The Puzzle of Educated Unemployment in West Africa*

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September 1, 2017

Abstract

Unemployment rates in urban West Africa are increasing or hump-shaped in education. This is puzzling because educated workers could downgrade to escape unemployment. We develop a search and matching model with heterogeneous agents who make an education choice and participate in a labour market with three sectors (public, private-formal and self-employment). We estimate the model using data from the West African 1-2-3-Survey. Low arrival rates and low productivity in self-employment explain why educated workers do not downgrade. Differential destruction rates across sectors and education levels further contribute to the observed shape of unemployment rates. We simulate the effect of two counterfactual policies: Public-sector vacancy creation and a compulsory primary education reform. Increased public-sector vacancy creation crowds out the formal sector and pushes workers into self-employment and unemployment. Moreover, the policy has important redistributive effects. It increases unemployment and lowers wages for those with intermediate education or less, while benefitting those with higher education. A primary education reform increases private-sector vacancy creation. The policy has a positive impact on public- and private-sector employment, and lowers self-employment. However, private-sector vacancy creation is too small to fully absorb the additional educated workforce, resulting in higher overall unemployment.

JEL: J24, J64, E24

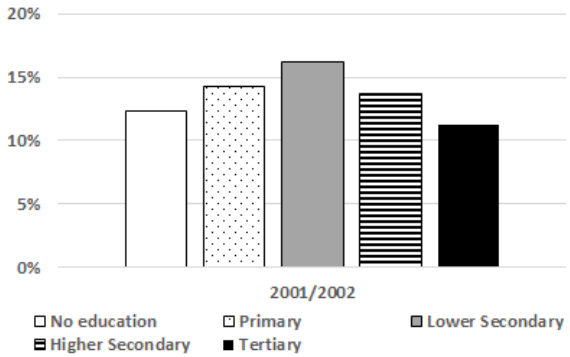
Keywords: Unemployment, education, search and matching model, urban West Africa

*The authors would like to thank DIAL - especially Constance Torelli and Francois Roubaud - for making the 1-2-3-Survey data available. Esther Mirjam acknowledges financial support by the Swiss National Center of Competence in Research LIVES, an instrument of the Swiss National Science Foundation. The paper also benefitted from discussions with conference and seminar participants at the CSAE (Oxford), European Winter Meeting of the Econometric Society (Edinburgh), Max-Planck Institute for Social Law and Social Policy and the University of Lausanne. The corresponding address is: Esther Mirjam Girsberger, UNIL, Department of Economics, Internef, 1015 Lausanne-Dorigny, Switzerland. Telephone: +41 21 692 33 29. E-Mail: EstherMirjam.Girsberger@unil.ch.

1 Introduction

Unemployment rates are decreasing in educational attainment in most developed countries. This contrasts sharply with the phenomenon of *educated unemployment* observed in many developing countries. In these countries, workers with intermediate or advanced education are more likely to find themselves in unemployment than workers with basic or no education. The phenomenon is hotly debated by media and policy makers in developing countries, yet it has received little attention in the economics literature so far.

A region where educated unemployment is particularly pronounced is Francophone West Africa[1]. The unemployment rate of workers with intermediate education (i.e. lower secondary) is 4pp higher than the rate of workers without education (see Figure 1).



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

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

This paper studies the phenomenon of educated unemployment in a developing context. We analyse education decisions, labour market entry and transitions, identify possible mechanisms and quantify their contribution to the phenomenon. Moreover, we investigate why educated workers do not (temporarily) downgrade to low-skilled jobs (i.e. self-employment) in order to escape unemployment. To do so, we first present stylised facts about (educated) unemployment and labour markets in urban West Africa and then develop and estimate a search- and matching model.

Our search and matching model features heterogeneous individuals who make a costly education choice before entering the labour market. The labour market consists of a public sector, firms in a private-formal sector and self-employment. We model the private-formal sector like the firm side in the famous Diamond-Mortensen-Pissardies model (see Pissarides (2000)). The public sector in our model posts an exogenous amount of vacancies and pays wages according to an exogenous wage rule (incl. a public-sector wage premium). Given that the public sector hires on the same labour market as the private-formal sector, changes in public vacancies or wages directly affect the private-formal sector. In contrast, business ideas (i.e. self-employment opportunities) arise independently of the state of the public/formal-private labour market. Matches in all sectors

[1] According to ILO statistics (year in parenthesis), educated unemployment is also prevalent in Argentina (2014), Bangladesh (2013), Bolivia (2015), Brazil (2009), Botswana (2010), Colombia (2013), Egypt (2005), Ethiopia (2012), Malawi (2013), Morocco (2012), South Africa (2016), Vietnam (2014), Uganda (2012), Yemen (2014), and many other countries.

get destroyed at an exogenous rate. In an extended version of the model, we allow self-employed workers to continue receiving offers from the public and private-formal sector, though at a lower rate. On the worker side, we assume that individuals are heterogeneous. Facing different education costs, they make different education choices and then participate in the labour market. As sectoral productivity and destruction rates differ by education, heterogeneous individuals sort along education into different sectors of the labour market.

We estimate the model using the 1-2-3 Survey data on seven Francophone West African capitals. These include Cotonou (Benin), Ouagadougou (Burkina Faso), Abidjan (Côte d'Ivoire), Bamako (Mali), Niamey (Niger), Dakar (Senegal) and Lomé (Togo). We find large differences in productivity across sectors for all countries, with public and private-formal sector productivity being relatively close and much lower productivity in self-employment. Job and self-employment offers arrive very infrequently. Unemployed workers receive on average less than one offer per year, while the annual rate for public and private-formal offers is even lower at 0.25 on average. The public sector in all countries pays important wage premia for lower education levels, however, the distortionary effect remains relatively small because these workers are mostly self-employed. In all countries, public sector vacancy creation is quantitatively important. In Côte d'Ivoire's capital Abidjan, the most developed country in the sample, 1 out of 4 vacancies is public. At the other end, in Ouagadougou, more than 3 out 4 vacancies are public. All in all, low offer rates, large sectoral productivity differences and differential job destruction across sectors are the three main explanatory factors for educated unemployment.

