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ABSTRACT

The Puzzle of Educated Unemployment in West Africa*

Many developing countries exhibit a puzzling pattern given their scarce human capital: unemployment rates increase with education. We develop and estimate a model where educated unemployment arises from heterogeneous workers participating in a frictional labour market with three sectors (public, private and self-employment). We estimate that public sector distortions explain around two-thirds of educated unemployment in urban Burkina Faso and one-quarter in Senegal. We then simulate three equally costly policies. In contrast with public job creation and subsidies to self-employment income, subsidies for private sector vacancy creation effectively reduce educated unemployment and improve aggregate workers' welfare.

JEL Classification: J24, J64, E24

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

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1 Introduction

'A major benefit of education is the lower risk of unemployment at higher educational levels.' Mincer (1991)

Unemployment rates are decreasing with education in most developed economies. This contrasts sharply with the phenomenon of *educated unemployment* observed in many developing countries. In these countries, workers with intermediate and advanced education are more likely to find themselves unemployed than workers with basic or no education. Given the relative scarcity of educated workers and formal jobs, educated unemployment is not only a puzzle but also a major challenge for policy makers in the developing world.[1] This raises three key questions. First, why are educated workers more likely to be unemployed than their less educated peers? Secondly, is the public sector distorting the labour market through its wage and hiring policy and hereby contributing to this phenomenon? Finally, which labour market policies are most effective in combatting educated unemployment?

In this paper, we tackle these three questions and make the following main contributions. First, we present novel empirical evidence on the prevalence of educated unemployment across the globe. Second, we develop a simple, yet flexible framework that captures key characteristics of labour markets in a developing context. Educated unemployment arises in equilibrium as a result of heterogeneous workers participating in a frictional labour market composed of a public sector, private firms and self-employment. We pay particular attention to the role of the public sector, which provides a significant proportion of wage employment but may crowd out the private sector. We estimate the model and assess by how much public sector distortions and other labour market frictions can explain educated unemployment. Finally, we use our framework to simulate the impact of different public policies on the labour market in equilibrium. More specifically, we evaluate and discuss their diverse effects on educated and overall unemployment, sectoral labour market shares and composition, incomes, worker welfare and government expenditures.

We focus on Francophone West Africa in our analysis, that is, countries of the West African Economic and Monetary Union (UEMOA). The UEMOA comprises the following seven countries at the time of our data: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal, and Togo. Analysing educated unemployment for this region is particularly interesting for three reasons. First, UEMOA countries are characterised by a substantial amount of educated unemployment, as we show in Section 2. This is puzzling because self-employment in these economies is widespread. It thus raises the question of why educated workers do not become (at least temporarily) self-employed to escape unemployment. Secondly, UEMOA countries suffer from a lack of (skilled) employment opportunities that has been recognised by the national governments.[2] Many of the relatively scarce formal jobs are located in the public sector. The prospect of higher wages

[1] Educated unemployment has been suggested as one of the main causes of the Arab Spring upheavals in North Africa (Campante and Chor, 2012).

[2] For example, the communication of the Ivorian Ministerial Council of 8 April 2015 states the following: 'La question de l'emploi est aujourd'hui une des problématiques les plus importantes qui reste à régler par le gouvernement.' (The question of employment is today one of the most important problematic that remains to be solved by the government.)

and more stable employment in the public sector can drive up workers' reservation wage, which in turn increases unemployment.[3] The presence of a public sector can thus distort the labour market equilibrium and contribute to educated unemployment. Last but not least, many UEMOA governments have taken an active role by setting themselves targets for new employment creation and launching large recruitment programmes in the public sector in response to the acuity of the problem.[4] Some UEMOA countries have also created employment agencies that facilitate meetings between employers and potential employees to increase search efficiency and reduce recruitment costs,[5] and others have employed strategies to encourage self-employment by directly or indirectly subsidising entrepreneurial projects.[6] Because of the size of the public sector and the scope of these policies, it is important to understand their effects in equilibrium.

We start by presenting stylised facts about educated unemployment across the globe and highlight key features of urban labour markets in the UEMOA. We show that educated unemployment is a widespread and global phenomenon observed in many developing countries, including all seven UEMOA countries. More than one half of all low-income and lower-middle-income countries experience educated unemployment, while fewer than one of six upper-middle-income and high-income countries experience this issue. Many developing countries are characterised by a small formal sector and a large informal sector composed primarily of self-employment. In the UEMOA, public administration and public enterprises provide close to half of all formal employments. There is strong sorting into sectors along the educational gradient, with low-educated workers being over-represented in self-employment and high-educated workers being mainly employed in the public sector and in formal private-sector jobs. These stylised facts inform our modeling decisions.

We then develop and estimate a search- and matching model with a labour market that consists of a public sector, firms in a private (formal) sector and self-employment. Our interest in the complex interactions between different employment sectors and the resulting labour market equilibrium are the main reasons for favouring a structural modelling approach. It also permits the analysis of counterfactual policy scenarios. We model the private sector like the firm side in the Diamond–Mortensen–Pissarides model (Pissarides, 2000). Firms endogenously create job vacancies and upon meeting with a worker, they bargain over the wage. The public sector in our model posts an exogenous amount of vacancies, stipulates a minimum wage and pays wages according to an exogenous wage rule (that could include a public wage premium). We assume that the public sector hires on the same labour market as the private sector; thus, changes (i.e. increases) in

[3] On the characteristics of public sector employment in the region, see, for example, De Vreyer and Roubaud (2013). Duflo et al. (2021) describe a similar situation for Ghana, an English-speaking country in West Africa.

[4] Benin set a target of 500,000 jobs over the period 2016 to 2021, Côte d'Ivoire of 2 million jobs between 2012 and 2017, and 3 million jobs between 2021 and 2030, Niger of 200,000 jobs between 2011 and 2015, and Senegal of 500,000 jobs between 2012 and 2019. In Niger, President Issoufou reported that between 2011 and 2014, 87,000 permanent employments have been created in the country, among them, 47,000 in the public sector. In Mali, the government reported 207,254 jobs created in the country over the period from 2013 to 2017, among them, 107,114 job creations in the public sector. In Senegal, an announcement by President Sall in December 2012 about the opening of 5,500 jobs in the public sector resulted in more than 115,000 applications from mostly unemployed graduates within three months. See Appendix F for all relevant media sources.

[5] Examples include Benin, Côte d'Ivoire and Senegal.

[6] For example, in Benin, the Agence Nationale Pour l'Emploi, in collaboration with the World Bank, financed 8,500 micro-enterprises in 2017. In Côte d'Ivoire, the Ministère de la Promotion de l'emploi des jeunes announced loans for 7,200 entrepreneurial projects in 2015.

public vacancies or wages directly affect the private sector by imposing a negative externality on the latter (see Bradley et al. (2017) and Albrecht et al. (2019) for similar examples in the case of England and Colombia, respectively). In contrast, profitable business ideas (i.e. self-employment opportunities) arise independently of the state of the public/private labour market. We allow self-employed workers to continue receiving offers from the public and private sector, though at a lower rate. Matches in all sectors are destroyed at an exogenous rate. On the worker side, we assume heterogeneous individuals with respect to education and parental background.[7] As sectoral productivity, job arrival rates, destruction rates and the cost of unemployment differ across these dimensions, heterogeneous workers sort along education and parental background into different sectors of the labour market. This brings about unemployment rates that differ across worker types and can give rise to educated unemployment. Overall, our model allows for different sources of educated unemployment.

We take the model to the data for the capital cities of Burkina Faso and Senegal using the 1-2-3 Survey conducted from 2000 to 2002 in the UEMOA countries. The 1-2-3 Survey has two key features that make it particularly suitable for estimating our model. First, the survey not only covers formal employment, but it also specifically targets economic activities in the informal sector. Because of this, the survey contains information to compute self-employment incomes. Secondly, the survey includes past labour market outcomes, allowing us to estimate labour market transitions. Both of these variables are rarely observed in other data sources on Sub-Saharan African countries.

Our estimation results of the model offer the following insights. Overall, the distortions induced by the public sector explain around two-thirds of educated unemployment in Burkina Faso and one-quarter in Senegal. The urban labour markets in Burkina Faso and Senegal are highly frictional. The private sector faces high vacancy creation costs that result in low vacancy creation. Offer arrival rates for workers are low in all sectors, and search efficiency when self-employed is low. Job destruction varies greatly across sectors and education levels. The estimated minimum wage in the public sector is well above workers' reservation wage in the private sector and self-employment, indicating that public sector jobs are highly rationed. At the same time, the share of vacancies posted by the public sector is large when compared to the private sector. However, many matches between the public sector and workers are not consummated because the match value falls short of the stipulated minimum wage, leading to large inefficiencies in the public hiring process.

As a last contribution, we simulate the impact of three public policies that have been envisaged or implemented by UEMOA governments in the recent past as discussed above. First, (i) public sector vacancy creation have been a prime instrument to combat unemployment of (mainly educated) workers. Second, governments in the region have also implemented reforms to (ii) encourage self-employment by directly or indirectly subsidising entrepreneurial projects. Finally, they have also sought to (iii) reduce vacancy posting costs in the private sector, for example, by creating *employment agencies* to act as meeting platform for employers and employees. Equipped with our model of the urban labour market, we compare the performance of all three policies for

[7] De Mel (2020) shows that parental wealth in Ghana is a key determinant for job search and unemployment.

similar government expenses.

First, an increase in public sector vacancies has the unintended effect of increasing overall and educated unemployment. In fact, expanding public sector vacancies crowds out private sector vacancies. Because the indirect negative effect on firms dominates the direct positive effect in the public sector, employment prospects worsen. Some workers thus become self-employed, and others find themselves in unemployment. Overall, the policy decreases welfare across all groups of workers. Secondly and somewhat surprisingly, subsidising self-employment has little effect for moderate levels of subsidies. However, it may also result in a larger overall unemployment and educated unemployment if the subsidies are large. In the latter case, the better prospect in self-employment ultimately crowds out private sector vacancies in the same way as public sector job creation, while leaving the public sector unaffected. This results in a drop in job offers from the private sector. In sharp contrast, reducing vacancy posting costs for the private sector achieves uniformly lower unemployment rates than the two previous policies at similar levels of budgetary expenses. Reducing costs improves employment outcomes for individuals with secondary education, without harming the other education groups. This ultimately improves aggregate workers' welfare. Interestingly, subsidies up to 20% of the vacancy opening cost remain budget neutral from the perspective of the government because the new job creation entails a reallocation of the workforce from the public to the private sector and reduces the public sector wage bill.

Our paper ties into three different strands of the literature. First, our paper contributes to our understanding of educated unemployment. Educated unemployment in a developing context has previously been identified in the literature, but it has not yet been the object of much scrutiny. Fan and Stark (2007) and Stark and Fan (2011) explain educated unemployment within a theoretical model as a result of international migration prospects and rigid wages. Feng et al. (2021) provide empirical evidence of educated unemployment – without naming it as such – in developing countries and its absence in more developed economies. They explain this cross-country pattern within a model of skilled-biased productivity differences and economic development. In their model, the expansion of a modern sector increases the value of search and makes some workers more willing to queue for jobs rather than create their own employment. In a developing country, only high-skilled workers thus want to search for jobs in the modern sector, while job search becomes beneficial for all workers as an economy develops. In this paper, we privilege the workings of Sub-Saharan labour markets as the main explanation of educated unemployment and focus on the role of the public sector in particular.[8] Our equilibrium model of a frictional labour market with multiple sectors and heterogeneous workers thus allows for several potential sources of educated unemployment. One key contribution of our paper is that we take our model to the data to quantify the importance of each source of educated unemployment, which turns out to be different across countries. Our findings reveal that distortions created by the public sector explain around two-thirds of educated unemployment in Burkina Faso and one-quarter in Senegal, while

[8] According to the Worldbank Indicators, emigration rates of tertiary educated individuals in Francophone West Africa in 2012 are below the average rate of 18.9% for low-income economies. Moreover, a considerable share of 'international' migration in our sample occurs within the UEMOA region (see Vreyer et al. (2009) and Girsberger et al. (2020)). Migration prospects are thus unlikely to be the main explanation of educated unemployment in this area.

differential job destruction and parental background only play a minor role.

Our paper also contributes to a rapidly expanding literature analysing the interactions between unemployment, self-employment and wage employment in developing labour markets. Bandiera et al. (2022) aptly describe a 'vicious cycle' in African labour markets, 'where most people run subsistence enterprises because there are no salaried jobs and there are no salaried jobs because most enterprises operate at subsistence levels.' In line with this view, Rud and Trapeznikova (2021) highlight the weakness of the wage employment sector as a consequence of important labour market frictions and entry barriers in Sub-Saharan Africa. Poschke (2019) finds that the high degree of frictions in urban labour markets pushes job seekers into own-account jobs, thereby reducing further the size of the wage employment sector in equilibrium. As Sub-Saharan African economies are characterised by large shares of labour force being self-employed, self-employment is an important ingredient of our West African labour market model.[9] Our contribution to this literature is to point out the distinctive role of the public sector, which creates an important share of formal jobs in developing economies, offers high wages and more secure employment.[10] The public sector increases the value of search but imposes negative externalities on the private sector and constrains its expansion. In equilibrium, we find that the public sector leads to a contraction of the overall formal sector and pushes workers into unemployment and self-employment.

Finally, 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 the labour market outcome of unskilled workers, Charlot and Decreuse (2010), who analyse education choices in a two-sector, two-education level matching model, and Flinn and Mullins (2015) and Bobba et al. (2022), who both model and estimate an equilibrium search model with a binary education decision. The first paper models search in a semi-segmented fashion (i.e. high-skilled workers can search for simple jobs but not vice versa), while the latter three papers assume that the search market is completely segmented by education. In our setup, workers (and firms) cannot direct their search. In equilibrium, heterogeneous workers are employed in all three sectors, though with different shares (as is observed in the data). In our model, the public and private sector directly compete for the same workers by posting vacancies. An increase in public sector vacancies impacts job filling-rates in the private sector and vice versa. This allows us to study how labour market policies targeted towards one sector – such as a public vacancy creation policy or subsidies to entrepreneurial projects – have spillover effects unto other sectors and reshuffle workers across sectors.

The main conclusion of our analysis is that policy intervention should target the private sector's

[9]Several recent contributions study formal wage work and informality in a Latin American context (see, for example, Ulyssea (2010), Albrecht et al. (2011), Meghir et al. (2015), Ulyssea (2018), Narita (2020) and Bobba et al. (2022)). While the informal sector in a Latin American context is, to a large extent, comprised of wage workers who do not contribute to social security or taxes, Sub-Saharan African workers in the informal sector are primarily self-employed or contributing family workers. This distinction is relevant both for modelling and policy purposes in our context (see Kerr (2012) for a similar argument in the Tanzanian case).

[10]Search and matching models with a public sector include Burdett (2012), Gomes (2015), Bradley et al. (2017), Yassin and Langot (2018) and Albrecht et al. (2019). None of these papers relate to a Sub-Saharan or low-income economy.

vacancy cost in particular,[11] and labour market frictions in general, rather than implementing *ad hoc* policies to reduce unemployment in the short-term. The questions of why these cost are so large and how to best address them are beyond the scope of this paper. However, and fortunately, robust answers are emerging from a literature studying labour market frictions and self-employment in developing countries at the micro level, with the use of observational data and experiments. For this, Bandiera et al. (2022) offers an excellent review. We note that in line with our findings, many of the proposed solutions therein target an expansion of the still-fragile private sector.

The remaining part of this paper is structured as follows. Section 2 presents the main stylised facts about educated unemployment and labour markets in urban West Africa and the data used for estimation. Section 3 develops a search and matching framework with different sectors and heterogeneous individuals who differ in their education level and parental background. Section 4 presents the estimation strategy and discusses identification. Section 5 estimates this model to recover the underlying structural parameters. In Section 6, we use the model to answer the question whether the public sector has a distortionary effect. Then, in Section 7, we evaluate the impact of alternative labour market policies. Section 8 concludes.

2 Stylized facts and data

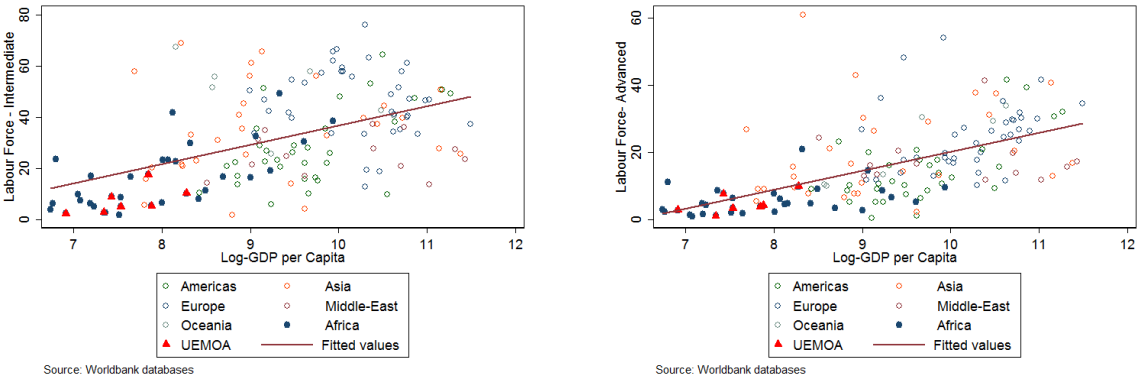
2.1 Stylized facts about educational attainment and labour markets

In this section, we present several stylized facts about educational attainment and labour markets across countries of varying income levels. We discuss these patterns with a particular focus on Francophone West African economies that form the West African Economic and Monetary Union (French acronym: UEMOA) and that are among the poorest economies worldwide. The UEMOA includes the following seven countries: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. The empirical evidence guides our subsequent modelling decisions.

First, UEMOA countries – similar to many other developing countries – are characterised by a scarcity of skilled workers, as shown in Figure 1. Fewer than one of five male adult workers have completed intermediate (i.e. upper secondary) education and fewer than 10% have completed advanced (i.e. tertiary) education. In Burkina Faso, Mali and Niger, the countries of the region with the lowest educational attainment, the shares are as low as 5% with intermediate and 3% or less with advanced education. For comparison, in India, the share of the adult male population with intermediate education is to 22% and 13% have advanced education. Educational attainment in most UEMOA countries is among the lowest worldwide.

Second, even when human capital is scarce, higher education does not necessarily shield workers from unemployment. On the contrary, educated workers in the UEMOA and many other developing countries are *more* likely to be unemployed than those with only basic education. In Figure 2, Panel (a) illustrates a positive relationship between the ratio of the unemployment rate

[11] Alfonsi et al. (2020) reach a similar conclusion for Uganda where firms are also reluctant to create formal jobs.



(a) Share with intermediate education (b) Share with advanced education

Source: Author's calculations using World Bank Development Indicators.
Panel (a) plots the average log GDP per capita, PPP adjusted, over the period 1996–2016, against the average share of the working-age population with intermediate (upper secondary) education. Panel (b) considers the same relationship between log GDP per capita and the share of the working-age population with advanced (tertiary) education.

Figure 1: Educational attainment and development

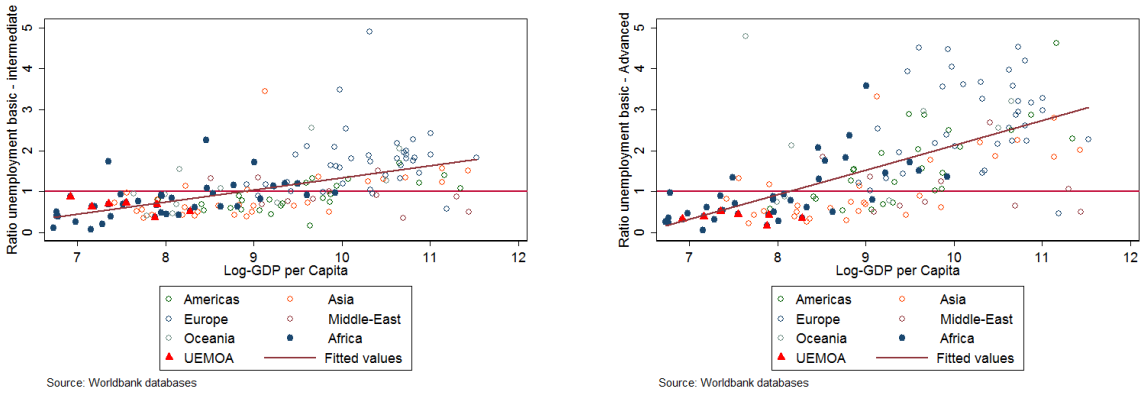
with basic education (lower secondary and below) over the unemployment rate with intermediate education and purchasing power parity (PPP)-adjusted GDP per capita. Panel (b) illustrates the same positive relationship for the ratio of the unemployment rate with basic education over the unemployment rate with advanced education. A ratio below one implies that workers with intermediate (advanced) education are more likely to be unemployed than workers with basic education. Most UEMOA countries and developing economies exhibit ratios below one, whereas the opposite is true for economies with higher income levels. We term this phenomenon observed in large parts of the developing world: *educated unemployment*. It is important to recognise that, by international standards, the level of unemployment of workers with basic education is unusually low in developing countries (see Figure A.1, Panel (a) in the Appendix). At the same time, unemployment rates of educated workers are relatively high (see Panels (b) and (c) in Figure A.1 in the Appendix). Educated unemployment in developing countries is thus the result of both of these forces.[12]

Finally, in many developing countries, wage employment only makes up a relatively small share of total employment. Moreover, a sizeable proportion of wage employment is located in the public sector. About 24 to 27% of the employed male labour force in low-income countries between 1996 and 2016 are wage earners, compared to about 50% in middle income countries and about 80% in high-income countries in the same period.[13] Workers facing such low-wage employment prospects create their own income-generating activity as they cannot afford to stay unemployed (see, for example, Poschke, 2013; Blattman and Dercon, 2018). In UEMOA countries, own-account workers and contributing family workers represented about 65 and 70% of the male employed labour force. Workers with basic education are more likely to engage in this low-productivity subsistence work than intermediate or high-educated individuals.[14]

[12] Feng et al. (2021) also document the pattern of educated unemployment (albeit without referring to it in this way) by combining household survey and census data from the IPUMS and World Bank's Living Standards Measurement Surveys data sets. Their analysis differs from ours in that it uses a binary educational categorisation (high vs low) and relies on a smaller number of countries and a longer time period.

[13] These numbers are according to ILO aggregate estimates for the period of 1996 to 2016.

[14] Several studies have proposed various factors that constrain wage-sector growth in low-income economies. For a



(a) Unemployment ratio basic – intermediate (b) Unemployment ratio basic – advanced

Source: Author's calculations using World Bank development indicators.
Notes: The unemployment rate by education is not available for all years. The ratio is calculated by, first, averaging the country-specific unemployment rate by education level for men for all available years between 1996 and 2016, and, second, dividing the corresponding averages for each country. Panel (a) plots the average GDP per capita, PPP adjusted, over the period 1996–2016, against the average ratio of unemployed with basic (lower secondary or below) education over the unemployed with intermediate (upper secondary) education. Panel (b) considers the same ratio between basic and advanced (tertiary) education. A ratio below one implies that intermediate and high-educated workers are more likely to be unemployed than workers with basic education.

