment. First, a large share of the population never attend school because of financial reasons (around 30%, not shown). Secondly, drop out rates from school are relatively high. Individuals who drop out do so because they have a preference for a professional pathway (around 20%, not shown) or because of academic failure (another 20%, not shown).

2.2 Descriptive evidence about employment and unemployment

Labour markets in developing countries are known to be very heterogeneous. A common distinction is usually made between the public, formal and the informal sector. The informal sector spans the economic activity which is not monitored by the government and does not pay taxes (and social security contributions). Self-employment makes up a significant share of the informal sector. While these sectors clearly differ in terms of their educational composition (or skill requirement) and incomes, the sector-specific labour markets are not segmented. There is some transition between these different sectors. Figure 2 shows the activity status and the sectoral composition of

the employed labour force of men by education level.

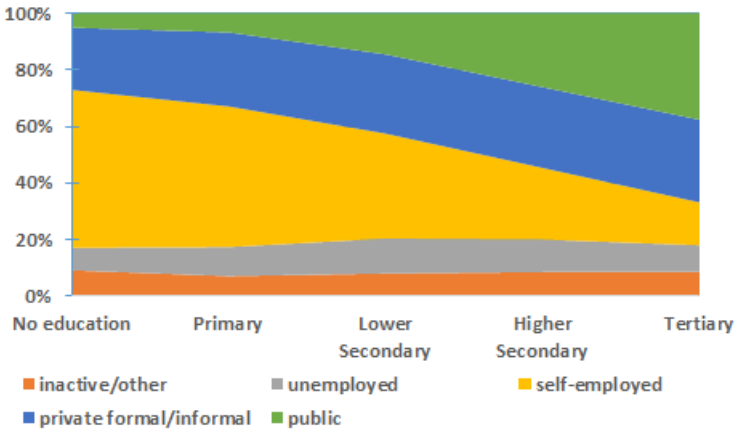


Figure 2: Activity & employment status of men (25 to 64 year-olds)

We find that as the education level increases, the share of employment in the public sector increases whereas the share in self-employment decreases. However, labour markets are not (strictly) segmented along education. Around 6% of the uneducated labour force works in the public sector (compared to 40% among those with tertiary education), and more than 17% of the labour force with tertiary education is self-employed (61% among the uneducated). The share of salaried private employment (formal or informal) remains relatively stable across education levels at 25% to 30%. Table 2 displays the mean earnings and standard deviation of earnings by sector and education level.

	Public	Private-Formal	Private-Informal	Self-employment
No education	67,000	66,900	42,500	58,100
	(48,100)	(82,000)	(67,500)	(123,800)
Primary	73,000	59,900	36,300	44,600
	(52,900)	(49,900)	(34,200)	(75,100)
Lower secondary	94,500	76,000	37,400	60,400
	(89,700)	(69,800)	(36,400)	(145,800)
Upper secondary	106,500	85,200	49,500	91,700
	(77,900)	(88,500)	(45,600)	(255,800)
Tertiary	194,600	227,200	100,500	164,600
	(172,300)	(314,900)	(129,600)	(283,500)

Table 2: Mean and standard deviation of monthly earnings by sector and education (in CFA)

The public sector pays a wage premium for all education levels, except at tertiary education. Generally, incomes in the public sector are highest, followed by those in the private-formal sector, self-employment and then in the private-informal sector. Incomes in the private-formal sector are approximately 20% lower than in the public sector for individuals with primary or secondary education. Self-employed individuals earn 15% to 40% less than those in the public sector, the difference again being largest for those with primary and (lower) secondary education. Finally, individuals in the private-informal sector have incomes which are around 40% to 60% lower than in the public sector. In terms of dispersion, we find that income dispersion is lowest in the public sector and highest in self-employment.

Another key factor of labour markets in developing countries is 'precarious' employment. Even though workers are employed, they face wages which are below the minimum wage. Figure 3 shows the share of the labour force who is employed above the hourly minimum wage, below the hourly minimum wage and who is unemployed.

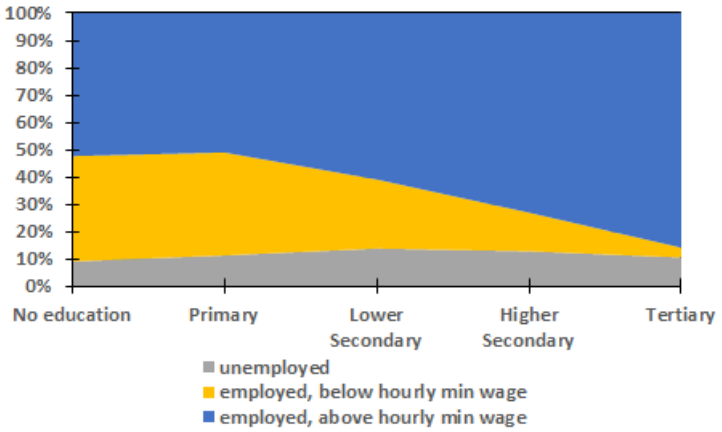


Figure 3: Under- & unemployment of men (25 to 64 year-olds)

In order to meet financial needs, many workers in 'precarious' employment increase their monthly income by taking on a second job or by working more hours. Average working hours in the main job decrease from around 48 hours for those without any education to 41 hours for those with tertiary education.

Among the seven West African countries studied in this paper, none offers a general unemployment insurance scheme. Therefore, it is surprising that around 15% of the labour force declare to be unemployed. Around 80 to 90% of the unemployed individuals receive financial support from the family. Among the unemployed, a large fraction are labour market entrants.

One key question is why individuals who are unemployed do not start or work for a micro-company, that is why they do not become self-employed. The main reasons for not starting or working for a micro-company are that it is not easy to start such an activity, low incomes and skill mismatch.

3 Preliminary estimation results

3.1 Unemployment patterns

In order to understand unemployment patterns, it is important not to limit inspection to unemployment rates but to consider also flows into and out of unemployment and the duration of unemployment spells. In Table 3 we present some further evidence on unemployment patterns in West Africa.

	None	Primary	Lower secondary	Higher secondary	Tertiary
Observations	15,167	12,477	8,391	2,678	3,004
Age	34.5	28.4	30.9	33.5	36.9
Share female (%)	56.2%	48.0%	41.1%	34.5%	24.3%
Unemployment rate	13.5%	16.5%	18.7%	14.6%	11.7%
Unemployment rate (25 to 64 years)	12.3%	14.3%	16.2%	13.7%	11.3%
Unemployed since ... years	4.35	3.95	4.09	3.67	2.45
Labour market entrant (% of unemployed)	52.3%	56.2%	58.2%	59.5%	68.7%

Notes: Labour market entrants are individuals who are looking for their first job.

Table 3: Unemployment characteristics by education level

The unemployment rate is inverse U-shaped, both when considering the full labour force aged 10 and older, as well as when considering only those aged 25 to 64. The slightly lower unemployment rate among the second group indicates that unemployment is more prevalent in the early and very late years of labour market participation. This fact is also reflected in the high share of labour market entrants among the unemployed. More than 50% of all unemployed have not previously been employed, indicating that the transition from out of the labour force/school to working is highly frictional. The duration of the current unemployment spell decreases with the education level (in line with the increasing share of labour market entrants). This suggests that the unemployment rate among those with low education is mainly driven by (few) long-term unemployed, while the unemployment rate of those with higher education mirrors frictional labour market entry.

3.2 Unemployment regressions

In this section, we assess the robustness of the descriptive results by controlling on confounders. Namely, we include sequentially in a reduced form regression sets of controls about individual characteristics (education and experience), household-specific controls (household income excluding the individual of interest, share of unemployed/non-working in household, size of household,...), as well as interaction terms between the individual's education and the family background. If those with middle education would stay unemployed because the family can afford it, the inverse U-shape pattern should be stronger the better the family socio-economic background. Moreover, we separate workers by age group to assess, which cohort is driving the peculiar relationship between unemployment and education.