We use our framework to simulate the effect of different counterfactual labour market and education policy reforms. First, we study the elimination of the public-sector wage premium. This policy results in a large drop in public reservation wages and a small increase in private-formal and self-employment reservation wages. Given that the average productivity in the public sector is slightly higher than in the private-formal sector, the public sector remains attractive and grows a bit. The growth in the public sector almost offsets the negative employment effects in the private-formal sector and self-employment and hence, overall unemployment increases only marginally. Secondly, we analyse the impact of doubling public sector vacancies. An increase in public sector vacancies has the unintended effect of increasing overall unemployment. In fact, more public sector vacancies crowd out private-formal sector vacancies, translating into a drop in the offer rate. Moreover, the policy has important redistributive effects. Workers with lower secondary education and less see their unemployment rates rise (because of fewer private-formal offers), while workers with tertiary education benefit from more public employment. Finally, we simulate the effect of a compulsory primary education reform (i.e. no worker would have less than primary education). As the average education level of the worker pool increases, the private-formal sector posts more vacancies, which result in a slightly higher offer rate. However, for most countries (Burkina Faso and Togo are exceptions) this effect is not large enough to compensate the compositional effect in unemployment (i.e. the effect of an increased share of better educated workers, who have higher unemployment rates). As a consequence, overall unemployment increases by 0.3pp to 2.8pp, depending on the country.

Our paper ties into two different strands of the literature[2]. First of all, it relates to papers which study public sector employment or self-employment in a search and matching model of equilibrium unemployment. Search and matching models with a public sector include Burdett (2012), Bradley et al. (ming), Gomes (2015), Albrecht et al. (2015), and Langot and Yassin (2016). Albrecht et al. (2011), Kerr (2012) and Narita (2017) model self-employment in a search and matching model in a developing countries. Among these papers, Albrecht et al. (2015) is closest to ours both in terms of the model and the specificity of the developing country context. We extend their model in two important dimensions. First, we add another sector in the labour market: self-employment. Sub-Saharan African economies are characterised by large shares of the workforce in self-employment. Moreover, becoming self-employment could be a strategy for unemployed workers while waiting for a better offer in the public or private-formal sector. Studying self-employment is thus key to understanding educated unemployment. Secondly, we endogenise the education choice of individuals. Doing so allows us to study how individuals sort into education and labour markets, and evaluate how different labour market and education policies affect these sorting patterns.

Secondly, our paper also relates to the literature on heterogeneous workers, who differ by skill level or education, in a search and matching framework. These papers include Gautier (2002), who studies the positive and negative externalities of skilled workers on unskilled workers, Charlot and Decreuse (2010), who analyse education choices in a two sector/two education level matching model, and Flinn and Mullins (2015), who model and estimate an equilibrium search model with a binary education decision. While we model the education decision in a similar fashion as Flinn and Mullins (2015), they assume that individuals with different education levels are active in two separate labour markets, which do not affect each other. In our set-up, the public and private-formal sector compete for the same workers. An increase in public sector vacancies impacts job filling-rates in the private-formal sector, and vice versa. This allows us to study how labour market policies targeted towards one sector have spillover effects into other sectors and how they affect education choices.

The remaining part of this paper is structured as follows. Section 2 presents the data and some stylised facts about (educated) unemployment and labour markets in urban West Africa. Section 3 develops a search- and matching framework with different sectors and heterogeneous individuals who make a schooling decision. In Section 4 we estimate this model to recover the underlying structural parameters, which we then use to evaluate alternative education and labour market policies (Section 5). Section 6 concludes.

2 Stylized Facts

In this section, we highlight some stylized facts of labour markets in Francophone West-Africa. We start by presenting the data used for this study. Then, we discuss the structure of the studied

[2]Fan and Stark (2007) develop a theoretical model which explains educated unemployment within a framework of international migration prospects.

labour markets with respect to three dimensions: the heterogeneity between employment sectors, the heterogeneity of unemployment probability across education groups, and the transition between employment status.

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 The Heterogeneity across Employment Sectors

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 in one-person firm and non-salaried work makes up a significant share of the informal sector (around 85% in our data). In order to avoid confusion with the term 'informal sector' used in the context of Latin American countries[3], we apply the term self-employment instead.

A first dimension of heterogeneity between sector is the education level of the employees within each sector. Figure 2 shows the activity status and the sectoral composition of the employed labour force of men by education level.

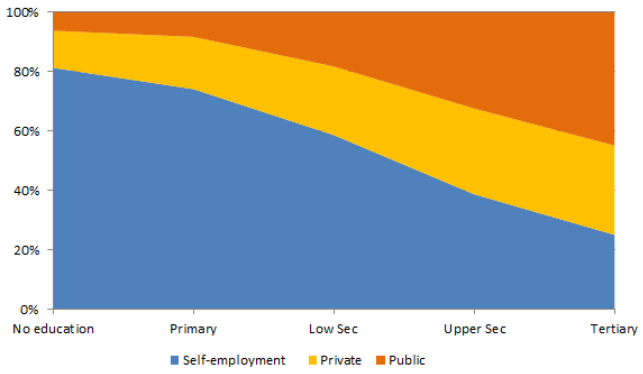


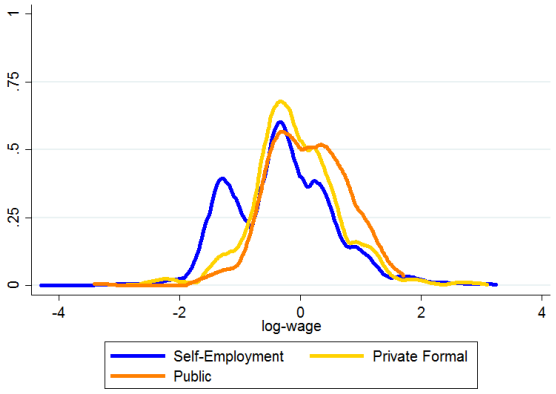
Figure 2: Activity & employment status of men (25 to 64 year-olds)

As the education level increases, the share of employment in the public sector increases whereas the share in the informal sector 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 close to 20% of the working labour force with tertiary education is working the informal sector (80% among the uneducated). The share of private formal employment remains relatively stable across education levels at 15% to 20%.

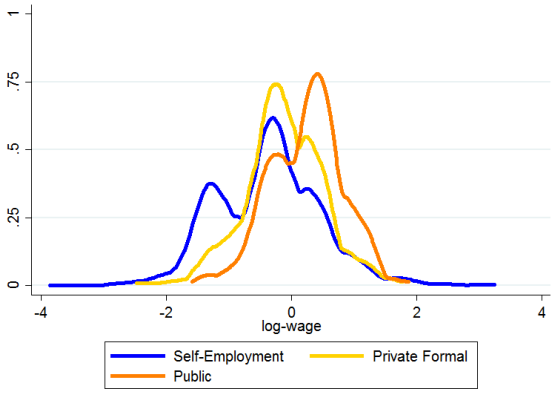
A second dimension of heterogeneity between the sectors is the wage paid to the employees. Figure 3 shows the distribution function of the log-wage by education level and by sector.