Figure 2: Educated unemployment and development

We argue in this paper that the low unemployment rate of less educated workers and the high unemployment rate of their more educated counterparts are both related to their differential sorting into employment sectors in response to a relatively small private wage employment sector. The 'missing' wage employment sector deprives mostly individuals with intermediate and advanced education of employment opportunities.[15] Adding to the existing literature, we point out the possible role of the public sector in constraining the private sector's growth and thereby, in aggravating rather than alleviating the issue of educated unemployment. When assessing the patterns of unemployment, it is important to bear in mind the divide between urban and rural regions. Educated unemployment is mainly a phenomenon of urban centres, where educated workers are concentrated, and where the public sector and private wage employment are mainly located.[16]

2.2 Data and descriptive statistics on UEMOA countries

Our data is drawn from the first phase of the 1-2-3 Survey conducted in 2001 and 2002 in the economic capital cities of the seven Francophone UEMOA countries (see Brilleau et al. (2005)). 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 rich information on socio-demographic characteristics, current labour market status, part of the employment history (max. last two spells), and current income. For job seekers it also reports income aspirations, the

survey, see Rud and Trapeznikova (2021).

[15] Figure A.2 in the Appendix shows that a positive relationship also exists between the unemployment ratios of education groups and the share of wage employment, analogous to the educated unemployment pattern found for low-income countries shown in Figure 2.

[16] Moreover, urban areas and rural regions also differ in their composition of the remaining workforce, that is, those who are self-employed or contributing family workers. In rural regions, non-wage work often takes the form of subsistence farming, while in urban areas, it corresponds to self-employment and contributing family workers in the informal (service) sector.

reservation wage, job search behaviour and employment prospects.

We restrict our sample to male individuals in the labour force who are between 18 and 64 years old. Table 1 presents summary statistics for each country.

	Benin	Burkina Faso	Côte d'Ivoire	Mali	Niger	Senegal	Togo
Demographic statistics							
Age	33.9	33.2	33.5	35.8	35.6	33.9	33.1
Migrant background	53%	61%	72%	54%	62%	40%	61%
Educational attainment and parental background							
No education	14%	36%	30%	41%	42%	28%	11%
Primary	34%	26%	22%	17%	21%	36%	31%
Lower secondary	26%	21%	25%	16%	20%	20%	38%
Upper secondary	10%	8%	8%	16%	5%	6%	10%
Tertiary	16%	8%	14%	10%	12%	10%	10%
Father in formal sector	29%	19%	24%	22%	20%	32%	27%
Labour market statistics							
Unemployment rate	6.0%	14.5%	13.6%	7.7%	14.9%	14.2%	10.3%
Public sector (% of employed)	13%	18%	10%	16%	22%	13%	14%
Private sector (% of employed)	16%	15%	32%	15%	16%	24%	15%
Self-employment (% of employed)	71%	66%	59%	69%	62%	62%	70%
Monthly earnings (10,000 CFA)	58.3	58.0	104.2	83.2	70.7	101.0	43.3
Observations	2,502	3,156	2,852	2,431	2,779	3,878	2,314
GDP per capita in 2002 ($ PPP)	2,571	1,362	3,849	1,825	976	2,581	1,271

Notes: The table shows key statistics on our sample of male individuals in the labour force in the economic capital of each country who are aged between 18 and 64 years at the time of the survey (1-2-3 Survey). 'Migrant background' denotes the share of our sample not born in the economic capital. It includes internal and international migrants (mostly from other UEMOA countries). 'Father in formal sector' denotes the share of our sample whose father works/worked in the public or private (formal) sector. 'Private sector' measures the share of the employed labour force who works in a formal employment in the private sector. Informal private sector employment is classified as self-employment (see text for explanation). Monthly earnings are given in 10,000 CFA. In 2002, 10,000 CFA corresponded to around 13.44 USD. GDP per capita (PPP) is measured in constant international 2017 $ for each country (World Bank Indicators).

Table 1: Sample characteristics of economic capitals

According to the World Bank, all seven UEMOA countries are classified as 'low-income' countries in 2002. However, Côte d'Ivoire and Senegal have a significantly higher GDP per capita and a larger private (formal) sector, suggesting that they are somewhat more developed than the other UEMOA countries.[17]

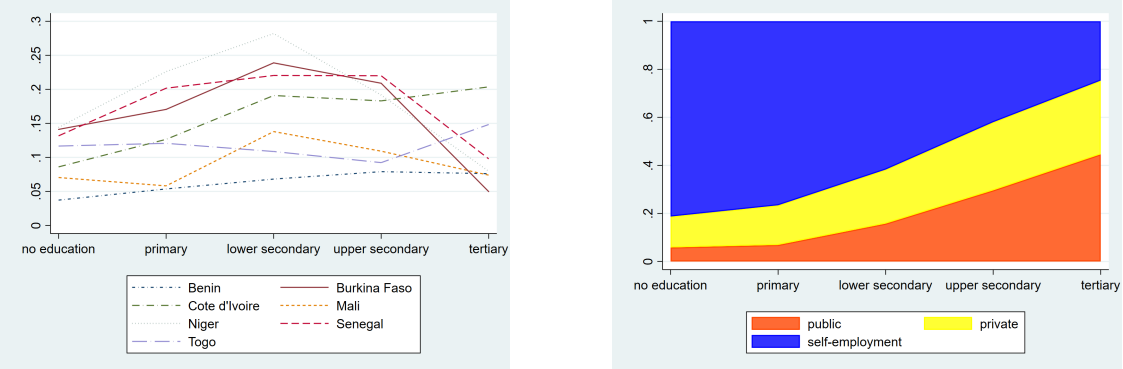
A considerable share of the labour force in each economic capital city was born elsewhere, this reflects substantial intra-regional population mobility within the UEMOA (see Girsberger et al. (2020)). Moreover, educational attainment is low even in the economic capitals, where between one and four out of ten male workers have not completed any education at all. Two factors contribute to the low educational attainment, according to the 1-2-3 Survey data. First, a large share of the population never attended school for financial reasons (around 30%, not shown).

[17]Benin is a peculiar case. When using PPP-adjusted GDP per capita, Benin could be categorised among the more developed economies in the UEMOA. However, when considering nominal GDP per capita and other labour market indicators, Benin more resembles the less developed UEMOA countries. We classify it among this latter group.

Secondly, drop-out rates from education are relatively high and mainly driven by a preference for a vocational pathway (around 20%, not shown) and by academic failure (around 20%, not shown).

In our sample, unemployment rates vary across economic capitals from 6% in Benin to almost 15% in Niger. Among those who are employed, we distinguish different sectors of employment, as 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 that is not monitored by the government and does not pay taxes or make social security contributions. In our context, self-employment in one-person firms and non-salaried work makes up a significant share of the informal sector (around 85% in our data, not shown). In order to avoid confusion with the term 'informal sector' used in the context of Latin American countries, we apply the term self-employment instead.[18] Formal employment – that is, public and private sector employment combined – makes up around one-third of employment in most countries, with slightly higher rates in Côte d'Ivoire and Senegal.

Educational attainment is the key characteristic along which workers sort into different sectors of employment and unemployment. Figure 3 shows unemployment rates by education across UEMOA capitals (left panel) and sector of employment of the male labour force in UEMOA countries across different education levels (right panel).



(a) Unemployment rates (b) Sector of employment by education level

Notes: Panel (a) presents the unemployment rates of the male labour force aged between 18 and 64 years across all seven UEMOA economic capital cities. Panel (b) shows the sector of employment of all men in the labour force aged 18 to 64 years old pooled across all seven UEMOA countries.
Source: Authors' calculations using the 1-2-3 Survey, 1st phase, 2001/2002; AFRISTAT, DIAL, INS; authors' calculations.

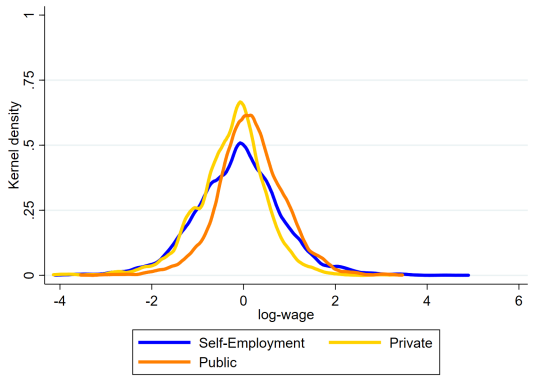
Figure 3: Educated unemployment and sector of employment

All urban labour markets in this region are characterised by a substantial degree of educated unemployment. In Benin and Côte d'Ivoire, unemployment rates are increasing with education, with tertiary educated workers being almost twice as likely to be unemployed as workers without any education.[19] The unemployment rates in the remaining countries are broadly hump-shaped in

[18] 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). In our data, there are only few informal wage earners who are not self-employed or contributing family workers. For this reason, we prefer the term "self-employment".

[19] Togo is somewhat of an outlier to this pattern as the unemployment rate is fairly constant across education levels up to upper secondary education, but it jumps upwards for workers with tertiary education.

education; that is, the incidence of unemployment increases for low and intermediate levels of education (compared to no education) but drops substantially for workers with tertiary education. The right panel of Figure 3 reveals a strong patter of workers sorting into different sectors along their educational attainment. The share of employment in the public sector increases along the educational gradient, while the share of workers in self-employment decreases. Notwithstanding, labour markets are not (strictly) segmented along education. Around 6% of the labour force without any education works in the public sector (compared to 40% among those with tertiary education), and close to 20% of workers with tertiary education are self-employed (compared to 80% among those without any education). The share of private employment remains relatively stable across education levels and varies between 15% and 20%.



Source: Authors' calculations using the 1-2-3 Survey.
Notes: The figure presents the residual wage distribution in each sector after correcting for country and education level fixed effects.

Figure 4: Residual wage distribution across sectors

Labour market sectors not only differ in their workforce composition but also in the wages paid to employees. Figure 4 shows the kernel density estimate of the residual (log-)wage distribution in each of the three sectors after controlling for country and education level fixed effects. The public sector pays a wage premium compared to the other sectors; it stochastically dominates the two other residual wage distributions at almost all income levels (except possibly for the very highest wages). Private sector wages resemble self-employment earnings for the low tail of the residual wage distribution, but private sector jobs are somewhat less likely to offer high wages than the public sector and self-employment. Overall, wage dispersion is highest in self-employment.

To sum up, urban labour markets in UEMOA countries are characterised by a relatively low-educated workforce, which sorts primarily into a large informal self-employment sector. When employed, intermediate and high-educated workers are disproportionately represented in the formal sector. The formal sector is relatively small and divided between public and private employers in proportions that vary across countries, with more developed countries generally having a somewhat larger private sector. The public sector pays a wage premium and offers more stable employment. Finally, and importantly, educated unemployment is a robust pattern observed in all seven countries in our sample.

3 An equilibrium search model with a public sector and self-employment

3.1 Environment

In this section, we develop a general equilibrium search and matching model in the spirit of Pissarides–Mortensen–Diamond (see Pissarides (2000)). Our model captures key features of labour markets in urban West Africa and allows us to evaluate different labour market policies that have been implemented or suggested to alleviate (educated) unemployment. A frictional labour market consisting of a public sector, a private (formal) sector and self-employment is at the core of our model. The private sector is composed of many infinitesimally small homogeneous profit-maximising firms that post job vacancies and bargain over wages if they match with a worker. The public sector is a single employer that posts a fixed number of vacancies with wage offers drawn from an exogenous offer distribution (Bradley et al., 2017). It also defines a minimum wage below which the public sector will not hire any worker. Firms and the public sector together compose the formal sector. Neither sector directs its search but randomly meets with job seekers. Contacts in each of these two sectors are endogenous. They are governed by a Cobb–Douglas matching function that depends on the total public and private sector vacancies on the one hand and the total number of job seekers on the other hand. In our environment, the public sector and firms thus compete for the same pool of job seekers (Albrecht et al. (2019)). This implies that policies targeting the public sector have direct repercussions on firms through a change in contact rates.

Workers are heterogeneous. They differ in their education level and parental background. Education enhances productivity and governs job destruction rates in each sector. Parental background affects the cost of unemployment of job seekers (De Mel (2020)) and contact rates with private firms and the public sector, but it does not alter productivity. This reflects the fact that workers whose parents were employed in the public or private sector might have better connections with employers. The rich labour market structure on the one side and the heterogeneity of workers on the other side result in imperfect sorting of workers across sectors and education-specific unemployment rates.

The model assumes stationarity, continuous time and infinitely lived agents (i.e. workers, firms and the public sector), who are subject to a common discount rate r. There is a continuum of workers with a mass normalised to 1. Workers are characterised by their parental background k and their education level h. The education distribution in the economy is given by $F_{(H|k)}(.|k)$, implying that educational attainment and parental background can be correlated. In line with our empirical analysis, we consider two levels of parental background $k \in \{0, 1\}$ (i.e. whether the father was employed in the formal sector or not) and five levels of schooling denoted by $h \in \{0, 1, \cdots, 4\}$, where 4 corresponds to the highest level (tertiary) and 0 to not having any education. A worker can be in one of four labour market states: unemployed, self-employed, employed in the private sector or employed in the public sector. Throughout the paper, we indicate a worker's labour market state using a subscript $j \in \{u, s, p, g\}$ for unemployment, self-employment, employment in the private sector and employment in the public sector. The steady-state measure of workers with characteristic y in each employment state are denoted $n_u(y), n_s(y), n_p(y), n_g(y)$, where y can be a

pair (h, k), a singleton h or k, or designate the whole population, in which case, it is omitted.

3.2 Search in unemployment and self-employment

Workers only search for jobs when they are unemployed or self-employed.[20] Unemployed workers receive an instantaneous utility flow $b(h, k)$, which depends both on their education level and parental background. Job seekers randomly search for work opportunities without targeting any sector in particular. Workers of different education levels and parental backgrounds thus interact in the same market.[21] Job offer rates from the public and private sectors, that is, λ_{ug} and λ_{up}, depend on labour market tightness, parental background and the relative proportion of vacancies posted by the public sector and private firms.

Self-employment opportunities arrive at a Poisson rate λ_{us} and are characterised by a self-employment income, denoted x_s, which is a draw from the exogenous distribution $F_{(X_s|h)}(.|h)$. We think of these self-employment opportunities as (profitable) business ideas created by an unemployed worker. These opportunities arrive independently of the state of the labour market (i.e. labour market tightness).[22] The heterogeneous self-employment income reflects the heterogeneity in ideas, ability and costs. It is allowed to vary with schooling level h. Self-employed workers continue to randomly search for jobs in the private and public sectors (but not in self-employment), albeit at a reduced intensity ψ, with $0 < \psi \leq 1$.[23]

Undertaking a self-employment opportunity is thus a trade-off between the income it delivers coupled with lower search efficiency, and the higher search efficiency when unemployed. Modelling self-employment is important because policies targeted at the public or private sector not only have repercussions on unemployment but also on self-employment. Self-employment can act as a buffer between the formal sector and unemployment. Moreover, encouraging self-employment is an important pillar of recent labour market policies in UEMOA countries.

3.3 Matching with firms and the public sector

Private firms and the public sector post vacancies at rates v_p and v_g, respectively. As firms and the public sector do not direct their search, their contact rates with workers of different education

[20] This assumption simplifies the analysis. However, it is in line with observed employment durations in the public and private sectors that often exceed 10 years. Moreover, our data contain information on past labour market status, allowing us to estimate transitions across sectors, but the data do not contain any information on past incomes. This makes identification of job-to-job transitions within a sector impossible.

[21] The assumption of random search produces imperfect sorting of heterogeneous workers across sectors as is observed in the data. Moreover, many job seekers do not report targeting any sector in particular in the 1-2-3 Survey.

[22] In our setting, self-employment opportunities are not always available. The arrival rate of self-employment opportunities can be interpreted as an (inverse) measure of barriers of entry to profitable self-employment. In the limiting case when this arrival rate tends to infinity, self-employment opportunities become a readily available fall-back option, as in Rud and Trapeznikova (2021). However, frictionless entry into self-employment is not consistent with our data for urban West Africa. According to the 1-2-3 Survey, unemployed job seekers are prevented from becoming self-employed for the following two main reasons: (i) the difficulty of becoming self-employed (54%) and (ii) low incomes in self-employment (20%).

[23] As argued in Franklin (2018) and Abebe et al. (2021a) for Addis Ababa in Ethiopia, job search for formal (permanent) positions in African cities is costly, time-consuming and often requires travelling to the city centre. Most self-employed workers in our data work full-time; hence, they can only dedicate a limited amount of hours to a job search compared to their peers who are unemployed.

levels and parental backgrounds are determined in equilibrium and depend on the share of each type of worker among unemployed and self-employed job seekers. Let $\phi = v_p/(v_p + v_g)$ be the proportion of vacancies posted by private firms. The measure of contacts in the formal sector is given by m. Denote by v the total number of vacancies posted by the public sector and private firms. The matching technology is characterised by

$$m = AI^{\eta}v^{1-\eta} \text{ with } I := n_u(0) + \zeta n_u(1) + \psi\left(n_s(0) + \zeta n_s(1)\right)$$

where $0 < \psi \leq 1$ reflects the lower search efficiency of workers who are currently self-employed relative to the unemployed, and $\zeta \geq 1$ reflects a greater search efficiency of workers with a high parental background (i.e. $k = 1$) compared to those without. A measures the matching efficiency, and η captures the matching function elasticity.

The rate of contacts per vacancy is

$$q(\kappa) = \frac{m}{v} = A\kappa^{\eta},$$

where $\kappa = I/v$ is a measure of the market tightness.

The contact rates of an unemployed worker with the private and public sectors are given by:

$$\lambda_{up}(0) = \phi\frac{n_u(0)}{I}\frac{m}{n_u(0)} = \phi A\kappa^{\eta-1} \quad (1)$$

$$\lambda_{ug}(0) = (1-\phi)\frac{n_u(0)}{I}\frac{m}{n_u(0)} = (1-\phi)A\kappa^{\eta-1} \quad (2)$$

$$\lambda_{uj}(1) = \zeta\lambda_{uj}(0), \text{ for } j \in \{p, g\} \quad (3)$$

Similarly, the contact rates of a self-employed worker are given by:

$$\lambda_{sp}(0) = \phi\frac{\psi n_s(0)}{I}\frac{m}{n_s(0)} = \phi\psi A\kappa^{\eta-1} \quad (4)$$

$$\lambda_{sg}(0) = (1-\phi)\frac{\psi n_s(0)}{I}\frac{m}{n_s(0)} = (1-\phi)\psi A\kappa^{\eta-1} \quad (5)$$

$$\lambda_{sj}(1) = \zeta\lambda_{sj}(0), \text{ for } j \in \{p, g\} \quad (6)$$

A meeting between a job seeker and a private sector firm results in a match-specific productivity x. The match distribution $F_{(X|h)}(.|h)$ depends on the worker's education level h. The match value x, the education level h, the parental background k, the employment status (unemployed or self-employed), and, if currently in self-employment, the self-employment income x_s are observed by both parties upon meeting. They engage in bargaining to determine the wage and to decide if they will accept the match or not. The flow utility of an unemployed worker who enters private sector employment is characterised by the wage $w_{up}(x, h, k)$. The flow utility of a self-employed worker who enters the private sector is characterised by the wage $w_{sp}(x, x_s, h, k)$.

For each posted vacancy, the public sector meets job seekers at the same rate as private firms. We assume that upon meeting job seekers, the public sector observes a productivity draw associated

with the match x_ω. This productivity draw corresponds to an individual offer ω. The public sector productivity distribution remains unobserved to us, and we refrain from parameterising the public-sector wage schedule. We thus denote the distribution of wage offers given by $F_{(\Omega|h)}(.|h)$.[24] We allow for the public sector to reject a match if the productivity draw of the individual is below an exogenous value determined by the public sector. That is, for a job seeker of education level h, there exists a public-sector reservation wage rule ω_h such that matches producing $\omega < \underline{\omega}_h$ are rejected. This minimum wage rule may be higher than the worker's reservation wage, which creates rationing of public-sector jobs.

In each sector, jobs are exogenously destroyed at a rate $\delta_j(h)$, which depends on the education level.[25]

3.4 Value functions

3.4.1 The worker's problem

The present value of unemployment $V_U(h,k)$ is defined by the following Bellman equation:

$$\begin{aligned} rV_U(h,k) &= b(h,k) + \lambda_{up}(k)\mathbb{E}_{F_{(X|h)}} \max\{V_{up}(x,h,k) - V_U(h,k), 0\} \\ &\quad +\lambda_{ug}(k)\mathbb{E}_{F_{(\Omega|h)}} \max\{V_{ug}(\omega,h,k) - V_U(h,k), 0\} \\ &\quad +\lambda_{us}\mathbb{E}_{F_{(X_s|h)}} \max\{V_{us}(x_s,h,k) - V_U(h,k), 0\} \end{aligned} \tag{7}$$

Offers arrive from the private and public sectors at rates $\lambda_{up}(k)$ and $\lambda_{ug}(k)$, respectively, while self-employment opportunities arrive at rate λ_{us}. The option values created by the contact with each sector have similar structures. The contact with a private firm is characterised by a productivity draw x. In this case, agents bargain over wages and decide if they will accept the job or not. A contact with the public sector is characterised by a wage draw, and the match is consumed if the draw is larger than agents' reservation values (characterised below). Finally, each business idea an unemployed worker has comes with a self-employment income draw. The self-employment opportunity is accepted if the draw is larger than the worker's self-employment reservation wage (also characterised below).

A similar value function defines a self-employed worker:

$$\begin{aligned} rV_{us}(x_s,h,k) &= x_s + \delta_s(h)\left(V_U(h,k) - V_{us}(x_s,h,k)\right) \\ &\quad +\lambda_{sp}(k)\mathbb{E}_{F_{(X|h)}} \max\{V_{sp}(x,x_s,h,k) - V_{us}(x_s,h,k), 0\} \\ &\quad +\lambda_{sg}(k)\mathbb{E}_{F_{(\Omega|h)}} \max\{V_{sg}(\omega,h,k) - V_{us}(x_s,h,k), 0\} \end{aligned} \tag{8}$$

The worker receives a flow value from the instantaneous self-employment income x_s. The next term characterises the loss of value the worker would incur if he were to transit into unemployment.

[24] For example, Albrecht et al. (2019) parameterise the public-sector wage schedule. This allows them to quantify public wage premia and analyse productivity in the public sector.

[25] We assume that parental background does not affect destruction shocks. This is in line with our interpretation of parental background as opening more connections to potential employers in the public and private sectors. Once a labour relationship is established, the agent no longer benefits from these connections.

Finally, the self-employed worker derives an option value from searching in the private and public sectors.

Two Bellman equations define the present value of employment in the private sector of a worker transiting out of unemployment or self-employment, given a previous income in self-employment of x_s.

$$rV_{up}(x,h,k) = w_{up}(x,h,k) + \delta_p(h)\left(V_U(h,k) - V_{up}(x,h,k)\right) \quad (9)$$

$$rV_{sp}(x,x_s,h,k) = w_{sp}(x,x_s,h,k) + \delta_p(h)\left(V_U(h,k) - V_{sp}(x,x_s,h,k)\right) \quad (10)$$

The value of employment in the private depends on whether the worker was unemployed (Equation 9) or self-employed (Equation 10) in the previous spell. Given that firms and workers bargain over wages w_p, a previously self-employed individual may command a different wage from an unemployed worker because his outside option in the bargaining process was different. If employees receive a termination shock characterised by $\delta_p(h)$, they return to the unemployment state, which is reflected in the last term on the right-hand side of each equation.