Table 4 presents the results of a logit regression of the decision to remain unemployed for all individuals aged above 10. The first column includes only the individual characteristics. Compared to the reference group, those with no education, the probability to be unemployed increases first with the level of education, being the highest for those with a secondary education (the odd ratio is about 51% higher, and the marginal effect about 41% higher). Then, the unemployment probability drops to fall below the reference level for those with the tertiary education. Including the household characteristics does not change the pattern significantly. The increase in the odd ratio is more moderate (38%) but still significant. The odds ratio then drops by about 23% for those with tertiary education. While higher household size, share of individuals unemployed and

	(1) unemployed	(2) unemployed	(3) unemployed
Individual characteristics			
Ref. No Education	-	-	-
Primary	0.138*	0.0819	0.131
	(2.20)	(1.28)	(1.92)
Lower Secondary	0.413***	0.322***	0.396***
	(6.40)	(4.87)	(5.50)
Higher Secondary	0.255**	0.131	0.134
	(2.86)	(1.43)	(1.24)
Tertiary	-0.146	-0.257**	-0.329**
	(-1.65)	(-2.79)	(-2.94)
Potential_exp	-0.0410***	-0.0389***	-0.0391***
	(-9.55)	(-8.64)	(-8.67)
Potential_exp2	0.000541***	0.000507***	0.000513***
	(7.41)	(6.69)	(6.75)
Household characteristics			
Household Size		0.0293***	0.0291***
		(7.15)	(7.10)
Share Above age 10		-0.235***	-0.230***
		(-3.48)	(-3.41)
Share Unemployed		1.245***	1.246***
		(18.91)	(18.92)
Household Income		0.853	0.877
		(1.50)	(1.55)
Father's education		0.0346***	0.0642***
		(6.48)	(4.36)
Interaction			
Ref. No Education × Father's education			-
Primary × Father's education			-0.0419*
			(-2.27)
Lower Secondary × Father's education			-0.0446**
			(-2.58)
Higher Secondary × Father's education			-0.0240
			(-1.20)
Tertiary × Father's education			-0.0110
			(-0.58)
Constant	-2.444***	-2.637***	-2.669***
	(-21.56)	(-20.42)	(-20.56)
Country FE	yes	yes	yes
Observations	22,104	22,104	22,104

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Logit regression of the unemployment probability

household income all increase the probability of unemployment, the share of people above age 10 decreases this probability. Finally for one additional year of the father's education, the odd ratio increases by about 3%.

Finally, column (3) includes the interaction terms. The interaction terms suggest that the better the socio-economic background of the household, the less pronounced is the curve of the inverse U-shape relationship. Indeed, in comparison with the reference both interaction terms are significantly negative for the group of secondary educated. Note however, that the interaction between household income and education is somewhat poorly estimated.

Table 5 separates workers in three cohorts: age 15-24, 25-34, and above 35, and use the full regression. The results suggest that the two extreme cohorts drive the observed inverse U-shape relationship. In the youngest cohort, unemployment probability increases with education. However, one needs to be cautious about this finding, since part of the youths are excluded because they are still in education. In the middle cohort, unemployment decreases almost monotonically with education, with the probability of unemployment of the average individual decreasing by about two third. Conversely, in the oldest cohort, the unemployment rate almost doubles from the no education state to the intermediate education state, before falling again. Not surprisingly, the interaction term is only significant in the youngest cohort: the higher the father's education, the lower the probability that a low educated be unemployed.

To sum up, the inverse U-shape relationship between unemployment and education is robust to the inclusion of observable controls, and is mainly driven by young adults and workers above 35 years old. For these different groups, we also investigate the relationship between the duration of unemployment and education as shown in Table 6.

Contrary to what the raw data would suggest, once observable characteristics are controlled for, the duration of current unemployment tends to increase with education across all cohorts. It increases steadily before peaking for secondary educated and staying fairly stable, as education level increase. Household characteristics do not seem to matter much for the duration of unemployment.

3.3 Labour market entry, transition and employment perspectives

This subsection inspects labour market entry and transition of men aged 25 to 64 years. Table 7 presents 3-year transition rates between different employment status by education level. We distinguish unemployed (and inactive) individuals, those who are self-employed (incl. family workers), salaried employees in the private informal sector, salaried employees in the private formal sector and employees in the public sector.

Overall, Table 7 shows a high persistence in labour market states over a 3-year period (reflected by the diagonal elements in each panel). One out of three men who were unemployed (or inactive) 3 years ago are still unemployed in the current period. For those who were employed in the public or private-formal sector around 90% are still employed in the same sector. For

	(1) Age 15-24	(2) Age 25-34	(3) Age 35 +
Individual characteristics			
Ref. No Education	-	-	-
Primary	0.271	-0.402*	0.604***
	(1.69)	(-2.42)	(5.31)
Lower Secondary	0.758***	-0.121	0.680***
	(4.12)	(-0.65)	(5.19)
Higher Secondary	0.683*	-0.637**	0.598**
	(2.44)	(-2.60)	(2.98)
Tertiary	0.0581	-1.025***	-0.0214
	(0.10)	(-3.68)	(-0.10)
Potential_exp	0.142***	-0.166***	0.0588***
	(3.74)	(-4.24)	(3.45)
Potential_exp2	-0.00628**	0.00245*	-0.000399*
	(-2.92)	(2.02)	(-2.03)
Household characteristics			
Household Size	0.0103	0.0491***	0.00447
	(1.38)	(7.38)	(0.52)
Share Above age 10	-0.403**	-0.279*	0.185
	(-2.83)	(-2.56)	(1.61)
Share Unemployed	2.065***	1.199***	0.708***
	(15.39)	(10.24)	(6.30)
Household Income	0.585	1.327	1.595
	(0.53)	(1.43)	(1.37)
Father's education	0.0612*	0.0450	0.0631*
	(2.40)	(1.79)	(2.23)
Interaction			
Ref. No Education × Father's education	-	-	-
Primary × Father's education	-0.0675*	-0.0105	-0.00311
	(-2.23)	(-0.32)	(-0.08)
Lower Secondary × Father's education	-0.0699*	-0.0316	-0.0181
	(-2.35)	(-1.09)	(-0.51)
Higher Secondary × Father's education	-0.0364	-0.00746	-0.0251
	(-0.97)	(-0.24)	(-0.61)
Tertiary × Father's education	0.0683	-0.0276	-0.0148
	(1.37)	(-0.93)	(-0.40)
Constant	-3.743***	-0.800*	-4.976***
	(-11.72)	(-1.97)	(-12.02)
Country FE	yes	yes	yes
Observations	5,506	6,940	9,095

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Logit regression of the unemployment probability, by cohort

	(1) Age 15-24	(2) Age 25-34	(3) Age 35 +
Individual characteristics			
Ref. No Education	-	-	-
Primary	12.15***	11.93***	9.923***
	(4.81)	(4.73)	(3.59)
Lower Secondary	14.79***	14.57***	12.79***
	(5.74)	(5.63)	(4.45)
Higher Secondary	13.68***	13.25***	12.49**
	(3.98)	(3.82)	(3.03)
Tertiary	11.76***	11.37**	9.459*
	(3.36)	(3.19)	(2.22)
potential_exp	1.671***	1.734***	1.755***
	(8.60)	(8.81)	(8.89)
potential_exp2	-0.00851*	-0.00916**	-0.00972**
	(-2.46)	(-2.63)	(-2.78)
Household characteristics			
Household Size		0.419*	0.431**
		(2.51)	(2.58)
Share Above age 10		-4.794	-4.988
		(-1.77)	(-1.84)
Share Unemployed		5.241	5.196
		(1.94)	(1.92)
Household Income		-23.07	-23.45
		(-1.05)	(-1.07)
Father's education		0.279	-0.719
		(1.40)	(-1.28)
Interaction			
No Education × Father's education			-
Primary × Father's education			1.393
			(1.90)
Lower Secondary × Father's education			1.140
			(1.75)
Higher Secondary × Father's education			0.882
			(1.20)
Tertiary × Father's education			1.104
			(1.57)
Constant	0.817	-1.351	-0.0231
	(0.17)	(-0.26)	(-0.00)
Observations	2,883	2,883	2,883

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: OLS regression of the unemployment duration

	Current employment status				
Past labour market status	Unemployed	Self-Employed	Informal	Formal	Public
No education					
Unemployed/inactive	29.3%	42.5%	15.2%	11.0%	1.9%
Self-Employed	1.0%	97.1%	1.3%	0.5%	0.1%
Private-Informal	4.5%	3.9%	90.3%	0.9%	0.4%
Private-Formal	6.0%	4.0%	2.1%	87.6%	0.3%
Public	3.9%	2.9%	2.4%	0.5%	90.2%
Total	7.0%	65.2%	13.3%	9.9%	4.6%
Primary education					
Unemployed/inactive	28.6%	36.8%	15.0%	16.2%	3.4%
Self-Employed	1.5%	95.8%	1.5%	0.9%	0.2%
Private-Informal	7.3%	3.7%	86.2%	2.8%	0%
Private-Formal	6.4%	4.2%	3.2%	85.6%	0.6%
Public	3.4%	2.3%	2.6%	0%	91.7%
Total	9.2%	54.8%	12.5%	16.0%	7.6%
Lower secondary education					
Unemployed/inactive	31.5%	29.3%	12.5%	18.7%	7.9%
Self-Employed	2.1%	94.3%	1.1%	2.2%	0.3%
Private-Informal	5.8%	6.2%	84.1%	1.6%	2.3%
Private-Formal	8.5%	5.1%	1.7%	83.8%	1.0%
Public	3.3%	1.6%	0.6%	1.8%	92.7%
Total	11.8%	40.8%	10.5%	20.6%	16.3%
Upper secondary education					
Unemployed/inactive	32.6%	19.5%	6.3%	23.7%	17.9%
Self-Employed	2.0%	93.6%	0.7%	3.2%	0.5%
Private-Informal	4.0%	10.7%	78.7%	4.0%	2.7%
Private-Formal	4.1%	3.1%	1.0%	90.2%	1.5%
Public	2.4%	1.6%	0%	1.4%	94.5%
Total	11.6%	26.8%	5.3%	26.3%	30.0%
Tertiary education					
Unemployed/inactive	34.2%	14.7%	5.5%	24.5%	21.1%
Self-Employed	1.7%	96.6%	0%	0.4%	1.3%
Private-Informal	6.1%	0%	81.6%	10.2%	2.0%
Private-Formal	4.0%	4.2%	1.6%	89.2%	1.1%
Public	1.1%	0.8%	0.7%	2.3%	95.1%
Total	11.9%	18.0%	4.4%	27.1%	38.6%