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, and then self-employment. Incomes in the private-formal sector are on average approximately 20% lower than in the public sector for individuals with primary or secondary education. Individuals

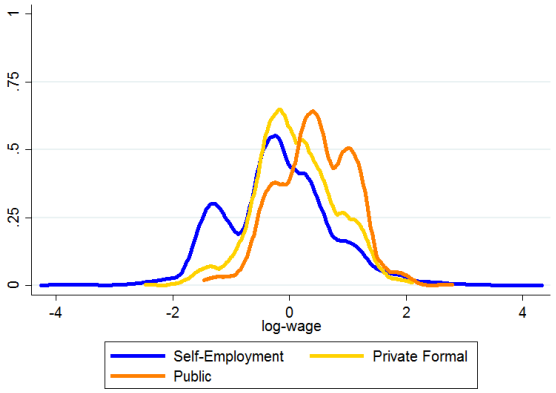
[3]Most papers using data on Latin American countries define the informal sector as wage earners who do not contribute to social security and self-employed workers (see, for example, Albrecht et al. (2011) and Meghir et al. (2015).



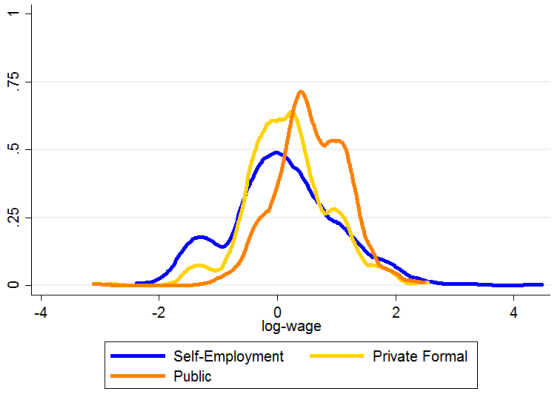
(a) No Education



(b) Primary



(c) Lower Secondary



(d) Upper Secondary

(e) Tertiary

Note: Estimated log-wage density function subtracting the average log-wage level for each country of education.

Figure 3: Density Function of the Log-wage by sector and by Education Level

in the self-employment sector earn 15% to 40% less than those in the public sector, the difference again being largest for those with primary and (lower) secondary education. In terms of dispersion, we find that the income dispersion is lowest in the public sector and highest in the informal sector.

2.3 The Heterogeneity of Unemployment Probability across Education Groups

Table 2 presents the general patterns of unemployment in our sample.

	None	Primary	Lower secondary	Higher secondary	Tertiary
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 2: Unemployment characteristics by education level

The unemployment rate is hump-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.

We assess the robustness of those descriptive results by controlling on potential confounders. Namely, we include in a reduced form regression (of the employment outcome) sets of controls about individual characteristics (education and experience), and household-specific controls (household income excluding the individual of interest, share of unemployed/non-working in household, size of household, father's education). Furthermore, we analyse the effect of education on unemployment using different sub-samples based on age at survey, and on the father's education. The results are presented in Table 3.

The first column shows that, compared to the reference group (no education), the probability to be unemployed increases first with the level of education, being the highest for those with a secondary education (3.4 percentage point increase, that is a 41% increase from the average). 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. Irrespective of the sub-group considered, the unemployment rate seems to be at least as high in secondary education, as it is in the reference group.

	No HH Controls	HH Controls				
			Age	Age	Father	Father
	All	All	25-34	35 - 64	No educ.	some educ
Primary	0.016*	0.012	-0.043**	0.049***	0.012	-0.001
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Lower secondary	0.034***	0.026***	-0.016	0.052***	0.032***	-0.018
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Upper Secondary	0.012	0.002	-0.074**	0.041**	0.003	-0.016
	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)	(0.03)
Tertiary	-0.031**	-0.041***	-0.121***	0.008	-0.049***	-0.036
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)
Observations	15,665	15,665	6,932	8,733	11,187	2789

Linear Probability model of Unemployment Probability at the time of the survey.
All models control for potential experience, migration status and country fixed-effects.
All models, except the first, control for family characteristics.
Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: The Effect of Education on the Unemployment Probability (Linear-Probability Model)

2.4 Labour market entry, transition and employment perspectives

This subsection analyses labour market entry and transition of men aged 25 to 64 years. Table 4 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 4 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 between 80% and 90% are still employed in the same sector. For those in self-employment, on average less than 5% had left self-employment in this period.

Beyond these general patterns, we notice that observed labour market transitions differ substantially by education level. The probability of staying employed in the public sector increases from 73% in the case of no education, to 98% with a tertiary education. Conversely, while the stayer-probability in the self-employment sector decreases from 98% to 80%. Besides, 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 both on the sector of employment and 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 4). An unemployed/inactive individual without schooling finds employment in the private-formal or public sector with a probability of 12.5%. 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 56% for individuals without education to close to 20% for those with tertiary education. This evidence suggests

	Current Labor Market Status			
Past Labor Market Status	Unemployed /Inactive	Self-employed	Private formal	Public
No education				
Unemployed/Inactive	30.0%	56.5%	11.3%	2.2%
Self-employed	1.2%	98.3%	0.4%	0.1%
Private	6.0%	6.2%	87.6%	0.3%
Public	8.4%	16.9%	1.5%	73.2%
Total	6.8%	78.5%	9.9%	4.8%
Primary education				
Unemployed/Inactive	29.9%	52.6%	14.3%	3.2%
Self-employed	1.9%	96.7%	1.0%	0.5%
Private	7.1%	7.5%	84.6%	0.7%
Public	7.8%	10.3%	3.8%	78.1%
Total	9.1%	67.1%	16.1%	7.7%
Lower secondary education				
Unemployed/Inactive	32.2%	42.1%	17.7%	8.0%
Self-employed	3.0%	93.7%	2.6%	0.7%
Private	9.2%	7.1%	82.7%	1.0%
Public	3.0%	6.4%	0.8%	89.8%
Total	11.7%	51.3%	20.6%	16.4%
Upper secondary education				
Unemployed/Inactive	33.2%	25.5%	23.2%	18.1%
Self-employed	3.9%	89.6%	4.1%	2.4%
Private	4.7%	4.5%	89.3%	1.5%
Public	0.6%	2.1%	0.6%	96.6%
Total	11.6%	32.3%	26.3%	29.7%
Tertiary education				
Unemployed/Inactive	36.4%	20.2%	24.5%	19.0%
Self-employed	3.1%	80.6%	4.3%	12.0%
Private	4.0%	6.6%	88.1%	1.3%
Public	0.5%	0.4%	1.1%	98.1%
Total	11.9%	22.7%	27.2%	38.3%

Table 4: Observed 3-year labour market transition rates of men (25 to 64 year-olds)

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 4) vary greatly across sectors. The risk of moving from private-informal employment into unemployment is between 4% and 9% over a 3-year period, while transition from the public sector to unemployment is lower than 1% for those with tertiary education and 8.4% for those without any education.