Analogous Bellman equations define the present value of employment in the public sector:

$$rV_{ug}(\omega,h,k) = \omega + \delta_g(h)\left(V_U(h,k) - V_{ug}(\omega,h,k)\right) \quad (11)$$

$$rV_{sg}(\omega,h,k) = \omega + \delta_g(h)\left(V_U(h,k) - V_{sg}(\omega,h,k)\right) \quad (12)$$

Equations (12) and (11) are identical because there is no bargaining over public wages. As we will show below, workers transiting out of self-employment have a different reservation wage to enter the public sector from unemployed workers, affecting the rate of taking up a public sector offer.

3.4.2 The firm's problem

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

$$\begin{aligned} rV = & -c + q(\kappa)\frac{n_u(0)}{I}\mathbb{E}_{F_{(X,H|0)}}\max\{J_u(x,h,0) - V, 0\} \\ & + q(\kappa)\frac{\zeta n_u(1)}{I}\mathbb{E}_{F_{(X,H|1)}}\max\{J_u(x,h,1) - V, 0\} \\ & + q(\kappa)\frac{\psi n_s(0)}{I}\mathbb{E}_{F_{(X,X_s,H|0)}}\max\{J_s(x,x_s,h,0) - V, 0\} \\ & + q(\kappa)\frac{\psi\zeta n_s(1)}{I}\mathbb{E}_{F_{(X,X_s,H|1)}}\max\{J_s(x,x_s,h,1) - V, 0\} \end{aligned} \quad (13)$$

The flow cost of keeping a vacancy open is denoted by c. Contact with a searching worker (unemployed or self-employed) occurs at rate $q(\kappa)$, which will be determined in equilibrium. Firms do not direct their search, and hence, they must form expectations over the joint distribution of match-specific productivity shocks x and education h among unemployed and self-employed workers of different backgrounds $k \in \{0,1\}$. Because search efficiency varies across workers in different labour market states and by parental background, the firm must take this into account

by weighting each type of worker accordingly. Each line in Equation 13 refers to a different type of worker, with the first two lines referring to jobs filled by unemployed workers and the last two lines to jobs filled by self-employed workers.

If the employer meets an unemployed worker of education h and background k, he decides whether to hire him or keep the vacancy open. This is reflected by the term $\max\{J_u(x,h,k)-V,0\}$, where $J_u(x,h,k)$ defines the present value associated with a job filled by this worker. The behaviour of the employer is similar when he meets a self-employed worker, except that he takes into account the worker's current self-employment income x_s, which affects the worker's outside option. Therefore, the firm forms expectations over the joint distribution $\mathbb{E}_{F_{(X,X_s,H|k)}}$.

The flow value of a filled job depends on the type of employee the firm meets and is given by:

$$rJ_u(x,h,k) = x - w_{up}(x,h,k) - \delta_p(h)J_u(x,h,k) \quad (14)$$

$$rJ_s(x,x_s,h,k) = x - w_{sp}(x,x_s,h,k) - \delta_p(h)J_s(x,x_s,h,k) \quad (15)$$

This represents the surplus a private firm makes, that is, the difference between the match-specific productivity shocks and the wage the firm must pay. The last term is the loss incurred when the job is terminated.

3.5 The public sector's decisions

In our setting, the public sector's labour demand decision is taken as given and is governed by the following three policy dimensions. First, the public sector decides on a fixed amount of vacancies v_g to post (Albrecht et al. (2019)). The public sector then meets unemployed and self-employed searchers at the same rate as private firms, that is, $q(\kappa)$. Like private firms and workers, the public sector cannot direct its search. Secondly, wages in the public sector are determined by an exogenous continuous wage offer distribution $F_{(\Omega|h)}(.|h)$ that is under the control of the public sector (Bradley et al. (2017)). Finally, the public sector can stipulate an education-specific minimum wage rule $\underline{\omega}_h$ that only applies to the public sector.[26] The public sector thus only hires workers of education level h if $\omega \geq \underline{\omega}_h$. This minimum wage rule can create rationing of public sector jobs, as some potential employees would have been willing to work for a lower wage.

All three dimensions of the public sector's labour demand decision can potentially distort the labour market equilibrium and result in educated unemployment.

3.6 Labour market equilibrium

The labour market equilibrium objects are the reservation wage schedules, $R_{up}(h,k)$, $R_{ug}(h,k)$, $R_{us}(h,k)$ and $R_{sp}(x_s,h,k)$, the labour market tightness, κ, and the fraction of vacancy postings from the private sector, ϕ (see Albrecht et al. (2019)).[27] For the details of the derivation, see

[26] In our data, the official (general) minimum wage rule does not appear to be binding in the private sector. A non-negligible share of wages paid in the private (formal) sector is lower than the official minimum wage.

[27] The reservation wage $R_{up}(h,k)$ is defined as the productivity for which an unemployed worker and the employer are indifferent between consummating the match and not consummating. At this point, the productivity equals

Appendix B.

First, we characterise the reservation wage schedules. We assume that wages in the private sector are determined by Nash bargaining. The worker's bargaining power is given by β. The worker bargains with the present value of unemployment or self-employment as an outside option, while the firm's surplus is the value of a filled job. Assuming a free-entry condition for private-sector vacancies

$$V = 0, \tag{16}$$

we show that the wage schedules in the private sector conditional on the worker's past labour market status are determined by the following equations:

$$w_{up}(x,h,k) = \beta x + (1-\beta) R_{up}(h,k) \tag{17}$$

$$w_{sp}(x,x_s,h,k) = \beta x + (1-\beta) R_{sp}(x_s,h,k) \tag{18}$$

The first component of the wage rule of a worker in a private firm who was previously self-employed is identical to the wage rule of a worker who was unemployed and corresponds to a fixed share of the match productivity. However, the previously self-employed worker additionally receives a fraction of the value of the surplus from self-employment, compared to unemployment (Equation (18)).

The reservation wage schedules for an unemployed worker are characterised by the following equations:

$$\begin{aligned} R_{up}(h,k) = {} & b(h,k) + \frac{\lambda_{up}(k)\beta}{r+\delta_p(h)} \int_{R_{up}(h,k)} [x - R_{up}(h,k)] \; dF_{(X|h)}(x|h) \\ & + \frac{\lambda_{ug}(k)}{r+\delta_g(h)} \int_{R_{ug}(h,k)} [\omega - R_{up}(h,k)] \; dF_{(\Omega|h)}(\omega|h) \\ & + \frac{\lambda_s}{r+\delta_p(h)} \int_{R_{us}(h,k)} [R_{sp}(x_s,h,k) - R_{up}(h,k)] \; dF_{(X_s|h)}(x_s|h) \end{aligned} \tag{19}$$

$$\tilde{R}_{ug}(h,k) = R_{up}(h,k) \tag{20}$$

$$R_{ug}(h,k) = \max(\tilde{R}_{ug}(h,k), \underline{\omega}_h) \tag{21}$$

$$\begin{aligned} R_{us}(h,k) = {} & R_{up}(h,k) - \frac{\lambda_{sp}(k)\beta}{r+\delta_p(h)} \int_{R_{up}(h,k)} [x - R_{up}(h,k)] \; dF_{(X|h)}(x|h) \\ & - \frac{\lambda_{sg}(k)}{r+\delta_g(h)} \int_{R_{sg}(R_{us}(h,k),h,k)} [\omega - R_{up}(h,k)] \; dF_{(\Omega|h)}(\omega|h) \end{aligned} \tag{22}$$

The reservation wage schedule for an unemployed worker considering entering the private sector is given by Equation (19). This is equal to his public-sector reservation wage (Equation (20)). However, a match between a potential employee and the public sector is only consummated if

the wage, and thus, the match surplus is equal to 0. The reservation wage $R_{sp}(x_s,h,k)$ gives the wage for which a self-employed worker with self-employment income x_s and the employer are indifferent between matching and not matching. The reservation wage $R_{jg}(h,k)$ is defined as the maximum between the wage for which the worker of current labour status j is indifferent between consummating the match and not consummating, and the public-sector minimum wage rule. The reservation self-employment income $R_{us}(h,k)$ is defined as the income for which the unemployed worker is indifferent between undertaking the self-employment opportunity and not undertaking it. For conciseness of exposition, we use the term 'reservation wage schedules' in all cases.

both the worker and the public sector are at least indifferent between forming a match and not (Equation (21)). Note that the reservation wage for self-employment (Equation (22)) is lower than the private-sector reservation wage (Equation (23)) because it accounts for the possible transition to a public or private job in the future.

The reservation wage schedules for a self-employed worker are characterised by the following equations:

$$\begin{aligned} R_{sp}(x_s,h,k) &= R_{up}(h,k)+\frac{r+\delta_p(h)}{r+\delta_s(h)}\left(x_s-R_{up}(h,k)\right) \\ &\quad +\frac{\lambda_{ps}(k)\beta}{r+\delta_s(h)}\int_{R_{sp}(x_s,h,k)}\left[x-R_{sp}(x_s,h,k)\right]\ dF_{(X|h)}(x|h) \\ &\quad +\frac{r+\delta_p(h)}{r+\delta_s(h)}\frac{\lambda_{gs}(k)}{r+\delta_g(h)}\int_{R_{sg}(x_s,h,k)}\left[\omega-R_{up}(h,k)\right]\ dF_{(\Omega|h)}(\omega|h) \\ &\quad -\frac{\lambda_{gs}(k)}{r+\delta_s(h)}\left(1-F_{(\Omega|h)}(R_{sg}(x_s,h,k)|h)\right)\left(R_{sp}(x_s,h,k)-R_{up}(h,k)\right) \quad (23) \\ \tilde{R}_{sg}(x_s,h,k) &= R_{up}(h,k)+\frac{r+\delta_g(h)}{r+\delta_p(h)}\left[R_{sp}(x_s,h,k)-R_{up}(h,k)\right] \quad (24) \\ R_{sg}(x_s,h,k) &= \max\left(\tilde{R}_{sg}(x_s,h,k),\underline{\omega}_h\right) \quad (25) \end{aligned}$$

The reservation wage of transitioning from self-employment to private-sector employment depends on the current self-employment income x_s (Equation (23)). The higher the current income, the higher the reservation wage. Moreover, the agent also takes into account the different job destruction rates in self-employment and the private sector and thus, the probability of becoming unemployed. The worker's reservation wage in the public sector is then adjusted in a similar fashion (Equation (24)).

The next step is to characterise labour market tightness κ. To do so, we use the free-entry condition for private-sector vacancies and steady-state conditions for worker flows into and out of each sector. Equations (13), (14), (15) and the free-entry condition (16) give:

$$\begin{aligned} c &= \frac{q(\kappa)}{I}\sum_{h=0}^{4}\Bigg\{P(h|0)\int_{R_{up}(h,0)}\frac{1-\beta}{r+\delta_p(h)}n_u(h,0)(x-R_{up}(h,0))dF_{(X|h)}(x|h) \quad (26) \\ &\quad +\zeta P(h|1)\int_{R_{up}(h,1)}\frac{1-\beta}{r+\delta_p(h)}n_u(h,1)(x-R_{up}(h,1))dF_{(X|h)}(x|h) \\ &\quad +\psi P(h|0)\int_{R_{us}(h,0)}\int_{R_{sp}(x_s,h,0)}\frac{1-\beta}{r+\delta_p(h)}n_s(h,0)(x-R_{sp}(x_s,h,0))dF_{(X|h)}(x|h)dF_{(X_s|h)}(x_s|h) \\ &\quad +\psi\zeta P(h|1)\int_{R_{us}(h,1)}\int_{R_{sp}(x_s,h,1)}\frac{1-\beta}{r+\delta_p(h)}n_s(h,1)(x-R_{sp}(x_s,h,1))dF_{(X|h)}(x|h)dF_{(X_s|h)}(x_s|h)\Bigg\} \end{aligned}$$

where $P(h|k)$ is the proportion with education level h among agents with parental background k. In the above equation, the unknowns $n_u(h,k)$ and $n_s(h,k)$ are characterised by the steady-state conditions for all h and k where flows into unemployment from each sector (LHS) equal the flows

out of unemployment into each sector (RHS):

$$\begin{aligned}
\delta_p(h)n_p(h,k) &= \lambda_{up}(k)\left[1-F_{(X|h)}(R_{up}(h,k)|h)\right]n_u(h,k) \\
&\quad +\lambda_{sp}(k)\int_{R_{us}(h,k)}\left[1-F_{(X|h)}(R_{sp}(x_s,h,k)|h)\right]dF_{(X_s|h)}(x_s|h)n_s(h,k) \quad (27)\\
\delta_g(h)n_g(h,k) &= \lambda_{ug}(k)\left[1-F_{(\Omega|h)}(R_{ug}(h,k)|h)\right]n_u(h,k) \\
&\quad +\lambda_{sg}(k)\int_{R_{us}(h,k)}\left[1-F_{(\Omega|h)}(R_{sg}(x_s,h,k)|h)\right]dF_{(X_s|h)}(x_s|h)n_s(h,k) \quad (28)\\
\delta_s(h)n_s(h,k) &= \lambda_{us}\left[1-F_{(X_s|h)}(R_{us}(h,k)|h)\right]n_u(h,k) \\
&\quad -\lambda_{sp}(k)\int_{R_{us}(h,k)}\left[1-F_{(X|h)}(R_{sp}(x_s,h,k)|h)\right]dF_{(X_s|h)}(x_s|h)n_s(h,k) \\
&\quad -\lambda_{sg}(k)\int_{R_{us}(h,k)}\left[1-F_{(\Omega|h)}(R_{sg}(x_s,h,k)|h)\right]dF_{(X_s|h)}(x_s|h)n_s(h,k) \quad (29)
\end{aligned}$$

and

$$n_p(h,k)+n_g(h,k)+n_s(h,k)+n_u(h,k)=1. \quad (30)$$

Finally, we characterise the fraction of vacancy postings that are accounted for by the private sector, ϕ, by noting that:

$$\phi=\left(\frac{I}{\kappa}-v_g\right)/\frac{I}{\kappa}. \quad (31)$$

The definition of equilibrium is very similar to the one of Albrecht et al. (2019), and the proof of existence follows from theirs.

Definition 1. *A steady-state equilibrium consists of functions $R_{up}(h,k)$, $R_{us}(h,k)$ and $R_{sp}(x_s,h,k)$ that satisfy (19), (22), and (23) for all (x_s,h,k), and together with scalars κ and ϕ that satisfy (26), (27) -(28) and (31).*

In what follows, we assume that the labour market is in steady-state equilibrium.

4 Identification and estimation

We estimate our model using the 1-2-3 Survey data described in Section 3. Our sample of interest is men in the labour force who are aged between 18 and 64 years. We consider five discrete levels of education h ranging from 0 to 4: no education, primary, lower secondary, upper secondary and tertiary education. We also distinguish two levels of parental background h, where $h=1$ stands for a worker whose father was employed in the formal sector and 0 otherwise. The distribution of educational attainment conditional on parental background, that is, $F_{(H|k)}(.|k)$, is thus discrete. The share of each type of worker can directly be computed from the data. Each worker is in one of four mutually exclusive labour market states: unemployment, employment in the public sector, employment in the private sector or self-employment. For each country and education level, we trim the income distribution and treat data as missing if an income observation is below the 1st or above the 99th percentile.[28]

[28] For some workers, we only observe the income bracket but not income itself. We impute the income for these workers using the results of a regression of log-income on age, age-squared, education level-dummies, migration status, parental background, sector of employment and firm size for each country-income bracket. This results

4.1 Identification

We estimate the model by the method of simulated moments (MSM). We target a set of moments to identify the structural parameters of our model. These moments include static and dynamic moments by education and parental background on wages, unemployment rates, and sectoral shares. Moreover, we target the education-parental background composition of each sector, employment duration in all three sectors and 3-year education-specific transition rates between labour market states. Table 2 summarises the parameters to be estimated (column 1) and the corresponding moments used to identify them (column 2). Column 3 gives the number of moments. In total, there are 50 parameters (of which four are fixed ex-ante) and 263 moments.

Two key objects to identify are the education-specific wage offer distribution in each sector and the reservation wage schedule in the private sector for each type of worker. The truncated offer distribution relates directly to the observed income distribution. In order to keep the estimation simple, we assume that the wage offer distribution in each sector follows a log-normal distribution as is common in the literature (see Eckstein and Van den Berg (2007)). This boils down to estimating the location $\mu_j(h)$ and scale parameters $\sigma_j(h)$ in each sector j for education level h. We use the mean and standard deviation of observed incomes by education and parental background in each sector to identify these parameters.

The reservation wage in the private sector corresponds to the truncation point in the wage offer distribution. Its empirical counterpart is the observed minimum income (see Flinn and Heckman (1982)). Instead of targeting the observed minimum income (which could be affected by measurement error), we use the lowest percentile of the private income distribution to identify the reservation wage. In the same vein, we use the lowest percentile of the public and self-employment income distributions to identify the respective reservation wages.[29] The difference between the public reservation wage and the private one allows us to pin down the minimum wage rule $\underline{\omega}_h$ in the public sector (if it is binding) and to quantify the degree of rationing. The wedge between the self-employment and reservation wage in the private sector identifies the search efficiency in self-employment ψ.

Finally, we use the full set of corrected 3-year transition rates between all labour market states (by education),[30] as well as sectoral shares and unemployment rates for each type of worker, mean employment duration by sector and the education-parental background composition of each sector to pin down labour market tightness κ, the share of private vacancies ϕ, the arrival rate of self-employment opportunities λ, search efficiency in the public and private sector of workers

in smooth (approximately log-normal) income distributions. We have also experimented with other imputation methods (e.g. mid-point). While the mean estimates are similar across methods, the resulting income distributions from these latter methods are not smooth and often have multiple modes.

[29] For some countries, we only observe few workers within a type (no education-high parental background) for a given sector. In this case, we refrain from targeting the lowest income percentile in this sector.

[30] Due to the nature of our data with exact information about the current labour market spell but incomplete information about the prior labour market spell, the raw 3-year transition rates out of unemployment are upwards biased, leading to an underestimating of the unemployment rate in equilibrium. We correct the transition rates out of unemployment into the three sectors in such a way as to obtain the same equilibrium unemployment rates as observed in the data. The transition rates into each sector conditional on exiting unemployment are kept constant.

Parameter	Moment	#
Income/productivity distribution by sector $F_{x,j,y}$		
Public sector: $\mu_g(h)$, $\sigma_g(h)$	Mean & std. dev. of public income by education and background	20
Private sector: $\mu_p(h)$, $\sigma_p(h)$	Mean & std. dev. of private income by education and background	20
Self-employment: $\mu_s(h)$, $\sigma_s(h)$	Mean & std. dev. of self-employment income by education and background	20
	Mean of public and private income by education conditional on past self-employment	10
Reservation wages, public minimum wage, search efficiency		
Reservation wage private sector: $R_{up}(h,k)$	1st percentile of private income by education and background	10
Public min. wage rule: $\underline{\omega}_h$	1st percentile of public income by education and background	10
Search efficiency in self-employment: ψ	1st percentile of self-employment income by education and background	10
Search efficiency with high parental background: ζ	same as above and sectoral shares by background as below	
Offer arrival and destruction rates		
Self-employment arrival rate: λ_s	Share of self-employment by education and background	10
Labour market tightness: κ	Share of public sector by education and background	10
Share of private vacancies: ϕ	Share of private sector by education and background	10
Destruction rates: $\delta_j(h)$	Mean employment duration by sector	3
	Unemployment rate by education and background	10
All above	Corrected 3-year transition rates by education	80
	Educational-background composition of each sector	40
Calibrated parameters		
Interest rate: $r = 0.10$		
Bargaining power worker: $\beta = 0.5$		
Matching elasticity: $\eta = 0.5$		
Matching efficiency: $A = 0.1$		
	Total moments	263

Notes: For workers for whom we only observe the income bracket but not the income, we impute the income (see main text for details). Three-year transition rates are corrected so that the resulting steady-state unemployment rates correspond to the observed unemployment rates (see main text for details).

Table 2: Model parameters and corresponding moments (by country)

with a high parental background ζ, and the education-specific destruction rates in each sector $\delta_j(h)$.

Some parameters, like the cost of vacancy posting c, the flow value of unemployment $b(h,k)$ and public vacancy posting v_g, are not directly estimated. They can be backed out from the equilibrium conditions and the parameters estimated above. Finally, there are some parameters that cannot be identified from our data. We set the interest rate $r = 0.1$, the bargaining power of workers $\beta = 0.5$, the matching elasticity $\eta = 0.5$ and the matching efficiency $A = 0.1$.[31]

4.2 Estimation and simulation protocol

In a first step of the estimation, we numerically solve the model given an initial set of parameters. To do so, we discretise the self-employment income distribution of x_s, produce the reservation wages (i.e. decision rules) in all sectors and ensure that the labour market clearing conditions hold. In a second step, we use the reservation wages and equilibrium conditions to simulate labour market outcomes (i.e. labour market status, wage and speel duration) for three spells of a set of simulated individuals. In total, we simulate 60,000 individuals per education-parental background type.[32] Hereby, we produce a simulated data set. In a third step, we construct the moments from the simulated data set and compare them to their empirical counterparts. For the static moments, we use the initial labour market status and wage. For the transition rates, we compare the initial labour market status and the labour market status three years later. Finally, using the Nelder–Mead algorithm, these three steps are repeated with different sets of parameters until the quadratic loss function is minimised. The optimal parameter estimate $\hat{\theta}_{MSM}$ solves:

$$\hat{\theta}_{MSM} \quad = \quad \arg\min \left(\hat{\mu}(\theta) - \hat{m}\right)' W \left(\hat{\mu}(\theta) - \hat{m}\right) \tag{32}$$

where $\hat{m}$ is the vector of empirical moments (i.e. the sample estimate of the unknown population moments), $\hat{\mu}(\theta)$ are the simulated moments that are an estimate of the model's true unconditional moments $\mu(\theta)$, and W is the weighting matrix. We employ a diagonal weighting matrix where the inverse elements are the estimated variance of the empirical moments.[33] In order to achieve a good fit on our main target, the unemployment rates, we increase the weight given to these moments by a factor of ten.

[31] Few studies aim to estimate or calibrate the bargaining power and matching function parameters for Sub-Saharan African countries. We set them to conventional values. Rud and Trapeznikova (2021) estimate the bargaining worker and matching efficiency for several countries in Sub-Saharan Africa. Their findings indicate a bargaining power parameter between 11% and 27% and a matching efficiency of less than 1%. Given their focus on matching national labour market moments, comprising both urban and rural areas, we calibrate the corresponding parameters for our urban sample at somewhat higher values. The absolute value of these parameters is not relevant for the results and analyses we present in the following sections. For example, if we set the bargaining power of workers to 0.2 instead of 0.5, the parameters of the private wage offer distributions would change. However, the resulting wage offers and accepted wages – of which we target the latter directly – would still be approximately the same.

[32] For moments that are aggregated over all education levels and parental backgrounds, we re-weight the different types of workers by their observed shares $F_{(H|k)}(.|k)$ in the population (see Table C.1 in Appendix C.)

[33] Some variances, like the ones of the standard deviation of income and the first income percentile, are bootstrapped.