Table 7: Observed 3-year labour market transition rates of men (25 to 64 year-olds)

those in self-employment, on average less than 5% had left self-employment in this period. The private-informal sector is the sector with the highest fluctuation, but even in this sector fluctuation remains low. Only 10% to 20% of private-informal employees had left the sector after three years, some of them had gone into unemployment and others had become self-employed.

Beyond these general patterns, we notice that observed labour market transitions also differ by education level. The probability of staying employed in the public sector slightly increases with education, while the stayer-probability in the private-informal sector decreases. The probability of an unemployed (or inactive) individual to remain in unemployment slightly increases with education. The probability of moving from employment to unemployment depends largely on the sector of employment rather than on the education level of the individual.

Moreover, we find that the education level is crucial in determining in which sector a labour market entrant or an unemployed individual finds employment (first row in each panel of Table 7). An unemployed/inactive individual without schooling finds employment in the private-formal or public sector with a probability of 12%. This probability increases to 45% for someone with tertiary education. The converse is true for transition from unemployment/inactivity to self-employment. It monotonically decreases with education: From more than 40% for individuals without education to less than 15% for those with tertiary education. This evidence suggests that individuals with higher education could have an interest in searching longer for a job in the private-formal or public sector before becoming self-employed (i.e. downgrading).

This interpretation would also be in line with the finding that once an individual is employed in a specific sector, relatively little sectoral transition occurs and an individual's education affects these transition probabilities only marginally. For example, observed separation rates (second column in Table 7) vary greatly across sectors. The risk of moving from private-informal employment into unemployment is between 4% and 7% over a 3-year period, while transition from the public sector to unemployment is around 1% for those with tertiary education and 4% for those without any education.

The ranking of sectors in terms of average earnings (see Table 2) is not reflected in the ranking according to job stability. The public sector is clearly the one which offers on average the highest wages and which exhibits the highest job stability. Self-employed individuals have similar job stability patterns, but their average earnings are clearly lower and much more disperse. The private-formal sector and the private-informal sector have similar job separation rates. However, incomes in the formal sector are much higher than in the informal sector. It is surprising that transition rates from private-informal to self-employment are not higher, given that incomes of self-employed are on average 20% to 60% higher than those of employees in the private-informal sector.

In what follows, we extend the analysis from *observed* employment status changes to *desired* employment changes. If observed employment changes are found to be very different from desired employment changes, this would suggest that labour market transitions are highly frictional. Table

8 presents employment perspectives of men by their current employment status. The second column shows the share of individuals who want to change their current job (change firm or get promotion within the current firm), columns 3 to 6 show into which employment status these individuals would want to switch.

	Change job (%)	**Desired employment status**			
Current employment status		Self-Employed	Private	Public	Unknown
Self-Employed	51.0%	70.6%	16.9%	10.0%	2.5%
Private-Informal	59.0%	58.7%	23.0%	14.2%	4.1%
Private-Formal	55.1%	50.7%	33.5%	12.4%	3.3%
Public	39.7%	31.4%	14.3%	48.9%	5.4%

Table 8: Employment perspectives of employed men

Overall, we find that the share of men who want to change their job in the future (second column in Table 8) generally mirrors the observed stayer rates shown in Table 7. Employees of the public sector and self-employed individuals are the least likely of wanting to change their job, in line with the high observed stayer rates. Even among those who do want to change, a majority would like to find work in the same sector (70% for those in self-employment, 49% for those in the public sector).

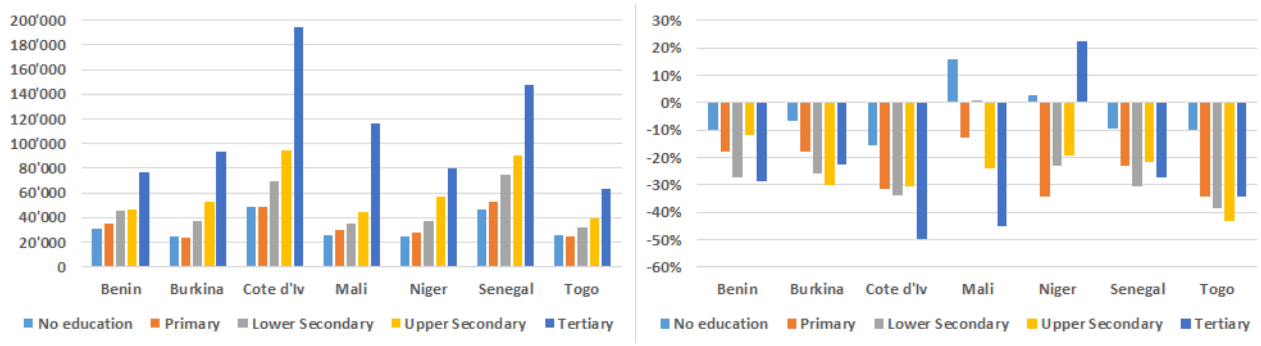
Around one out of two employees in the private sector (formal and informal) would like to change the job, both with a clear preference for self-employment. This result is slightly puzzling for two different reasons. First, it is surprising that the share of individuals desiring to change jobs is of similar magnitude among those in the informal and the formal sector. Given the large income difference in these sector, we would have expected higher change rates in the informal sector. Secondly, we would have expected much less than 50% of change-willing employees in the formal sector would want to become self-employed, where average incomes are up to 30% lower.

3.4 Predicted income and reservation wage of unemployed

Following the above analysis of unemployment, an adequate question is whether unemployed individuals have too high wage expectations compared to the market wage (and thus cannot find work) and whether the biased expectations vary significantly with the education. In order to investigate this issue, we estimate Mincerian equations on the employed individuals and then predict incomes for their unemployed peers. If selection in unemployment would solely depend on observable characteristics, we would be predicting correctly unemployed's expected wage. However, because there is selection on unobservable characteristics, the estimation is likely to be biased.

Nevertheless, the comparison is highly informative. Indeed, we observe the reservation wage for the unemployed, say $E(RW|U,X)$, that we compare to market wage of the employed with the same characteristics, say $E(W|E,X)$. We can argue without difficulty that $E(RW|E,X) < E(W|E,X)$ and $E(RW|U,X) > E(W|U,X)$ - or unemployed would be working. If we find in the data that $E(RW|U,X) > E(W|E,X)$, it follows that $E(RW|U,X) > E(W|X)$.

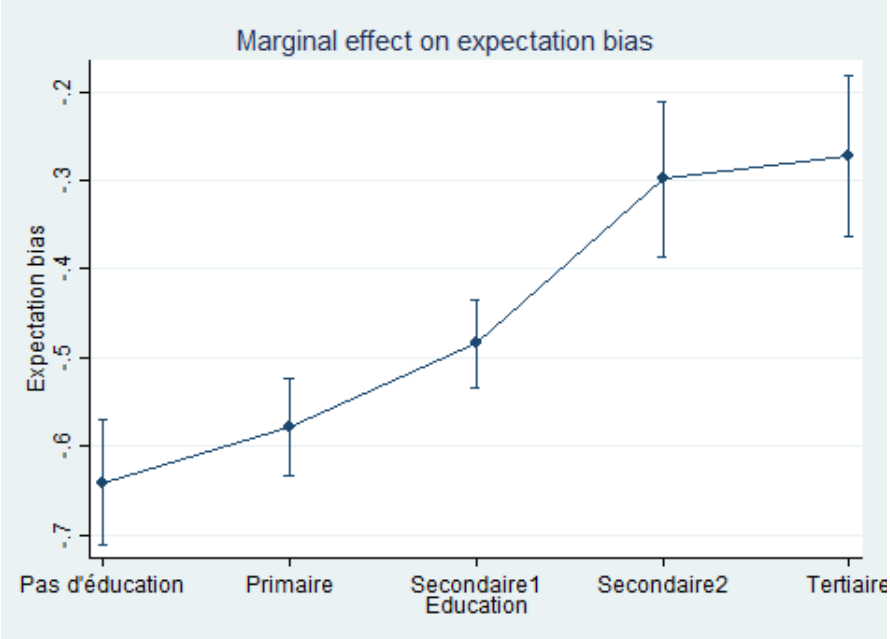
Figure 4 shows the monthly reservation wage of unemployed men by education level (left panel). The right panel displays the difference of the predicted monthly income to the monthly reservation wage.