3 The Model

In this section, we 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 lead to sorting of heterogeneous workers across sectors and produce education-specific unemployment rates.

We extend Albrecht et al. (2015) (henceforth ARAV) in two important dimensions. We endogenise the education decision of workers and add self-employment as an additional sector.

3.1 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 general equilibrium (GE) model. To simplify notations, we refer to $y = (h,k)$, with distribution F_Y.

3.2 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 :

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

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 $R_p(y)$.

3.3 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.

4 Calibration results of the model

4.1 Calibration results

We calibrate the model from Section 3 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 5 in the Appendix summarises the parameters which were set ex-ante, Tables 6 to 10 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 a maximum of 70% in Burkina Faso 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.

4.2 Goodness of Fit

Tables 12 to 15 in Appendix D show how well the calibrated model fits the data. Overall, the model does a very good job in matching the data. Some moments - such as the educational attainment distribution and sectoral employment shares by education - are calibrated exactly to the observed distributions, and hence, the calibrated moments perfectly match the observed moments. The model also achieves a good fit of the sectoral wage distributions. The mean public and formal wages by education are well matched, while the model fits slightly less well the corresponding standard deviation of sectoral wages and the mean wages in self-employment.

5 Alternative policy analysis

In this section we simulate the effects of different education and labour market policies, which have recently been implemented or envisaged by West African governments. Namely, we 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), the creation of public-sector jobs and minimum wage laws.

In what follows, we discuss the results found for Abidjan (Côte d'Ivoire). Notice that the quantitative size of the effect is specific to Abidjan, but the qualitative picture and rationale hold for all countries.

5.1 Increasing public-sector vacancies

In the first simulation we study the effects of doubling public-sector vacancies in order to lower unemployment. We keep the education distribution fixed.

Doubling public-sector vacancies has a small, but negative effect on unemployment. We find that overall unemployment increases by 0.5pp and the job arrival rates falls slightly (from 0.1584 to 0.150). ϕ, the share of private sector vacancies falls. The rationale for this is that public sector has externalities on the formal sector. Overall, public sector employment and self-employment increases, while formal sector employment decreases in equilibrium.

Moreover, the 'public sector vacancy creation' policy has important redistribution effects among the different education groups. Figure 4 shows the change in the unemployment rates by education, figure 5 shows the reservation productivities by sector and education in the baseline and under the policy simulation.

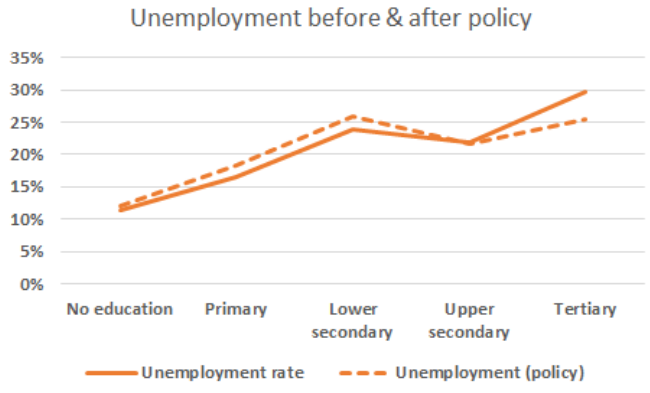


Figure 4: Unemployment before & after policy change (v_g)

All in all, the public-sector policy benefits those who are most likely to work in the public sector before the reform. These are the workers with tertiary (or upper secondary) education. This is true despite the fact that the policy boosts public-sector employment across all education groups. The reason is that the increase in public sector vacancies crowds out formal sector vacancies.

Those without or with low education see their employment perspectives in the formal sector collapse due to the reform. As a consequence they find themselves in self-employment or even in unemployment. The better employment opportunities in the public sector do not compensate for the lost formal-sector employment opportunities, so those with low education are worse off.

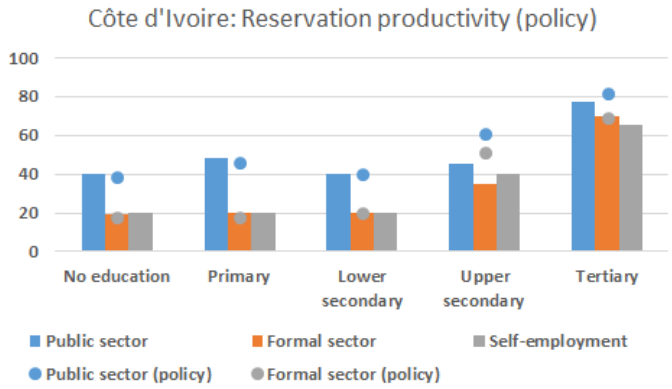


Figure 5: Reservation productivity before & after policy change (v_g)

The reservation productivities shown in Figure 5 perfectly co-move with reservation (and average) wages in each sector. We find that the public-sector vacancy policy increases the reservation (and average) wage for those with upper secondary and tertiary education for all education levels, while it decreases reservation wages in all sectors for those with lower secondary education and less. Hence, the public sector policy not only has redistributive effects in terms of employment and sectoral allocation, but also in terms of employment. Those with upper secondary and tertiary clearly benefit from this policy, those with lower secondary and less education lose both in terms of employment and in terms of wages.

5.2 Compulsory primary education reform

In this second simulation we analyse the effects of a compulsory primary education reform. We assume that only 1% of individuals get less than primary education, while all other education levels grow proportionally.

A compulsory primary education reform increases the average educational attainment of the worker pool. This has a positive effect on private-formal vacancy creation. Because private-formal firms cannot direct their search and mean productivity of workers increases with education, private-formal vacancy posting responds positively to an increase in the average educational attainment. The job arrival rate in Abidjan thus rises from 0.158 to 0.169. Higher job arrival rates increase the value of unemployment, and thus, the public and private-formal/self-employed reservation productivity as shown in Figure 6.

The total effect on unemployment rates by education depends both on the job arrival rate, as well as on the sectoral reservation productivities.