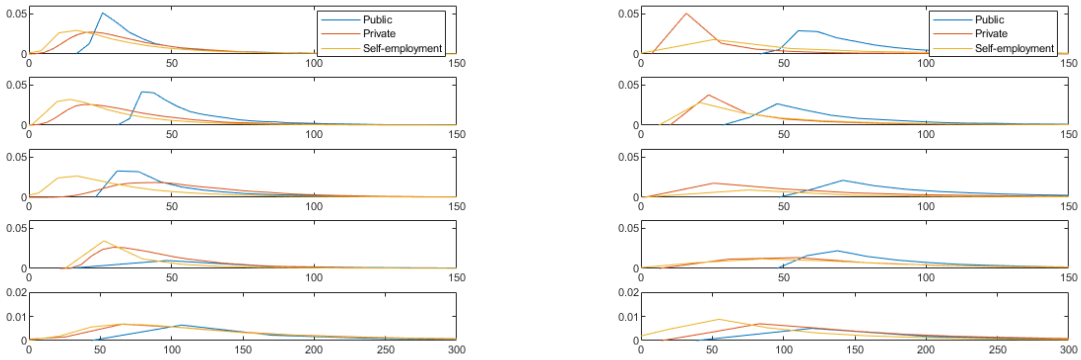
5 Estimation results of the model

5.1 Estimation results

In our estimation, we focus on the capital cities of Burkina Faso (Ouagadougou) and Senegal (Dakar). These two locations represent two typical but different cases in the UEMOA. At the time of the survey, in 2001, Senegal had the second highest GNI per person of the sampled countries after Côte d'Ivoire[34], while the other five countries in the sample were less developed, with Burkina Faso being in the intermediate position in this second group. In what follows, we discuss the main patterns of our estimation results and highlight key differences between a low-income (i.e. Burkina Faso) and a lower-middle-income country (i.e. Senegal). Tables C.1 to C.6 in Appendix C present the full estimation results for the capitals of Burkina Faso and Senegal. We discuss the most important parameters related to wages, job arrival and destruction, and search efficiency in the following sections.

5.1.1 Reservation wage, public minimum wage rule and and wages

To facilitate the interpretation and comparison of the estimated parameters related to wages, Figure 5 plots kernel density estimates of the accepted wage distributions across sectors by education (from 'no education' in the top panel to 'tertiary education' in the bottom panel) for Burkina Faso (left column) and Senegal (right column).



(a) Burkina Faso (b) Senegal

Notes: The figures show the estimated kernel density of accepted wages across sectors by education. The five education levels shown in rows are: no education, primary, lower secondary, higher secondary, tertiary. The x-axis shows the wage level in 1,000 CFA/month. The bottom panel (for tertiary education) has different scaling for the x- and y-axes. The panels in the left column refer to Burkina Faso, and the panels in the right column to Senegal.
Source: Authors' calculations.

Figure 5: Estimated accepted wage distribution by education (kernel density)

The lower bound of accepted wages in the private sector (orange line) corresponds to the reservation wage $R_{up}(h,k)$ (see Table C.2 in the Appendix for all estimated reservation wages and the minimum public wage rule). The reservation wage is convex in education in both countries. It stands at around 4,000 CFA/month in Burkina and 13,000 CFA/month in Senegal for workers without any education and goes up to more than 40,000 CFA/month for workers with tertiary

[34] Côte d'Ivoire was undergoing a turbulant phase at the moment of the survey. It experienced a military coup in 1999, a constitutional reform in 2000 and two civil wars from 2002 to 2007 and from 2010 to 2011.

education. For most types of workers, the reservation wage is considerably lower than the official minimum wage, which at the time stood at 27,080 CFA/month and 39,000 CFA/month in Burkina Faso and Senegal, respectively.

In the public sector, the estimated public minimum wage rule hovers around the official minimum wage in Burkina Faso for education levels below tertiary, while it is slightly higher than the official minimum wage in Senegal. Given that the worker's reservation wage is much lower than the official minimum wage – and hence, the estimated public minimum wage rule – this indicates that public sector jobs are highly rationed. Many unemployed workers would be willing to work in the public sector for a fraction of what it currently pays if only they could land a job there. Public sector job rationing is an important source of distortions in West African labour markets (see Duflo et al. (2021)).

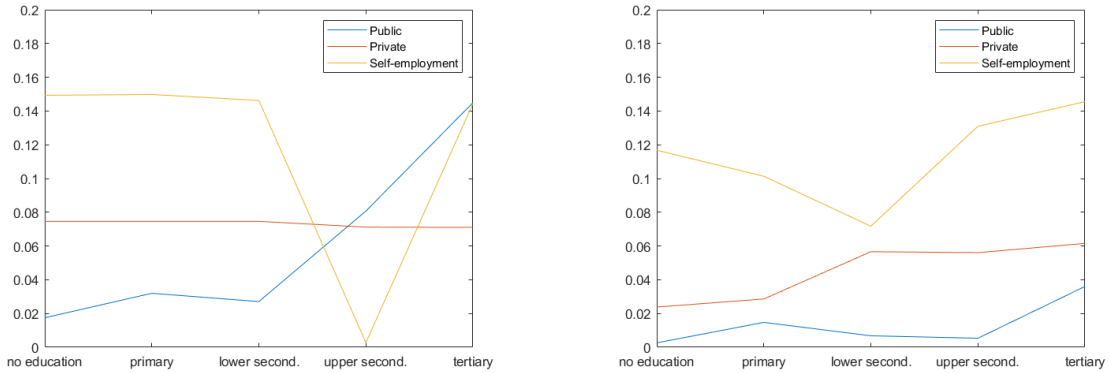
Another distinctive feature of the public sector, already mentioned as a stylized fact, is the large wage premia paid compared to the other sectors. In both countries and for most education levels, we observe a significant shift to the right of the public wage distribution (blue lines) with respect to the private sector and self-employment wages (orange and yellow lines, respectively). It is important to note that although the *accepted wage* distribution in the public sector often dominates the *accepted wage* distribution in the private sector, the private *wage offer* distribution dominates the public *wage offer* distribution for both countries and education levels. The reversal is explained by the fact that a significant proportion of matches between workers and the public sector is discarded because of the high minimum wage rule. Hence, the apparent wage premium in the public sector is not the result of higher productivity but of rationing. We will return to this in Section 6.

5.1.2 Arrival and destruction rates

The yearly offer arrival rates in all three sectors are low. A worker in Burkina Faso receives per year on average 0.72 offers from the public/private sector and 0.21 self-employment offers. The corresponding numbers in Senegal are 0.17 and 0.15, respectively. A considerable share of formal vacancies are posted in the public sector. The share of private jobs among all formal vacancies is estimated to be 6% in Burkina Faso and 36% in Senegal. This is much lower than the estimate of 93% reported for Colombia (see Albrecht et al. (2019)). One crucial factor for the low vacancies posted by firms seem to be the high vacancy posting costs faced by the private sector. They amount to between 10% and 30% of the average income of workers with primary education and less in the private sector in Burkina Faso and Senegal, respectively.

While ex-ante offer arrival rates are assumed to be constant across education levels, ex-post transition rates into different sectors depend on the likelihood of a match exceeding the reservation wage or the public minimum wage rule. Figure 6 shows ex-post arrival rates by education across sectors and countries for unemployed workers with low parental background.

These figures illustrate that *ex-post* arrival rates can be quite different from ex-ante arrival



(a) Burkina Faso (b) Senegal

Notes: The figures show the estimated ex-post offer arrival rates by education across sectors and countries for workers with low parental background. The left figure refers to Burkina Faso; the figure on the right refers to Senegal.
Source: Authors' calculations.

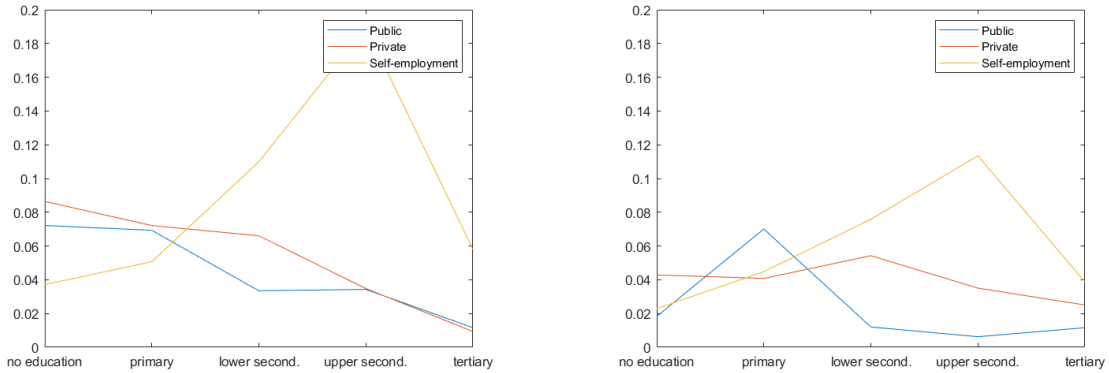
Figure 6: Ex-post sectoral offer arrival rates by education – low parental background

rates, in particular in the public sector where we find a sharply increasing gradient along the education level. Moreover, acceptable self-employment opportunities arrive with the highest likelihood for almost all education levels (except for workers with upper secondary education in Burkina Faso). Many unemployed workers do not receive a single work offer within a year, leading to long unemployment spells.

While self-employed workers continue to receive job offers from the public and private sector, their search efficiency is estimated to be fairly low at 10% in Burkina Faso and 36% in Senegal. Self-employment is thus not an absorbing state but almost so. Searching for a formal job is costly, both financially and time-wise. Given that self-employed workers often work full-time, their low search efficiency seems natural. Workers whose father worked in the public or private sector also exhibit a reduced search efficiency at 50% (Burkina Faso) and 75% (Senegal), respectively, compared to those with a less privileged background. While surprising at first sight, the finding could capture a lower search effort made by workers from a more privileged parental background.

To understand the pronounced sectoral sorting of heterogeneous workers, we must also inspect how the likelihood of workers' losing their job varies across sectors and education levels. Figure 7 presents the yearly destruction rates for Burkina Faso (left panel) and Senegal (right).

Mirroring low job arrival rates, destruction rates are also fairly low in all sectors and below 10% for most education levels. Destruction rates generally decrease with education in the public and private sector, reflecting that higher education not only offers positive wage returns but also higher job stability. For example, a worker without any education in Burkina Faso risks losing his public-sector job within a year with a likelihood of 7%, while the probability drops to 1% for someone with tertiary education. In self-employment, in contrast, the destruction rate is hump-shaped in education, peaking at (lower or upper) secondary education. Taken together, workers at the extremes of the education distribution sort into a sector with relatively low job destruction (self-employment for those with low education, the public sector and private sector



(a) Burkina Faso (b) Senegal

Notes: The figures show the estimated job destruction rates by education and across sectors for Burkina Faso (left) and Senegal (right).
Source: Authors' calculations.

Figure 7: Estimated sector-specific job destruction rates by education

for those with tertiary education), while those with intermediate education face a relatively high average job destruction across different sectors.

Overall, our estimation results offer the following key take-away. The sectoral allocation of workers is not only determined by the highest mean wage in a sector, but it also depends on labour market distortions and differential job destruction. All three sectors differ greatly in their wage structure, and offer arrival and job destruction for workers with different education levels. Differences along parental background (conditional on education), however, are only secondary.

5.2 Goodness of fit

Figures D.1 to D.15 and tables D.1 to D.2 in Appendix D show how well our estimated model fits the data. Overall, the model does a good job in matching the data. Most simulated moments are not statistically different from the data moments at the 5% significance level.

Our model matches the key moments of unemployment rates by education and parental background very well. Unemployment rates for workers with low parental background are very precisely matched, while the fit of unemployment rates for workers with high parental background is (only) good. Given that this latter group of workers is much smaller, the data moments are less precisely estimated, and thus, they receive a lower weight in the estimation procedure. This fact explains why our model generally matches the low-parental-background moments better than moments related to high-parental-background workers.

Overall, the simulated moments also match the observed wage distribution moments (mean, standard deviation) well across sectors and education levels. The model somewhat underpredicts mean wages but overpredicts the lowest percentile of wages in the public sector in Burkina Faso and Senegal, in particular for low-background workers. As a consequence, our estimate of the distortionary effect of the public wage distribution in Section 6 should be interpreted as a lower bound of the true effect, while our estimate of the distortionary effect of the public minimum

wage rule should be interpreted as an upper bound of the true effect.

Our model fits the worker composition (by education and parental background) of each sector and unemployment extremely well. The sectoral shares are fairly well matched, except for the model's overprediction of high-parental-background workers in self-employment (rather than in unemployment) both in Burkina Faso and Senegal. In terms of labour market dynamics, our model matches the very long mean duration in the private sector but overpredicts by around 10% the duration length in the public sector and self-employment. Our model also reproduces the broad transition patterns between labour market sectors and status over time by education, except that transitioning into unemployment is generally overestimated.[35]

6 How distortionary is the public sector?

On the labour market, the public sector operates differently from the private sector. The resulting interaction imposes some externalities on the private sector and can distort the market equilibrium. We identify three distinctive features of the public sector: first, the public wage offer distribution is different from the private wage offer distribution. This alters workers' outside option and reservation wage. The private sector, in turn, reacts by adjusting wages and vacancy postings. Second, a minimum wage rule in the public sector that lies above the workers' reservation wage rations public sector jobs: it prevents matches between workers and the public sector being formed, even though the worker would want to work at a given wage. Third, by posting (many) public vacancies exogenously, the public sector potentially crowds out the private sector via the typical congestion externality present in a frictional matching environment. This last channel is at work even if public sector wage offers are identical to private sector offers, and there is no public minimum wage rule.[36]

To understand the distortionary impact of the public sector, we simulate key labour market outcomes in three different policy scenarios and compare them with the baseline. In scenario (1), we align the public wage offer distribution with the private wage offer distribution for each education level. In our estimated baseline, the private *wage offer* distribution dominates the public *wage offer* distribution. The simulation thus shifts the public wage offer distribution to the right and is interpreted as making the public sector more productive. In scenario (2), we remove the public minimum wage rule, making the public sector less likely to reject a match with a worker. This is interpreted as making the public sector less selective in its hiring. We also report the outcome when the first two scenarios are combined, (1) + (2), resulting in public wages perfectly mirroring private wages. For these two scenarios, we show the results both when keeping the number of public vacancies fixed and when keeping the public wage bill fixed. Finally, in scenario (4), we reduce public sector vacancy creation by 99%. This corresponds to (almost) shutting down the public sector and eliminating its distortions altogether.

[35] The duration and transition moments use different variables from our data set, and our model abstracts from employment–employment transitions, other than out of self-employment. Hence, it is possible that our model overpredicts the duration of employment spells and entry into unemployment at the same time.

[36] We also investigate differential lay off by education group as a fourth distinctive feature. This is not quantitatively important. See Table 3, scenario (3), Column (viii).

The presence of the public sector differentially affects unemployment, worker sorting into sectors, and workers' welfare overall and by education level. To quantify the extent of educated unemployment, we define the following statistic:

$$EdU := \sum_{(h,k)} P(h,k) \left(U_h - \min \left\{ U_{\tilde{h}} : \tilde{h} < h \right\} \right). \tag{33}$$

It measures the excess unemployment in higher levels of education relative to the baseline level of education, that is, no education. We also define overall workers' welfare as a weighted sum of (ex-post) welfare of different types of workers in different labour market states:

$$\begin{aligned} W &= \sum_{h,k} Prob(h,k) \left[u(h,k) r V_u(h,k) + n_{ug}(h,k) \left(\int_{R_{ug}(h,k)}^{\infty} r V_{ug}(\omega,h,k)\, dF(\omega|G,h,k) \right) \right. \\ &+ n_{up}(h,k) \left(\int_{R_{up}(h,k)}^{\infty} r V_{up}(w,h,k)\, dF(w|P,h,k) \right) \\ &+ n_s(h,k) \left(\int_{R_{us}(h,k)}^{\infty} r V_{us}(x_s,h,k)\, dF(x_s|S,h,k) \right) \\ &+ n_{sg}(h,k) \left(\int_{R_{sg}(h,k)}^{\infty} r V_{sg}(\omega,h,k)\, dF(\omega|\mathrm{SG},h,k) \right) \\ &+ \left. n_{sp}(h,k) \left(\int_{R_{sp}(h,k)}^{\infty} r V_{sp}(w,h,k)\, dF(w|\mathrm{SP},h,k) \right) \right] \\ &= \sum_{h,k} Prob(h,k) W_{(h,k)} \end{aligned} \tag{34}$$

The ex-post value of being employed in each sector depends on whether a worker came from unemployment or self-employment. The values can be computed using the re-arranged equations derived in the Appendix in Equations (49), (50), (55), (56) and (57).

Table 3 presents the results of these simulation scenarios. Consider first scenario (1), where public and private *wage offers* are aligned. If the public sector maintained the same level of vacancies as in the baseline irrespective of the wage bill (column (ii)), it would increase almost fourfold in size, diverting almost all the labour force from the private sector. Indeed, as the meeting between workers and the public sector generates higher quality matches, the minimum wage rule is not binding, and matches are made more often. Reservation wages increase, and the private sector, handicapped by its high cost of hiring, reduces its vacancy opening. Unable to compete with the public sector, it is virtually forced out of the labour market. Unemployment rates fall by 8.4 pp in Burkina Faso and 2.3 pp in Senegal; our measure of educated unemployment declines by two-thirds and one-quarter respectively; workers' welfare surges by 120 % in Burkina Faso and a more modest 29% in Senegal. However, and importantly, the cost of such change appears unsustainable as the public sector wage bill is multiplied by a factor three to five.

In the more realistic case of a fixed wage bill (column (iii)), public vacancy openings dwindle to a mere 8% in Burkina Faso and 24% in Senegal of their respective original size. A match being more likely, the public sector requires fewer vacancy openings. The lower number of public

	Baseline	Align wage offers (1)		No pub. min. wage (2)		Same wages (1) + (2)		Same destr. (3)	No pub. sect. (4)
		v_g fixed	bill fixed	v_g fixed	bill fixed	v_g fixed	bill fixed	v_g fixed	v_g −99%
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Burkina Faso									
Unemployment	16.6%	8.2%	10.1%	10.4%	12.3%	7.7%	9.9%	15.7%	10.2%
Educated unemp.	3.1%	1.0%	0.8%	1.1%	1.4%	0.5%	0.7%	2.9%	0.9%
Public sector	15.9%	65.7%	16.2%	55.7%	34.5%	67.9%	17.5%	15.7%	0.1%
Private sector	12.8%	0.0%	44.3%	0.0%	14.7%	0.0%	43.7%	18.4%	60.4%
Self-employment	54.6%	26.0%	29.4%	33.9%	38.5%	24.3%	28.8%	50.2%	29.2%
Welfare	31.1	68.6	57.8	25.8	31.0	68.9	57.8	33.3	58.9
Public wage bill	12.5	61.0	12.5	17.2	12.5	61.4	12.5	10.2	0.1
Share of prior v_g	1	1	0.08	1	0.62	1	0.08	1	0.1
Senegal									
Unemployment	17.1%	14.9%	15.3%	13.4%	14.7%	12.2%	14.4%	16.9%	15.9%
Educated unemp.	4.7%	3.3%	3.1%	3.8%	4.0%	3.7%	3.2%	4.2%	3.6%
Public sector	11.3%	34.3%	11.1%	40.8%	22.4%	51.4%	17.3%	10.8%	0.1%
Private sector	20.5%	0.0%	28.0%	5.7%	20.7%	0.0%	26.3%	23.1%	39.3%
Self-employment	51.0%	50.8%	45.5%	40.1%	42.1%	36.4%	42.0%	49.2%	44.7%
Welfare	52.8	67.9	63.3	46.2	53.1	68.1	62.8	53.8	60.9
Public wage bill	13.0	39.0	13.0	20.3	13.0	39.6	13.0	10.7	0.1
Share of prior v_g	1	1	0.24	1	0.65	1	0.22	1	0.01

Notes: The table shows some key labour market statistics for the baseline estimation and several simulation scenarios. Simulation scenario (1) aligns the public wage offer distribution to the private wage offer distribution (i.e. the offer distribution prior to acceptance). Simulation scenario (2) removes the public minimum wage rule. The next simulation scenario combines (1) and (2), resulting in aligned public and private wages (i.e. identical ex-post wages). For each of these scenarios, we provide the statistics when keeping the number of public vacancies fixed (left column) and when keeping the public wage bill fixed (right column). Simulation scenario (3) eliminates the differential job destruction in the public sector and sets it to the mean value. Simulation scenario (4) reduces public vacancy posting by 99%, resulting in (almost) eliminating the public sector and its distortions. The public sector wage bill is calculated as in Equation (35).

Table 3: Channels of public sector distortions

vacancy openings keeps reservation wages and the congestion externality under control. This, in turn, allows the private sector to expand, at the expense of the self-employment sector. Overall welfare increases by more than 80% in Burkina Faso and almost 20% in Senegal. Overall unemployment drops by 6.5 pp to 10.1% in Burkina Faso and by 1.8 pp to 15.3% in Senegal. Educated unemployment decreases by two-thirds in Burkina Faso and one-third in Senegal.

The strong divergence between the two cases (v_g fixed and bill fixed) highlights an inefficiency of the public sector hiring technology. Meetings between workers and the public sector often generate low-wage matches that we interpret as low productivity matches. A significant proportion of these matches is discarded because of the high minimum wage rule. The low quality of matches implies that to fill its positions, the public sector must open comparatively more vacancies than a more efficient private sector operator would. The excess public vacancies constrains the private sector.

Interestingly, scenario (2) begets similar insights, with some nuances. Removing the minimum wage rule without restricting the wage bill (column (iv)) increases the share of the public sector at the expense of the private; it reduces unemployment but also overall welfare. The wage bill rises by close to 50% in both countries. In this configuration, a less selective public sector creates many low-productivity jobs and destroys high productivity ones in the private sector. Restricting the wage bill to its baseline level (column (v)) implies a drop by one-third of the public sector vacancy creation. Nevertheless, the public sector share doubles in both countries. Unemployment and educated unemployment decrease. There is a marginal growth of the private sector and a sizeable drop of self-employment. Thus, although the public sector openings are less abundant than in the baseline, the increased number of matches between workers and public sector still imposes an externality on the private sector.

Coupling scenario (1) and (2) produces similar results as scenario (1) (columns (vi) and (vii)). This is because the higher wage distribution in the private sector makes the minimum wage rule less binding. Hence, the distortion induced by the minimum wage rule is relevant in the baseline only because of the low quality of matches between workers and the public sector.

Our final policy simulation (Column (ix)) shows the overall distortion induced by the public sector. These distortions are larger in Burkina Faso than in Senegal, as indicated by the increase in overall workers' welfare of 89% and 15%, respectively, when eliminating the public sector. In the absence of a public sector, the private sector would increase five-fold in Burkina Faso and would double in Senegal, while the share in self-employment would slightly shrink. In Burkina Faso, public sector distortions explain 70% of educated unemployment, while they explain 24% in Senegal.

Overall, the results highlight that the public sector, in its current form, induces important labour market distortions and aggravates educated unemployment. The main mechanism seems to be a congestion externality: the public sector creates too many vacancies, seemingly as a response to low-quality matches. Of course, eliminating the public sector entirely is not desirable as it produces a public good that is not directly accounted for in the present analysis. However, workers

and the private sector would stand to benefit greatly from a more productive public sector with a lower number of vacancies.

