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Migration, Education and Work Opportunities

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ABSTRACT

Migration, Education and Work Opportunities*

I study individual location, education and work decisions in a dynamic life-cycle model in a developing country. I estimate the model exploiting panel data on migrants and stayers in Burkina Faso, and cross-sectional data on permanent emigrants. Individuals self-select into migration and locations based on education. Migration to urban centres increases with education, while migrants at the extremes of the education distribution tend to move abroad. Local unemployment rates, skilled work opportunities and returns to education result in differential expected income gains across locations and hereby explain the complex migration pattern observed. Large income gains from migration are partially offset by direct and indirect migration costs, as well as by higher investment in education (for rural migrants). Migration prospects to urban centres drive education choices of rural individuals. Hence, migration policies can be used to stimulate educational attainment in rural regions.

JEL Classification: J61, O15, R58

Keywords: migration, education, life-cycle model, simulated method of moments, Burkina Faso

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1 Introduction

Migration is a key challenge both in developed and in developing countries. In 2013 there were 232 million international migrants in the World.[1] Another estimated 740 million people have migrated within country borders.[2] All in all, around 1 out of 7 people worldwide live outside their country or region of birth. Policy makers' concerns often relate to excessive rural-urban migration in developing countries, brain drain and low-skilled immigration to developed countries.

Migration and location decisions depend on economic opportunities and costs at home and in alternative locations. One major determinant of economic opportunities in a specific location is the return to human capital. Differences in local returns to human capital lead to self-selection of migrants. However, migration opportunities themselves are anticipated and have a profound effect on life choices such as human capital acquisition. The links between migration, location and education decisions are complex and, to date, not well understood. Quantifying returns to migration represents a challenge as the alternative to migration is not necessarily staying at home.

This paper studies self-selection into education, work and locations, and the interaction of these decisions in a dynamic framework of a developing country. To do this, I develop a life-cycle model of endogenous location, education and work choices. Forward-looking individuals decide each period where to locate and in which activity to engage. Activities include attending school, participating in the labour force or remaining out of work (nonworking). Facing different current and future work opportunities, benefits and costs in alternative locations, the individual thus chooses an optimal location and activity path.

The location-activity model attaches a particular importance to modelling local labour markets in a developing country, which differ across urban, rural and international locations. Work opportunities in rural locations include (subsistence) farming and working in low-skilled occupations. Returns to education in farming and rural work are small. Urban and international labour markets, in contrast, offer work opportunities both in low and skilled occupations. Return to education accrue from higher incomes within occupations, as well as from higher chances of working in skilled occupations (which pay higher incomes). Unemployment is another key feature of urban and international labour markets. It is non-monotonic in education, hereby altering expected local returns to education. Apart from local labour markets, locations also differ in

[1] United Nations (2013)
[2] United Nations (2009)

education opportunities, amenities, migration costs and other factors, which create further differential migration incentives.

I estimate this model using the method of simulated moments. To do so, I compiled data on all relevant determinants of migration. The main data set contains detailed retrospective migration, education and employment histories of migrants and stayers in Burkina Faso, and cross-sectional data on permanent emigrants. This allows me to simultaneously study selection into *internal* and *international* migration and how it relates to education. I also use a retrospective community survey on location characteristics, and labour force surveys from Burkina Faso and Côte d'Ivoire. By combining these pieces of information, I can estimate a range of structural parameters which pin down local returns to education, labour market outcomes, education and migration costs, as well as other benefits and costs associated with location and activity choices.

The model matches the rich education-migration pattern observed in Burkina Faso and sheds light unto the underlying mechanisms. Better educated individuals migrate more to urban centres, while migration abroad is U-shaped in education. A complex interplay of unemployment, skilled work opportunities and incomes in urban and international locations explains this pattern.

The opportunity to migrate increases life-cycle welfare of rural and urban individuals by around 10% and 1%, respectively. Life-cycle income itself increases by 80% for rural individuals, but migration comes at a large (opportunity) cost: Individuals invest more in education, and lose welfare when moving as they have a strong preference for staying in their origin (worth 65% of farming income). Urban individuals, in contrast, lower their investment in education, get lower incomes and locate where positive migration shocks occur. To sum up, returns to migration go beyond changes in (life-cycle) income and crucially depend on the context such as the origin of potential migrants.

Life-cycle returns to education are convex for both urban and rural individuals. These returns take into account expected income gains as well as direct and indirect costs of education. Returns to primary education are negative (around -5% per year), and positive for secondary and tertiary education (15% and 23%, respectively). Rural individuals have higher expected income gains from education, because they face worse income prospects when remaining uneducated than urban individuals. However, getting education is also more costly for the former: due to fewer schools in rural regions, the direct schooling cost is larger. Moreover, rural individuals need to migrate - and hence, incur direct and indirect costs of migration - to reap returns to education. This substantially lowers net returns to education, and translates into lower rural education.

I use the estimated life-cycle model to study how migration prospects affect education decisions. Migration prospects are a key determinant of education decisions of rural individuals. Rural individuals get on average 2.07 years of schooling. When migration to urban centres becomes infinitely costly, rural education drops by more than 60%. If individuals could not migrate at all, rural education would drop by almost 90% to 0.27 years. Urban individuals, in sharp contrast, make the same education choices even when certain migration destinations become unavailable. Education decisions also react to a decrease in direct migration costs. If migration was costless, rural education would increase by 35%. The increase would be even larger (60%) if only migration to urban centres was costless. Under costless migration, both the opportunity cost of education (by costless migration abroad) and returns to education (by costless urban migration) become larger. When only migration to urban centres becomes costless, solely the incentive effect through higher returns remains. For urban individuals, costless migration increases the opportunity cost of education without increasing expected returns, hence resulting in slightly lower urban education. These findings show how sensitive education choices are to migration prospects, suggesting that migration restrictions can have important consequences in terms of education outcomes.

The model developed in this paper builds on a small but growing body of research which studies migration choices in a life-cycle framework with many locations (see, for example, Kennan and Walker (2011), Gemici (2011) and Lessem (2013)). I extend the dynamic multi-location migration model in one important dimension, that is to include education and work choices as studied in the career choice literature (see for example, Keane and Wolpin (1997) and Attanasio et al. (2012)). The interaction of location, education and work choices is key when economic opportunities differ across locations and when education facilities are geographically concentrated, as is the case in many developing countries. Attanasio et al. (2012) model the education-work trade-off of children in Mexico. They point out that rural children reap returns to education by migrating from rural regions to urban centres. My paper explicitly models both education and migration decisions, and hereby allows me to study how migration prospects affect education choices and vice versa.

This paper is also related to a small literature which studies self-selection of heterogeneous agents into alternative locations. Dahl (2002), for example, studies how workers self-select through migration into US states and how this affects observed returns to education. My paper contributes to this research by extending the analysis to a developing country context and adopting a dynamic view of education, location and work decisions. The dynamic process in particular allows me to identify how education decisions are affected by migration prospects in the first place.

In response to the vast literature on brain drain (see Docquier and Rapoport (2012) for a survey), a few papers have attempted to study empirically how changes in emigration (see, for example, Batista et al. (2012)) or internal migration prospects (see, for example, Pan (ming)) affect education decisions. Using a dynamic and multi-location framework, my analysis provides a new perspective on these previous results. The impact of migration prospects are nuanced and depend crucially on the economic opportunities of individuals in the origin and possible migration destinations. Hence, better migration prospects lead to increased education for some individuals, and lower education of others. These results also offer new insights into private returns to education and education decisions in Sub-Saharan Africa (see Schultz (2004)).[3] While returns to education estimated from incomes of wage earners might appear large (even at primary education), net returns over the life cycle might be much lower. In fact, education decisions are not only driven by expected income gains, but also by unemployment risk, schooling and migration costs.

The remaining part of this paper is structured as follows. Section 2 presents empirical evidence on migration, education and labour market outcomes in Burkina Faso. It highlights the need for a dynamic structural model when studying migration decisions. Section 3 develops a dynamic structural model which features forward-looking individuals who maximise expected lifetime utility by choosing an optimal sequence of locations and activities. Section 4 discusses the estimation procedure, the estimation results are presented in Section 5. Sections 6 and 7 use the estimated model to provide an in-depth-analysis of returns to migration and returns to education in Burkina Faso. Using counterfactual simulations, Section 8 studies how migration prospects affect education and location decisions of individuals. Section 9 concludes.

2 Data and empirical evidence

2.1 Data

This paper combines information from different data sources. The main data set comes from the research project *'Migration Dynamics, Urban Integration and Environment*

[3]Following a widely cited and repeatedly updated cross-sectional study by Psachoropolous on the private returns to education (see Psachoropoulos (1994)), many studies have since estimated private returns to education in Sub-Saharan countries using a Mincerian framework. Other recent contributions include Kazianga (2004), Nordman and Roubaud (2009), Chirwa and Matita (2009), Oyelere (2010), Lassibille and Tan (2005), Appleton (2001) and Kuepie et al. (2009).

Survey of Burkina Faso' (henceforth, EMIUB[4]). In year 2000, the EMIUB collected nationally representative data on 3,500 households, their 20,000 male and female members, and 1,260 male and female permanent emigrants who had lived in the household prior to emigration (Poirier et al. (2001)). It contains exceptionally rich, retrospective life-history data on stayers and migrants from Burkina Faso, and cross-sectional data on permanent emigrants.

For the descriptive evidence and estimation, I draw on the EMIUB for location, education and labour market histories of migrants and stayers, and the same cross-sectional outcomes for permanent emigrants. The EMIUB provides detailed information on employment status and occupation, but it does not report earnings. I complement this with income data from the DSA-EP surveys[5] of Burkina Faso and Côte d'Ivoire in 1994 and 1993, respectively. The income of subsistence farmers is calibrated using regional agricultural production and price data.[6] Location characteristics on 600 towns and villages in Burkina Faso are from a community survey which was designed to complement the EMIUB (Schoumaker et al. (2004)). It reports retrospectively collected data on schools and health centres, employment opportunities, agricultural structure, transportation, natural disasters and conflicts since 1960.