In the case of Abidjan, unemployment rates by education remain virtually unchanged (see

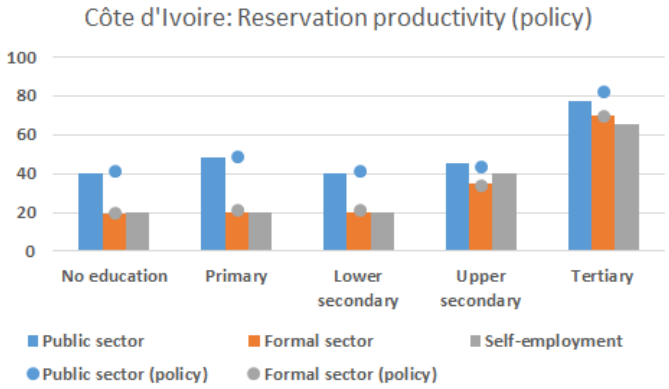


Figure 6: Reservation productivity before & after primary education policy

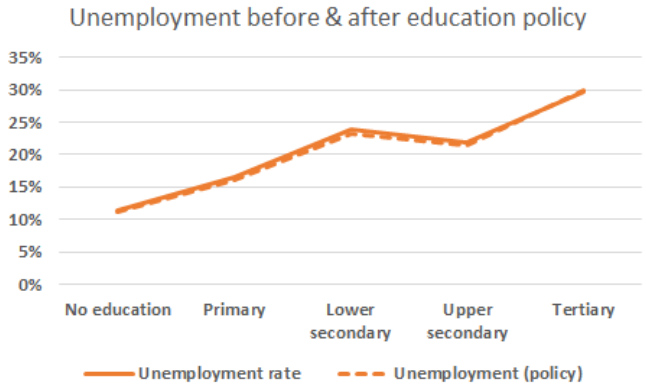


Figure 7: Unemployment rates before & after primary education policy

Figure 7). In combination with the shift in the educational composition of the workforce, this translates into an increase in the overall unemployment rate from 19.1% to 21.8%. As shown in Figure 8, the policy also has important effects on the sectoral composition of workers.

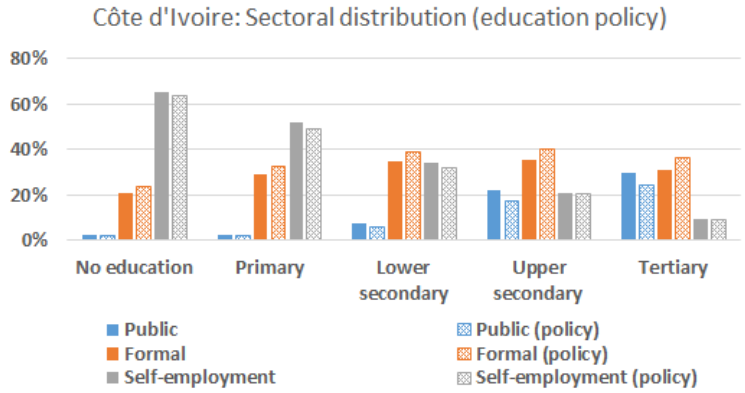


Figure 8: Sectoral employment before & after primary education policy

The private-formal sector vacancy creation not only leads to an increase in the arrival rate, but the share of private-sector vacancies in the market also increases from 74% to 80% (given that the public sector does not increase their vacancies). This leads to a relatively large increase in private-sector employment (from 28.9% to 36.3%) and a smaller public employment increase (from 9% to 0.5%). The share in self-employment, however, drops from 43.1% to 31.9%. All in all,

the education reform pushes a considerable share of workers from self-employment, which is characterised by low productivity and low wages, into the more productive public and private-formal sector. At the same time, it also increases overall unemployment as the additional private-sector vacancy creation is not large enough to absorb the additional educated workforce.

6 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 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.

In a second part of the paper, we develop and estimate a general equilibrium search and matching model with different labour market sectors and an endogenous schooling decision. The estimates of the model confirm our descriptive analysis. Low job arrival rates, large differences in productivity between the public/private-formal and self-employment sector, and differential job destruction rates across sector jointly explain the phenomenon of educated unemployment.

Finally, we use this framework to evaluate different education and labour market policies which have recently been implemented or envisaged by West African governments. We uncover that public vacancy creation has an unintended effect of increasing overall unemployment by crowding out private-formal sector vacancy creation. It also has important redistributive effects. Workers with lower secondary education and less see their unemployment rates rise (because of fewer private-formal offers), while workers with tertiary education benefit from the increased public sector vacancies. The compulsory primary education reform, in contrast, has a positive effect on private-formal sector vacancy creation. As the average education level of the worker pool increases, the private-formal sector posts more vacancies, which result in a slightly higher offer rate. However, this effect is generally not large enough to compensate the compositional effect in unemployment (i.e. the effect of an increased share of better educated workers, who have higher unemployment rates). As a consequence, overall unemployment still increases. The policy also reduces self-employment considerably, most of the workforce is now employed in the private-formal sector, but a part of it finds itself in unemployment.

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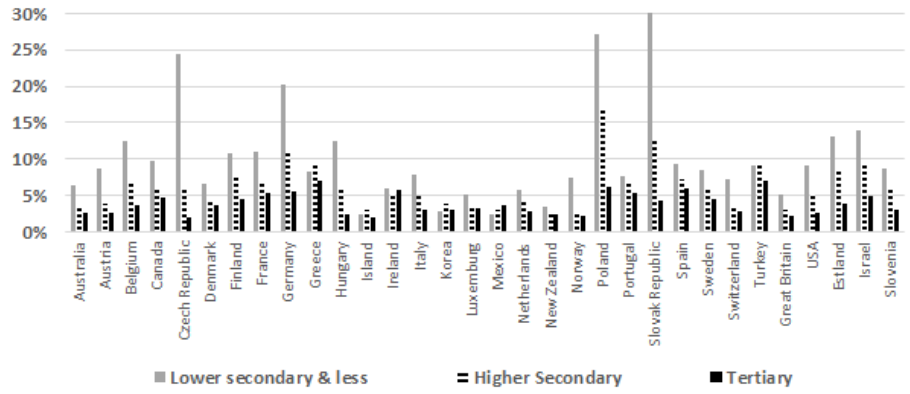
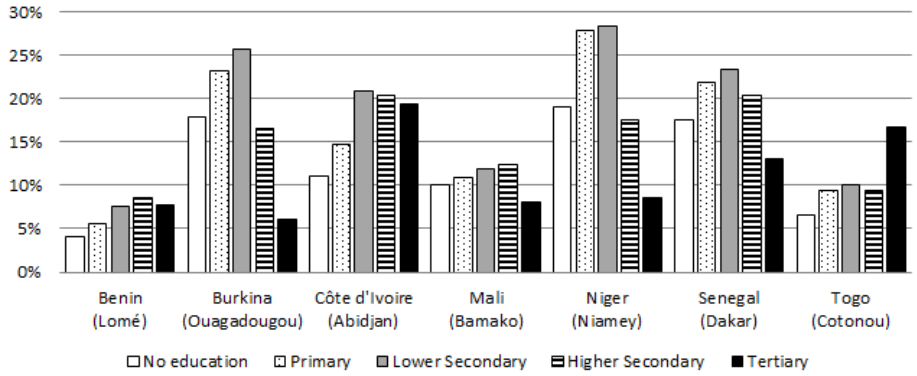
Appendix