7 Evaluating the effect of public policies

In this section, we quantitatively assess and compare the effects of public policies implemented or envisaged to address the issue of educated unemployment in West Africa. Equipped with a model that mimics the complex interactions of the labour market, we simulate the effect of three non-exclusive government policies:

1. an expansion of the public sector by the means of additional vacancy creation;
2. subsidies to entrepreneurial projects to offer unemployed workers the opportunity to create their own employment;
3. direct or indirect subsidies to the private sector to support the cost of additional vacancy creation.

We compare the effect of these policies on the sorting of workers across sectors, the level of overall unemployment and educated unemployment, and worker welfare. To do so, we use the measures of educated unemployment defined in Equation (33) and worker welfare defined in Equation (34).

To compare the three policies on the same metric, we follow Bradley et al. (2017) and compute the government expenses generated by each of these interventions. To be more specific, before the policy intervention, the public sector expenses consists exclusively of its wage bill, the definition of which is given by:

$$B_0 := \sum_{(h,k)} P(h,k) n_g(h,k) \frac{\int_{R_{ug}(h,k)} \omega dF_{(\Omega|h)}(\omega|h)}{1 - F_{(\Omega|h)}(R_{ug}(h,k)|h)} \tag{35}$$

Policy (1) consists in increasing public sector vacancies creation by a factor π. Hence, the new level of public sector vacancy creation, say $v_g^\star$, is defined by $v_g^\star = (1+\pi)v_g$, with $\pi \in (0; a)$ for some real $a > 0$. The opening of new vacancies in the public sector eventually results in new jobs in the public sector characterised by the new distribution of workers in the public sector $n_g^\star(h,k)$, and a new reservation wage $R_{ug}^\star(h,k)$. The wage schedule of the public sector remains unchanged. The increase in government expenses is essentially due to an increase in the public sector wage bill (if any). Thus, the change in public sector expenses for policy (1) is defined by:

$$\Delta B_1 := \sum_{(h,k)} \left(P(h,k) n_g^\star(h,k) \frac{\int_{R_{ug}^\star(h,k)} \omega dF_{(\Omega|h)}(\omega|h)}{1 - F_{(\Omega|h)}(R_{ug}^\star(h,k)|h)} \right) / B_0 - 1 \tag{36}$$

Policy (2) consists in a subsidy to self-employment. We consider a subsidy that is a fraction of the productivity in self-employment, that is, the new wage in the self-employment sector is $x_s^\star = (1+\pi)x_s$, with $\pi \in (0; a)$ for some real $a > 0$. The change in the self-employment wage results in new jobs in this sector, but it will also change the sectoral distribution of workers, with

some workers potentially exiting the public (and private) sector. From the perspective of the government, the change in expenses due to policy (2) is measured by:

$$\Delta B_2 := \sum_{(h,k)} P(h,k) \left(n_s^\star(h,k)\pi \frac{\int_{R_{us}^\star(h,k)} x_s dF^\star_{(X_s|h)}(x_s|h)}{1 - F^\star_{(X_s|h)}(R_{us}^\star(h,k)|h)} + n_g^\star(h,k) \frac{\int_{R_{ug}^\star(h,k)} \omega dF_{(\Omega|h)}(\omega|h)}{1 - F_{(\Omega|h)}(R_{ug}^\star(h,k)|h)} \right) / B_0 - 1 \tag{37}$$

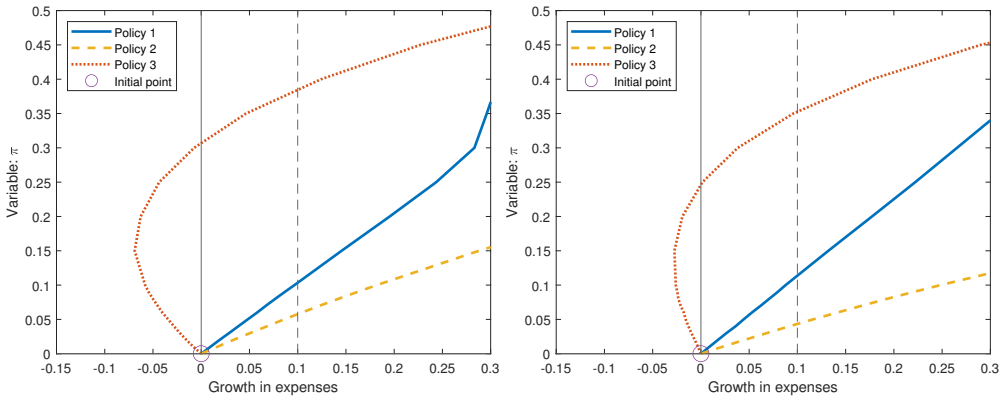
The definition of ΔB_2 reflects the fact that part of the change in expenses accrues to the subsidies (the first term in the brackets) – the direct effect – and another part accrues to the change in the proportion of worker in the public sector (the second term in the brackets) – the indirect effect.

Finally, policy (3) considers a transfer to private firms to reduce the cost of new vacancy creation. These could be direct or indirect transfers, as in the case of the creation of employment agencies to act as meeting platform for employers and employees and, thus, increase search efficiency and reduce recruitment costs. As with the previous case, we consider a change $c^\star = (1-\pi)c$, with $\pi \in (0,1)$. The change in expenses is measured by:

$$\Delta B_3 := \left(\pi c v_p^\star + \sum_{(h,k)} P(h,k) n_g^\star(h,k) \frac{\int_{R_{ug}^\star(h,k)} \omega dF_{(\Omega|h)}(\omega|h)}{1 - F_{(\Omega|h)}(R_{ug}^\star(h,k)|h)} \right) / B_0 - 1 \tag{38}$$

where $v_p^\star$ is the new equilibrium vacancy creation in the private sector, and $\pi c v_p^\star$ is the direct subsidy cost.

Note that because policies (2) and (3) might induce workers to sort out of the public sector, it is possible that they lead to a decrease in government expenses by generating a reduction in the public sector wage bill stronger than the direct cost of the subsidies.



(a) Burkina Faso (b) Senegal

Notes: Change in simulated public expenditures for policy 1 (increase in public sector vacancies), policy 2 (wage subsidies for self-employment), and policy 3 (subsidy for private sector vacancy creation).
Source: Authors' calculations.

Figure 8: Relationship between π and government expenses growth

Figure 8 illustrates the relationship between the parameter π (y-axis) and the change in the government expenses (x-axis) for each of the three counterfactual policies. For example, in Burkina Faso, a 10% increase of these expenses corresponds to 10.3% increase in the public sector

vacancy creation, a subsidy to self-employment income of 5.8%, and a subsidy to private vacancy creation as high as 38.4%. In Senegal, the corresponding numbers are 11.4%, 4.3% and 35.3%. The potentially large subsidy to private vacancy creation is explained by the fact that for policy (3), moderate values of the subsidy result in a negative growth of government expenses. The policy remains fairly budget-neutral for subsidies below 30% in Burkina Faso and below 22% in Senegal. However, these expenses increase rapidly for subsidies above the 30% mark, once the direct subsidy costs clearly dominate the indirect employment effect.

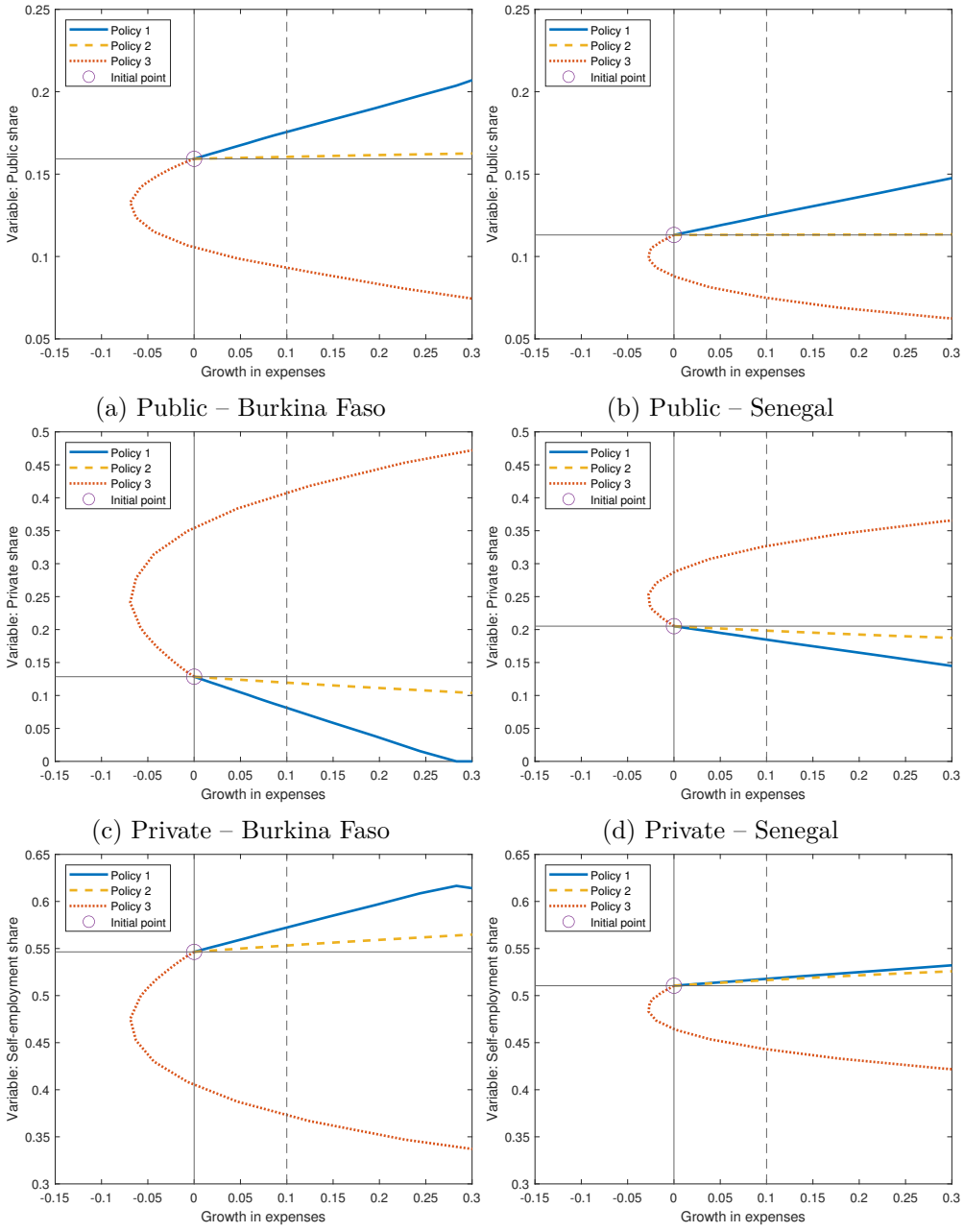
7.1 Effect on sectoral employment

We start the discussion with the effects of the counterfactual policies on sectoral employment. The main results are presented in Figure 9 that maps, on the x-axis, the growth in government expenses into the proportion of the male labour force in the public, private and self-employment sectors, respectively. The left panel presents the result for Burkina Faso and the right panel the results for Senegal. The initial point (baseline) is marked with a circle. The markers at intersection of 10% on the x-axis are provided as an illustrative aid for the reader.

Let us first consider Burkina Faso. For policy (1), an increase in vacancy creation that corresponds to 10% of the initial government expenditures raises the proportion of the workforce in the public sector from 16% to 17.6%, an increase of about 10.2%, and in the self-employment sector from 55.3% to 57.2%. This same increase is detrimental to the private sector, which shrinks in size from 13% of the workforce to 8.1%, a 36.8% decrease. In the simulations, a further increase in public sector vacancy creation can completely oust the private sector, while leaving self-employment mainly unaffected. In line with the stylized fact that public sector hires predominantly better educated workers, the groups of upper secondary and tertiary educated workers benefit the most from the newly created public sector jobs (see Tables E.1 and E.2 in the Appendix). However, they also suffer the most from the contraction of the private sector.

Subsidizing self-employment (policy (2)) yields qualitatively similar results but of a milder magnitude. A 10% increase in expenditures that subsidize self-employment encourages entry in this sector, which grows marginally by 1 percentage point (pp). This has little effect on the size of the public sector but leads to a contraction of the private sector of about 1 pp, a 7% decrease. A further increase in these subsidies accentuates these trends. Note that the expansion of the self-employment sector attracts primarily low-educated workers and crowds out employment opportunities for educated workers in the private sector. This leads to slightly more high-educated workers moving into the public sector.

Policy (3) has a strong effect on private-sector job creation. A 10% increase in expenditures raises the proportion of the workforce in this sector from 13% of the workforce to close to 40%, a tripling of the proportion. As a consequence, both the public sector and self-employment shrink, from about 15.8 to 9.3%, and from 55 to 37.3%, respectively. The expansionary trend is sustained for larger subsidies, but the corresponding expenses increase 10 to 20 times faster. As for the heterogenous effects across education groups, the growth of the private sector attracts workers from



(a) Public – Burkina Faso (b) Public – Senegal

(c) Private – Burkina Faso (d) Private – Senegal

(e) Self-employment – Burkina Faso (f) Self-employment – Senegal

Notes: Change in simulated public expenditures for policy 1 (increase in public sector vacancies), policy 2 (wage subsidies for self-employment), and policy 3 (subsidy for private sector vacancy creation).
Source: Authors' calculations.

Figure 9: Sectoral shares in relation to government expenses growth

all education backgrounds but privileges higher educated workers. For example, a 10% increase in expenditures raises the proportion of the workforce in the private sector with intermediate education by between 30 and 40 pp.

The aforementioned patterns are similar across both countries, so we refrain from discussing the case of Senegal. Thus, the counterfactual policies offer a consistent picture: the sector favoured by the intervention grows in size at the expense of one or both remaining sectors. In particular, the private sector is affected by both policies expanding public employment and self-employment. Conversely, vacancy posting subsidies to the private sector reduce the size of the two other sectors. Yet, policy (3) targeted to the private sector distinguishes itself by achieving larger effects and being more equally distributed, even at low levels of expenses growth.

7.2 Effect on unemployment

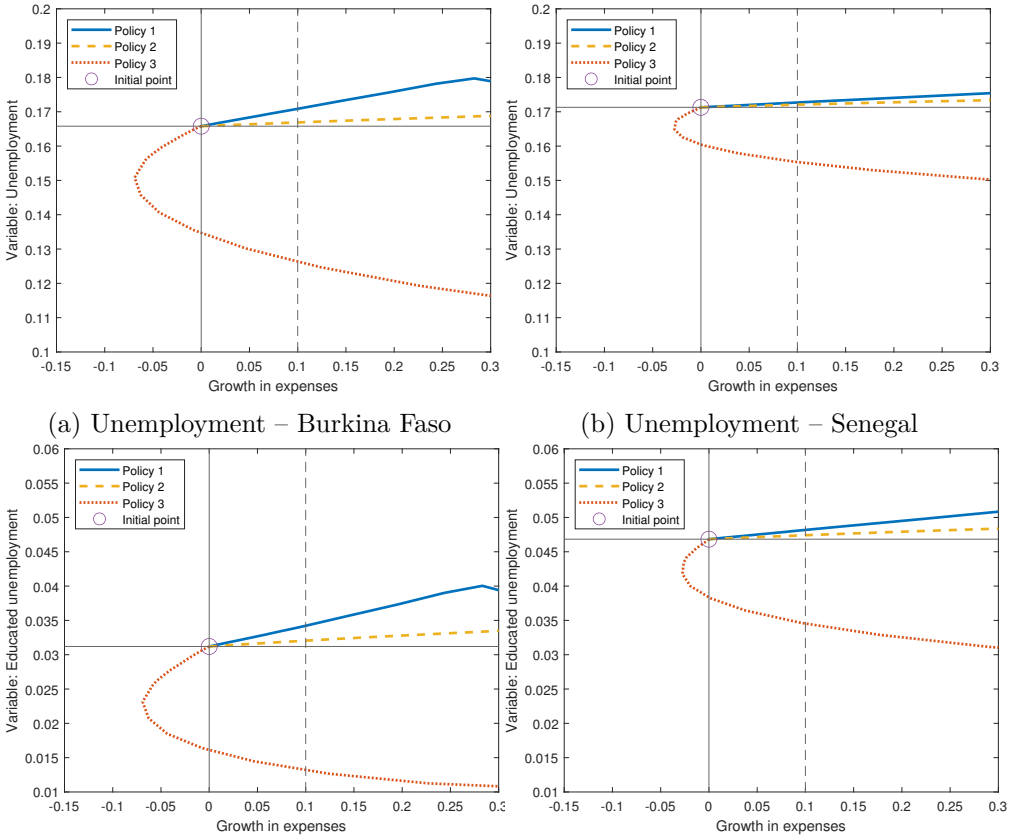
The effects on unemployment are noticeably different between policy (3) and the alternatives, as illustrated by Figure 10. In Burkina Faso, a 10% increase in expenditures targeting private vacancies results in a reduction of overall unemployment of 4 pp, a 23.8% decrease, and a halving of our measure of educated unemployment. This is the consequence of better job opportunities for workers with intermediate education. In stark contrast, policy (2) leaves overall unemployment and educated unemployment levels untouched, and policy (1) worsens (increases) unemployment by half a percentage point and our measure of educated unemployment by 10%.

The lessons are very similar for Senegal. For a 10% increase of expenses, policy (1) and policy (2) reduce neither the already high level of unemployment nor educated unemployment. Policy (3) achieves a decrease of overall unemployment of about 1.7 pp, a 9.3% fall, and a reduction of educated unemployment by about 26%. Hence, direct creation of public sector jobs has little effect on unemployment for moderate values of expenses and could even worsen the situation for higher levels. Instead, subsidizing private sector vacancy creation achieves lower levels of overall unemployment and educated unemployment.

7.3 Welfare

Workers' welfare gives a more complete assessment of the policy effects for the labour force. Examining this measure confirms the previous insight that direct job creation in the public sector is an inappropriate intervention to address the shortcoming of the labour market (Figure 11). Workers' welfare decreases by about 4.3% in Burkina Faso and -1.1% in Senegal after a 10% increase of government expenses. Subsidies to self-employment fare slightly better but only marginally improve workers' welfare. This is again in sharp contrast with the policy targeting hiring costs in the private sector. Here, a 10% increase of expenses results in a 47.4% increase of welfare in Burkina Faso and an 18.3% increase in Senegal.

Tables E.1 and E.2 in the Appendix detail the welfare changes following a 10% increase of expenses by education group. The direct creation of public sector vacancy (policy (1)) is inefficient to improve overall welfare even for the highly educated who benefit from a higher rate of entry in



(a) Unemployment – Burkina Faso (b) Unemployment – Senegal

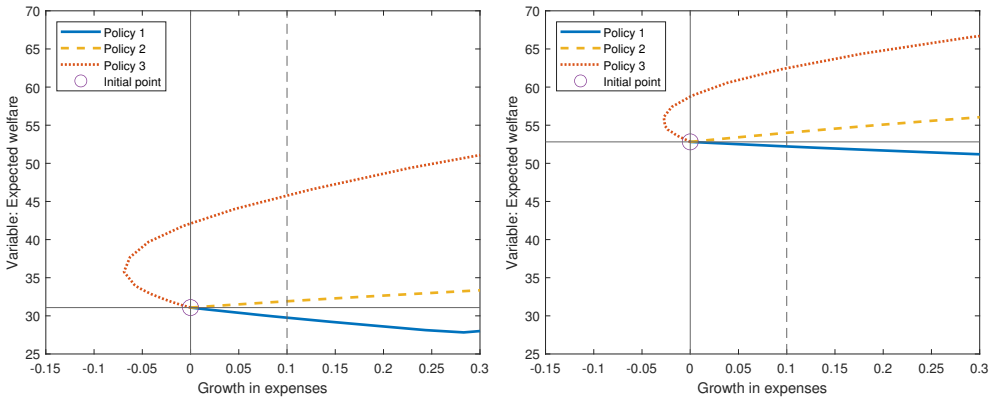
(c) Educ. unemployment – Burkina Faso (d) Educ. unemployment – Senegal

Notes: Change in simulated public expenditures for policy 1 (increase in public sector vacancies), policy 2 (wage subsidies for self-employment), and policy 3 (subsidy for private sector vacancy creation).
Source: Authors' calculations.

Figure 10: Unemployment and educated unemployment in relation to government expenses growth

the public sector. They are not better off because of the congestion externalities created by this policy that have a negative impact on the private sector. Subsidies to self-employment (policy (2)) mainly favour the low-educated groups that see a marginal increase of their welfare but have little or no impact for the intermediate and highly educated population. Finally, columns 4 and 8 strongly suggest a positive impact of a subsidy to private vacancy creation across all education groups. Workers' welfare increases in all education and parental background groups, with the largest effects for those with lower secondary education.

In summary, our policy simulations suggest that the recent public recruitment programmes in West Africa are an inappropriate tool to combat overall and educated unemployment. Although the public sector might absorb some of the idle labour force, its expansion further constrains an already marginal private sector, worsening rather than alleviating the issue of educated unemployment. Current public vacancy posting is high (in comparison to private sector vacancy posting), but matching and hiring are inefficient, and private vacancy posting costs are very large. Targeting these high costs appears to be the most promising approach.



(a) Burkina Faso (b) Senegal

Notes: Change in simulated public expenditures for policy 1 (increase in public sector vacancies), policy 2 (wage subsidies for self-employment), and policy 3 (subsidy for private sector vacancy creation).
Source: Authors' calculations.

Figure 11: Workers' welfare in relation to government expenses growth

8 Conclusion

Educated workers are relatively scarce in West Africa, yet they are more likely to be unemployed than their peers with only basic or no education. This puzzling fact of *educated unemployment* is also observed in many other developing countries. Combating educated unemployment and creating jobs is thus a key priority for governments in West Africa. We develop and estimate a frictional labour market model where workers differ in their parental background and education level and search for jobs in the public sector, in private (formal) firms and in self-employment. Educated unemployment arises in equilibrium. Our results show that distortions induced by the public sector explain a significant amount of educated unemployment in West Africa. Comparing the findings on Burkina Faso and Senegal suggests that distortions are larger in countries with a lower income level and smaller shares of the labour force employed in the private sector. Using our framework, we simulate the equilibrium effects of three different labour market policies for an equivalent increase in government expenditures. We find that a policy that lowers the cost of creating private sector jobs substantially reduces educated unemployment and improves workers' welfare. Creating public sector job vacancies or providing subsidies to boost self-employment incomes appeal as alternative policies at first sight because of their expected direct positive effects. However, in equilibrium, these policies crowd out an already marginal private sector and, hereby, have adverse effects on educated (and overall) unemployment.

Our findings have important implications for designing much needed labour market reforms in West Africa. First, governments should revert the trend and refrain from directly creating jobs in the public sector. According to our estimates, one additional filled job in the public sector displaces more than one formal job in the private sector, resulting in an overall increase in unemployment and exacerbating educated unemployment. These counter-intuitive findings are the result of equilibrium forces and are in line with similar figures reported for OECD countries (Algan et al., 2002). Our results also highlight that reforms that make the public sector more productive or less selective in hiring – and hence, more competitive – can harm the private sector if they are not accompanied by reduced public sector vacancy postings. Reforms in the public

sector must thus be carefully implemented with this trade-off in mind. Secondly, our results caution against strengthening self-employment opportunities in an untargeted way. Proportional subsidies to entrepreneurial projects increase incomes earned in self-employment, yet they also re-allocate workers from formal employment in private firms to the informal sector consisting of self-employed workers. Their overall impact on employment is negative – albeit small – and they can slightly increase educated unemployment. This type of policy disproportionally benefits those with little or no education and comes at a relatively high cost for the government implementing it. Thirdly, our results suggest that targeting the high costs of creating formal jobs in the private sector appears as the most promising approach in West Africa. This policy substantially cuts educated and overall unemployment and boosts workers' welfare. If well calibrated, the seemingly high price of subsidising vacancy creation in the private sector will be compensated by the reduction in the public sector wage bill, as workers move from the public to the private sector. Other policies that also stimulate private sector growth (see Hjort and Poulsen (2019), McKenzie (2017) and Bandiera et al. (2022)) are expected to have similarly positive results. All in all, our findings complement the insights gained from recent local labour market interventions in African cities (see Franklin (2018); Alfonsi et al. (2020); Abebe et al. (2021b) and others) and point out that there can be non-negligible equilibrium effects if such interventions are scaled up.