2.2 Descriptive statistics

Table 1 presents sample statistics on educational attainment, labour market and migration outcomes of Burkinabe men by origin. In survey year 2000, they were between 15 and 48 years old. The origin (or home) is defined as the place of residence at age 6.

Urban and rural individuals differ in many respects. Individuals from a rural origin are on average four years older, have lower educational attainment (only 29% have ever gone to school) and are more likely to have migrated (72%) compared to those of urban origin, where the corresponding schooling and migrant shares are 82% and 37%, respectively. More rural individuals have migrated than gone to school, while more

[4]The EMIUB survey was conducted by the 'Institut Supérieur des Sciences de la Population' (ISSP) at the University of Ouagadougou, the 'Département de Démographie' of the University of Montreal and the 'Centre d'Etudes et de Recherche sur la Population pour le Développement ' (CERPOD) in Bamako. EMIUB stands for 'Enquête migratoire, insertion urbaine et environment au Burkina Faso'.

[5]In the 1980s many 'Structural Adjustment Programmes' were implemented in Sub-Saharan Africa. In order to evaluate their social impact, the World Bank launched a programme called 'Dimensions sociales de l'Ajustement Structurel' (in English: Social Dimensions of Structural Adjustment). One part of this programme consisted of conducting a priority survey, the 'Dimensions sociales de l'Ajustement Structurel - Enquête Prioritaire', henceforth abbreviated as 'DSA-EP'.

[6]This data is provided by the 'Direction Générale des Prévisisons et des Statistiques Agricoles du Burkina Faso' (DGSPA) and the 'Food and Agriculture Organization' (FAO).

[7]Moves per migrant are downward biased because observed/reconstructed location histories are incomplete for most permanent emigrants.

	All	Origin Urban	Rural
Summary statistics			
Number of individuals	3,804	919	2,885
Person-years		19,733	73,503
Mean age in year 2000	29.51	26.47	30.48
Educational attainment in 2000			
No schooling (%)	58.5%	17.7%	71.5%
Primary (%)	18.9%	33.9%	14.1%
Secondary (%)	20.1%	43.9%	12.6%
Tertiary (%)	2.5%	4.5%	1.8%
Labour market status in 2000			
Students (%)	8.9%	23.1%	3.9%
Labour force (%)	90.0%	76.3%	94.9%
Non-working (%)	1.1%	0.6%	1.2%
Migration statistics			
Migrants (%)	63.1%	36.9%	71.5%
Moves per migrant[7]	1.97	2.12	1.95
Yearly migration rate	5.52%	3.77%	6.02%
Residence of migrants in 2000			
Returned home (%)		60.2%	26.5%
Urban centre (%)		13.6%	41.7%
Rural region (%)		1.2%	4.8%
Abroad (%)		25.1%	27.1%

Notes: Migrants are those individuals who have migrated at least once between age 6 and year 2000.

Table 1: Descriptive statistics

urban individuals have gone to school than migrated.

Whether a migrant returns home or not depends on his origin. 60% of migrants from an urban origin had returned home by year 2000, while among those from a rural origin the rate was only 27%. Independently of origin, one out of four migrants were living abroad in year 2000. These observations would be missing in a standard labour force survey. Studying migration decisions, hence, requires information on emigrants who have not returned to their sending country. This data is available in the EMIUB survey.

Table 2 provides descriptive evidence on migration flows observed for migrants of urban and rural origin (upper and lower panel). Rows refer to provenance, columns to destination. Net flows are given by the total of inflows (column) minus total outflows (row).

		Destination				
Urban origin		Home	Urban	Rural	Abroad	Total
Provenance	Home	-	83	143	167	393
	Urban	49	-	8	4	61
	Rural	120	19	22	10	171
	Abroad	86	6	1	-	93
	Total	255	108	174	181	718
Rural origin						
Provenance	Home	-	902	219	1,264	2,385
	Urban	150	119	88	123	480
	Rural	86	116	28	61	291
	Abroad	655	167	44	-	866
	Total	891	1,304	379	1,448	4,022

Table 2: Migration flows for urban and rural migrants

Migration flows are complex. Urban migrants tend to move temporarily. Almost all migrations to rural regions are reversed, while return rates are lower but still large for international and urban destinations. Rural migrants, instead, move and tend to stay away. Their main migration destinations are international and urban locations with gross inflows of 1448 and 1304, respectively. Of these 1448 emigrations, 655 returned to their rural home, 582 stayed abroad and another 167 moved on to an urban centre. Migrations decisions are dynamic and oftentimes involve different locations within a country and abroad.

2.3 Empirical evidence on migration, education and labour market outcomes

Table 3 shows migration statistics by educational level attained in year 2000.[8]

	Urban origin				Rural origin			
	none	prim	sec	tert	none	prim	sec	tert
Migrants(%)	45%	36%	30%	78%	66%	77%	92%	100%
Moves per migrant	1.76	1.91	2.43	2.50	1.86	1.86	2.22	3.04
Emigrants (% of migrants)	77%	54%	31%	55%	76%	50%	18%	43%
Living abroad in 2000 (% of emigrants)	58%	57%	37%	25%	46%	41%	28%	4%
Migrants to urban (% of migrants)	13%	21%	37%	53%	29%	61%	91%	98%
Mean age in 2000	31.3	26.2	24.3	30.6	30.7	30.1	29.0	35.0

Notes: The education levels are: no education (none), primary (prim), secondary (sec) and tertiary education (tert). Emigrants and migrants to urban centres are the share of migrants who have moved at least once abroad and to a (national) urban centre (other than the origin), respectively. These two groups are not mutually exclusive.

Table 3: Migration statistics by education

The share of migrants by education differs across origin. The share of migrants increases in education for individuals of rural origin, and is J-shaped for those of urban origin. Urban individuals with primary or secondary education are the least likely to migrate. The qualitative pattern of the other migration statistics is the same across origins. Moves per migrant increase with education, emigration is U-shaped in education, return from abroad and urban migration both increase in education. Education is a key determinant of migration and location decisions.

Not all migrations are motivated by work or financial reasons. Some individuals (need to) migrate for education. Figure 1 shows the relative share of different migration motives by migrants' final education, i.e. the education level attained in year 2000.

Work and financial considerations are the main migration motive across all education levels (black bars). Family- and return-related migration motives become less important with rising education, while migrations motivated by education considerations (dotted bars) increase with education. Among educated migrants, around 17% of migrations are motivated by education choices (not shown).

[8]The education level attained in year 2000 is not necessarily known for migrants who have gone abroad without returning to Burkina Faso. In this case, they are classified by their education level at emigration. Most emigrants have completed their education by the time they emigrate. Some students go abroad for university. They are listed under secondary education.

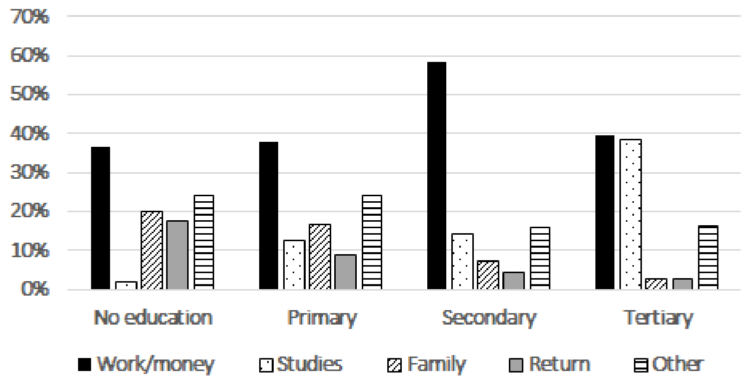

Figure 1: Migration motives by education

Location and education choices are linked and need to be studied jointly. An individual faces different economic opportunities, which depend on his education, at home and elsewhere. Table 4 presents labour market outcomes of locals and migrants in urban centres, rural regions and abroad.

	Urban residence		Rural residence		Abroad
	Local	Migrant	Local	Migrant	Migrant
Mean age	24.4	28.2	25.1	27.1	26.3
Years in school	7.53	6.24	1.40	4.95	2.86
Labour force (LF) (%)	83.1%	89.1%	96.5%	91.2%	91.3%
Unemployment rate (% of LF)	4.4%	3.2%	0.2%	0.4%	0.9%
Occupational composition (share of employed LF (%))					
Self-employed farming	16%	6%	93%	59%	22%
Salaried farming	0%	1%	1%	1%	38%
Low-skilled occupations	71%	71%	5%	12%	35%
Medium-skilled occupations	10%	18%	2%	24%	4%
High-skilled occupations	2%	4%	0%	4%	1%
Observations	8,309	11,820	22,160	2,399	7,478
Share of migrant observations		58.7%		9.8%	100.0%

Notes: Self-employed farming are self-employed and family workers in agriculture. Salaried farming are salaried workers or apprentices in agriculture. Low-skilled occupations include artisans, domestic servants, manual workers, workers in transportation and other unskilled workers. Medium-skilled occupations include clerks, public employees, security forces, administrative and technical personnel. High-skilled occupations include liberal professions, managers, directors and executives in the public and private sector.

Table 4: Labour market outcomes by migration status

Educational attainment, labour force participation, unemployment rates and occupational composition differ across locations and migration status. Urban residents are better educated, less likely to participate in the labour force and more likely to be unemployed than those in rural regions or abroad. The occupational composition is also different. The urban labour force works mainly in non-agricultural occupations, 18% are employed in medium- or high-skilled occupations. This share is only 4% and 5% in rural regions and abroad, respectively. Migrants are less likely to engage in farming and more likely to work in skilled occupations compared to locals, indicating positive selection of migrants. Observations of migrants make up almost 60% in urban centres, but less than 10% in rural regions.

2.4 Regional differences

Different locations offer different economic opportunities, returns to education, education facilities among others. Table 5 summarises economic, geographical and infrastructural characteristics of Burkinabe locations. I define 2 urban centres (Ouagadougou, Bobo-Dioulasso) and 5 rural regions (Sahel, East, Center, West, South-West).[9] I also include Côte d'Ivoire (abbreviated as 'CI'), the main destination country of Burkinabe emigrants.