Source: Author's calculations.

Figure 4: Reservation wage (left panel) and difference of predicted income to reservation wage (right panel, in %) of unemployed men, by education level

The figures suggest that the average reservation wage exceeds the predicted income of unemployed men for almost all education groups in all West African capitals. Besides, this difference seems to increase with the education level. However, controlling for observable characteristics gives a somewhat different picture. Figure 5 shows the marginal effect of education on the bias between predicted market wage and stated reservation wage.



Source: Author's calculations.

Figure 5: Marginal effect of education on the expectation bias

The bias, which is always negative, reduces with the educational attainment. All things being equal, higher educated have more accurate predictions. This finding suggests that those of the low educated who do not work are those with unreasonable wage expectations, while those of the

high educated who do not work probably do not find a job in the formal sector.

4 The Model

In this section, we will develop a general equilibrium search and matching model in the spirit of Pissarides-Mortensen-Diamond (see Pissarides (2000)). The model features heterogeneous individuals, which first make a costly education decision before entering the labour market. Individuals differ in terms of ability/productivity and their family background, which impacts schooling costs and non-monetary benefits/costs of unemployment. The firm side is characterised by different labour market sectors, that is the public sector, the private sector and self-employment. These sectors have different production functions, matching frictions and face certain regulations (i.e. minimum wage laws in the public sector). Altogether, these elements will lead to sorting of heterogenous workers across sectors and education-specific unemployment rates.

In a second step, we will use the 1-2-3 Survey data on West African capitals in order to estimate the structural parameters of the search- and matching model developed above. We will use a Simulated Method of Moments estimation procedure. It is key to identify the effect of parental background on schooling costs and non-monetary benefits/costs of unemployment, as well as to quantify the matching frictions in different sectors and how they translate to different endogenous job arrival and job separation rates.

The framework is a slight modification of Albrecht et al. (2015) (henceforth ARAV) to include self-employment and prior education decisions.

4.1 Schooling decision

Let a be the ability of an agent, with distribution function F_A, and k the family capital, with distribution function F_K, which summarizes the family background of the individual. The household chooses the optimal human capital of the individual h, so to solve the following problem:

$$\max_h V_U(h,k) - c(a,k).h \tag{1}$$

where $V_U(h,k)$ is the net present value of unemployment of an individual with human capital h and family capital k. $c(a,k)$ is the constant marginal cost of an additional year of education for an individual with ability a and family capital k.

In the subsequent analysis, we derive the present value of unemployment in GE model. To simplify notations, we refer to $y = (h,k)$, with distribution F_Y.

4.2 Values Functions, Wages and Reservation Values

We define four different states for the individual: (i) unemployed, (ii) employed in the public sector, (iii) employed in the private sector, or (iv) self-employed. The labor market is defined by a matching function where firms, private and public, post vacancies at rates v_p and v_g respectively. Let $\phi = v_p/(v_p + v_g)$, the proportion of vacancies posted by private firms. Define by u the

unemployment rate in the economy and by $\theta = (v_p + v_g)/u$ the labor market tightness. Matching on the labor market is governed by a function $m(\theta)$ with the usual properties. Contact between firms and individuals occur randomly and do depend neither on the individual's schooling, nor on the firm type. Each contact produces a match specific productivity X with distribution $F_{X,j}$ in sector j. When they are in the unemployment state, workers receive a flow value of unemployment $b(y)$. Workers also draw a self-employment specific productivity X_s, with distribution $F_{X,s}$, at a Poisson rate $\lambda(y)$. Denote by $\delta_j(y)$, for $j \in \{p, g, s\}$ the job destruction rate in each sector.

The present value in each state can then be written as follows:

$$\begin{aligned} rV_U(y) &= b(y) + \phi m(\theta)\mathbb{E}_{F_{X,p}} \max\{V_p(x,y) - V_U(y), 0\} \\ &\quad + (1-\phi)m(\theta)\mathbb{E}_{F_{X,g}} \max\{V_g(x,y) - V_U(y), 0\} \\ &\quad + \lambda(y)\mathbb{E}_{F_{X,s}} \max\{V_s(x,y) - V_U(y), 0\} \qquad (2) \\ rV_p(x,y) &= w_p(x,y) + \delta_p(y)\left(V_U(y) - V_p(x,y)\right) \qquad (3) \\ rV_g(x,y) &= w_g(x,y) + \delta_g(y)\left(V_U(y) - V_g(x,y)\right) \qquad (4) \\ rV_s(x_s,y) &= x_s + \delta_s(y)\left(V_U(y) - V_s(x_s,y)\right) \qquad (5) \end{aligned}$$

In the public sector, wage are determined by an exogenous rule $w_g(x, y)$. We follow ARAV in assuming that recruitment in the public sector occurs only if $x \geq w_g(x, y)$.

On the private-sector firm side, let $J(x, y)$ be the present value associated with a job filled by a worker of type (y) whose match-productivity is x. Denote by V the value associated with posting a private-sector vacancy. These values are defined by :

$$\begin{aligned} rV &= -c + \frac{m(\theta)}{\theta}\mathbb{E}_{\mathbb{F}_{\mathbb{X},\mathbb{Y},\mathbb{I}}} \max\{J(x,y) - V, 0\} \qquad (6) \\ rJ(x,y) &= x - w_p(x,y) - \delta_p(y)J(x,y) \qquad (7) \end{aligned}$$

where $F_{X,Y,p}$ is the joint distribution of (X, Y). Note also that we assume that once a job is destroyed, the firm does not open a new vacancy.

In the private sector, the axiomatic Nash Bargaining solution determines the worker's wage. Let β be the worker's bargaining power. It follows that:

$$w_p(x,y) = \beta x + (1-\beta)rV_U(y) \qquad (8)$$

Denote $R_j(y)$, the reservation productivity to work in the sector j, that is $R_j(y)$ is such that $V_j\left(R_j(y), y\right) = V_U(y)$. Introducing Eq.(8) in Eq.(3), we obtain

$$R_p(y) = rV_U(y). \qquad (9)$$

Similarly, we can show that:

$$R_s(y) = R_p(y).$$

Furthermore, using the characterization of the reservation productivity in each sector given y,

and Eq.(3), (4) and (5), we obtain:

$$V_p(x,y) - V_U(y) = \frac{\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) \tag{10}$$

$$V_g(x,y) - V_U(y) = \frac{1}{r+\delta_g(y)}\left(w_g(x,y) - R_p(y)\right) \tag{11}$$

$$V_s(x_s,y) - V_U(y) = \frac{1}{r+\delta_s(y)}\left(x_s - R_p(y)\right) \tag{12}$$

To characterize $R_p(y)$, it now suffices to use Eq.(2) that gives:

$$\begin{aligned} R_p(y) = b(y) &+ \frac{\phi m(\theta)\beta}{r+\delta_p(y)} \int_{R_p(y)} \left[x - R_p(y)\right] dF_{X,p}(x|y) \\ &+ \frac{(1-\phi)m(\theta)}{r+\delta_g(y)} \int_{R_g(y)} \left[w_g(x,y) - R_p(y)\right] dF_{X,g}(x|y) \\ &+ \frac{\lambda(y)}{r+\delta_s(y)} \int_{R_p(y)} \left[x - R_p(y)\right] dF_{X,s}(x|y) \end{aligned} \tag{13}$$

For given values of θ and ϕ, there exists a unique solution for $R_p(y)$. The indeed, the RHS is positive at $R_p(y) = 0$, goes to b as $R_p(y) \to +\infty$ and decreasing in $R_p(y)$.

4.3 Free-entry and steady State Conditions

By Eq.(7), we obtain that:

$$J(x,y) = \frac{1-\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) \tag{14}$$

Then imposing the free-entry condition $V = 0$ in Eq.(6), it follows that :

$$c = \frac{m(\theta)}{\theta} \int_{Supp\{Y|U\}} \int_{R_p(y)} \frac{1-\beta}{r+\delta_p(y)} (x - R_p(y)) dF_{X,p}(x|y) dF_Y(y|U) \tag{15}$$

where $F_Y(.|U)$ is the joint distribution of schooling and family capital among those who are unemployed, and $Supp\{Y|U\}$ its support. This distribution is unknown and can be recovered by using the steady state conditions. Let $n_j(y)$ be the proportion of agents with characteristic (y) who work in the sector j in the steady-state. Let $u(y)$ be the corresponding proportion of unemployed agents.