Our results also caution against the hope that improving educational attainment of workers will be a panacea for tackling high unemployment rates and poor labour market performance in West Africa.[37] While a better educated worker pool may incentivise private firms to create some additional formal jobs, at the same time, such a reform would also push some workers with intermediate or advanced education into unemployment. Many African economies are characterised by a relative lack of demand for educated workers. Global education reforms that aim to boost educational outcomes need to be carefully designed.[38] Moreover, changes in education policies must be accompanied by labour market reforms to reap the full benefits of improved education. These latter reforms should stimulate the creation of the necessary demand for educated workers and aim to remove frictions and distortions currently present in many African labour markets.

[37] See Duflo et al. (2021) for an evaluation of a free secondary education intervention and its (limited) impact on labour market outcomes in Ghana.

[38] For example, the Sustainable Development Goal 4 aims to ensure inclusive and quality education for all by providing free primary and secondary education and affordable vocational and tertiary education for all, among other key targets.

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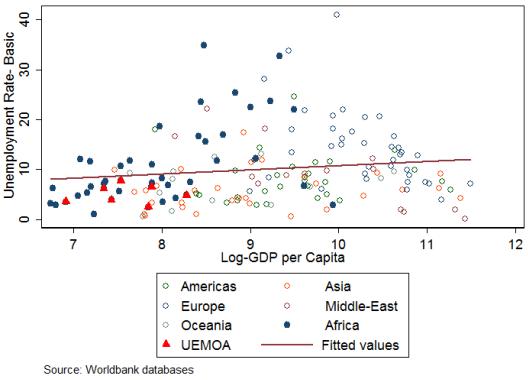
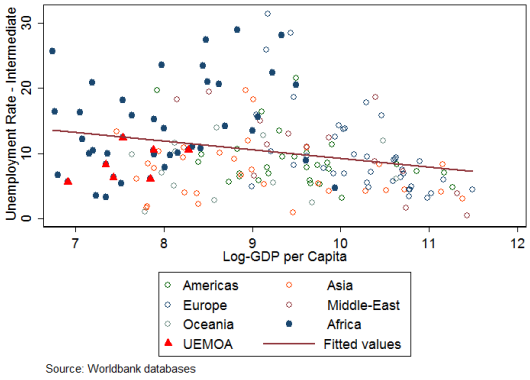
A Appendix: Additional figures

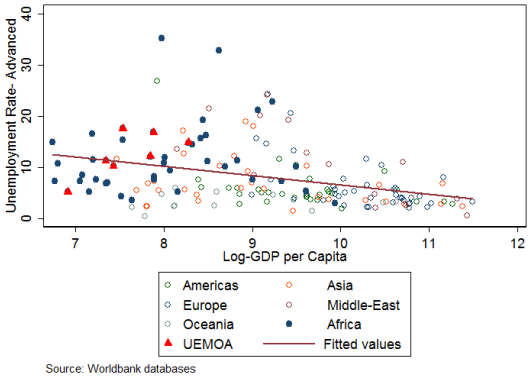
Appendix A.A Unemployment and development



(a) Unemployment rate - basic



(b) Unemployment rate - intermediate

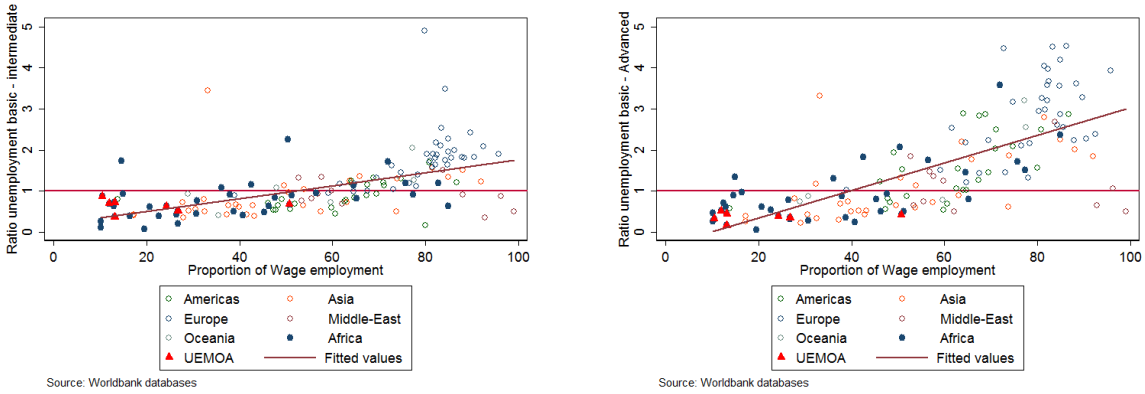


(c) Unemployment rate - advanced

Source: Authors' calculations using World Bank Development Indicators.
Notes: The unemployment rate by education level is not available for all years. We average the country-specific unemployment rate by education level for men for all available years between 1996 and 2016. The figures plot the average unemployment rate over the period 1996-2016 for workers with basic (lower secondary or below, Panel (a)), intermediate (upper secondary, Panel (b)), and advanced (some tertiary, Panel (c)) education.

Figure A.1: Unemployment and development

Appendix A.B Unemployment and wage employment



(a) Unemployment ratio basic - intermediate against wage employment share

(b) Unemployment ratio basic - advanced against wage employment share

Source: Authors' calculations using World Bank Development Indicators.
Notes: The unemployment rate by education level is not available for all years. The ratio is calculated by, first, averaging the country-specific unemployment rate by education level for men for all available years between 1996 and 2016, and, second, dividing the corresponding averages for each country. Panel (a) plots the average share of employed workers in wage employment, over the period 1996-2016, against the average ratio of unemployed with basic (lower secondary or below) education over the unemployed with intermediate (upper secondary) education. Panel (b) considers the same ratio between basic and advanced (tertiary) education. A ratio below one implies that intermediate and high-educated workers are more likely to be unemployed than workers with only basic (low) education.

Figure A.2: Educated unemployment and wage employment

B Appendix: Derivation of the wages and reservation wages

Appendix B.A Private wage rule after unemployment

In the private sector, wages are determined by Nash bargaining. The worker's bargaining power is given by β. The worker bargains with the present value of unemployment as an outside option, while the private firm's surplus is the value of a filled job given that the value of a job vacancy is 0 in equilibrium due to the free entry condition. The Nash bargaining solution thus has to solve the problem:

$$\max_{w} \left(V_{up}(x,h,k) - V_U(h,k)\right)^{\beta} J_u(x,h,k)^{1-\beta} \tag{39}$$

Rearranging Equation (9) gives the unemployed worker's surplus from accepting a private job with productivity x. Similarly, we can rearrange Equation (14) to get the present value of a job filled by a previously unemployed worker for a private firm. It follows that:

$$w_{up}(x,h,k) = \beta x + (1-\beta) r V_U(h,k) \tag{40}$$

Denote by $R_{uj}(h,k)$, the reservation wage to work in the sector j. In each sector it must satisfy:

$$\begin{aligned}
V_{uj}\left(R_{uj}(h,k),h,k\right) &= V_U(h,k),\ j \in \{p,s\} && (41)\\
V_{sp}\left(R_{sp}(x_s,h,k),x_s,h,k\right) &= V_s(x_s,h,k) && (42)\\
\tilde{R}_{ug}(h,k) &= R_{up}(h,k) && (43)\\
R_{ug}(h,k) &= \max(\tilde{R}_{ug}(h,k),\underline{\omega}_h) && (44)\\
V_{sg}\left(\tilde{R}_{sg}(x_s,h,k),x_s,h,k\right) &= V_s(x_s,h,k) && (45)\\
R_{sg}(x_s,h,k) &= max\left(\tilde{R}_{sg}(x_s,h,k),\underline{\omega}_h\right) && (46)
\end{aligned}$$

The reservation wage in the private sector and self-employment (Equation (41)) is such that the worker is indifferent between accepting a job at productivity x and remaining in unemployment. The reservation wage of transiting from self-employment to private employment is when the worker is indifferent between accepting the new private job and remaining in self-employment (Equation (42)). The worker's reservation wage in the public sector is equal to his private-sector reservation wage (Equation (43)). However, a match between a worker and the public sector is only consummated when the offer equals or exceeds both the worker's reservation wage and the public sector's minimum wage rule, resulting in a public-sector reservation wage given in Equation (44). Finally, the reservation wage in the public sector coming from self-employment (Equation (46)) is the maximum of the public sector's minimum wage rule and the worker's reservation wage (Equation (45)).

Introducing Equation (40) into a rearranged version of Equation (9), and using the definition of the private reservation wage (Equation(41)) we obtain

$$R_{up}(h,k) = r V_U(h,k) \tag{47}$$

Using this result, we can derive the wage rule in the private sector as:

$$w_{up}(x,h,k) = \beta x + (1-\beta) R_{up}(h,k) \tag{48}$$

Furthermore, using the characterization of the reservation wage in each sector given (h,k), and Equations

(9) and (11), we obtain:

$$V_{up}(x,h,k) - V_U(h,k) = \frac{\beta}{r+\delta_p(h)}\left(x - R_{up}(h,k)\right) \tag{49}$$

$$V_{ug}(\omega,h,k) - V_U(h,k) = \frac{1}{r+\delta_g(h)}\left(\omega - R_{up}(h,k)\right) \tag{50}$$

Appendix B.B Private wage rule after self-employment and reservation wages

For a transition from self-employment to the private sector, the worker bargains with the present value of self-employment as an outside option. The private wage is thus the solution to the following Nash bargaining problem:

$$\max_w \left(V_{sp}(x,x_s,h,k) - V_{us}(x_s,h,k)\right)^{\beta} J_s(x,x_s,h,k)^{1-\beta} \tag{51}$$

The worker's surplus from self-employment compared to unemployment is given by Equation (10). Rearranging terms, this reads as:

$$V_{sp}(x,x_s,h,k) - V_U(h,k) = \frac{w_{sp}(x,x_s,h,k) - rV_U(h,k)}{r+\delta_p(h)} \tag{52}$$

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 employment as:

$$V_{sp}(x,x_s,h,k) - V_{us}(x_s,h,k) = \frac{w_{sp}(x,x_s,h,k) + \delta_p(h)V_U(h,k) - (r+\delta_p(h))V_{us}(x_s,h,k)}{r+\delta_p(h)} \tag{53}$$

Substituting the worker's surplus (Equation (53)) and the firm's surplus from a filled job (rearranging Equation (15)) into the Nash bargaining problem, deriving the first order condition and rearranging terms leads to the following wage equation:

$$w_{sp}(x,x_s,h,k) = \beta x + (1-\beta)\left[rV_U(h,k) + (r+\delta_p(h))(V_{us}(x_s,h,k) - V_U(h,k))\right] \tag{54}$$

The first two components of the wage rule of a worker in a private firm who was previously self-employed is identical to the wage rule of one who was unemployed. However, the previously self-employed worker additionally receives a fraction of the value of the surplus from self-employment (compared to unemployment). At the reservation wage in self-employment $R_{us}(h,k)$, the surplus from self-employment is 0, and hence, the wage rule is the same as of an unemployed worker.

Using the characterization of the reservation wage and Equation (52), it follows immediately that:

$$V_{sp}(R_{sp}(x_s,h,k),x_s,h,k) - V_U(h,k) = V_{us}(x_s,h,k) - V_U(h,k) = \frac{R_{sp}(x_s,h,k) - R_{up}(h,k)}{r+\delta_p(h)} \tag{55}$$

Hence:

$$V_{sp}(x,x_s,h,k) - V_{us}(x_s,h,k) = \frac{\beta}{r+\delta_p(h)}\left(x - R_{sp}(x_s,h,k)\right) \tag{56}$$

Using Equation (12) and Equation (55), we obtain:

$$V_{sg}(\omega,x_s,h,k) - V_{us}(x_s,h,k) = \frac{1}{r+\delta_g(h)}\left(\omega - R_{up}(h,k) - \frac{r+\delta_g(h)}{r+\delta_p(h)}\left[R_{sp}(x_s,h,k) - R_{up}(h,k)\right]\right) \tag{57}$$

Using again Equation (42), Equation (8), and the two previous expressions, we can characterize

$R_{sp}(x_s,h,k)$ and $R_{sg}(x_s,h,k)$:

$$\begin{aligned} R_{sp}(x_s,h,k) &= R_{up}(h,k) + \frac{r+\delta_p(h)}{r+\delta_s(h)}\left(x_s - R_{up}(h,k)\right) + \frac{\lambda_{sp}(k)\beta}{r+\delta_s(h)}\int_{R_{sp}(x_s,h,k)}^{} \left[x - R_{sp}(x_s,h,k)\right]\ dF_{X|h}(x|h) \\ &+ \frac{r+\delta_p(h)}{r+\delta_s(h)}\frac{\lambda_{sg}(k)}{r+\delta_g(h)}\int_{R_{sg}(x_s,h,k)}^{} \left[\omega - R_{up}(h,k)\right]\ dF_{\Omega|h}(\omega|h) \\ &- \frac{\lambda_{sg}(k)\left[1 - F_{\Omega|h}(R_{sg}(x_s,h,k)|h)\right]}{r+\delta_s(h)}\left[R_{sp}(x_s,h,k) - R_{up}(h,k)\right] \end{aligned} \tag{58}$$

and

$$\tilde{R}_{sg}(x_s,h,k) = R_{up}(h,k) + \left[\frac{r+\delta_g(h)}{r+\delta_p(h)}\left[R_{sp}(x_s,h,k) - R_{up}(h,k)\right]\right] \tag{59}$$

$$R_{sg}(x_s,h,k) = max\left(\tilde{R}_{sg}(x_s,h,k), \underline{\omega}_h\right) \tag{60}$$

To characterize $R_{us}(h,k)$ and $R_{up}(h,k)$, note first that from Equation (42) and Equation (55), $R_{sp}(R_{us}(h,k),h,k) = R_{up}(h,k)$. Substituting this result into Equation (58), we note that the last term of the right-hand side of this equation is 0. Hence, the reservation wage in self-employment is given by:

$$\begin{aligned} R_{us}(h,k) &= R_{up}(h,k) - \frac{\lambda_{ps}(k)\beta}{r+\delta_p(h)}\int_{R_{up}(h,k)}^{} \left[x - R_{up}(h,k)\right]\ dF_{X|h}(x|h) \\ &- \frac{\lambda_{sg}(k)}{r+\delta_g(h)}\int_{R_{sg}(R_{us}(h,k),h,k)}^{} \left[\omega - R_{up}(h,k)\right]\ dF_{\Omega|h}(x|h) \end{aligned} \tag{61}$$

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 Equation (7), we obtain:

$$\begin{aligned} R_{up}(h,k) &= b(h,k) + \frac{\lambda_{up}(k)\beta}{r+\delta_p(h)}\int_{R_{up}(h,k)}^{} \left[x - R_p(h,k)\right]\ dF_{X|h}(x|h) \\ &+ \frac{\lambda_{ug}(k)}{r+\delta_g(h)}\int_{R_{ug}(h,k)}^{} \left[\omega - R_{up}(h,k)\right]\ dF_{\Omega|h}(\omega|h) \\ &+ \frac{\lambda_{us}}{r+\delta_p(h)}\int_{R_{us}(h,k)}^{} \left[R_{sp}(x_s,h,k) - R_{up}(h,k)\right]\ dF_{X_s|h}(x_s|h) \end{aligned} \tag{62}$$

since $R_{sp}(R_{us}(h,k),h,k) = R_{up}(h,k)$.

For given values of $\lambda_{up}(k)$ and $\lambda_{ug}(k)$, there exists a unique solution for $R_{up}(h,k)$. Indeed, the RHS is positive at $R_{up}(h,k) = 0$, goes to b as $R_{up}(h,k) \to +\infty$ and is decreasing in $R_{up}(h,k)$.

The private-sector wage rule equation upon transition from self-employment (see Equation (54) above) can be simplified using the results that $rV_U(h,k) = R_{up}(h,k)$ and Equation (55). It results in:

$$w_{sp}(x,x_s,y) = \beta x + (1-\beta)R_{sp}(x_s,h,k) \tag{63}$$

C Appendix: Estimation results

	Burkina Faso		Senegal	
	low PB	high PB	low PB	high PB
No education	0.35	0.02	0.24	0.04
Primary	0.22	0.05	0.22	0.12
Lower secondary	0.15	0.07	0.12	0.09
Upper secondary	0.04	0.03	0.04	0.03
Tertiary	0.05	0.03	0.06	0.04

Notes: The table shows the observed share of each type of worker with education level h and parental background level k (low/high) in Burkina Faso and Senegal, respectively.

Table C.1: Observed shares of education-parental background types $P(h,k)$

	Reservation wage				Public min. wage	
	Low PB $R_{up}(h,k=0)$		High PB $R_{up}(h,k=1)$		$\underline{\omega}_h$	
	Est.	SE	Est.	SE	Est.	SE
Burkina Faso						
No education	4.44	0.74	7.97	3.07	23.16	1.07
Primary	3.63	2.09	5.19	0.31	37.58	1.07
Lower secondary	7.70	0.49	4.58	0.73	29.93	0.93
Upper secondary	20.99	0.55	18.46	0.94	19.84	1.33
Tertiary	46.89	4.49	17.38	12.03	59.06	1.95
Senegal						
No education	12.63	0.52	8.07	1.22	52.28	3.35
Primary	18.81	1.20	17.03	1.63	40.36	4.10
Lower secondary	20.05	1.43	14.62	1.17	61.14	7.41
Upper secondary	20.55	3.59	46.01	2.34	58.01	3.76
Tertiary	43.16	2.96	51.42	4.65	59.06	2.89

Notes: The table shows the estimated reservation wages in the private sector by parental background (low PB, high PB) and the estimated public minimum wage rule for Burkina Faso (upper panel) and Senegal (lower panel), respectively. The estimates are in 1,000 CFA/month. Asymptotic standard errors are computed following French and Jones (2011).

Table C.2: Estimated reservation wage and public minimum wage rule

	Public				Private				Self-employment			
	$\mu_g(h)$		$\sigma_g(h)$		$\mu_p(h)$		$\sigma_p(h)$		$\mu_s(h)$		$\sigma_s(h)$	
	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Burkina Faso												
No education	0.75	0.11	1.24	0.03	4.02	0.05	0.64	0.04	3.19	0.03	0.73	0.02
Primary	2.19	0.09	0.87	0.03	4.04	0.06	0.64	0.03	3.10	0.02	0.72	0.01
Lower secondary	1.26	0.16	1.24	0.05	4.57	0.03	0.49	0.02	3.23	0.06	0.79	0.03
Upper secondary	1.41	0.14	1.42	0.04	4.10	0.11	0.62	0.06	-0.28	2.30	1.52	0.36
Tertiary	3.22	0.16	1.13	0.04	5.25	0.13	0.84	0.06	4.66	0.09	0.71	0.04
Senegal												
No education	2.02	0.25	0.98	0.09	2.07	0.30	1.47	0.08	3.24	0.16	1.05	0.06
Primary	2.59	0.24	1.00	0.06	2.76	0.30	1.41	0.09	3.15	0.21	0.97	0.08
Lower secondary	2.45	0.53	1.08	0.17	4.28	0.19	1.03	0.09	2.29	0.54	1.40	0.16
Upper secondary	2.30	0.37	1.06	0.09	4.20	0.70	0.99	0.24	3.61	0.59	0.96	0.17
Tertiary	3.57	0.40	1.13	0.10	5.28	0.17	0.81	0.09	4.20	0.30	0.91	0.12

Notes: The table shows the estimated productivity and wage offer distribution parameters (location, scale) of the log-normal distributions for Burkina Faso (upper panel) and Senegal (lower panel), respectively. Asymptotic standard errors are computed following French and Jones (2011).

Table C.3: Estimated productivity and wage offer parameters

	$\delta_g(h)$		$\delta_p(h)$		$\delta_s(h)$	
	Est.	SE	Est.	SE	Est.	SE
Burkina Faso						
No education	0.07	0.01	0.09	0.00	0.04	0.00
Primary	0.07	0.01	0.07	0.00	0.05	0.00
Lower secondary	0.03	0.00	0.07	0.00	0.11	0.01
Upper secondary	0.03	0.00	0.03	0.00	0.19	0.01
Tertiary	0.01	0.00	0.01	0.00	0.06	0.01
Senegal						
No education	0.02	0.00	0.04	0.01	0.02	0.00
Primary	0.07	0.01	0.04	0.00	0.04	0.00
Lower secondary	0.01	0.01	0.05	0.01	0.08	0.01
Upper secondary	0.01	0.00	0.04	0.01	0.11	0.02
Tertiary	0.01	0.00	0.03	0.00	0.04	0.01

Notes: The table shows the estimated destruction rates in each sector for Burkina Faso (upper panel) and Senegal (lower panel), respectively. Asymptotic standard errors are computed following French and Jones (2011).

Table C.4: Estimated destruction rates

	Burkina Faso		Senegal	
	Est.	SE	Est.	SE
Estimated parameters				
$q(\kappa)$: contact rate with public/private vacancy	0.01	0.00	0.06	0.01
ϕ: Fraction private vacancies	0.06	0.00	0.36	0.05
λ: Self-employment offer rate	0.21	0.01	0.15	0.01
ψ: Search efficiency in self-employment	0.10	0.01	0.36	0.06
ζ: Search efficiency for high parental background	0.50	0.05	0.75	0.10

Notes: The table shows all the remaining estimated parameters for Burkina Faso (columns 2 and 3) and Senegal (columns 4 and 5), respectively. Asymptotic standard errors are computed following French and Jones (2011).

Table C.5: Estimated remaining parameters

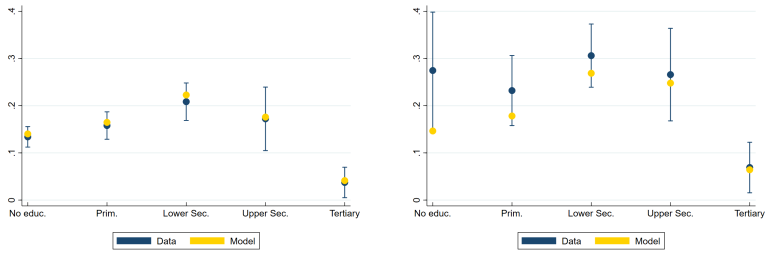
	Flow value of unemployment			
	Burkina Faso		Senegal	
	low PB $b(h, k = 0)$	high PB $b(h, k = 1)$	low PB $b(h, k = 0)$	high PB $b(h, k = 1)$
No education	-46.85	-36.65	-26.00	-35.24
Primary	-49.55	-44.38	-13.10	-15.95
Lower secondary	-42.02	-48.50	-16.82	-25.05
Upper secondary	-8.58	-13.16	-31.27	11.98
Tertiary	-243.29	-352.25	-128.99	-102.39
Other parameters				
$\frac{q(\kappa)}{\kappa}$: Public/private offer arrival rate	0.72		0.17	
c: Cost of private vacancy posting	3.20		9.10	
v_g: Public sector vacancies	16.54		1.21	

Notes: The table shows some parameters of interest which are easy to interpret or which are used for the simulation scenarios. These parameters have been calculated using the calibrated parameters and the estimated parameters reported in tables C.1 to C.5. The uppper panel shows the flow value of unemployment for each education-parental background type, the lower panel shows parameters pertaining to the creation of public and formal vacancies.