Urban centres and rural regions differ in almost all respects: Labour market structure, income, education facilities and other infrastructure. Urban centres have a low employment share in agriculture, higher unemployment, and nominal (low-skilled) incomes which are around 3 times larger than farming income in rural regions. Urban centres provide more education facilities, especially for secondary and tertiary education, and have a higher development level.

Rural regions are heterogeneous. Average rainfall increases from North (Sahel region) to South (South-West region), changing the climatic conditions for agriculture and thus shifting the relative importance from cattle to crop farming. In terms of development and schooling facilities, the rural regions have lessened the gap to urban centres between 1960 and 2000, while preserving the regional ranking. Among rural regions, the Sahel ranks last in terms of development level, primary and secondary schools, distance to urban centres and public transportation. The Center and South-West are close to an urban centre and provide more schooling facilities than other rural regions. The South-West shares a border with Côte d'Ivoire. Regional income from farming is not perfectly aligned with regional rainfall, nor is it perfectly correlated with the regional development level. Farming income is highest in the West and lowest in the Center, however, the two regions resemble each other in terms of average rainfall and development level.

Côte d'Ivoire's unemployment rate is lower than in urban centres. A large share share of its labour force is employed in agriculture. Côte d'Ivoire boasts large plantations and is a dominant exporter of agricultural produce (cacao, coffee and other products).

[9] For a map of Burkina Faso and a definition of the different locations, see Figure 18 in Appendix A.

	Ouaga	Bobo	Sahel	East	Center	West	S-West	CI
Economic indicators in 2005								
Employment share agriculture	6.9%	7.0%	90.9%	93.0%	89.7%	90.5%	86.2%	45.4%
Share in low-skilled occupation	78.5%	82%						
Share in medium-skilled occupation	11.2%	8.9%						
Share in high-skilled occupation	3.5%	2.6%						
Unemployment	12.6%	11.6%	0.6%	0.5%	1.0%	0.5%	0.9%	4%
Share of villages/towns with								
- salaried non-agric. employm. 2000			41.1%	51.2%	51.2%	51.2%	31.3%	
Income in early 1990s (in 1,000 CFA/month)								
Calibrated farming income			5.3	5.7	4.7	6.5	5.8	
Income in low-skilled occupations	17.5	16.8						21.4
Income in medium-skilled occupations	57.9	64.3						49.6
Income in high-skilled occupations	112.5	92.8						(251.7)
Geographical indicators								
Avg. rainfall (in mm)	500-900	> 900	250-500	500-900	500-900	500-900	> 900	1,350
Population of capital 2000 (in 1,000)	1,288	447	22	38	84	37	68	156
Main ethnic group ($> 50\%$)	Mossi	-	Peul	Gourma	Mossi	-	-	-
Avg. distance to Ouaga (in km)	0	329	242	244	113	219	334	743
Avg. distance to CI (in km)	743	490	969	897	760	667	509	0
Share of villages/towns with								
- public transportation 2000			34.7%	53.1%	50.2%	62.2%	63.5%	
Infrastructural indicators								
Share of villages/towns with								
- primary school 2000	100%	100%	64%	70%	89%	80%	81%	100%
- secondary school 2000	100%	100%	13%	19%	32%	25%	28%	100%
University since	1974	1995	-	-	1996	-	-	1958
Development indicator 2000	0.97	0.99	0.46	0.57	0.58	0.57	0.58	0.84

Notes: Data sources are summarised in Table 10 in Appendix B.

Table 5: Regional differences: Economic, geographical and infrastructural indicators

It offers salaried employment in agriculture while Burkina Faso's agricultural sector is mainly composed of subsistence farming. Low-skilled incomes in Côte d'Ivoire are around 25% higher than in urban Burkina Faso.

3 A life-cycle model of location, education and work choices

In this section I develop a life-cycle model of endogenous location and activity choice. The model features three key characteristics. First of all, there are several urban, rural and international locations to capture the rich migration pattern. Locations differ in terms of work and economic opportunities, education facilities, geographical and infrastructural characteristics. Secondly, I model different activities, namely education, work and nonwork activities. They entail different income opportunities, benefits and costs in the present, but they also affect future income, for example through acquiring education. Finally, individuals are heterogeneous ex-ante and make different choices over their life cycle. Schooling facilities are geographically concentrated, work opportunities and returns to education vary across locations. Each location and each activity provides distinct incentives, which induce heterogeneous individuals to select into different locations and activities.

The life-cycle model tracks men from age 6 until the end of their life T. At the beginning of each period t, individual i maximises his expected life-time utility by trading off current and future income opportunities and amenities with activity- and migration-related costs in different locations. He chooses where to locate l_{it} and, depending on the choices available in this location, in which activity to engage d_{it}. The individual knows his state vector Ω_{it}. The value function of individual i in period t reads as follows:

$$V_t(\Omega_{it}) = \max_{l_{it},d_{it}} \{\mathrm{E}_t\left[u(l_{it}, d_{it}; \Omega_{it}) + \beta\, V_{t+1}(\Omega_{it+1})\right] + \zeta(l_{it}, d_{it}; \Omega_{it})\} \tag{1}$$

where E_t represents the expectation operator conditional on information available at the beginning of period t. β denotes the discount factor and $\zeta(l_{it}, d_{it}; \Omega_{it})$ are location-activity-specific preference shocks. They are drawn from an i.i.d. extreme value type 1 distribution. The per-period utility of choosing l_{it} and d_{it} is given by:

$$\mathrm{E}_t\left[u(l_{it}, d_{it}; \Omega_{it})\right] = \mathrm{E}_t\left[\tilde{w}(l_{it}, d_{it}; \Omega_{it}) + b(l_{it}; \Omega_{it}) - c(l_{it}, d_{it}; \Omega_{it})\right] \tag{2}$$

The individual derives utility from expected income $\mathrm{E}_t\left[\tilde{w}(l_{it}, d_{it}; \Omega_{it})\right]$, local amenity benefits $b(l_{it}; \Omega_{it})$, location- and activity-related costs $c(l_{it}, d_{it}; \Omega_{it})$. He makes his location and activity choice at the beginning of the period, that is, before knowing his labour market outcome and before observing the income shocks of period t.

3.1 The location and activity choice

At the beginning of a period the individual decides where to locate l_{it}. The location choice set comprises the two urban centres Ouagadougou and Bobo-Dioulasso, the five rural regions Sahel, East, Center, West, and South-West, and Côte d'Ivoire as international location. The locations are denoted by $l = 1, ..., 8$.

Locations differ in several respects. First, I distinguish urban/international locations and rural locations. Urban and international locations offer different work opportunities (i.e. work activities) from rural locations. Labour markets are local, characterised by location-specific unemployment, occupational structure and returns to education. This translates into differential local income distributions $\tilde{w}(l_{it})$. Finally, locations also differ in amenity benefits, schooling and migration costs.

At the same time the individual must also choose one activity d_{it} among the following set of activities: schooling, urban work, farming, rural work, nonworking. They are denoted by $d = 1, ..., 5$.

Schooling refers to attending school. The location-specific work activities mirror the economic structure in urban and rural locations. Rural locations provide farming and rural work opportunities, urban work (which may result in unemployment) is available in urban and international locations. Rural work is low-skilled (and potentially, seasonal), whereas urban labour markets also offer work opportunities in skilled occupations. Nonworking is the residual activity. It includes those individuals who neither attend school nor work, such as children out of school, sick individuals and retirees. In total, there are 29 location-activity combinations.

3.2 State space

An individual i of age t makes his choice conditional on his state space Ω_{it}. Some of the state variables evolve over time, while others are time-invariant and capture ex-ante heterogeneity. At the beginning of a period (before making a location-activity choice), an individual of age t knows his location before migration l_{it-1}, his past activity d_{it-1}, his past labour market status lm_{it-1} (if any), his past occupation o_{it-1} (if any) and his current schooling level s_{it}. These variables are summarised in x_{it}, the time-variant subset of the state space Ω_{it}. Ex-ante heterogeneity f_i includes ability τ_i, home location hl_i, father's occupation of_i and birth-year cohort by_i. Table 6 summarises the notation of choice and state variables.

	Notation	Values
Choice variables		
Location	l_{it}	{*1* Ouaga, *2* Bobo, *3* Sahel, *4* East, *5* Center, *6* West, *7* South-West, *8* Côte d'Ivoire}
Activity	d_{it}	{*1* school, *2* urban/international work, *3* farming, *4* rural work, *5* nonworking}
Age and state variables		
Age	t	$[6, 55]$
State space	$\Omega_{it} = x_{it} \times f_i$	$\Re^9$
Time-variant state space	x_{it}	$\Re^5$
Past location	l_{it-1}	same as l_{it}
Past activity	d_{it-1}	same as d_{it}
Past labour market status	lm_{it-1}	{*e* employed, *ue* unemployed, *olf* out of urban/international labour force}
Past occupation	o_{it-1}	{*2* skilled, *1* low, *0* none/other}
Schooling level	s_{it}	{*0* none, *1* primary, *2* secondary, *3* tertiary}
School years	$SY(s_{it})$	{SY(0) = 0, SY(1) = 3.5, SY(2) = 10, SY(3) = 16}
Ex-ante heterogeneity		
Ex-ante heterogeneity	f_i	$\Re^4$
(Unobserved) ability	τ_i	{*0* low, *1* high}
Home location	hl_i	{*1* Ouaga, *2* Bobo, *3* Sahel, *4* East, *5* Center, *6* West, *7* South-West}
Father's occupation	of_i	{*1* skilled, *0* other}
Birth-year cohort	by_i	{*6* 1952-1956, *5* 1957-1961, *4* 1962-1966, *3* 1967-1971, *2* 1972-1976, *1* 1977-1981, *0* 1982-1985}
Preference shocks		
Vector of preference shocks	ζ_{it}	$\Re^{29}$

Table 6: Overview of choice variables and state space

Past location l_{it-1} and past activity d_{it-1} keep track of the individual's choice in the last period. At age 6, the individual makes his first activity choice. The activity at age 5 is set to nonworking, i.e. $d_{i5} = 5$. Location choices are made from age 7 onwards. The initial location at age 6 corresponds to the home location hl_i.