The steady state conditions impose that, for some (y) the proportion of job created is the same as the proportion of job-destroyed, so that :

$$\begin{aligned} \delta_p(y) n_p(y) &= \phi m(\theta) \left[1 - F_{X,p}(R_p(y)|y)\right] u(y) \\ \delta_g(y) n_g(y) &= (1-\phi) m(\theta) \left[1 - F_{X,g}(R_g(y)|y)\right] u(y) \\ \delta_s(y) n_s(y) &= \lambda(y) \left[1 - F_{X,s}(R_p(y)|y)\right] u(y) \end{aligned}$$

and

$$n_p(y) + n_g(y) + n_s(y) + u(y) = 1.$$

It follows that:

$$u(y) = \frac{\delta_p(y)\delta_g(y)\delta_s(y)}{A(\phi,\theta,y)} \tag{16}$$

$$n_p(y) = \frac{\delta_g(y)\delta_s(y)\phi m(\theta)\left[1-F_{X,p}(R_p(y)|y)\right]}{A(\phi,\theta,y)} \tag{17}$$

$$n_g(y) = \frac{\delta_p(y)\delta_s(y)(1-\phi)m(\theta)\left[1-F_{X,g}(R_g(y)|y)\right]}{A(\phi,\theta,y)} \tag{18}$$

$$n_s(y) = \frac{\delta_p(y)\delta_g(y)\lambda(y)\left[1-F_{X,s}(R_p(y)|y)\right]}{A(\phi,\theta,y)} \tag{19}$$

where

$$\begin{aligned} A(\phi,\theta,y) = {} & \delta_p(y)\delta_g(y)\delta_s(y) + \delta_p(y)\delta_s(y)(1-\phi)m(\theta)\left[1-F_{X,g}(R_g(y)|y)\right] \\ & +\delta_g(y)\delta_s(y)\phi m(\theta)\left[1-F_{X,p}(R_p(y)|y)\right] + \delta_p(y)\delta_g(y)\lambda(y)\left[1-F_{X,s}(R_p(y)|y)\right]. \end{aligned}$$

It suffices to note now that:

$$dF_Y(y|U) = \frac{u(y)dF_Y(y)}{u},$$

where $u = \int u(y)dF_Y(y)$, and replace the unknown distribution in Eq.(15)

To close the model, we need to find ϕ. By definition,

$$\phi = v_p/(v_p+v_g) = (\theta u - v_g)/\theta u \tag{20}$$

Since, v_g is exogenously determined, Eq.(20) closes the model.

5 Calibration results of the model

We calibrate the model from Section 4 to yearly data from the 1-2-3-Survey on 7 West African capitals. We consider men who were between 18 and 64 years old and who worked at least 30 hours or who were unemployed. The different calibration steps, which closely follow Albrecht et al. (2015), are outlined in Appendix B. In this first version, we assume education to be exogenous.

Table 9 in the Appendix summarises the parameters which were set ex-ante, Tables 10 to 14 in the Appendix present the preliminary calibration results for the remaining parameters.

Our preliminary calibration results indicate that the yearly offer arrival rate in the public/formal sector is relatively low. It lies between 0.20 and 0.44. Self-employment opportunities present themselves more frequently, but remain moderate at 0.20 to 0.75. This means that more than one out of three unemployed workers do not get a single work offer (either in self-employment or in the public or formal sector) within a year. We also find that a considerable share of vacancies are posted in the public sector. The share goes from 70% in Burkina Faso and to 27% in Côte d'Ivoire, the country with the highest GDP in the sample. However, the 'low' Ivoirian estimate of 27% is still much larger than for example in Colombia, where it was estimated to be 8% (see Albrecht et al. (2015).

The calibration results also show that the reservation productivity at 12,000 to 25,000 CFA/month (except for tertiary education) is much lower than the official minimum monthly wage in all countries (not shown). It slightly increases with education. In terms of productivity, we find that the mean of the productivity match in the public sector dominates the formal sector, which in turn dominates self-employment for almost all countries and education levels. While the difference between the public and the formal sector remains small, it is considerable with respect to self-employment. Together with only small differences in reservation productivity across sectors, this makes that only around 5% of all offers in the public and formal sector are rejected, while the rejection rates amounts to 15% in self-employment (not shown). Interestingly, the rejection rate is similar across education levels in the public and formal sector. Yet in self-employment, a large share of the rejections comes from those with upper secondary and tertiary education.

In line with the job arrival rates, we also find relatively low destruction rates in all sectors and for all education levels. However, an interesting pattern with respect to education emerges. Job destruction decreases with education in the public sector, and also in the formal sector (but to a lesser degree), yet it increases in self-employment. For example, a worker without education risks loosing his public-sector job within a year with more than 30% chance, while the probability drops to 2% for someone with tertiary education. In self-employment, the destruction probability is highest for individuals with secondary and tertiary education.

Finally, the unemployment benefits are negative and similar for all education levels (except for tertiary). Altogether, this brings us to conclude that the increasing and inverse U-shaped unemployment pattern is mostly driven by differential destruction rates across education levels and sectors. Those with intermediate education face relatively high destruction rates in all sectors, while those without education have a long expected duration in self-employment and those with tertiary education in the public sector.

6 Alternative policy analysis

In this section we want to simulate the effects of different education and labour market policies, which have recently been implemented or envisaged by West African governments. Namely, we would like to study the effect of the following policies on educational attainment, unemployment and the worker distribution across sectors: decreasing schooling costs, self-employment subsidies (in contrast to unemployment insurance), minimum wage laws and the creation public-sector jobs.

To be done.

7 Discussion and conclusion

In this paper we show that unemployment rates in urban West Africa are inverse U-shaped in education, in contrast to the decreasing pattern found for OECD countries. This raises the key question of why educated workers do not downgrade to lower skilled jobs.

The descriptive and preliminary empirical analysis suggests that the inverse U-shaped pattern is robust across a variety of individual and household-specific controls. We then show that relatively little transition of employed individuals from one labour market sector to another sector occurs, independently of an individual's education level. However, the education level plays a key role in determining in which sector an unemployment worker or a labour market entrant finds work. These findings indicate that better educated individuals might have a higher option value of searching for a job in the formal or public sector, before downgrading to self-employment.

We also show that unemployed individuals have reservation wages which are larger than market wages. Especially those unemployed with a low or a medium level of education overestimate the probability of entering the public/formal sector, where incomes are higher. The expectation bias between reservation wages and market wages decreases with education. We interpret this finding as evidence that the uneducated unemployed have unrealistic high income expectations, while those with medium education have an economic return to searching for a better match.

In a second part of the paper, we shall develop and estimate a general equilibrium search and matching model with different labour market sectors and an endogenous schooling decision. We use this framework to evaluate different education and labour market policies which have recently been implemented or envisaged by West African governments.

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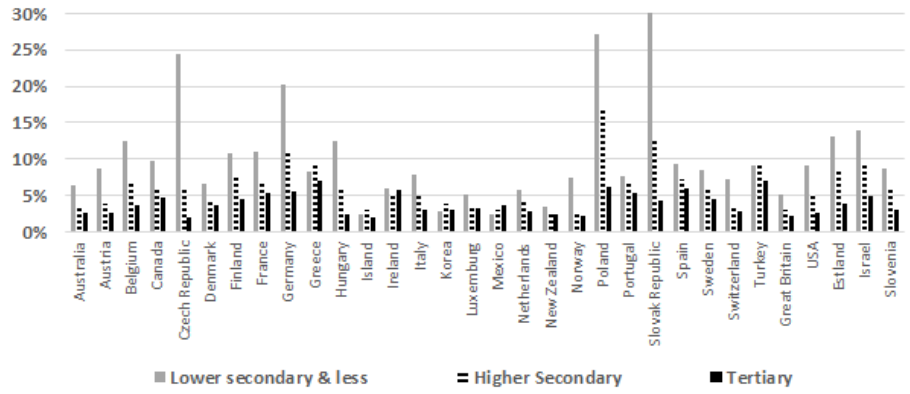
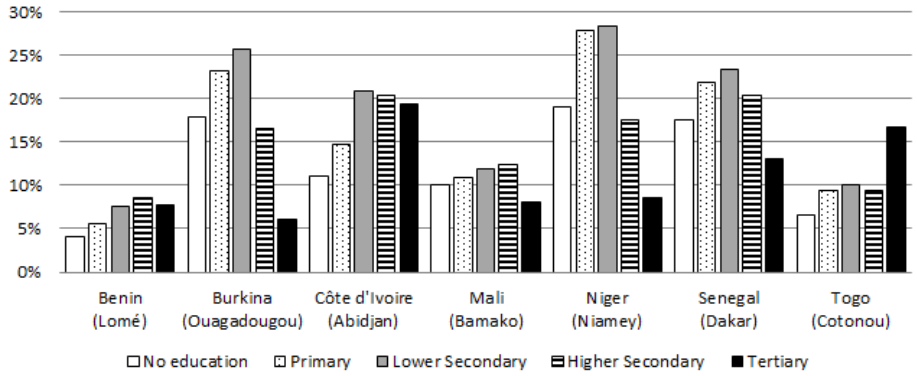
Appendix



Source: OECD

Figure 6: Unemployment rates of men (25 to 64 years old) in OECD countries by education level



Source: 1-2-3-Survey, 1st phase, 2001/2002; AFRISTAT, DIAL, INS; authors' calculations.