Table C.6: Parameters of interest derived from estimated parameters

D Appendix: Goodness of Fit

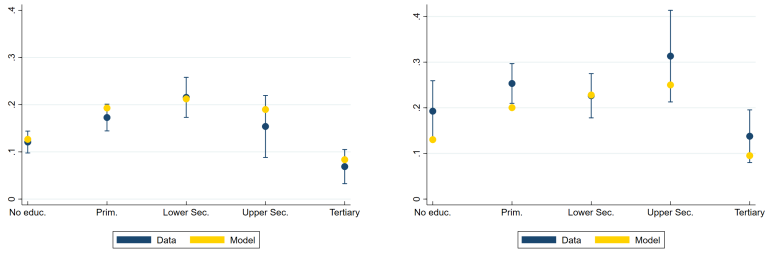
Appendix D.A Goodness of Fit



(a) Low (b) High

Notes: The figures show observed unemployment rates (dark dots) by parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Burkina Faso. The first panel refers to unemployment rates of individuals with low parental background, the second to those with high parental background.
Source: Authors' calculations.

Figure D.1: Goodness of Fit - Burkina Faso - Unemployment

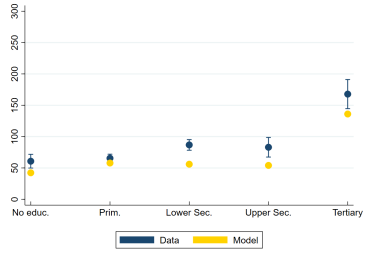


(a) Low (b) High

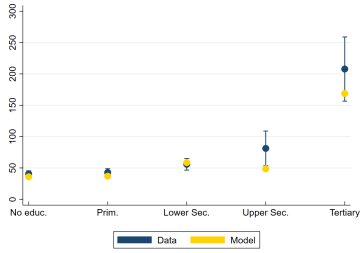
Notes: The figures show observed unemployment rates (dark dots) by parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Senegal. The first panel refers to unemployment rates of individuals with low parental background, the second to those with high parental background.
Source: Authors' calculations.

Figure D.2: Goodness of Fit - Senegal - Unemployment

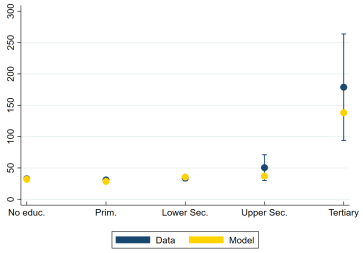
Mean wages



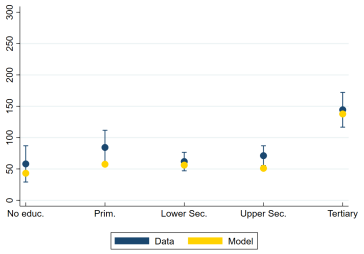
(a) Public - Low



(b) Private - Low

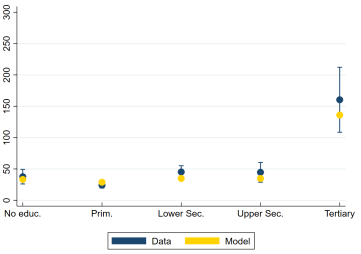


(c) Self-employment - Low



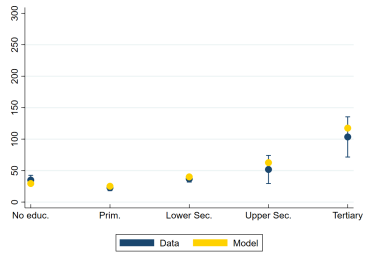
(d) Public - High

(e) Private - High

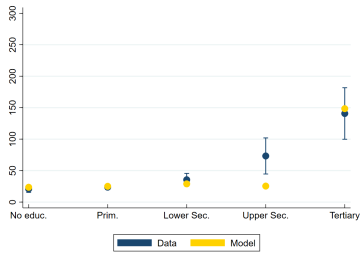


(f) Self-employment - High

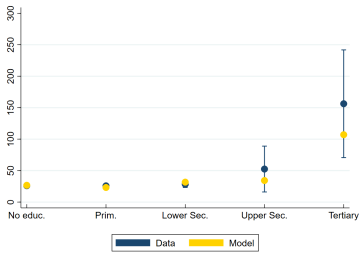
Standard deviation of wages



(g) Public - Low

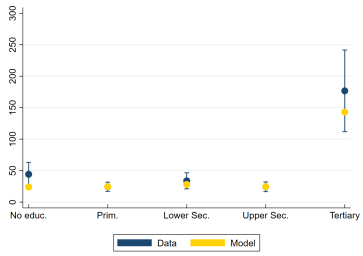


(h) Private - Low

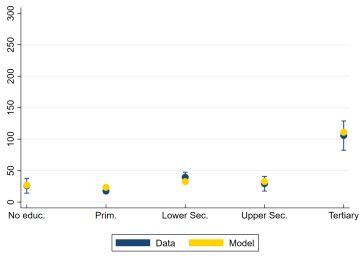


(i) Self-employment - Low

(j) Public - High



(k) Private - High

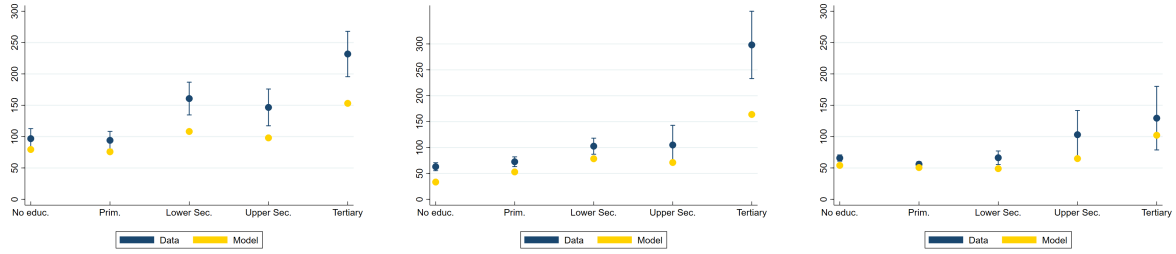


(l) Self-employment - High

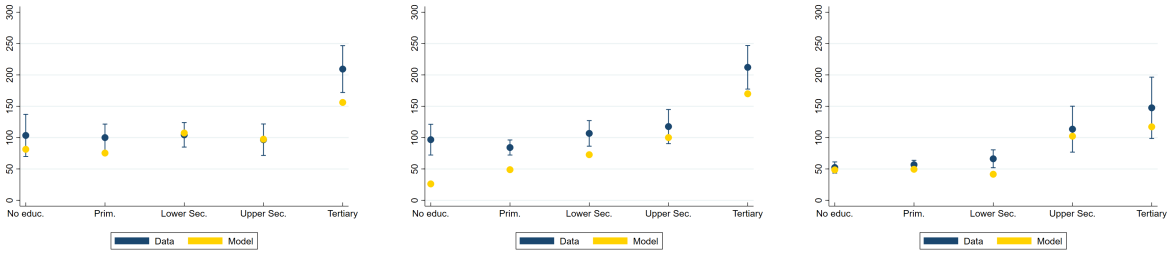
Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Burkina Faso. The first six panels (a) to (f) refer to mean wages, and the last six panels (g) to (l) to the standard deviation of wages.
Source: Authors' calculations.

Figure D.3: Goodness of Fit - Burkina - Wage moments: Mean and standard deviation

Mean wages

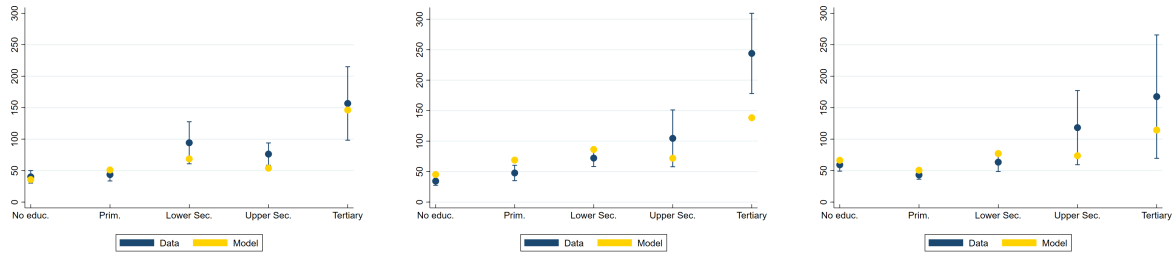


(a) Public - Low (b) Private - Low (c) Self-employment - Low

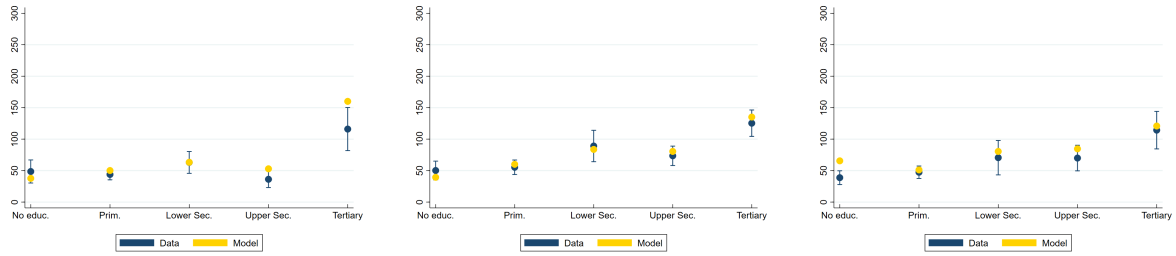


(d) Public - High (e) Private - High (f) Self-employment - High

Standard deviation of wages



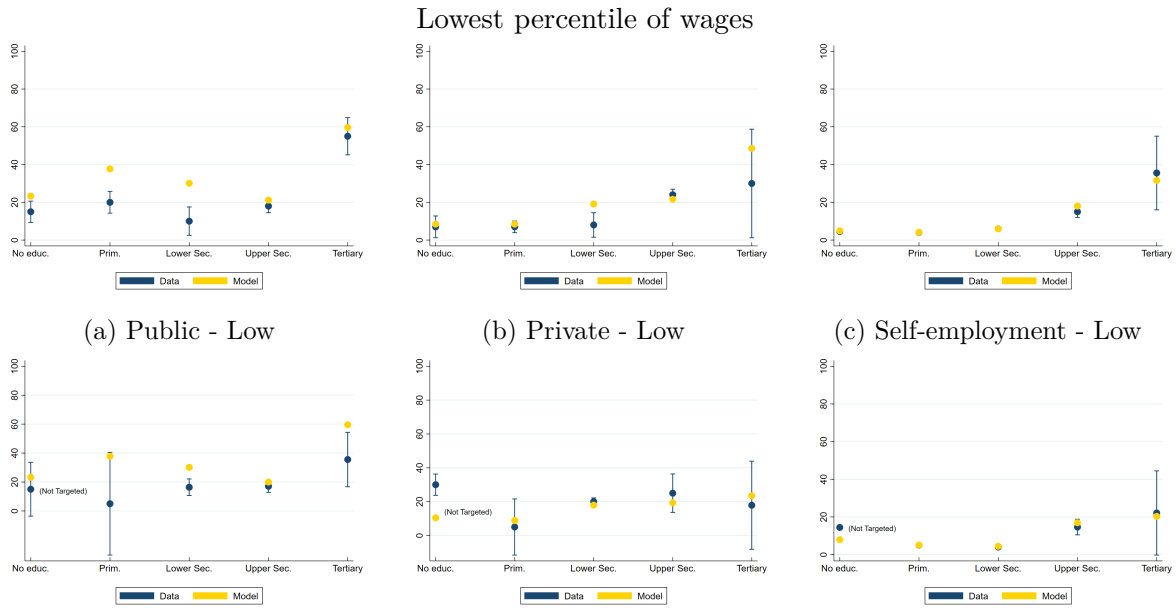
(g) Public - Low (h) Private - Low (i) Self-employment - Low



(j) Public - High (k) Private - High (l) Self-employment - High

Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Senegal. The first six panels (a) to (f) refer to mean wages, and the last six panels (g) to (l) to the standard deviation of wages.
Source: Authors' calculations.

Figure D.4: Goodness of Fit - Senegal - Wage moments: Mean and standard deviation

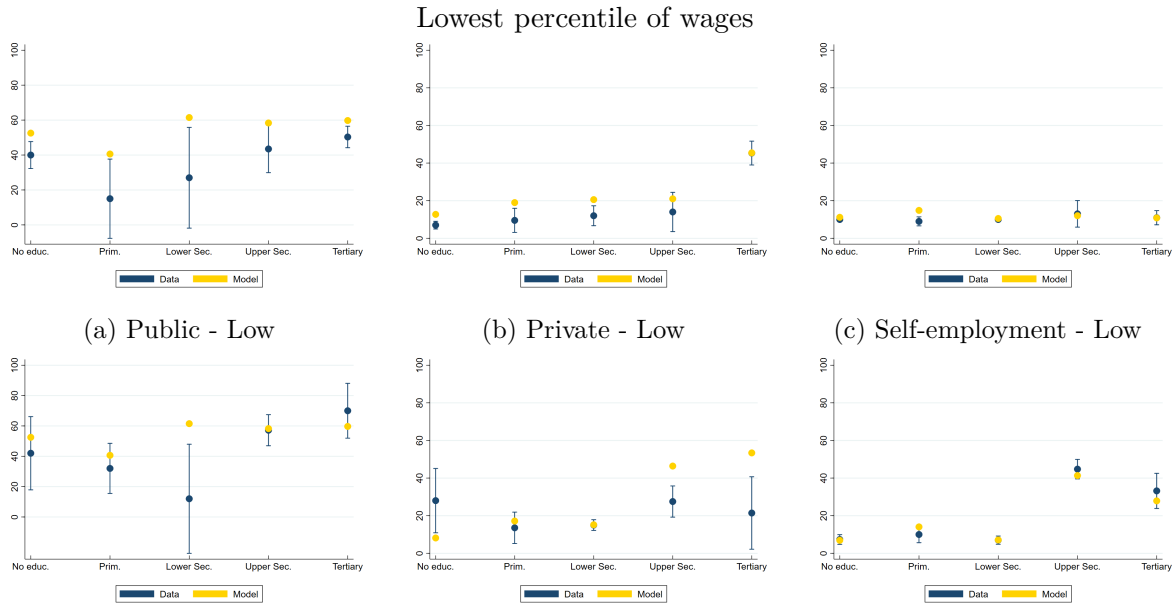


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Burkina Faso. The six panels refer to the lowest percentile of wages. Due to too few observations, the lowest percentile of wages was not targeted for workers with "no education" and high parental background.
Source: Authors' calculations.

Figure D.5: Goodness of Fit - Burkina - Wage moments: Lowest percentile

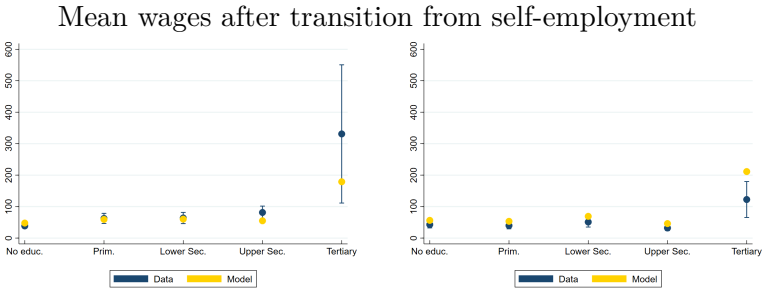


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Senegal. The six panels refer to the lowest percentile of wages.
Source: Authors' calculations.

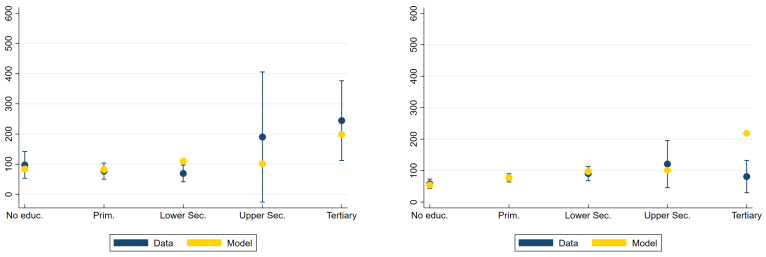
Figure D.6: Goodness of Fit - Senegal - Wage moments: Lowest percentile



(a) Public (b) Private

Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Burkina Faso. The first panel refers to the mean wage in the public sector after transitioning from self-employment. The second panel refers to the mean wage in the private sector after transitioning from self-employment.
Source: Authors' calculations.

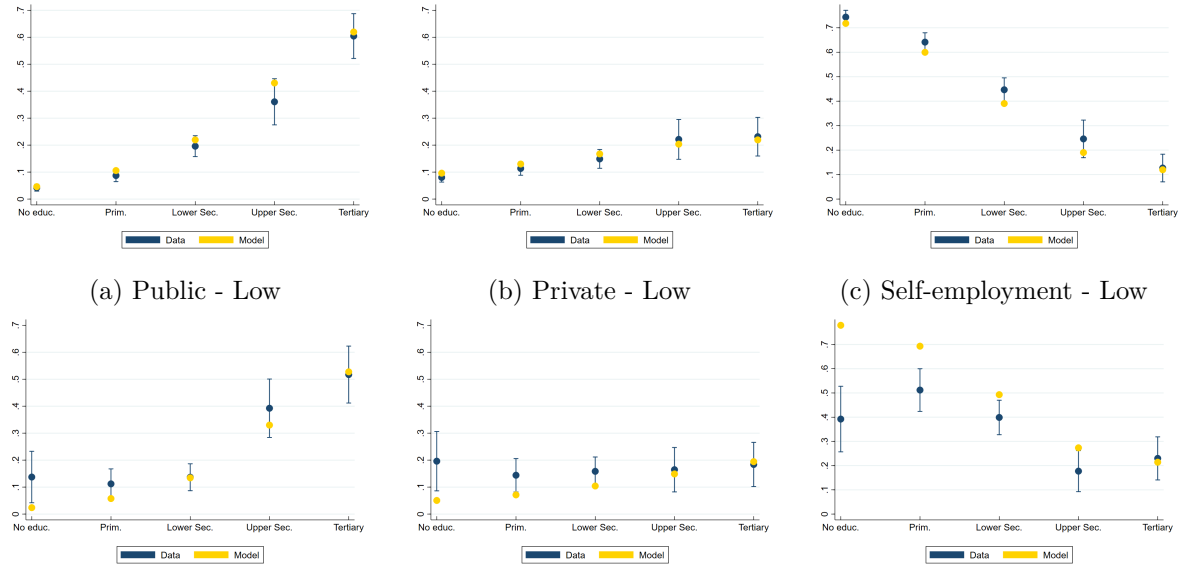
Figure D.7: Goodness of Fit - Burkina - Mean wages after self-employment



(a) Public (b) Private

Notes: The figures show observed wage moments (dark dots) by sector and parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Senegal. The first panel refers to the mean wage in the public sector after transitioning from self-employment. The second panel refers to the mean wage in the private sector after transitioning from self-employment.
Source: Authors' calculations.

Figure D.8: Goodness of Fit - Senegal - Mean wages after self-employment

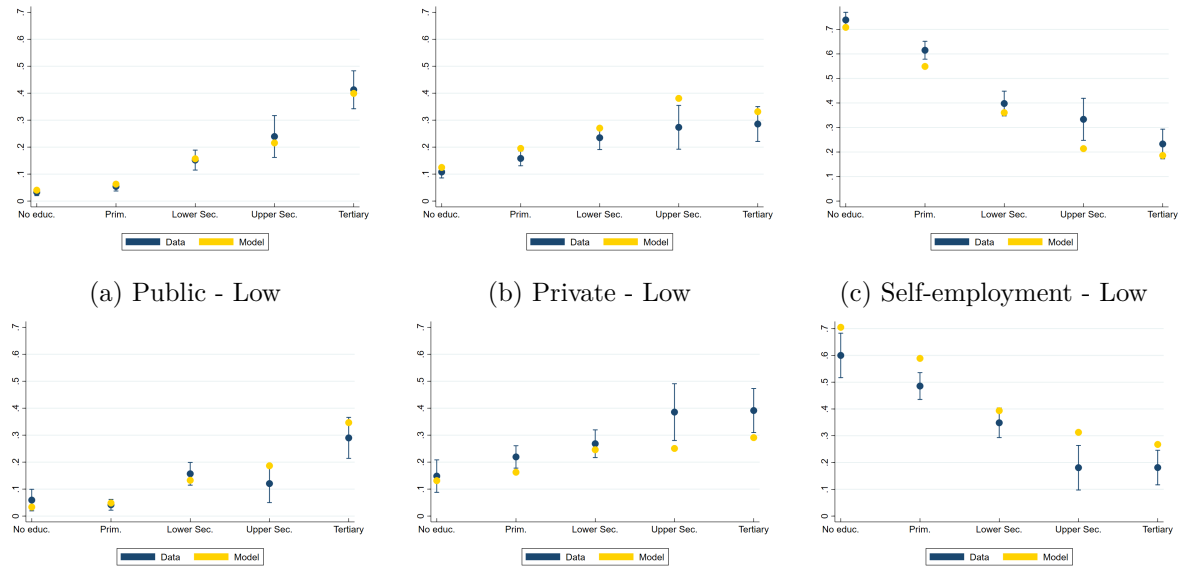


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed sectoral shares among all individuals (dark dots) by parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Burkina Faso.
Source: Authors' calculations.

Figure D.9: Goodness of Fit - Burkina Faso - Sectoral shares

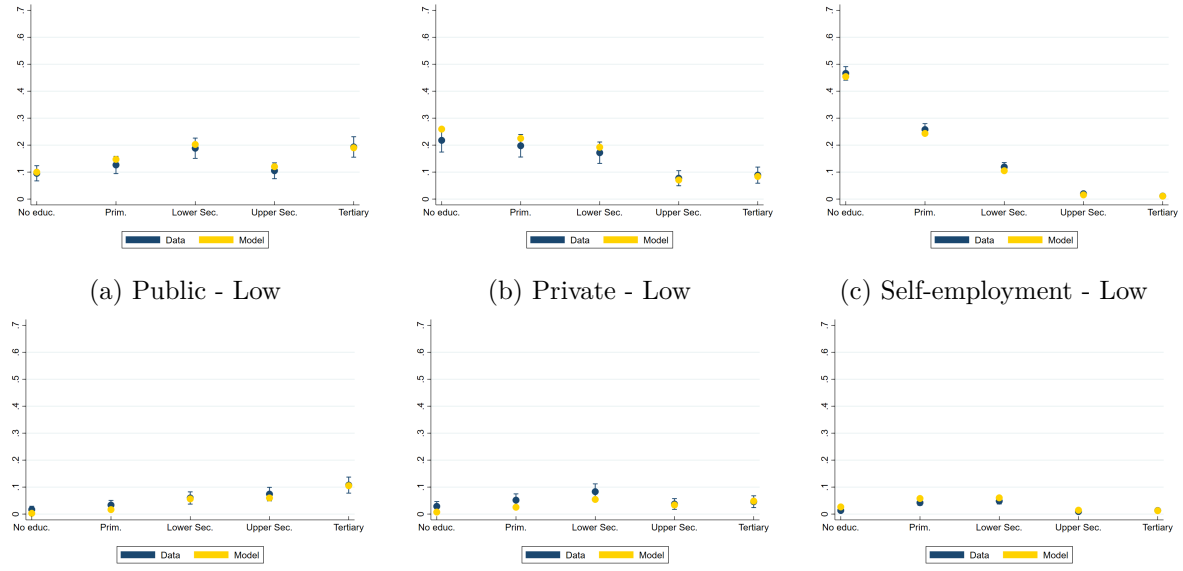


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed sectoral shares among all individuals (dark dots) by parental background (low, high) for different education levels (x-axis), the corresponding 95% confidence intervals (whiskers) and their simulated counterparts (light dots) for Senegal.
Source: Authors' calculations.