Source: OECD

Figure 9: 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 10: 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 been self-employed without an intermediate 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 worker, offers from the public and the private sectors arrive at Poisson rates $\lambda_{p,u}(y)$ and $\lambda_{g,u}(y)$ respectively (and are determined in equilibrium), and from the self-employment sector at exogenous 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:

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

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:

$$rJ_u(x,y) = x - w_p(x,y) - \delta_p(y)J_u(x,y) \tag{29}$$

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

Wages

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

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

The worker's surplus from self-employment compared to unemployment is given by equation (21). Rearranging terms, this reads as:

$$V_{p,s}(x,x_s,y) - V_U(y) = \frac{w_{p,s}(x,x_s,y) - rV_U(y)}{r+\delta_p(y)} \tag{32}$$

Subtracting the flow value of self-employment on both sides and rearranging terms, we can derive the worker's surplus of moving from self-employment to private-formal employment as:

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

Using Eq.(30), we derive the value of a filled job by a previous self-employed workers as:

$$J_s(x,x_s,y) = \frac{x - w_{p,s}(x,x_s,y)}{r+\delta_p(y)} \tag{34}$$

Substituting the worker's surplus and the firm's surplus into the Nash bargaining problem, deriving the FOC and rearranging terms leads to the following wage equation:

$$w_{p,s}(x,x_s,y) = \beta x + (1-\beta)\left[rV_U(y) + (r+\delta_p(y))(V_s(x_s,y) - V_U(y))\right] \tag{35}$$

Reservation Wages

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

$$V_{p,s}(R_{p,s}(x_s,y),x_s,y) - V_U(y) = V_s(x_s,y) - V_U(y) = \frac{R_{p,s}(x_s,y) - R_p(y)}{r+\delta_p(y)} \tag{36}$$

Hence:

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

Using Eq.(22) and Eq.(36), we obtain:

$$V_{g,s}(x,x_s,y) - V_s(x_s,y) = \frac{1}{r+\delta_g(y)}\left(w_g(x,y) - R_p(y) - \frac{r+\delta_g(y)}{r+\delta_p(y)}\left[R_{p,s}(x_s,y) - R_p(y)\right]\right) \tag{38}$$

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

$$\begin{aligned} R_{p,s}(x_s,y) - R_p(y) &= \frac{r+\delta_p(y)}{r+\delta_s(y)}\left(x_s - R_p(y)\right) + \frac{\lambda_{p,s}(y)\beta}{r+\delta_s(y)}\int_{R_{p,s}(x_s,y)}\left[x - R_{p,s}(x_s,y)\right]\, dF_{X,p}(x|y) \\ &+ \frac{r+\delta_p(y)}{r+\delta_s(y)}\frac{\lambda_{g,s}(y)}{r+\delta_g(y)}\int_{R_{g,s}(x_s,y)}\left[w_g(x,y) - R_p(y)\right]\, dF_{X,g}(x|y) \\ &- \frac{\lambda_{g,s}(y)\left[1 - F_{X,g}(R_{g,s}(x_s,y)|y)\right]}{r+\delta_s(y)}\left[R_{p,s}(x_s,y) - R_p(y)\right] \end{aligned} \tag{39}$$

and

$$w_g(R_g s(x_s, y), y) = R_{p,s}(x_s, y). \tag{40}$$

To characterize $R_s(y)$ and $R_p(y)$, note first that from Eq.(28) and Eq.(32), $R_{p,s}(R_s(y), y) = R_p(y)$. Substituting this result into Eq. (39), we note that the left-hand side and the last term of the right-hand side of this equation are 0. Hence, the reservation productivity in self-employment is given by:

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

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

$$\begin{aligned} R_p(y) &= b(y) + \frac{\lambda_{p,s}(y)\beta}{r+\delta_p(y)}\int_{R_p(y)}\left[x - R_p(y)\right]\, dF_{X,p}(x|y) \\ &+ \frac{\lambda_{g,s}(y)}{r+\delta_g(y)}\int_{R_g(y)}\left[w_g(x,y) - R_p(y)\right]\, dF_{X,g}(x|y) \\ &+ \frac{\lambda_s(y)}{r+\delta_p(y)}\int_{R_s(y)}\left[R_{p,s}(x,y) - R_p(y)\right]\, dF_{X,s}(x|y) \end{aligned} \tag{42}$$

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:

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

$$\lambda_{g,s}(y) = (1-\phi)\frac{\psi s}{u+\psi s}\frac{m}{s} = (1-\phi)\psi k^{\eta-1} \tag{44}$$

The contact rate of an unemployed is given by:

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

$$\lambda_{g,u}(y) = (1-\phi)k^{\eta-1} \tag{46}$$

Free-Entry Condition and Steady State

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

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

$$+q(k)\frac{\psi s}{u+\psi s}\mathbb{E}_{FX,X_s,Y,p}\max\{J_s(x,x_s,y)-V,0\} \tag{48}$$

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:

$$J_u(x,y) = \frac{1-\beta}{r+\delta_p(y)}\left(x - R_p(y)\right) \tag{49}$$

and

$$J_s(x,x_s,y) = \frac{1-\beta}{r+\delta_p(y)}\left(x - R_{p,s}(x_s,y)\right) \tag{50}$$

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

$$0 = -c + q(k)\frac{s}{u+\psi s}\int\int_{R_p(y)}\frac{1-\beta}{r+\delta_p(y)}(x-R_p(y))dF_{X,p}(x|y)dF_Y(y|U) \tag{51}$$