The past labour market status lm_{it-1} and past occupation o_{it-1} capture the individual's employment and occupation situation in the previous period. These are state, not choice variables. If the individual chooses urban work in the current period $d_{it} = 2$, his labour market status will either be *employed* or *unemployed*. If he gets employed, he may work in a *low* or in a (medium-high) *skilled occupation*. The labour market status of all other individuals is *out of the urban/international labour force*, their occupation is *none/other*. The schooling level s_{it} takes one the following values: *no schooling*, *primary*, *secondary* or *tertiary* education. Due to high repetition rates, the schooling level is more informative about an individual's human capital than the number of years spent in school. In some parts of the estimation, the categorical schooling variable is transformed into average (theoretical) years of education at each schooling level $SY(s_{it})$. In Burkina Faso, primary education lasts for 6 years, secondary education for 7 years and tertiary education for 4 to 5 years (see Kabore et al. (2001)).

Ability τ_i is binary (high, low), affecting schooling costs and the probability of work in skilled occupations. Ability is observed by the individual and employers, but not by the econometrician. It is orthogonal to other initial conditions. The probability of high ability is given by π_τ, a parameter to be estimated. Parental background is captured by father's occupation of_i, a binary variable indicating if he last worked in a skilled occupation. Finally, I define birth cohorts by_i which span 5 years. The following seven cohorts are defined: 1952-1956, 1957-1961, ... and 1982-1985, with the youngest cohort as baseline. Using birth cohorts rather than birth years has two main advantages. First, it reduces the size of the state space and hereby increases the number of observations per type. Secondly, it washes out measurement error contained in reported birth years, the timing of location and activity episodes (see also Section 4.3). The calender year is approximated by the median birth year of a birth cohort plus age.

The following sections present the per-period utility and future benefits of each activity choice.

3.3 Attending school

An individual acquires education through schooling. Attending school entails a direct cost, an opportunity cost in terms of lower income and a higher option value for the future. More specifically, an individual who attends school $d_{it} = 1$ in location l_{it} derives the following per-period utility from his choice:

$$u\left(l_{it}, 1; \Omega_{it}\right) = \underline{w} - c_{school}(l_{it}, 1; \Omega_{it}) + \chi(l_{it}, 1; \Omega_{it}) \tag{3}$$

The per-period utility of schooling is made up of a deterministic (subsistence) income $\underline{w}$, schooling cost c_{school}, and other benefits and costs χ, which are discussed in Section 3.8. All individuals without a work income get a fixed subsistence income of $\underline{w}$, for example through informal transfers. c_{school} reflects direct monetary and non-monetary costs for one year of schooling:

$$c_{school}\left(l_{it},1;\Omega_{it}\right) \;=\; \begin{cases} \delta_{0,s_{it}} + \delta_1(1 - S_{s_{it}}(l_{it};t,by_i)) + \delta_2 t - \delta_3 by_i - \delta_4 of_i - \delta_5 \tau_i & \text{if } s_{it+1} = s_{it} \\ \delta_{0,s_{it}+1} + \delta_1(1 - S_{s_{it}+1}(l_{it};t,by_i)) + \delta_2 t - \delta_3 by_i - \delta_4 of_i - \delta_5 \tau_i & \text{if } s_{it+1} = s_{it}+1 \end{cases} \tag{4}$$

If an individual with education s_{it} is promoted at the end of the year (e.g. from primary to secondary), his schooling costs correspond to the next-higher schooling level (second line of equation 4), otherwise the first line applies. The first term in each line is a fixed schooling level-specific cost. It captures tuition, material, psychological and organisational costs. The second terms refer to a schooling level-specific variable cost which depends on the density of schools in location l_{it}.[10] Intuitively, fewer schools imply higher schooling costs because of transportation, social or psychological costs (see, for example, Lalive and Cattaneo (2009)). Schooling costs further depend on age, birth cohort, parental background and ability.[11] The effect of birth cohorts can be interpreted as a linear time trend, measuring the change in schooling costs over time.

The probability of promotion to the next-higher education level is given by π_{school}. Transition is modelled as a first order Markov process conditional on age. If location l_{it} does not have any schools of the next-higher education level, the individual keeps his current education level. Equation 5 shows how the time-variant characteristics in x_{it} evolve after a period of schooling:

$$x_{it+1} = \begin{pmatrix} l_{it} \\ d_{it} = 1 \\ lm_{it} = olf \\ o_{it} = 0 \\ s_{it+1} = \begin{cases} s_{it}+1 & \text{with } \pi_{school}\left(s_{it}+1|l_{it},1;\Omega_{it}\right) \\ s_{it} & \text{with } 1-\pi_{school}\left(s_{it}+1|l_{it},1;\Omega_{it}\right) \end{cases} \end{pmatrix} \tag{5}$$

3.4 Urban/international work

The second activity choice refers to working in an urban centre or abroad (henceforth, urban work). An individual who chooses urban work faces two sources of uncertainty.

[10] More specifically, $S_j(l_{it};t,by_i)$ denotes the (population-weighted) share of municipalities in location l_{it} which have at least one school offering schooling level j. Values of the indicator in 2000 for the different regions are reported in Table 5.

[11] Instead of including the effect of ability on schooling costs I could have opted for ability-dependent transition rates. The data does not allow me to identify both effects at the same time. Modelling ability in schooling costs is more straightforward than having ability-specific transition rates.

First, he does not know whether he will find employment or remain unemployed (unemployment risk). Secondly, he does not know in which occupation level he will be employed (occupational uncertainty). The utility of urban work $d_{it} = 2$ in location l_{it} is given by:

$$u\left(l_{it}, 2; \Omega_{it}\right) \;=\; \begin{cases} \underline{w} + \chi(l_{it}, 2; \Omega_{it}) & \text{if } lm_{it} = ue \\ w_1(l_{it}; \Omega_{it})/\lambda + \chi(l_{it}, 2; \Omega_{it}) & \text{if } lm_{it} = e \text{ and } o_{it} = 1 \\ w_2(l_{it}; \Omega_{it})/\lambda + \chi(l_{it}, 2; \Omega_{it}) & \text{if } lm_{it} = e \text{ and } o_{it} = 2 \end{cases} \tag{6}$$

The first line shows the utility pay-off in case of unemployment, the second line if employed in a low occupation, and the last line if employed in a skilled occupation. $\underline{w}$ is the fixed subsistence income, the same as obtained in school or nonworking. w_1 and w_2 are the location-specific incomes in low and skilled occupations, respectively. They depend on individual characteristics such as education, age and migration status (see Section 4.1). λ is a scaling parameter, which transforms urban income into units comparable to farming income. It captures urban-rural living cost differentials and differences in income measures (i.e. different data sets). χ are other benefits and costs (see Section 3.8).

The unemployment and occupational probabilities follow a first order Markov process. The specifications vary by past labour market status and occupation level. The unemployment probability is given by equation 7:

$$\pi_{ue}(lm_t = ue|l_{it}, 2; \Omega_{it}) \;=\; \begin{cases} \omega_{UU,1}\mathbf{1}(l_{it} = l_{it-1}) + \omega_{UU,2}\mathbf{1}(l_{it} \neq l_{it-1}) & \text{if } lm_{it-1} = ue \\ \omega_{EU,1}\mathbf{1}(l_{it} = l_{it-1}) + \omega_{EU,2}\mathbf{1}(l_{it} \neq l_{it-1}) & \text{if } lm_{it-1} = e \\ 1 - \frac{1}{1+exp\left[-(\omega_{U,l} + \omega_{U,11}SY(s_{it}) + \omega_{U,12}SY(s_{it})^2)\right]} & \text{if } lm_{it-1} = olf \end{cases} \tag{7}$$

Unemployment probabilities are parsimoniously parametrised. The first line gives the unemployment probability for unemployed individuals (unemployment-unemployment transition), the second line for individuals who where employed in the previous period (employment-unemployment transition). In both cases, stayers (first term) and migrants (second term) face different unemployment risks. The third line gives the unemployment probability for labour market entrants. It differs across locations (captured by the location-specific intercept $\omega_{U,l}$), and has a linear and quadratic term in schooling years. Non-monotonic unemployment rates in education are a key feature of unemployment rates among labour market entrants in West Africa (see Brilleau et al. (2004)).

An individual who gets employed faces occupational uncertainty. The probability of being offered a skilled occupation $\pi_{occ}(o_{it}=2|l_{it},2;\Omega_{it})$ depends on his past occupation. It is given in equation 8:

$$\pi_{occ}(o_{it}=2|l_{it},2;\Omega_{it}) \;=\; \begin{cases} 1-\frac{1}{1+exp\left[-(\omega_{o0,l}+\omega_{o0,1}\tau_i+\omega_{o0,2}SY(s_{it})+\omega_{o0,31}t+\omega_{o0,32}t^2+\omega_{o0,4}of_i+\omega_{o0,5}by_i)\right]} & \text{if } o_{it-1}=0 \\ 1-\frac{1}{1+exp\left[-(\omega_{o1,l}+\omega_{o1,1}SY(s_{it})^2+\omega_{o1,21}t+\omega_{o1,22}t^2+\omega_{o1,3}by_i)\right]} & \text{if } o_{it-1}=1 \\ 1-\frac{1}{1+exp\left[-(\omega_{o2,l}+\omega_{o2,1}SY(s_{it})+\omega_{o2,2}t)\right]} & \text{if } o_{it-1}=2 \end{cases} \quad (8)$$

where the first line refers to those without an occupation in the last period (i.e. labour market entrants and unemployed), the second line to those with a low occupation and the third line to those with a skilled occupation, respectively. The probability of employment in a skilled occupation of labour market entrants and unemployed depends on ability, father's occupation (potential network effects), birth-year cohort (time trends), school years and age. Occupational upgrading and downgrading occurs, but not very frequently. The probability of occupational transitions depends on education, age and change over time.[12]

In this framework, education impacts expected income through three channels: The unemployment risk, the occupational assignment and the wage. In order to understand education decisions (and the effect of education and labour market policies), one needs to quantify each of these three channels. Returns to education can be high in certain occupations, but if individuals face a low probability of entering these occupations or a high risk of unemployment, getting education might then not be optimal.