Figure 7: Unemployment rates of men (25 to 64 years old) in West African economic capitals by education level

Appendix A: Model Extension: Self-employment as a Search State

In this section, we propose and solve an extension of the model where self-employed are also searching on the labor market, albeit with a reduced intensity. There are now six possible states.

Values

In addition to the four previous states, there are two additional states: being employed in the private or public sector while having previously self-employed without an unemployment spell. Given a previous productivity in the self-employment state of x_s, the respective present value for each of these states is given by the following equations:

$$rV_{p,s}(x, x_s, y) = w_{p,s}(x, x_s, y) + \delta_p(y)\left(V_U(y) - V_{ps}(x, x_s, y)\right) \tag{21}$$

$$rV_{g,s}(x, x_s, y) = w_{g,s}(x, x_s, y) + \delta_g(y)\left(V_U(y) - V_{g,s}(x, x_s, y)\right) \tag{22}$$

The expressions for three of the four previous values remain unchanged. For an unemployed, offers from the public and the private sectors arrive at Poisson rates $\lambda_{p,u}(y)$ and $\lambda_{g,u}(y)$ respectively, and from the self-employment sector at rate $\lambda_s(y)$. We then have:

$$\begin{aligned} rV_U(y) = {} & b(y) + \lambda_{p,u}(y)\mathbb{E}_{F_{X,p}} \max\{V_p(x, y) - V_U(y), 0\} \\ & + \lambda_{g,u}(y)\mathbb{E}_{F_{X,g}} \max\{V_g(x, y) - V_U(y), 0\} \\ & + \lambda_s(y)\mathbb{E}_{F_{X,s}} \max\{V_s(x, y) - V_U(y), 0\} \end{aligned} \tag{23}$$

$$rV_p(x, y) = w_p(x, y) + \delta_p(y)\left(V_U(y) - V_p(x, y)\right) \tag{24}$$

$$rV_g(x, y) = w_g(x, y) + \delta_g(y)\left(V_U(y) - V_g(x, y)\right) \tag{25}$$

With offers from the public and the private sectors arriving at Poisson rates $\lambda_{p,s}(y)$ and $\lambda_{g,s}(y)$ respectively, the present value for self-employment becomes:

$$\begin{aligned} rV_s(x_s, y) = {} & x_s + \delta_s(y)\left(U(y) - V_s(x_s, y)\right) \\ & + \lambda_{p,s}(y)\mathbb{E}_{F_{X,p}} \max\{V_{p,s}(x, x_s, y) - V_s(x_s, y), 0\} \\ & + \lambda_{g,s}(y)\mathbb{E}_{F_{X,g}} \max\{V_{g,s}(x, x_s, y) - V_s(x_s, y), 0\} \end{aligned} \tag{26}$$

The reservation productivity R_j in each sector must satisfy:

$$V_j\left(R_j(y), y\right) = V_U(y),\ j \in \{p, g, s\} \tag{27}$$

$$V_j\left(R_j(x_s, y), x_s, y\right) = V_s(x_s, y),\ j \in \{p, s; g, s\} \tag{28}$$

On the private-sector firm side, let $J_u(x, y)$ be the present value associated with a job filled by a worker previously unemployed of type (y) whose match-productivity is x. Let $J_s(x, x_s, y)$ be the present value associated with a job filled by a worker previously self-employed of type (y) whose match-productivity is x, and whose productivity in self-employment was x_s. Denote by V the

value associated with posting a private-sector vacancy. The values of a filled position must satisfy:

$$rJ_u(x,y) = x - w_p(x,y) - \delta_p(y)J(x,y) \tag{29}$$
$$rJ_s(x,y) = x - w_{p,s}(x,x_s,y) - \delta_p(y)J_s(x,x_s,y) \tag{30}$$

Wages

For a transition from unemployment to employment, the wage remain the same, so that $R_p(y) = rV_U(y)$. For a transition from self-employment to the private sector, the worker bargain with the present value of self-employment as an outside option. That is the Nash bargaining solution has to solve the problem:

$$\max_w \left(V_{p,s}(x,x_s,y) - V_s(x_s,y)\right)^\beta J_s(x,x_s,y)^{1-\beta} \tag{31}$$

Using Eq.(21), note first that:

$$V_{p,s}(x,x_s,y) - V_U(y) = \frac{\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) \tag{32}$$

So that:

$$V_{p,s}(x,x_s,y) - V_s(x_s,y) = \frac{\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) - \left[V_s(x_s,y) - V_U(y)\right]$$

Using Eq.(29), we have:

$$J(x,y) = \frac{x - w_{p,s}(x,x_s,y)}{r+\delta_p(y)} \tag{33}$$

The FOC leads to:

$$w_{p,s}(x,x_s,y) = \beta x + (1-\beta)\left[rV_U(y) + (r+\delta_p(y))(V_s(x_s,y) - V_U(y))\right] \tag{34}$$

Reservation Wages

Using the characterization of the reservation wage and Eq.(32), it follows immediately that:

$$V_{p,s}(R_{p,s}(x_s,y),x_s,y) - V_U(y) = V_s(x_s,y) - V_U(y) = \frac{R_{p,s}(x_s,y) - R_p(y)}{r+\delta_p(y)} \tag{35}$$

Hence:

$$V_{p,s}(x,x_s,y) - V_s(x_s,y) = \frac{\beta}{r+\delta_p(y)}\left(x - R_{p,s}(x_s,y)\right) \tag{36}$$

Using Eq.(25) and Eq.(32), we obtain:

$$V_{g,s}(x,x_s,y) - V_s(x_s,y) = \frac{1}{r+\delta_p(y)}\left(w_g(x,y) - R_{p,s}(x_s,y)\right) \tag{37}$$

Using again Eq.(28), Eq.(26), and the two previous expressions, we can characterize $R_{p,s}(x_s, y)$ and $R_{g,s}(x_s, y)$:

$$\begin{aligned} R_{p,s}(x_s, y) &= x_s + \frac{\lambda_{p,s}(y)\beta}{r + \delta_p(y)} \int_{R_{p,s}(x_s,y)} [x - R_{p,s}(x_s, y)] \; dF_{X,p}(x|y) \\ &\quad + \frac{\lambda_{g,s}(y)}{r + \delta_g(y)} \int_{R_{g,s}(x_s,y)} [w_g(x, y) - R_{p,s}(x_s, y)] \; dF_{X,g}(x|y) \end{aligned} \tag{38}$$

and

$$w_g(R_g s(x_s, y), y) = R_{p,s}(x_s, y). \tag{39}$$

To characterize $R_p(y)$ and $R_p(y)$, note first that from Eq.(28) and Eq.(35), $R_{p,s}(R_s(y), y) = R_p(y)$. Hence:

$$\begin{aligned} R_s(y) &= R_p(y) - \frac{\lambda_{p,s}(y)\beta}{r + \delta_p(y)} \int_{R_p(y)} [x - R_p(y)] \; dF_{X,p}(x|y) \\ &\quad - \frac{\lambda_{g,s}(y)}{r + \delta_g(y)} \int_{R_{g,s}(R_s(y),y)} [w_g(x, y) - R_p(y)] \; dF_{X,g}(x|y) \end{aligned} \tag{40}$$

Note that the reservation wage for self-employment is lower than the reservation wage for employment in the private sector. That is because a self-employed present value account for the possible transition in the future. Finally, using Eq.(23), we obtain:

$$\begin{aligned} R_p(y) &= b(y) + \frac{\lambda_{p,s}(y)\beta}{r + \delta_p(y)} \int_{R_p(y)} [x - R_p(y)] \; dF_{X,p}(x|y) \\ &\quad + \frac{\lambda_{g,s}(y)}{r + \delta_g(y)} \int_{R_g(y)} [w_g(x, y) - R_p(y)] \; dF_{X,g}(x|y) \\ &\quad + \frac{\lambda_s(y)}{r + \delta_s(y)} \int_{R_s(y)} [R_{p,s}(x, y) - R_p(y)] \; dF_{X,s}(x|y) \end{aligned} \tag{41}$$

since $R_{p,s}(R_s(y), y) = R_p(y)$.