Figure D.10: Goodness of Fit - Senegal - Sectoral shares

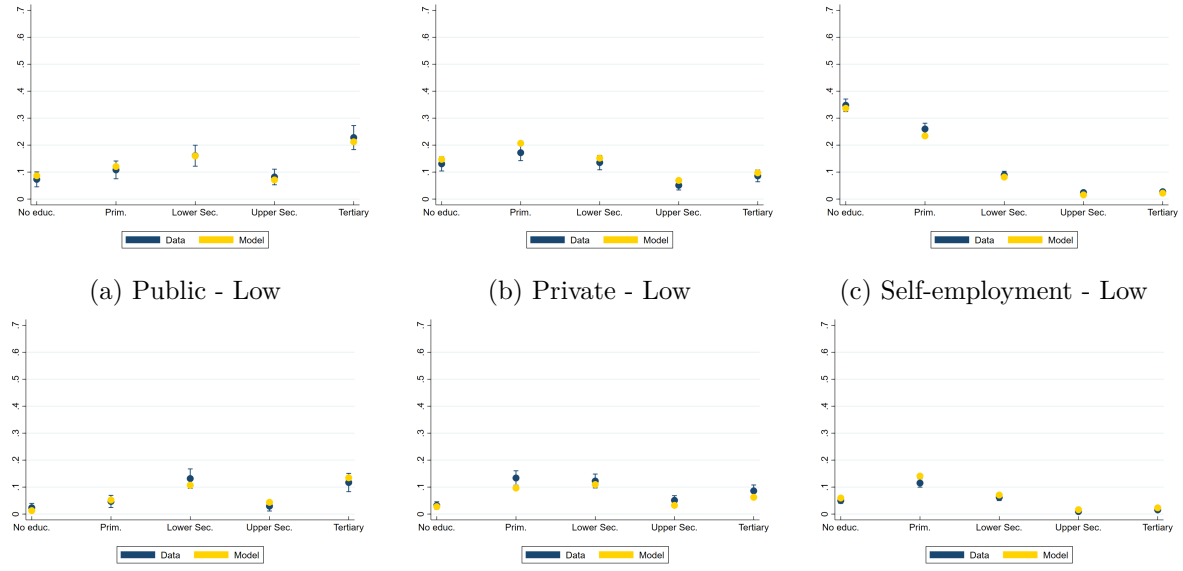


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed shares of each type of worker (education level - parental background) within a sector (dark dots). The figure also plots the corresponding 95% confidence intervals (whiskers) and the simulated shares (light dots) for Burkina Faso. For each sector, the dots over all education and parental background levels sum to 1.
Source: Authors' calculations.

Figure D.11: Goodness of Fit - Burkina Faso - Education-parental background composition of each sector

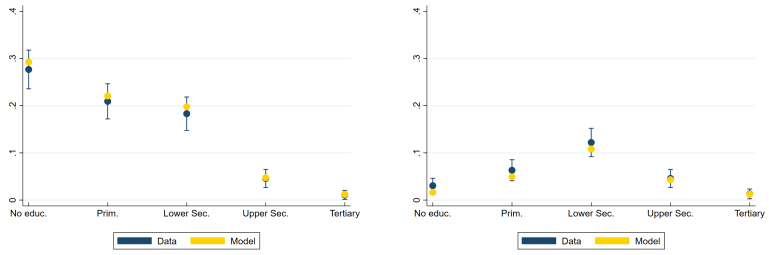


(a) Public - Low (b) Private - Low (c) Self-employment - Low

(d) Public - High (e) Private - High (f) Self-employment - High

Notes: The figures show observed shares of each type of worker (education level - parental background) within a sector (dark dots). The figure also plots the corresponding 95% confidence intervals (whiskers) and the simulated shares (light dots) for Senegal. For each sector, the dots over all education and parental background levels sum to 1.
Source: Authors' calculations.

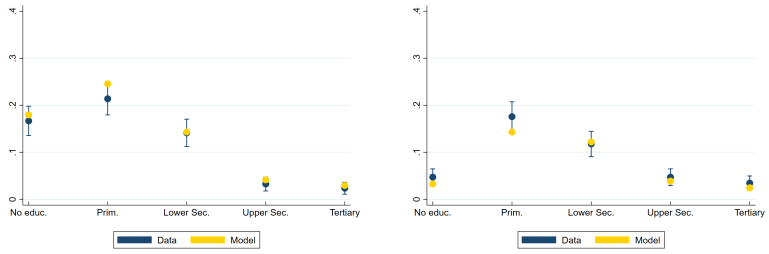
Figure D.12: Goodness of Fit - Senegal - Education-parental background composition of each sector



(a) Unemployment - Low (b) Unemployment - High

Notes: The figures show observed shares of each type of worker (education level - parental background) in unemployment (dark dots) for Burkina Faso. The figure also plots the corresponding 95% confidence intervals (whiskers) and the simulated shares (light dots). For each sector, the dots over all education and parental background levels sum to 1.
Source: Authors' calculations.

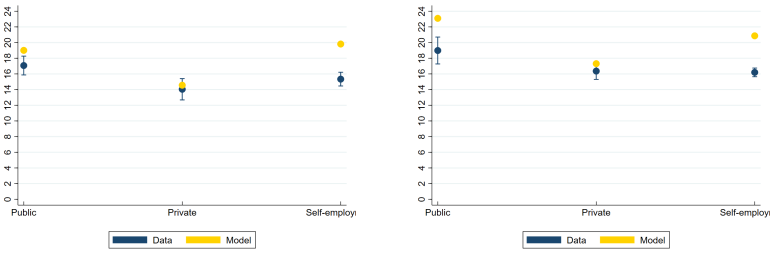
Figure D.13: Goodness of Fit - Burkina Faso - Education-parental background composition of unemployment



(a) Unemployment - Low (b) Unemployment - High

Notes: The figures show observed shares of each type of worker (education level - parental background) in unemployment (dark dots) for Senegal. The figure also plots the corresponding 95% confidence intervals (whiskers) and the simulated shares (light dots). For each sector, the dots over all education and parental background levels sum to 1.
Source: Authors' calculations.

Figure D.14: Goodness of Fit - Senegal - Education-parental background composition of unemployment



(a) Duration - Burkina Faso (b) Duration - Senegal

Notes: The figures show the average observed employment duration in each sector (dark dots) for Burkina Faso (left panel) and Senegal (right panel), respectively. The figure also plots the corresponding 95% confidence intervals (whiskers) and the simulated duration (light dots).
Source: Authors' calculations.

Figure D.15: Goodness of Fit - Burkina Faso and Senegal - Duration by sector

	Current State											
	Unemployed			Public			Private			Self-employed		
Past State	Data	SE	Model	Data	SE	Model	Data	SE	Model	Data	SE	Model
No education												
Unemployed	71.2%	3.1%	74.8%	0.9%	0.9%	1.7%	3.5%	1.7%	3.5%	24.4%	3.2%	20.0%
Public	15.4%	5.1%	17.9%	69.2%	6.5%	80.0%	1.9%	1.9%	0.4%	13.5%	4.8%	1.8%
Private	8.7%	3.4%	20.0%	0.0%	1.0%	0.1%	88.4%	3.9%	78.2%	2.9%	2.0%	1.7%
Self-Employed	3.3%	0.8%	4.6%	0.2%	0.2%	0.4%	0.5%	0.3%	0.8%	96.0%	0.8%	94.2%
Primary												
Unemployed	75.1%	3.3%	76.9%	1.3%	1.2%	2.3%	3.7%	2.0%	3.3%	19.9%	3.4%	17.4%
Public	9.1%	3.6%	16.6%	84.8%	4.4%	81.8%	1.5%	1.5%	0.3%	4.5%	2.6%	1.4%
Private	11.0%	3.7%	17.3%	0.0%	1.0%	0.2%	82.2%	4.5%	80.9%	6.8%	3.0%	1.6%
Self-Employed	3.0%	1.0%	6.4%	0.6%	0.4%	0.7%	0.0%	1.0%	0.9%	96.3%	1.0%	92.1%
Lower Secondary												
Unemployed	80.8%	3.4%	78.5%	2.8%	1.8%	2.2%	3.9%	2.1%	2.9%	12.5%	3.2%	16.3%
Public	3.6%	2.0%	8.6%	91.7%	3.0%	90.5%	0.0%	1.0%	0.2%	4.8%	2.3%	0.8%
Private	14.9%	4.2%	15.9%	1.4%	1.4%	0.2%	79.7%	4.7%	82.6%	4.1%	2.3%	1.3%
Self-Employed	3.7%	1.5%	12.4%	2.5%	1.2%	0.6%	2.5%	1.2%	1.1%	91.4%	2.2%	85.9%
Upper Secondary												
Unemployed	83.5%	5.4%	87.4%	7.7%	4.9%	8.2%	4.0%	3.9%	3.9%	4.7%	4.1%	0.4%
Public	2.4%	2.4%	9.2%	97.6%	2.4%	90.6%	0.0%	1.0%	0.2%	0.0%	1.0%	0.0%
Private	9.4%	5.2%	9.4%	9.4%	5.2%	0.4%	78.1%	7.4%	90.2%	3.1%	3.1%	0.0%
Self-Employed	3.7%	3.7%	20.0%	14.8%	7.0%	2.5%	3.7%	3.7%	1.2%	77.8%	8.2%	76.3%
Tertiary												
Unemployed	78.5%	6.5%	78.5%	14.3%	8.3%	7.6%	3.6%	5.7%	2.0%	3.6%	5.7%	11.9%
Public	0.0%	1.0%	3.1%	98.9%	1.1%	96.7%	1.1%	1.1%	0.0%	0.0%	1.0%	0.2%
Private	2.9%	2.9%	2.6%	2.9%	2.9%	0.1%	82.9%	6.5%	97.2%	11.4%	5.5%	0.2%
Self-Employed	2.7%	2.7%	6.9%	21.6%	6.9%	2.2%	8.1%	4.5%	0.8%	67.6%	7.8%	90.1%

Notes: The table shows the observed 3-year transition rates (i.e. column "Data"), their corresponding standard error (column "SE") and the simulated counterparts (column "Model") for Burkina Faso.

Table D.1: Goodness of Fit - Burkina Faso - Transition rates

	Current State											
	Unemployed			Public			Private			Self-employed		
Past State	Data	SE	Model	Data	SE	Model	Data	SE	Model	Data	SE	Model
No education												
Unemployed	90.9%	3.3%	93.7%	0.2%	0.8%	0.1%	1.1%	1.8%	1.1%	7.8%	3.4%	5.1%
Public	0.0%	1.0%	5.4%	90.6%	5.2%	94.4%	3.1%	3.1%	0.0%	6.3%	4.3%	0.1%
Private	2.4%	1.7%	11.4%	0.0%	1.0%	0.0%	92.8%	2.9%	88.4%	4.8%	2.4%	0.2%
Self-Employed	1.0%	0.5%	3.2%	0.0%	1.0%	0.2%	0.0%	1.0%	1.2%	99.0%	0.5%	95.5%
Primary												
Unemployed	86.8%	2.8%	93.8%	0.7%	0.9%	0.6%	3.7%	2.0%	1.2%	8.8%	2.6%	4.5%
Public	10.2%	4.4%	18.0%	81.6%	5.6%	81.5%	2.0%	2.0%	0.1%	6.1%	3.5%	0.4%
Private	3.6%	1.6%	11.1%	1.4%	1.0%	0.0%	92.8%	2.2%	88.7%	2.2%	1.2%	0.2%
Self-Employed	2.2%	0.7%	6.0%	0.0%	1.0%	0.9%	1.3%	0.5%	1.5%	96.5%	0.8%	91.6%
Lower Secondary												
Unemployed	88.3%	3.4%	94.2%	1.1%	1.4%	0.3%	4.6%	2.7%	2.4%	6.0%	3.0%	3.2%
Public	0.0%	1.0%	3.6%	97.6%	1.7%	96.3%	0.0%	1.0%	0.0%	2.4%	1.7%	0.0%
Private	4.6%	2.0%	14.6%	0.0%	1.0%	0.0%	91.7%	2.7%	85.1%	3.7%	1.8%	0.2%
Self-Employed	3.5%	1.4%	9.7%	0.6%	0.6%	0.6%	3.5%	1.4%	3.8%	92.4%	2.0%	86.0%
Upper Secondary												
Unemployed	87.9%	5.8%	94.8%	2.1%	3.4%	0.2%	6.5%	5.3%	1.6%	3.5%	4.3%	3.5%
Public	0.0%	1.0%	1.8%	100.0%	1.0%	98.1%	0.0%	1.0%	0.0%	0.0%	1.0%	0.0%
Private	5.6%	3.9%	9.6%	0.0%	1.0%	0.0%	94.4%	3.9%	90.2%	0.0%	1.0%	0.2%
Self-Employed	2.4%	2.4%	13.9%	0.0%	1.0%	0.3%	9.5%	4.6%	2.9%	88.1%	5.1%	82.9%
Tertiary												
Unemployed	81.9%	6.4%	97.2%	2.5%	3.8%	0.4%	9.5%	6.3%	0.6%	6.0%	5.4%	1.7%
Public	0.0%	1.0%	3.4%	100.0%	1.0%	96.6%	0.0%	1.0%	0.0%	0.0%	1.0%	0.0%
Private	5.1%	2.5%	7.0%	1.3%	1.3%	0.0%	91.1%	3.2%	92.9%	2.5%	1.8%	0.1%
Self-Employed	0.0%	1.0%	5.6%	4.0%	2.8%	2.2%	8.1%	4.5%	0.8%	94.0%	3.4%	88.3%

Notes: The table shows the observed 3-year transition rates (i.e. column "Data"), their corresponding standard error (column "SE") and the simulated counterparts (column "Model") for Senegal.

Table D.2: Goodness of Fit - Senegal - Transition rates

E Appendix: Policy simulations - Heterogeneity

		Low Parental Background				High Parental Background			
		Baseline	Policy 1	Policy 2	Policy 3	Baseline	Policy 1	Policy 2	Policy 3
		Level	percentage change			Level	percentage change		
Public sector	No Educ.	0.05	7.1	-2.0	-20.5	0.02	6.7	-1.9	-13.5
	Primary	0.11	8.5	0.3	-26.9	0.06	6.9	-0.1	-18.7
	Low Sec.	0.22	10.6	0.8	-37.5	0.13	8.2	0.4	-27.6
	Upper Sec.	0.43	15.0	2.6	-62.1	0.33	9.4	1.0	-58.1
	Tertiary	0.62	11.0	1.4	-57.3	0.53	10.5	0.8	-40.4
Private sector	No Educ.	0.10	-37.8	-7.9	260.3	0.05	-38.2	-8.4	280.3
	Primary	0.13	-36.9	-7.3	224.1	0.07	-37.9	-7.7	259.6
	Low Sec.	0.17	-35.7	-6.5	182.7	0.10	-37.2	-7.0	227.6
	Upper Sec.	0.21	-36.8	-6.7	180.0	0.15	-36.0	-6.3	206.9
	Tertiary	0.22	-35.1	-6.1	180.9	0.19	-36.1	-6.0	165.6
Self-employment	No Educ.	0.71	4.4	1.2	-30.9	0.78	2.1	0.6	-16.0
	Primary	0.60	5.5	1.3	-36.3	0.69	2.9	0.7	-21.1
	Low Sec.	0.39	6.5	1.6	-38.1	0.49	3.9	0.9	-27.0
	Upper Sec.	0.19	3.0	0.7	-28.4	0.27	4.5	1.2	-23.0
	Tertiary	0.12	6.4	3.1	-29.2	0.21	5.4	2.8	-39.2
Unemployment	No Educ.	0.14	1.4	0.1	-15.7	0.15	0.7	0.1	-8.8
	Primary	0.16	3.2	0.6	-25.2	0.18	1.7	0.3	-15.5
	Low Sec.	0.22	5.2	1.3	-35.2	0.27	3.2	0.8	-25.1
	Upper Sec.	0.17	3.1	0.7	-28.5	0.25	4.5	1.2	-23.1
	Tertiary	0.04	5.5	2.1	-26.3	0.07	4.9	2.0	-36.1
Welfare	No Educ.	21.7	-3.1	5.8	34.5	23.5	-3.7	6.1	37.4
	Primary	19.8	-4.0	4.2	45.8	19.4	-4.1	5.0	50.1
	Low Sec.	26.1	-8.2	1.4	74.7	20.2	-9.8	2.4	99.7
	Upper Sec.	35.9	-4.1	-1.3	44.8	30.1	-4.3	-1.3	55.7
	Tertiary	132.8	-3.2	0.6	44.4	117.2	-2.8	1.0	31.7

Notes: Labour market outcomes and statistics across heterogenous workers from alternative policy simulations following a 10% increase in government expenses. Policy 1: 10.3% increase in public sector vacancies, policy 2: 5.8% wage subsidy for self-employment, and policy 3: 38.4% subsidy for private sector vacancy creation. Columns 4 to 6, and 8 to 10 give the percentage changes with respect to the relevant baseline level.

Table E.1: Changes across education groups following a 10% increase of government expenses - Burkina Faso

		Low Parental Background				High Parental Background			
		Baseline	Policy 1	Policy 2	Policy 3	Baseline	Policy 1	Policy 2	Policy 3
		Level	percentage change			Level	percentage change		
Public sector	No Educ.	0.04	9.8	-1.1	-22.6	0.03	10.0	-1.3	-23.0
	Primary	0.06	10.8	-0.7	-28.1	0.05	10.4	-0.6	-26.9
	Low Sec.	0.15	11.2	0.6	-31.8	0.13	11.7	0.5	-32.7
	Upper Sec.	0.22	11.4	0.9	-34.5	0.19	10.3	0.6	-29.6
	Tertiary	0.39	9.3	0.3	-40.0	0.35	9.4	0.1	-44.3
Private sector	No Educ.	0.13	-10.7	-7.0	76.8	0.13	-10.4	-7.7	72.3
	Primary	0.19	-9.9	-3.7	61.7	0.16	-10.1	-4.0	63.9
	Low Sec.	0.27	-9.0	-1.6	46.8	0.24	-8.8	-1.8	46.1
	Upper Sec.	0.38	-8.8	-1.9	42.2	0.25	-9.8	-2.0	54.8
	Tertiary	0.33	-11.5	-1.7	62.4	0.29	-11.4	-1.9	65.8
Self-employment	No Educ.	0.70	1.3	1.3	-11.9	0.71	1.4	1.5	-11.8
	Primary	0.55	1.8	1.2	-14.8	0.59	1.5	1.0	-12.3
	Low Sec.	0.36	1.4	0.7	-13.9	0.40	1.0	0.7	-10.9
	Upper Sec.	0.22	2.6	1.5	-23.3	0.31	1.0	0.7	-15.2
	Tertiary	0.19	1.2	2.1	-22.4	0.27	0.4	1.7	-12.2
Unemployment	No Educ.	0.13	0.1	0.1	-2.6	0.13	0.1	0.1	-2.2
	Primary	0.19	1.4	0.5	-10.5	0.20	1.1	0.5	-8.8
	Low Sec.	0.21	1.0	0.5	-12.9	0.23	0.8	0.4	-11.2
	Upper Sec.	0.19	1.7	1.1	-18.9	0.25	0.8	0.7	-13.9
	Tertiary	0.08	-0.6	0.7	-9.7	0.10	-0.6	0.7	-6.0
Welfare	No Educ.	41.3	-0.5	4.7	7.3	36.6	-0.5	5.2	7.7
	Primary	40.0	-1.3	2.9	16.8	37.7	-1.2	3.1	16.5
	Low Sec.	49.4	-2.0	0.5	31.1	42.0	-2.3	0.6	36.8
	Upper Sec.	57.6	-0.9	1.1	20.3	75.5	-1.5	1.0	17.6
	Tertiary	135.9	-0.7	0.9	17.2	137.3	-0.9	1.1	19.9

Notes: Labour market outcomes and statistics across heterogenous workers from alternative policy simulations following a 10% increase in government expenses. Policy 1: 11.4% increase in public sector vacancies, policy 2: 4.3% wage subsidy for self-employment, and policy 3: 35.3% subsidy for private sector vacancy creation. Columns 4 to 6, and 8 to 10 give percentage changes with respect to the relevant baseline level.

Table E.2: Changes across education groups following a 10% increase of government expenses - Senegal

F Appendix: Media sources

On (public) employment creation:

- Côte d'Ivoire (2012-2015, prolonged until 2020): https://afriquemagazine.com/l-emploi-un-defi-majeur-pour-le-gouvernement and https://www.plan.gouv.ci/accueil/odd/3 both accessed on October 27, 2022.
- Côte d'Ivoire (2021-2030): https://www.agenceecofin.com/economie/0911-93023-le-gouvernement-ivoirien-entend-creer-8-millions-d-emplois-supplementaires-d-ici-2030 accessed on October 27, 2022.
- Mali: http://malizine.com/2017/07/18/200-000-emplois-promis-president-ibk-taux-dexecution-chiffre-a-998 accessed on October 27, 2022.
- Niger: http://atelier.rfi.fr/profiles/blogs/niger-an-3-du-pr-sident-issoufou-les-bons-et-mauvais-points-du-3 accessed on October 19, 2017.

On competition in selection procedures for public jobs:

- Burkina Faso: http://lefaso.net/spip.php?article78680 accessed on October 27, 2022
- Côte d'Ivoire: https://www.fonctionpublique.gouv.ci/?fp=nomenclature_concour accessed on November 6, 2017.
- Senegal: http://www.lejecos.com/Insertion-des-diplomes-Resorption-du-chomage-des-jeunes-Entre-lueurs-d-espoirs-et-issues-incertaines_a339.html accessed on October 5, 2022.

On supporting self-employment:

- Benin: http://anpe.bj/index.php?option=com_content&view=article&id=80:projet-emploi-des-jeunes-8-500-jeunes-selectionnes-pour-sortir-du-chomage-et-du-sous-emploi-2&catid=12:actualites-de-l-anpe&Itemid=128 accessed on October 19, 2017.
- Côte d'Ivoire: http://scaed.ci/content/emploi-des-jeunes-des-pr%C3%AAts-de-100-000-%C3%A0-700-000-f-cfa-aux-jeunes-de-10-r%C3%A9gions-pour-monter accessed on October 19, 2017.