At the end of the period, time-variant characteristics x_{it} are updated to x_{it+1} as shown in equation 9:

[12]The probability of entry and upward transition into skilled occupations increases up to a certain age and then decreases. This is captured by linear and quadratic age terms.

$$x_{it+1} = \begin{pmatrix} l_{it} \\ d_{it} = 2 \\ lm_{it} = \begin{cases} ue & \text{with } \pi_{ue}\left(ue|l_{it}, 2; \Omega_{it}\right) \\ e & \text{with } 1 - \pi_{ue}\left(ue|l_{it}, 2; \Omega_{it}\right) \end{cases} \\ o_{it} = \begin{cases} 0 & \text{with } \pi_{ue}\left(ue|l_{it}, 2; \Omega_{it}\right) \\ 1 & \text{with } \left(1 - \pi_{ue}\left(ue|l_{it}, 2; \Omega_{it}\right)\right)\left(1 - \pi_{occ}(2|l_{it}, 2; \Omega_{it})\right) \\ 2 & \text{with } \left(1 - \pi_{ue}\left(ue|l_{it}, 2; \Omega_{it}\right)\right)\pi_{occ}(2|l_{it}, 2; \Omega_{it}); \end{cases} \\ s_{it+1} = s_{it} \end{pmatrix} \tag{9}$$

3.5 Farming

The farming activity is only available in rural locations. It includes subsistence farming such as crop farmers (mostly millet and sorghum), livestock herders and market gardening. Farming is subject to weather shocks. An individual who farms $d_{it} = 3$ in location l_{it} derives the following utility from his choice:

$$u\left(l_{it}, 3; \Omega_{it}\right) = \begin{cases} \underline{w}_F(l_{it}; \Omega_{it}) + \chi(l_{it}, 3; \Omega_{it}) & \text{if } \eta_F(l_{it}) = BS \\ \overline{w}_F(l_{it}; \Omega_{it}) + \chi(l_{it}, 3; \Omega_{it}) & \text{if } \eta_F(l_{it}) = GS \end{cases} \tag{10}$$

The utility pay-off of farming is stochastic because of unforeseen weather shocks η which cause bad harvests. Weather shocks are either normal/favourable GS or bad BS. The farming income in a bad weather state $\underline{w}_F$ is given in the first line, income in the good weather state $\overline{w}_F$ in the second line. It depends on age and differs across locations (see Section 4.1). Returns to education in farming are set to zero.[13] χ denotes other benefits and costs (see Section 3.8).

The probability of a bad weather shock is location-dependent and given by $\pi_F(BS|l_{it})$. Weather shocks are assumed to be uncorrelated across years and do not enter the state space. The time-variant individual characteristics deterministically evolve as shown in equation 11.

[13] Schultz (1988) reviews several studies which find positive albeit small returns to education for farming productivity in low-income countries. Attanasio et al. (2012) find a small but not significant effect of education on rural wages of children in Mexico. They state that returns to education are substantial for adults, but they are reaped by adults migration to urban centres. I do not observe individual farm output, and hence, I cannot identify returns to education in agriculture.

$$x_{it+1} = \begin{pmatrix} l_{it} \\ d_{it} = 3 \\ lm_{it} = olf \\ o_{it} = 0 \\ s_{it+1} = s_{it} \end{pmatrix} \tag{11}$$

3.6 Rural work

Rural work is an activity which is only available in rural locations. Rural work includes all non-agricultural, low-skilled workers in rural regions, such as artisans, vendors, tradesman, etc. but it also comprises salaried workers in the agricultural sector. An individual who works in the rural sector $d_{it} = 4$ in location l_{it} derives the following utility from his choice:

$$u\left(l_{it}, 4; \Omega_{it}\right) = \begin{cases} \underline{w} + \chi(l_{it}, 4; \Omega_{it}) & \text{if } \eta_{RW}(l_{it}) = ue \\ 5/12 \cdot w_{RW}(l_{it}; \Omega_{it})/\lambda + \chi(l_{it}, 4; \Omega_{it}) & \text{if } \eta_{RW}(l_{it}) = srw \\ w_{RW}(l_{it}; \Omega_{it})/\lambda + \chi(l_{it}, 4; \Omega_{it}) & \text{if } \eta_{RW}(l_{it}) = frw \end{cases} \tag{12}$$

Income from rural work is stochastic because an individual may remain without work (first line), may find only seasonal work from May to September (second line) or work for a full year (third line). $w_{RW}(l_{it}; \Omega_{it})$ denotes the income from rural work if working for a full year. It varies across locations and depends on the age of the individual. λ is a scaling parameter to transform rural work income into units comparable to farming income.

The probability of finding rural work depends on the availability of paid seasonal and full-time work in rural locations. $\pi_{RW}(rw|l_{it})$ denotes the probability of finding rural work in location l_{it}, $\pi_{RW}(srw|l_{it}, rw)$ the probability of seasonal work conditional on finding rural employment. These probabilities are independent of last year's work outcome and education.[14] The time-variant individual characteristics evolve as in equation 11, with the exception of the past activity which is $d_{it} = 4$.

3.7 Nonworking

Finally, an individual may also decide to be nonworking $d_{it} = 5$. Nonworking individuals are those who neither go to school nor engage in any work or farming activity. He

[14] Rural work is often salaried work in agriculture and/or seasonal work, thus, this simplifying assumption seems plausible.

derives the following utility from his choice:

$$u\left(l_{it}, 5; \Omega_{it}\right) \ = \underline{w} + \chi(l_{it}, 5; \Omega_{it}) \tag{13}$$

Nonworking does not involve any uncertainty, it yields a fixed subsistence income $\underline{w}$ and entails other known benefits and costs χ (see Section 3.8). The time-variant individual characteristics evolve as in equation 11, except for the past activity which is updated to $d_{it} = 5$.

3.8 Amenity benefits, activity-switching and migration costs

Apart from the activity-specific benefits and costs presented above, an individual also receives other benefits and pays costs related to his location-activity choice. These benefits and costs are summarised in equation 14,

$$\chi(l_{it}, d_{it}; \Omega_{it}) \ = b(l_{it}; \Omega_{it}) + \kappa \mathbf{1}(d_{it} \neq d_{it-1}) + c_{mig}(l_{it}; \Omega_{it})\mathbf{1}(l_{it} \neq l_{it-1}) \tag{14}$$

where $b(l_{it}; \Omega_{it})$ are amenity benefits, κ is an activity-switching cost and $c_{mig}(l_{it}; \Omega_{it})$ are migration costs. $b(l_{it}; \Omega_{it})$ represents non-pecuniary and activity-independent benefits obtained from being in location l_{it}. It is given by equation 15.

$$b(l_{it}; \Omega_{it}) = \gamma_1 \mathbf{1}(l_{it} = hl_i) + \gamma_2 DI(l_{it}; t, by_i) \tag{15}$$

b includes a home premium and a single-valued index of development level $DI(l_{it}; t, by_i)$.[15] The home premium reflects monetary and non-monetary benefits of living in one's home location, where the individual has family and is part of a social network. It captures different aspects which are not explicitly modelled, such as the preference for living and marrying within one's own ethnic/linguistic group, the strength of family/clan ties, and access to informal insurance. The development level index ranges from 0 to 1, with 1 being the highest development level.

Whenever an individual switches his activity from one period to the next, he pays a fixed activity-switching cost κ. In a similar vein as migration costs, the activity-switching cost reflects the fact that individuals are reluctant to switch activity, even when they

[15] The development level index is an (unweighted) average of eight indicators. It includes health centres/pharmacies, infrastructure (water, electricity, telephones), leisure facilities (bar, cinema), the absence of diseases and internal conflicts. A principal component analysis of these eight indicators yielded results which only differ marginally from an unweighted average.

are nonworking.

Finally, the migration cost $c_{mig}(l_{it}; \Omega_{it})$ reflects monetary and non-monetary costs. The cost of migrating from the beginning-of-period location l_{it-1} to a new location l_{it} is given by equation 16.

$$c_{mig}(l_{it}; \Omega_{it}) = \left[\phi_0 + \phi_1 D(l_{it-1}, l_{it}) - \phi_2 T(l_{it-1}, t, by_i) - \phi_3 t + \phi_4 t^2\right] \quad (16)$$

The cost of moving from location l_{it-1} to l_{it} includes a fixed moving cost and variable costs. Migration cost are direct and indirect costs which accrue when moving, such as expenses incurred to find a place to live or psychic/social costs of relocating. The variable migration cost depends on distance $D(l_{it-1}, l_{it})$[16], public transportation in the sending location l_{it-1}[17] and age. The inclusion of public transportation $T(l_{it-1}, t, by_i)$ in the sending location renders migration cost c_{mig} asymmetric between locations (unless they have the same level of public transportation).

The age terms reflect non-monetary costs of migration, such as psychological or family-related costs. These costs are not explicitly modelled, and they vary over the life cycle. Migration costs are supposedly very large for (young) children. They decrease with age until the early/mid twenties, only to increase again for individuals past their twenties, possibly because of family obligations. This pattern is captured by linear and quadratic age terms.

4 Estimation

I estimate the life-cycle model by the Method of Simulated Moments (MSM). This estimation methods allows me to combine different data sets, such as the panel data on migrants and stayers, and the cross-sectional data on permanent emigrants. Another advantage of MSM relates to its robustness with respect to measurement error (see discussion in Section 4.3).

Some parameters are exogenously set to achieve identification.[18] These are the scale

[16]Distance between two locations is measured as the average great circle distance between all departmental capitals in location l_{it-1} and all departmental capitals in location l_{it}. In the literature, distance is often used as a proxy for migration cost.

[17]Public transportation captures the effect of remoteness on out-migration costs. Moreover, the more remote a location is, the less information about other places will reach it.

[18]See Magnac and Thesmar (2002) for a discussion of identification in discrete choice models.

parameter σ_G of the preference shocks[19], final age T of 56[20], the discount factor β at 0.95 and school transition rates π_{school} (see Appendix C for details).