Matching Function

Let m be the measure of contacts in the economy, n_s be the proportion of self-employed. Denote by v the total number of vacancies posted by the public and the private firms. The matching technology is characterized by the Cobb-Douglas function

$$m = (u + \psi s)^{\eta} v^{1-\eta}$$

where $0 < \psi \leq 1$ reflects the lower search efficiency of individuals who are currently self-employed relative to the unemployed. The rate of contacts per firm searching is

$$q(k) = k^{\eta}$$

where $k = (u + \psi s)/v$, and k is a measure of the market tightness. The proportion of self-employed who are searching is given by $\psi s/(u + \psi s)$. We assume that contacts with public and private occur randomly, and that contact rates do note vary with y. The contact rate of a self-employed

is then given by:

$$\lambda_{p,s}(y) = \phi\frac{\psi s}{u+\psi s}\frac{m}{s} = \phi\psi k^{\eta-1} \tag{42}$$

$$\lambda_{g,s}(y) = (1-\phi)\frac{\psi s}{u+\psi s}\frac{m}{s} = (1-\phi)\psi k^{\eta-1} \tag{43}$$

The contact rate of an unemployed is given by:

$$\lambda_{p,s}(y) = \phi k^{\eta-1} \tag{44}$$

$$\lambda_{g,s}(y) = (1-\phi)k^{\eta-1} \tag{45}$$

Free-Entry Condition and Steady State

The value for a private firm to post a vacancy is given by:

$$rV = -c + q(k)\frac{s}{u+\psi s}\mathbb{E}_{FX,Y,p}\max\{J_u(x,y)-V,0\} \tag{46}$$

$$+q(k)\frac{\psi s}{u+\psi s}\mathbb{E}_{FX,X_s,Y,p}\max\{J_s(x,x_s,y)-V,0\} \tag{47}$$

The first expectation is taken on (x,y), while the second expectation is taken on (x,x_s,y), for x_s being the productivity of those who accepted a self-employment job. Using the fact that:

$$J_u(x,y) = \frac{1-\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) \tag{48}$$

and

$$J_s(x,x_s,y) = \frac{1-\beta}{r+\delta_p(y)}\left(x - R_{p,s}(x_s,y)\right) \tag{49}$$

and the free-entry condition $V=0$, it follows that:

$$0 = -c + q(k)\frac{s}{u+\psi s}\int\int_{R_p(y)}\frac{1-\beta}{r+\delta_p(y)}(x-R_p(y))dF_{X,p}(x|y)dF_Y(y|U) \tag{50}$$

$$+q(k)\frac{\psi s}{u+\psi s}\int\int_{R_s(y)}\int_{R_p s(x_s,y)}\frac{1-\beta}{r+\delta_p(y)}(x-R_p(y))dF_{X,p}(x|y)dF_{X,s}(x_s|y)dF_Y(y|S)$$

Note that $F_{X,p}(x|x_s,y) = F_{X,p}(x|y)$, and $F_{X,p}(x|y,S) = F_{X,p}(x|y)$. The two unknown are $dF_Y(y|U)$ and $dF_Y(y|S)$, where the latter is the distribution y among self-employed. To characterize both distribution, it suffices to use again $dF_Y(y|U) = \frac{u(y)dF_Y(y)}{u}$, and $dF_Y(y|S) = \frac{n_s(y)dF_Y(y)}{s}$, and

the steady-state conditions given by:

$$\begin{aligned}
\delta_p(y)n_p(y) &= \lambda_p(y)\left[1-F_{X,p}(R_p(y)|y)\right]u(y) \\
&\quad +\lambda_{p,s}(y)\int_{R_s(y)}\left[1-F_{X,p}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (51)\\
\delta_g(y)n_g(y) &= \lambda_p(y)\left[1-F_{X,g}(R_g(y)|y)\right]u(y) \\
&\quad +\lambda_{g,s}(y)\int_{R_s(y)}\left[1-F_{X,g}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (52)\\
\delta_s(y)n_s(y) &= \lambda(y)\left[1-F_{X,s}(R_p(y)|y)\right]u(y) \\
&\quad -\lambda_{p,s}(y)\int_{R_s(y)}\left[1-F_{X,p}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \\
&\quad -\lambda_{g,s}(y)\int_{R_s(y)}\left[1-F_{X,g}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (53)
\end{aligned}$$

and

$$n_p(y)+n_g(y)+n_s(y)+u(y)=1. \qquad (54)$$

Given phi, k,ψ and η are uniquely determined by the job arrival and destruction rates. Finally, the equivalent of Eq.(20) closes the model:

$$\phi=\left(\frac{u+\psi s}{k}-v_g\right)/\frac{u+\psi s}{k} \qquad (55)$$

Appendix B: Estimation steps

Step 1: wages in the public sector

Define the wage scheme in the public sector:

$$w_g(x, y) = \phi(y) + \gamma x + (1 - \gamma) R_p(x)$$

In the baseline $\gamma = \beta$.

Under the condition $R_g(y) = w_g\left(R_g(y), y\right)$, it follows that:

$$R_g(y) = \frac{\psi(y)}{1 - \gamma} + R_p(y) \tag{56}$$

ARAV assumes that $\psi(y) = \bar{\psi}$.

Step 2: human capital distribution

Equate human capital measure Y with years of education. We distinguish 5 categories: no education, primary, lower secondary, upper secondary, and tertiary education. Calculate for each category $\{p^j\}_{j=1,\ldots,5}$, the distribution of education in the population.

Step 3: reservation productivities

By education group, in each sector (private, public and self-employment) trim the wage distribution below for the 10% lowest values, and above for the 5% highest values. Equate $\hat{R}_p^j, \hat{R}_g^j$, and $\hat{R}_s^j$ will be the minimum observed wage in each sector.

The model implies that $R_p(y) = R_s(y)$. Hence, take $\hat{R}^j = min\{\hat{R}_p^j, \hat{R}_s^j\}$.

Finally, by Eq.(56), we have:

$$\hat{\psi^j}/(1 - \gamma) = \hat{R}_g^j - \hat{R}^j.$$

Step 4: Productivity distribution

The productivity distribution is inferred from the wage distribution in each sector.

For the private sector, compute:

$$\ln x = \ln\left(\frac{w_p^j - (1 - \beta) R^j}{\beta}\right) \tag{57}$$

with $\beta = 0.5$.

The parameters of the productivity distribution μ^j and σ^j minimize the distance between the distribution of $\ln x$ and a truncated log-normal distribution (truncated at R^j) with parameters μ_g^j and σ_g^j. Similarly, for the public sector, compute:

$$\ln x = \ln\left(\frac{w_g^j - (1 - \gamma) R_g^j}{\gamma}\right) \tag{58}$$

and take μ_g^j and σ_g^j to minimize the distance between the distribution of $\ln x$ and a truncated log-normal distribution (truncated at R_g^j) with parameters μ_g^j and σ_g^j.

For self-employment, the productivity distribution $F_{X,s}^j$ is exactly the wage distribution.