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

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:

$$\begin{aligned}
\delta_p(y)n_p(y) &= \lambda_p(y)\left[1-F_{X,p}(R_p(y)|y)\right]u(y) \\
&\quad +\lambda_{p,s}(y)\int_{R_s(y)}\left[1-F_{X,p}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (52)\\
\delta_g(y)n_g(y) &= \lambda_p(y)\left[1-F_{X,g}(R_g(y)|y)\right]u(y) \\
&\quad +\lambda_{g,s}(y)\int_{R_s(y)}\left[1-F_{X,g}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (53)\\
\delta_s(y)n_s(y) &= \lambda(y)\left[1-F_{X,s}(R_p(y)|y)\right]u(y) \\
&\quad -\lambda_{p,s}(y)\int_{R_s(y)}\left[1-F_{X,p}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \\
&\quad -\lambda_{g,s}(y)\int_{R_s(y)}\left[1-F_{X,g}(R_{p,s}(x_s,y)|y)\right]dF_{X,s}(x_s)|y)n_s(y) \qquad (54)
\end{aligned}$$

and

$$n_p(y)+n_g(y)+n_s(y)+u(y)=1. \qquad (55)$$

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:

$$\phi=\left(\frac{u+\psi s}{k}-v_g\right)/\frac{u+\psi s}{k} \qquad (56)$$

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:

$$R_g(y) = \frac{\psi(y)}{1 - \gamma} + R_p(y) \tag{57}$$

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.(57), 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:

$$\ln x = \ln\left(\frac{w_p^j - (1 - \beta) R^j}{\beta}\right) \tag{58}$$

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:

$$\ln x = \ln\left(\frac{w_g^j - (1 - \gamma) R_g^j}{\gamma}\right) \tag{59}$$

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:

$$m(\theta)\phi = \sum_j p_p^j \frac{n_p^j}{E(T_p)\left(1 - F_{X,p}^j(R^j)\right)} \tag{60}$$

$$m(\theta)(1-\phi) = \sum_j p_g^j \frac{n_g^j}{E(T_g)\left(1 - F_{X,g}^j(R_g^j)\right)} \tag{61}$$

$$\lambda = \sum_j p_p^j \frac{n_s^j}{E(T_s)\left(1 - F_{X,s}^j(R^j)\right)} \tag{62}$$

Hence:

$$\phi = \frac{a_\phi}{1 + a_\phi} \tag{63}$$

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):

$$c = \frac{m(\theta)}{\theta} \sum_j p^j \frac{u^j}{u} \frac{(1-\beta)}{r + \delta_p^j} \int_{R^j} \left[1 - F_{X,p}^j(x)\right] dx. \tag{64}$$

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

$$\begin{aligned} b(y) &= R^j - \frac{\phi m(\theta)\beta}{r+\delta_p^j}\int_{R^j}\left[1-F_{X,p}^j(x)\right]dx \\ &\quad -\frac{(1-\phi)m(\theta)\gamma}{r+\delta_g^j}\int_{R_g^j}\left[1-F_{X,g}^j(x)\right]dx \\ &\quad -\frac{\lambda}{r+\delta_s^j}\int_{R^j}\left[1-F_{X,s}^j(x)\right]dx \end{aligned} \tag{65}$$

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 5: 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 6: 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 7: 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 8: 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 9: 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 10: 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 11: Calibrated unemployment benefits

Appendix D: Goodness of Fit

	BE		BF		CI		MA		NI		SE		TG	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Unemployment	0.088	0.088	0.240	0.240	0.191	0.191	0.107	0.107	0.249	0.249	0.238	0.238	0.157	0.157
Public employment	0.143	0.143	0.180	0.180	0.090	0.090	0.157	0.157	0.189	0.190	0.117	0.117	0.141	0.141
Formal employment	0.179	0.179	0.144	0.144	0.289	0.289	0.143	0.143	0.143	0.143	0.218	0.218	0.147	0.147
Self-employment	0.590	0.590	0.436	0.436	0.431	0.431	0.594	0.593	0.418	0.418	0.428	0.428	0.555	0.555
Mean earnings (public)	109.0	108.7	108.2	108.1	220.4	231.1	100.2	100.7	110.4	109.6	163.9	166.2	78.6	82.2
Mean earnings (formal)	68.2	66.2	82.3	82.3	116.1	116.4	74.2	72.4	82.1	77.3	139.6	140.1	52.8	52.6
Mean earnings (self)	58.8	52.8	52.6	47.3	74.8	68.1	74.2	66.2	62.8	58.2	83.6	80.6	38.1	33.5
Duration public	17.51	17.51	18.39	18.39	18.06	18.06	18.91	18.91	19.83	19.83	19.76	19.76	20.00	20.00
Duration formal	15.46	15.46	16.23	16.23	13.47	13.47	17.89	17.89	18.19	18.19	17.17	17.17	14.59	14.59
Duration self-employment	11.90	11.90	13.06	13.06	14.29	14.29	13.39	13.39	16.05	16.05	15.88	15.88	11.61	11.61

Table 12: Fit: Unemployment, sectoral employment, earnings and employment duration

	BE		BF		CI		MA		NI		SE		TG	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Unemployment														
No education	0.062	0.062	0.216	0.217	0.114	0.114	0.088	0.088	0.205	0.205	0.189	0.189	0.161	0.161
Primary	0.085	0.085	0.256	0.256	0.166	0.166	0.076	0.076	0.302	0.303	0.267	0.267	0.163	0.163
Lower secondary	0.092	0.092	0.319	0.319	0.240	0.240	0.166	0.166	0.358	0.358	0.291	0.291	0.140	0.140
Upper secondary	0.102	0.102	0.249	0.249	0.219	0.219	0.140	0.140	0.258	0.258	0.284	0.284	0.136	0.136
Tertiary	0.101	0.101	0.067	0.067	0.297	0.297	0.096	0.096	0.111	0.111	0.136	0.136	0.215	0.215
Public employment share														
No education	0.085	0.085	0.063	0.063	0.024	0.024	0.042	0.042	0.107	0.107	0.049	0.049	0.098	0.098
Primary	0.059	0.059	0.119	0.119	0.023	0.023	0.076	0.076	0.096	0.097	0.060	0.060	0.075	0.075
Lower secondary	0.116	0.116	0.194	0.194	0.074	0.074	0.155	0.155	0.203	0.203	0.167	0.167	0.132	0.132
Upper secondary	0.173	0.173	0.391	0.391	0.219	0.219	0.316	0.316	0.438	0.438	0.206	0.206	0.258	0.258
Tertiary	0.395	0.395	0.579	0.579	0.297	0.297	0.551	0.551	0.513	0.513	0.335	0.335	0.347	0.347
Formal employment share														
No education	0.188	0.188	0.114	0.114	0.208	0.208	0.084	0.084	0.104	0.104	0.126	0.126	0.145	0.145
Primary	0.115	0.115	0.127	0.127	0.293	0.293	0.165	0.165	0.143	0.144	0.190	0.190	0.098	0.098
Lower secondary	0.150	0.150	0.167	0.167	0.347	0.347	0.148	0.148	0.156	0.156	0.270	0.270	0.155	0.155
Upper secondary	0.281	0.281	0.195	0.195	0.353	0.353	0.243	0.243	0.157	0.157	0.310	0.310	0.205	0.205
Tertiary	0.283	0.283	0.207	0.207	0.312	0.312	0.199	0.199	0.249	0.249	0.398	0.398	0.229	0.229
Self-employment share														
No education	0.665	0.665	0.606	0.607	0.654	0.654	0.787	0.787	0.584	0.584	0.637	0.637	0.596	0.596
Primary	0.741	0.741	0.497	0.497	0.518	0.518	0.683	0.683	0.456	0.457	0.484	0.484	0.663	0.663
Lower secondary	0.642	0.642	0.320	0.320	0.339	0.339	0.531	0.531	0.282	0.282	0.272	0.272	0.573	0.573
Upper secondary	0.444	0.444	0.166	0.166	0.209	0.209	0.301	0.301	0.146	0.146	0.200	0.200	0.402	0.402
Tertiary	0.221	0.221	0.146	0.146	0.095	0.095	0.153	0.153	0.127	0.127	0.131	0.131	0.208	0.208