4.1 Estimating incomes

The EMIUB data set contains detailed information on employment status and occupation of individuals, but it does not report wages or income. Urban and international work incomes are thus estimated using the DSA-EP survey of Burkina Faso in 1994 and the DSA-EP survey of Côte d'Ivoire in 1993.[21]

Urban and international work income in low and skilled occupations, $w_1(l_{it};\Omega_{it})$ and $w_2(l_{it};\Omega_{it})$, respectively, are estimated by Mincerian income equations. Income of individual i in urban location l and occupation level o is estimated by the following equation:

$$\begin{aligned} log(income)_{ilo} =& \alpha_{lo,0} + \alpha_{o,11}\mathbf{1}\left(s_i \geq 1\right) + \alpha_{o,12}\mathbf{1}\left(s_i \geq 2\right) + \alpha_{o,13}\mathbf{1}\left(s_i = 3\right) \\ &+ \alpha_{o,21}age_i + \alpha_{o,21}age_i^2 + \alpha_{lo,3}\mathbf{1}\left(origin_i = l\right) + \epsilon_{ilo} \end{aligned} \tag{17}$$

where $log(income)_{ilo}$ is the logarithm of individual i's income in location l in occupation o, and s_i, age_i and $origin_i$ stand for his schooling level, age and origin[22], respectively. The origin indicator corrects for selection into urban locations through migration. Finally, ϵ is an i.i.d. error term.

Along the same line, the income equation for individual i with occupation level o in Côte d'Ivoire is given by the following equation. The Ivorian estimation coefficients are marked by an asterisk $*$ and the location subscript l is dropped. Selection abroad is

[19] $\sigma_{G,rural} = 0.185$ for those from a rural origin, $\sigma_{G,urban} = 0.205$ for urban origin, respectively.

[20] This corresponds to the life expectancy at age 5 in Burkina Faso, conditional on reaching age 5. I computed this statistic using the World Development Indicator data base of the World Bank. While life expectancy at birth has increased over the last decades (due to lower infant and young child mortality rates), remaining life expectancy at age 5 has remained roughly constant.

[21] Given that income data is only cross-sectional, I cannot identify local income growth and its impact on changing migration patterns. Controlling for time trends would be important if income growth differed across locations and occupations. To the best of my knowledge, panel (or repeated cross-sectional) data on incomes over the period studied is not available. I believe that differences in local income growth are small. The educational attainment of different migrant types has remained roughly the same across cohorts (see Table 36 in Appendix), despite an important increase in educational attainment over time. This suggests that changing migration patterns are driven by changes in educational attainment, and not so much by differences in local income growth. Nonetheless, expected incomes still change slightly over time because the probability of skilled work opportunities has a trend.

[22] In these regressions *origin* is an indicator whether the individual was born in location l or not. In the model estimation, 'origin' stands for an individual's location at age 6. Given that migration rates below age 6 are very low, I use these terms interchangeably.

controlled for by the foreign indicator. It denotes those individuals who were not born in Côte d'Ivoire.

$$\begin{aligned} log(income^*)_{io} =& \alpha^*_{o,0} + \alpha^*_{o,11}\mathbf{1}\left(s_i \geq 1\right) + \alpha^*_{o,12}\mathbf{1}\left(s_i \geq 2\right) + \alpha^*_{o,13}\mathbf{1}\left(s_i = 3\right) \\ & + \alpha^*_{o,21} age_i + \alpha_{o,21} age_i^2 + \alpha^*_{o,3}\mathbf{1}\left(foreign_i\right) + \epsilon^*_{io} \end{aligned} \tag{18}$$

Table 11 and 12 in Appendix D present the estimated coefficients of equations 17 and 18, and predicted income, respectively. Returns to education are convex, in line with the findings reported by Schultz (2004). Convexity holds for both occupation levels and both countries. In low occupations, Côte d'Ivoire has a higher income level than Ouagadougou and Bobo-Dioulasso, but foreign-born individuals see their returns to education discounted compared to locals and those in Burkina Faso. The converse is true for skilled occupations. In this case, the Ivorian baseline income in skilled occupations is lower than in Burkina Faso, but returns to education are steeper.

The farming, rural work and subsistence incomes are calibrated from different data sources. Refer to Appendix D for all details.

4.2 Estimation method and identification

The model is estimated by the Method of Simulated Moments (MSM). In a first step, I numerically solve the model by backward induction given an initial set of parameters. The model solution delivers the value function and probabilistic decision rules. In a second step, I use the decision rules to simulate the behaviour of a set of individuals and produce a simulated data set. In a third step, I construct moments from the simulated data set and compare them to their empirical counterparts. 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 $\hat{\theta}_{SMM}$ solves:

$$\hat{\theta}_{SMM} = \text{arg min}\left(\hat{\mu}(\theta) - \hat{m}\right)' W \left(\hat{\mu}(\theta) - \hat{m}\right) \tag{19}$$

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 which are an estimate of the model's true unconditional moments $\mu(\theta)$, and W is the weighting matrix. I employ a diagonal weighting matrix where the inverse elements are the estimated variance of the empirical moments.

In total, there are 46 parameters and 218 moments. The set of moments includes static, conditional, and dynamic moments on migration, education, and labour market outcomes. Migration moments make use of the panel data (PS) and the cross-sectional data on permanent emigrants (CS) in the EMIUB data set. In contrast, education and labour market moments are only computed on the panel data set. Because of few observations for older individuals, the model is fitted for men of age 6 to 38.[23]

Tables 7 and 8 lists all moments which are used to identify the model. Each parameter in column 1 is identified by one or several corresponding moments given in column 2. The number of moments is given in column 3. Finally, column 4 states from which data sets the moments are computed.

Table 7 summarises the identification scheme for labour market parameters. These parameters are identified by a set of moments on unemployment, occupational outcomes and labour market transitions. Except for ability, identification is relatively straightforward through static, conditional and dynamic moments. I use dynamic moments to identify labour market status and occupational transitions.[24] Static moments are used to identify unemployment and occupational parameters of labour market entrants. As ability is unobserved, identification of ability-related parameters relies on self-selection into locations by ability. Migration costs create a wedge in the skill mix of migrants compared to locals. Therefore, I use moments on locals and migrants to identify the effect of ability on occupational outcomes.

Table 8 summarises the identification scheme for the remaining parameters. These parameters are identified through static, dynamic, and conditional means (and ratio of means) on migration, education outcomes, and activities. Migration moments are used to pin down the value of amenities, migration costs and the probability of high ability. Schooling costs are identified by moments on educational attainment, the activity-switching cost and living cost differential by moments on activities.

Analogous to the ability parameter in labour market outcomes, I use self-selection into migration and locations to identify the ability parameter in schooling costs and the probability of high ability. For example, while a decrease in fixed schooling costs affects

[23]Past age 38, yearly migration drops below 2%, no one goes to school and no new labour market entries occur. Therefore, I solve a simplified model for ages 39 to 55 and compute recursively the continuation value for age 38. In the simplified model, schooling and nonworking in rural locations are not available anymore. However, individuals can still migrate and they experience labour market status and occupational changes.

[24]Because of few employment-unemployment transitions and few observations of continued unemployment (especially in Côte d'Ivoire), I calibrate the relevant four parameters ex-ante so as to match observed transition rates.

Parameter	Moment	#	Data set
Unemployment of labour market entrants			
Ouaga: $\omega_{U,l1}$	Proportion unemployed in Ouaga by education	4	PS
Bobo: $\omega_{U,l2}$	Proportion unemployed in Bobo by education	3	PS
CI: $\omega_{U,l8}$	Proportion unemployed in CI by education	2	PS
Schooling: $\omega_{U,11}$	Same as above		
Schooling^2: $\omega_{U,12}$	Same as above		
Unemployment-unemployment transition (calibrated)			
Stayer: $\omega_{UU,1}$	U-U transition rate stayer = 0.749	(1)	PS
Migrant: $\omega_{UU,2}$	U-U transition rate migrant = 0.414	(1)	PS
Employment-unemployment transition (calibrated)			
Stayer: $\omega_{EU,1}$	E-U transition rate stayer = 0.0039	(1)	PS
Migrant: $\omega_{EU,2}$	E-U transition rate migrant = 0.0497	(1)	PS
Skilled occupation of labour market entrants			
Ouaga: $\omega_{o0,l1}$	Proportion skilled local entrants in Ouaga	1	PS
	Same moment for rural migrants	1	PS
Bobo: $\omega_{o0,l2}$	Proportion skilled local entrants in Bobo	1	PS
	Same moment for rural migrants	1	PS
CI: $\omega_{o0,l8}$	Proportion skilled rural migrant entrants in CI	1	PS
Ability: $\omega_{o0,1}$	Same as above		
Schooling: $\omega_{o0,2}$	Proportion skilled entrants by education	4	PS
Age: $\omega_{o0,31}$	Proportion skilled entrants by age	5	PS
Age^2: $\omega_{o0,32}$	Age at which probability of skilled is maximum		
	Calibrated: $\omega_{o0,32} = \frac{-\omega_{o0,31}}{2 \cdot Age_{max}} = \frac{-\omega_{o0,31}}{2 \cdot 26}$		
Father's occ.: $\omega_{o0,4}$	Proportion skilled entrants by father's occupation	2	PS
Birth year: $\omega_{o0,5}$	Proportion skilled entrants by cohort	5	PS
Upward occupational transition			
Ouaga: $\omega_{o1,l1}$	Upward transition rate in Ouaga	1	PS
Bobo: $\omega_{o1,l2}$	Upward transition rate in Bobo	1	PS
CI: $\omega_{o1,l8}$	Upward transition rate in CI	1	PS
Schooling: $\omega_{o1,1}$	Upward transition rate by education	4	PS
Age: $\omega_{o1,21}$	Upward transition rate in BF by age	5	PS
Age^2: $\omega_{o1,22}$	Age at which upward transition is maximum		
	Calibrated: $\omega_{o1,22} = \frac{-\omega_{o1,21}}{2 \cdot Age_{max}} = \frac{-\omega_{o1,21}}{2 \cdot 24}$		
Birth year: $\omega_{o1,3}$	Upward transition rate by cohort	5	PS
Downward occupational transition			
BF: $\omega_{o2,l12}$	Downward transition rate in BF	1	PS
CI: $\omega_{o2,l8}$	Downward transition rate in CI	1	PS
Schooling^2: $\omega_{o2,1}$	Downward transition rate by education	3	PS
Age^2: $\omega_{o2,2}$	Downward transition rate by age	5	PS
	Total labour market moments	57 + (4)	

Notes: PS: EMIUB panel data. CS: EMIUB cross-sectional data (permanent emigrants).