Step 5: arrival and destruction rates

Use the empirical counterpart of average duration of employment to estimate $m(\theta), \phi$ and λ. Assume that: $\lambda(y) = \lambda$. We have:

$$m(\theta)\phi = \sum_j p_p^j \frac{n_p^j}{E(T_p)\left(1 - F_{X,p}^j(R^j)\right)} \tag{59}$$

$$m(\theta)(1-\phi) = \sum_j p_g^j \frac{n_g^j}{E(T_g)\left(1 - F_{X,g}^j(R_g^j)\right)} \tag{60}$$

$$\lambda = \sum_j p_p^j \frac{n_s^j}{E(T_s)\left(1 - F_{X,s}^j(R^j)\right)} \tag{61}$$

Hence:

$$\phi = \frac{a_\phi}{1 + a_\phi} \tag{62}$$

where

$$a_g = \sum_j p_p^j \frac{n_p^j}{E(T_p)\left(1 - F_{X,p}^j(R^j)\right)} \Big/ \sum_j p_g^j \frac{n_g^j}{E(T_g)\left(1 - F_{X,g}^j(R_g^j)\right)}$$

The destruction rates are given by:

$$\begin{aligned}
\delta_p^j &= \phi m(\theta)\left[1 - F_{X,p}^j(R_p^j)\right] u^j / n_p^j \\
\delta_g^j &= (1-\phi) m(\theta)\left[1 - F_{X,g}^j(R_g^j)\right] u^j / n_g^j \\
\delta_s^j &= \lambda\left[1 - F_{X,s}^j(R_p^j)\right] u^j / n_s^j
\end{aligned}$$

Step 6: Remaining parameters

The matching function is defined as:

$$m(\theta) = A\theta^\alpha$$

Assume that $A = 0.25$, and $\alpha \in [0.3; 0.5]$ (Pissarides and Petrongolo, 2001), to retrieve an estimate of θ.

$$\theta = \left(\frac{m(\theta)}{A}\right)^{1/\alpha}$$

The vacancy rate in the public sector is given by:

$$v_g = \theta u (1 - \phi)$$

Set $r = 10\%$. The cost of posting a vacancy c follows from Eq.(15):

$$c = \frac{m(\theta)}{\theta} \sum_j p^j \frac{u^j}{u} \frac{(1-\beta)}{r + \delta_p^j} \int_{R^j} \left[1 - F_{X,p}^j(x)\right] dx. \tag{63}$$

Finally, the flow-value of unemployment follows from Eq.(13):

$$\begin{aligned} b(y) &= R^j - \frac{\phi m(\theta)\beta}{r+\delta_p^j}\int_{R^j}\left[1-F_{X,p}^j(x)\right]dx \\ &\quad -\frac{(1-\phi)m(\theta)\gamma}{r+\delta_g^j}\int_{R_g^j}\left[1-F_{X,g}^j(x)\right]dx \\ &\quad -\frac{\lambda}{r+\delta_s^j}\int_{R^j}\left[1-F_{X,s}^j(x)\right]dx \end{aligned} \tag{64}$$

Appendix C: Calibration results

Parameter	Description	Value
r	Yearly interest rate	0.1
β	Bargaining power of worker	0.5
A	Matching function: technology parameter	0.25
α	Matching function: elasticity	0.5
γ	Public-sector wage rule: productivity weight	0.5

Table 9: Fixed parameters

	BE	BF	CI	MA	NI	SE	TG
No education	0.15	0.39	0.32	0.44	0.44	0.30	0.12
Primary	0.35	0.27	0.23	0.17	0.21	0.36	0.34
Lower sec.	0.26	0.21	0.25	0.15	0.19	0.19	0.38
Higher sec.	0.10	0.07	0.08	0.14	0.05	0.06	0.08
Tertiary	0.14	0.07	0.13	0.10	0.11	0.09	0.09

Table 10: Calibrated human capital distribution

Parameter	Description	BE	BF	CI	MA	NI	SE	TG
c	Vacancy cost	29	49	169	45	51	159	72
$m(\theta)$	Offer arrival rate	0.44	0.31	0.21	0.36	0.26	0.20	0.19
θ	LM tightness	3.16	1.59	0.67	2.06	1.12	0.65	0.56
ϕ	Fraction formal-sector vacancies	0.57	0.29	0.73	0.38	0.38	0.58	0.56
v_g	Public-sector vacancies	0.08	0.17	0.03	0.10	0.11	0.04	0.03
λ	Offer arrival rate self-employment	0.75	0.25	0.36	0.58	0.21	0.23	0.47

Table 11: Calibrated parameters

Education level	BE	BF	CI	MA	NI	SE	TG
Formal reservation productivities: $R_p(y)$							
No education	15	15	19	15	15	20	10
Primary	18	15	20	18	15	20	12
Lower secondary	20	15	20	20	15	30	10
Higher secondary	25	24	35	25	25	25	18
Tertiary	36	66	70	40	60	60	25
Self-employment reservation productivities: $R_s(y)$							
No education	15	14	20	12	12	20	9
Primary	13	15	20	15	13	20	7
Lower secondary	13	14	20	12	12	20	10
Higher secondary	21	20	40	25	20	25	16
Tertiary	40	66	65	40	55	70	30
Public-sector wage premium: $\psi(y)$							
No education	5	0.5	10.5	0	0	10	5.45
Primary	3.5	2.5	14	-1.5	0	8.5	3
Lower secondary	1	1	10	-2.5	-1.5	-1.5	2
Upper secondary	-1	-2	5	4	4	16.75	1
Tertiary	1	0	3.5	5	-3.5	5	5

Table 12: Calibrated reservation productivities and public-sector wage premium (in 1,000 CFA/month)

	BE		BF		CI		MA		NI		SE		TG	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Productivity parameters: Public sector														
No education	4.15	0.89	4.50	0.69	5.21	0.77	4.14	0.64	4.37	0.74	4.90	0.64	4.29	1.02
Primary	4.21	0.61	4.70	0.54	5.31	0.68	4.48	0.70	4.29	0.73	5.07	0.65	3.95	0.70
Lower sec.	4.14	0.79	4.96	0.63	5.24	0.92	4.67	0.66	4.68	0.66	5.36	0.68	4.37	0.76
Higher sec.	4.58	0.88	4.80	0.77	5.79	0.56	4.87	0.49	4.29	1.01	4.58	1.05	4.41	0.87
Tertiary	5.42	0.74	5.34	0.75	6.04	0.57	5.13	0.82	5.56	0.79	5.86	0.61	5.27	0.74
Productivity parameters: Formal sector														
No education	4.28	0.84	4.18	0.68	4.71	0.66	4.01	0.58	4.10	0.95	4.80	0.58	4.17	0.93
Primary	3.79	0.77	4.27	0.67	4.67	0.58	4.12	0.73	3.97	0.64	4.88	0.65	3.82	0.63
Lower sec.	3.90	0.84	4.47	0.70	4.98	0.70	4.22	0.75	4.19	0.87	5.02	0.78	3.98	0.68
Higher sec.	3.90	0.99	4.30	1.04	4.78	0.73	4.67	0.67	4.32	1.26	5.08	0.85	3.42	1.04
Tertiary	5.00	0.72	5.82	0.75	6.00	0.71	5.27	0.96	4.73	1.25	5.93	0.90	4.96	0.99
Productivity parameters: Self-employment														
No education	3.41	0.83	3.63	0.63	4.03	0.58	3.85	0.76	3.72	0.75	4.20	0.58	3.18	0.81
Primary	3.60	0.66	3.39	0.75	3.88	0.62	3.68	0.75	3.55	0.59	4.07	0.56	3.19	0.63
Lower sec.	3.71	0.65	3.60	0.74	4.10	0.71	3.92	0.88	3.91	0.80	4.19	0.66	3.29	0.70
Higher sec.	4.03	0.76	3.66	0.80	3.74	0.94	3.65	1.05	3.70	0.91	4.48	0.67	3.32	0.95
Tertiary	4.27	0.98	4.96	0.68	4.24	1.02	4.36	1.49	4.83	0.99	5.18	0.72	-0.77	2.29

Table 13: Calibrated productivity distributions

	BE	BF	CI	MA	NI	SE	TG
Destruction rates: Public sector							
No education	0.08	0.39	0.18	0.33	0.16	0.16	0.09
Primary	0.17	0.26	0.27	0.16	0.26	0.19	0.11
Lower sec.	0.10	0.22	0.12	0.18	0.17	0.09	0.06
Higher sec.	0.08	0.11	0.05	0.08	0.05	0.05	0.03
Tertiary	0.04	0.02	0.04	0.03	0.02	0.02	0.04
Destruction rates: Formal sector							
No education	0.06	0.09	0.06	0.10	0.10	0.09	0.08
Primary	0.11	0.09	0.06	0.04	0.11	0.08	0.11
Lower sec.	0.10	0.10	0.07	0.11	0.13	0.07	0.07
Higher sec.	0.05	0.07	0.07	0.06	0.09	0.07	0.04
Tertiary	0.07	0.02	0.10	0.05	0.02	0.03	0.07
Destruction rates: Self-employment							
No education	0.04	0.04	0.04	0.04	0.04	0.03	0.08
Primary	0.05	0.06	0.07	0.04	0.07	0.06	0.07
Lower sec.	0.07	0.13	0.17	0.13	0.15	0.14	0.07
Higher sec.	0.12	0.22	0.16	0.14	0.19	0.20	0.11
Tertiary	0.19	0.08	0.40	0.18	0.09	0.15	0.01

Table 14: Calibrated destruction rates

	BE	BF	CI	MA	NI	SE	TG
Unemployment benefits: b							
No education	-247	-81	-179	-223	-99	-139	-102
Primary	-188	-77	-130	-206	-52	-119	-71
Lower sec.	-208	-97	-161	-204	-88	-144	-97
Higher sec.	-276	-109	-131	-203	-95	-145	-93
Tertiary	-468	-441	-237	-677	-397	-448	-120

Table 15: Calibrated unemployment benefits