Table 13: Fit: Unemployment and sectoral employment shares by education

	BE		BF		CI		MA		NI		SE		TG	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Mean monthly earnings in public employment (in 1000 CFA)														
No education	64.7	60.6	64.6	66.3	142.6	152.1	46.8	47.6	58.8	60.5	101.8	111.0	72.7	75.2
Primary	54.7	57.5	72.8	76.0	145.9	163.9	62.8	64.1	55.2	56.0	116.2	125.6	43.2	46.4
Lower secondary	57.0	56.5	91.6	96.9	159.3	172.6	74.8	75.3	70.6	72.9	145.9	150.2	58.2	61.7
Upper secondary	84.7	83.5	89.6	91.6	207.9	219.0	90.2	94.2	86.9	76.6	136.6	111.2	68.6	71.0
Tertiary	168.1	168.0	176.9	167.4	282.1	290.5	147.4	144.5	205.5	203.5	247.6	252.2	145.5	150.6
Std. dev. of monthly earnings in public employment (in 1000 CFA)														
No education	40.5	40.1	37.2	31.2	89.3	40.8	27.9	55.2	35.5	45.8	41.1	49.0	47.4	30.8
Primary	26.4	32.6	32.9	32.6	58.3	38.8	34.9	44.0	34.1	25.9	67.9	41.0	20.2	20.6
Lower secondary	34.0	35.7	42.4	38.8	97.1	61.2	56.3	78.0	35.5	64.0	93.7	60.2	33.3	26.6
Upper secondary	61.7	64.8	57.3	47.4	78.6	72.8	36.8	90.3	55.4	66.4	74.2	81.2	38.5	50.0
Tertiary	123.9	135.4	107.0	130.9	146.5	153.6	93.3	669.5	145.5	253.4	154.5	181.3	98.1	136.9
Mean monthly earnings in formal employment (in 1000 CFA)														
No education	60.6	58.6	49.0	48.7	79.4	78.6	40.2	40.0	56.3	55.8	82.1	81.5	54.0	54.5
Primary	42.7	41.2	51.5	52.1	72.6	72.9	50.7	49.8	41.0	40.4	91.8	91.0	33.8	33.7
Lower secondary	49.2	48.5	63.0	63.1	102.8	102.5	56.7	56.0	58.4	56.4	118.4	117.9	38.8	38.6
Upper secondary	62.7	58.7	82.6	79.1	97.3	93.9	80.0	78.8	103.1	101.8	125.8	127.8	43.0	39.0
Tertiary	115.5	113.3	254.3	256.9	287.7	294.0	180.7	172.3	183.7	163.8	304.3	308.6	126.4	128.4
Std. dev. of monthly earnings in formal employment (in 1000 CFA)														
No education	48.4	51.4	28.9	30.4	57.7	51.3	19.8	19.2	42.9	49.1	48.8	45.0	46.0	55.1
Primary	33.8	22.6	27.1	33.2	36.2	39.5	34.7	30.5	24.5	22.0	62.3	58.7	17.5	17.3
Lower secondary	30.8	28.4	39.8	43.2	71.4	73.3	35.2	33.5	51.9	46.3	80.7	85.4	24.1	25.6
Upper secondary	48.7	43.3	69.8	74.7	56.5	63.6	50.2	49.8	89.4	124.4	91.3	118.2	28.1	31.1
Tertiary	71.7	77.5	150.2	195.3	159.4	215.6	184.8	186.9	135.2	203.3	233.9	308.0	97.7	148.9

Table 14: Fit: Earnings in public and formal employment

	BE		BF		CI		MA		NI		SE		TG	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Mean monthly earnings in self-employment (in 1000 CFA)														
No education	51.3	40.5	48.2	45.5	68.8	66.7	66.6	62.7	57.3	53.9	80.6	78.6	37.3	32.7
Primary	48.6	44.9	45.3	37.6	62.4	57.7	56.6	51.4	42.9	40.9	70.5	68.3	30.1	29.7
Lower secondary	53.0	50.2	51.1	46.8	82.0	76.5	76.8	73.3	72.7	68.3	86.0	82.0	36.9	33.8
Upper secondary	81.9	74.1	63.1	50.5	104.6	83.9	93.1	62.8	74.2	58.3	112.7	109.8	56.1	40.7
Tertiary	148.0	125.8	196.2	173.9	186.4	101.4	307.2	230.9	233.5	196.9	248.4	228.9	108.9	59.9
Std. dev. of monthly earnings in self-employment (in 1000 CFA)														
No education	48.5	40.1	30.5	31.2	43.2	40.8	64.3	55.2	49.3	45.8	52.7	49.0	35.4	30.8
Primary	40.6	32.6	29.4	32.6	39.4	38.8	41.9	44.0	26.6	25.9	44.4	41.0	19.7	20.6
Lower secondary	41.5	35.7	34.6	38.8	64.6	61.2	73.0	78.0	74.7	64.0	67.4	60.2	28.2	26.6
Upper secondary	62.0	64.8	49.8	47.4	78.1	72.8	93.5	90.3	65.8	66.4	75.4	81.2	47.5	50.0
Tertiary	125.6	135.4	116.9	130.9	134.6	153.6	376.0	669.5	181.9	253.4	213.1	181.3	120.4	136.9

Table 15: Fit: Earnings in self-employment