Table 7: Moments identifying labour market parameters

Parameter	Moment	#	Data set
Amenities			
Home premium: γ_1	Proportion returned migrants in 2000 by home location	7	PS + CS
Development: γ_2	Share of net migration in 70s, 80s, 90s by location	21	PS + CS
Schooling cost			
Primary: δ_P	Proportion no education in 2000 by home	7	PS
Secondary: δ_S	Proportion secondary | primary in 2000 by home	7	PS
Tertiary: δ_T	Proportion tertiary | secondary in 2000 by home	7	PS
Schools: δ_1	Proportion primary + at age 10 in 60s by home	7	PS
	Proportion rural primary + at age 10 in 70s, 80s, 90s	3	PS
	Proportion urban primary + at age 10 in 70s, 80s, 90s	3	PS
Age: δ_2	Proportion urban/rural students by age	10	PS
Birth year: δ_3	Same as for δ_1		
Father's occ.: δ_4	Avg school years by father's occupation, urban/rural home	4	PS
Ability: δ_5	Avg school years of locals by home, cohort	4	PS
	Ratio of same moment of emigrants/urban migrants to locals	10	PS
Migration cost			
Fixed cost: ϕ_0	Proportion never-migrants in 2000 by home	7	PS + CS
Distance: ϕ_1	Ratio of migrations closest/farthest destination by location	7	PS + CS
Transportation: ϕ_2	Rural out-migration rates (age 17 to 26) in 70s, 80s, 90s	15	PS + CS
Age: ϕ_{31}	Rural/urban migration rates by age	14	PS + CS
Age^2: ϕ_{32}	Same as above		
Activity-switching cost and living cost differential			
Fixed cost: κ	Proportion in same activity by past activity	4	PS
Living cost: λ	Ratio of log shares of farming to rural work by location	5	PS
Probability of high ability			
Probability: π_τ	Ratio urban migrants to emigrants in 2000 by home	7	PS + CS
Sample attrition			
	Share permanent emigrants among migrants urban/rural home	8	PS + CS
	Total other moments	157	

Notes: PS: EMIUB panel data. CS: EMIUB cross-sectional data (permanent emigrants).

Table 8: Moments identifying other parameters

educational attainment of all individuals, a decrease of schooling costs for highly able individuals only affects individuals who migrate to locations where returns to ability and education are large. In order to achieve identification, I need to restrict the sign of the ability parameter in labour market outcomes to be positive and in schooling costs to be negative.

Moreover, I target the shares of permanent emigrants among migrants by education and home location to ensure that the sample attrition of permanent emigrants in the simulated data matches the one in the observed data set.

4.3 Measurement error

Given the retrospective data collection method in Burkina Faso and Côte d'Ivoire, both countries characterised by low literacy rates, the EMIUB data set suffers from measurement error. Two kinds of measurement error can occur: the error of dating events and the failure to report residence, employment or education spells.

The histogram of reported age in 2000 reveals spikes for ages 15, 20, 25, ..., 55. An estimated 15% of all men misreport their birth year.[25] Previous research on long-term recall in Malaysia has shown that dates and other numerical information are less precisely recalled the further back the event lies (see Beckett et al. (2001)). Misreporting of dates within a year does not pose a problem as I aggregate the data to yearly frequency. Most misreporting across years should be washed out. First, I aggregate individuals into 5-year birth cohorts rather than using the reported birth year. Secondly, under- and over-reporting should cancel each other out. Misreporting of dates is only problematic if it is asymmetric around spikes, thus consistently over- or underestimating the true date. I do not find evidence of asymmetric misreporting in birth years.[26]

Failure to recall residence, employment or education changes is supposedly less likely than misreporting of dates, but also more consequential. More salient events are more likely to be remembered correctly (see Beckett et al. (2001)); for example, inter-state moves are less prone to misreporting than intra-state moves. As the analysis is mainly based on information with relatively high salience such as migration moves across regions

[25] I estimate a 5-year moving average of frequency of birth years (as an approximation for the true birth year distribution) and compute the absolute deviation of observed frequency from the approximated true distribution. The estimate should be interpreted as an upper bound. Due to erratic weather conditions and other catastrophic events, mortality rates are unlikely to be smooth. The true distribution is thus probably less smooth than its estimated approximation.

[26] I run a regression of the frequency of birth years on a 5-year moving average, an indicator for anchoring years (i.e. 1955, 1960, ..., 1985), an indicator for the year before an anchoring year and an indicator for the year after an anchoring year. While the coefficient for anchoring years is statistically different from 0, the ones for preceding and subsequent years are not statistically different from 0.

or abroad, occupation level changes, school attendance versus work alternatives, I believe that failure to report these events is small.

The Method of Simulated Moments (MSM) allows me to choose moments (such as means and ratio of means) which are robust to 'symmetric' measurement error without having to make any distributional assumption. This is a major advantage of MSM over Maximum Likelihood Estimation in this context.

5 Estimation results

5.1 Results on unemployment and (skilled) occupations

In this first part, I discuss the estimation results relative to unemployment. Figure 2 shows predicted unemployment rates conditional on past labour market status which are based on these estimates. Table 15 in Appendix E presents estimated unemployment parameters of equation 7.

Figure 2: Predicted unemployment probability conditional on past labour market status

The probability of unemployment for labour market entrants (left panel) substantially varies across locations and with education. It is inverse U-shaped in education in urban centres in Burkina Faso, with a peak at secondary education. Unemployment is increasing in education in Côte d'Ivoire. The same unemployment patterns are reported for many other West African cities (see Brilleau et al. (2004)). Higher unemployment rates at higher education levels make acquiring education more risky. This impacts (net) returns to education and hence, affects education decisions of individuals. Overall, unemployment is lowest in Côte d'Ivoire, intermediate in Bobo and highest in Ouagadougou. A labour market entrant with secondary education faces an unemployment probability of 14% in Ouagadougou, 9% in Bobo and less than 4% in Côte d'Ivoire. For someone without education the unemployment rates would be 3%, 2% and 1%, respectively. Migration allows labour market entrants to take advantage of these spatial differences. Migration also provides new employment perspectives for unemployed and employed workers. Unemployed migrants see their chances of exiting unemployment increase by more than 30pp (middle panel, different scale), while employed workers who migrate face higher employment insecurity than their staying peers (right panel).

Unemployment risk is an important determinant of labour market outcomes, but occupational attainment also plays a key role. In this second part, I turn to the estimation results relative to entry into skilled occupations and occupational mobility. Table 16 in Appendix E gives estimated skilled-occupation parameters of equation 8. Figure 3 shows the predicted probability of finding work in a skilled occupation for labour market entrants and unemployed workers (left panel), workers in a low occupation (middle panel) and workers in a skilled occupation (right panel, different scale). The skilled-occupation probability is predicted at the mean value of covariates (age, father's occupation, ability, birth cohort) of each past occupation status.

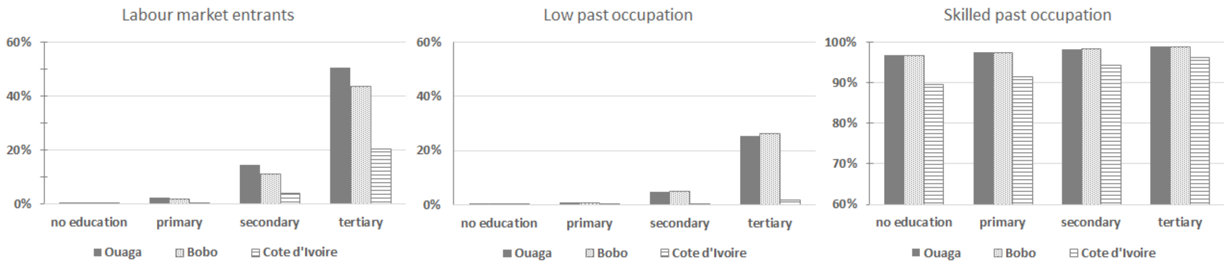

Figure 3: Predicted probability of skilled occupation conditional on past occupation

The probability of employment in a skilled occupation differs greatly across locations and education levels. Education is a crucial determinant of getting employed in a skilled occupation upon labour market entry (left panel). Below secondary education, this probability is close to 0, but it rises to above 40% with tertiary education. However, this only holds for urban centres in Burkina Faso. In Côte d'Ivoire, the probability remains at a low 20%, indicating that Burkinabe labour market entrants have a hard time finding work in skilled occupations abroad. Indeed, skilled work is often (but not exclusively) found in the public sector, which would explain why non-natives cannot get these jobs despite their high education level.

As shown in the middle and right panel, the global probability of occupational upgrading and downgrading is relatively low. Yet, education plays a key role in the likelihood of such transitions. Someone with secondary or tertiary education is much more likely to move or remain in a skilled occupation than an individual without education. For example, in Ouaga or Bobo, the probability of occupational upgrading within 3 years is 14% with secondary and 60% with tertiary education. In contrast, the respective probabilities in Côte d'Ivoire amount to less than 1% and 5%. Overall, Côte d'Ivoire offers much fewer skilled work opportunities for Burkinabe: Entry and promotion into skilled occupations are lower, and downward occupational transition is higher than in urban centres. The 3pp difference in yearly downward occupational transition with tertiary education seems small, but turns out to be consequential. After 30 years of continued employment, a skilled worker is still employed in a skilled occupation with a probability of 70% in Burkina Faso, but only 30% in Côte d'Ivoire.[27] These spatial differences in skilled work opportunities (partially) counterbalance the spatial income differences found within occupation groups (see Table 12).

5.2 Results on schooling and migration costs

Table 17 in Appendix E presents the estimation results for all location and activity-related parameters. In what follows, I use the results on schooling and migration cost parameters to predict the costs of observed education and migration decisions. I start by looking at schooling costs. Figure 4 shows the average estimated yearly schooling cost by education level and location, assuming that 15% of students have high ability. The left panel depicts schooling costs in the 1970s, the right panel in the 1990s.

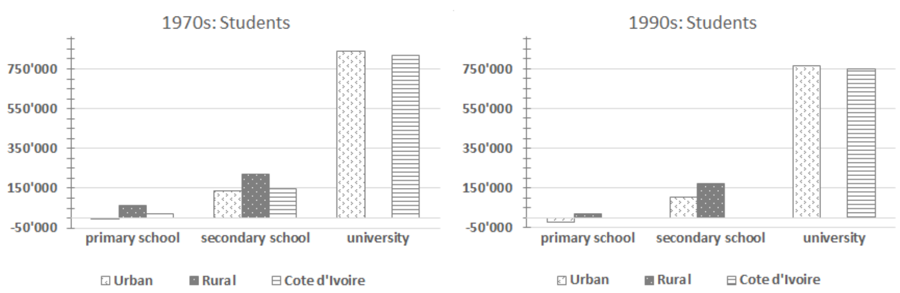

Figure 4: Average estimated schooling cost of children in school (CFA)

Schooling costs are large and convex. Moreover, they vary substantially across locations. In the 1970s, a year of primary education cost on average between -900 CFA (in urban centres) and 60,500 CFA (in rural regions). The rural primary education cost almost equals one year of farming income or 5 months of (nominal) low-skilled urban work income with primary education at age 22. This large cost is a key factor in explaining low educational attainment in rural regions at the time. In contrast, the estimated cost of urban primary education is negative. Going to primary school in urban centres is associated with non-monetary benefits (i.e. status gain) which dominate monetary and non-monetary costs.

[27] This abstracts from layoffs and subsequent occupational upgrading and further downgrading.

Reaching higher education is very costly. The average estimated cost of going to university exceeds 700,000 CFA. This corresponds to approximately one year of nominal urban skilled-occupation income with tertiary education at age 22. Only a small fraction of this cost are tuition fees.[28] The very large cost indicates that non-tuition costs of tertiary education are consequential, posing an entry barrier to many potential students.

Overall, schooling costs decreased between the 1970s and the 1990s. The decrease in incurred schooling costs was around 60% for primary, 20% for secondary and less than 10% for tertiary education. Furthermore, the previous analysis relies on estimated schooling costs of children who attended school. Yet, students positively self-select into education. A random child of the same cohorts as above would face somewhat larger primary schooling costs (around 5,000 to 70,000 CFA, not shown).

Figure 5 shows the 5%, median and 95% value of estimated migration cost of observed migrations. The different panels depict estimated migration cost by provenance: Urban (left), rural (middle) and abroad (right).

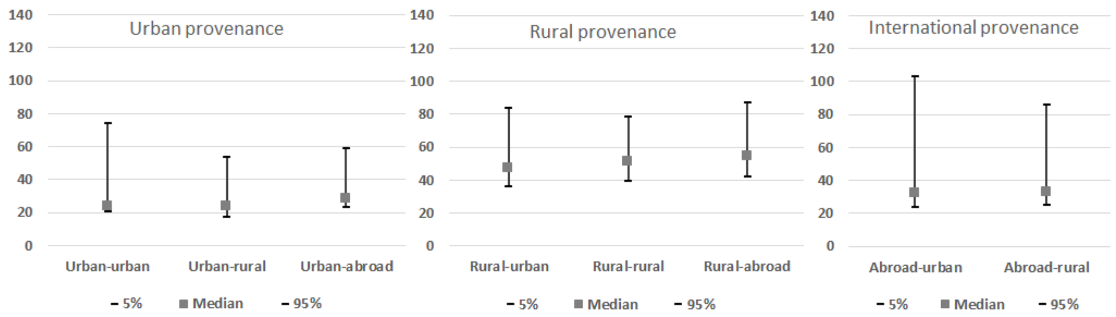

Figure 5: Estimated migration cost by provenance and destination (in 1,000 CFA)

The median estimated cost of migration amounts to 45,300 CFA, which is around 60% to 80% of yearly farming income and less than 5 months of (nominal) urban/Ivorian low-occupation income. This is a very moderate direct cost of migration. In fact, it is in the same order of magnitude as the (yearly) home premium of 45,700 CFA. Migration costs vary substantially across and within provenance-destination pairs. Overall, migrations from an urban provenance are less costly than those from a rural provenance (a median cost of 26,900 versus 51,500 CFA), reflecting the remoteness and worse transportation connections of rural locations. Migrations destined abroad cost more than internal migrations (a median cost of 52,400 CFA versus 42,300 CFA). These numbers suggest that the decision to migrate abroad (rather than internally) of migrants with little or no ed-

[28]In 2015, the university of Ouagadougou charged a subscription fee of 1,000 CFA and a tuition fee of 15,000 CFA for national/UEMOA students and 50,000 CFA if they were working. Students from outside the UEMOA paid a tuition fee of 250,000 CFA.

ucation is motivated by differences in returns to migration and not by cost considerations.

The following simple example illustrates this point. A rural individual faces a migration cost of 54,500 CFA if going abroad, the predicted yearly nominal income is approximately 153,000 CFA. If he migrates to an urban centre, he would pay a migration cost of 46,900 CFA for an income of approximately 105,000 to 112,000 CFA. Using the estimated living cost factor of 2 to deflate urban and Ivorian nominal income (see Table 17), we find a real income differential of approximately $\frac{153{,}000-112{,}000}{2} \approx 20,000$ CFA and a cost differential of less than 8,000 CFA. However, returns to migration go beyond simple income differences of employed workers, they also factor in employment and occupation prospects. I shall return to this subsequently.

Comparing schooling and migration costs offers the following two remarkable insights. First of all, a rural individual might find investing in migration less costly than investing in education. In the 1970s, one year of rural primary education cost on average 60,500 CFA, while the median rural-abroad migration cost during this time was 55,600 CFA. Over time, schooling costs decreased more sharply than migration costs, hereby increasing the relative attractiveness of education. In the 1990s, the respective costs of rural primary education were 20,000 CFA and of rural-abroad migration 53,000 CFA. Secondly, we report a substantial urban-rural schooling cost differential. Depending on the school level and year, the urban-rural gap amounts to 40,000 to 85,000 CFA. On the other hand, the median rural-urban migration cost is moderate at 46,900 CFA. Certain students might thus find it worthwhile to migrate while still in school, taking advantage of lower urban schooling costs.[29]

5.3 Goodness of fit

The model features 46 parameters. 6 of these are calibrated ex-ante while the remaining 40 parameters are estimated by MSM. Identification is achieved through more than 200 moments on migration, education, labour market and other outcomes. Overall, the model matches the observed patterns in migration, education and labour market outcomes reasonably well. For example, the model predicts the inverse U-shaped unemployment rate in education and spatial differences. It replicates the pattern of occupational outcomes of labour market entrants and occupational transitions. Furthermore, the model matches the differential educational attainment across locations, and the sorting pattern of individuals based on their education into migration and migration destinations. While the model reproduces well observed patterns, it often under- or

[29]Migrating away from one's origin also has an indirect migration cost, the loss of the home premium of 45,600 CFA per year.

overpredicts specific moments, that is, the simulated moment is statistically different from the observed moment. Generally, the fit of labour market moments is better than the fit of education and migration moments. One key reason for this is that the labour market part of the model is generously parametrised (29 out of 46 parameters). It takes advantage of the fact that the labour market equations (see equations 7 and 8) have a reduced form counterpart. The other location- and activity-related benefits and costs are more parsimoniously parametrised, and hence, do not achieve the same goodness of fit.

For detailed results and a more elaborate discussion of the goodness of fit, please refer to Tables 18 to 45 and the relevant discussion in Appendix F.

6 Measuring returns to migration

How large are returns to migration? Different measures have been used to answer this question. In this section I use simple income comparisons, estimates of migration premia and a decomposition of life-cycle welfare to provide an estimate of private returns to migration.

6.1 Income comparisons and migration premia

For a simple descriptive purpose, I first compare incomes of migrants and stayers. Figure 6 shows average (predicted) real monthly incomes of stayers, migrants and return migrants (by origin) who were in the labour force in year 2000 (grey, lined and dotted bars). It also depicts the share of those who have migrated at least once and the share of migrants who have returned home by year 2000 (black and dashed lines, respectively).

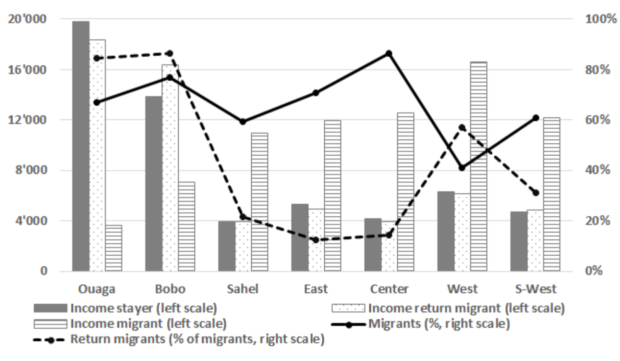

Figure 6: Incomes of stayers and migrants in year 2000

Migrants from a rural origin earn about twice as much as rural stayers, while urban migrants earn less than half of what urban stayers earn. Simple income comparisons are biased because of selectivity of migrants and dynamic effects. Indeed, migrants from urban centres are negatively selected in terms of age, education, ability and parental background (not shown), while those from rural regions are positively selected.

To eliminate selection effects in income comparisons, I compute counterfactual incomes for the same sample as above. Figure 7 plots realised incomes (grey bars), predicted income in the origin (checkered bars) and the highest predicted income in another location than the current one (white bars). I define the migration premium as the difference between the realised and counterfactual income (as a percentage of the income at home). For stayers and return migrants, the counterfactual is the best predicted migration income. For migrants, it is the predicted income at home. The left and right panel regroup individuals from urban and rural origin, respectively.

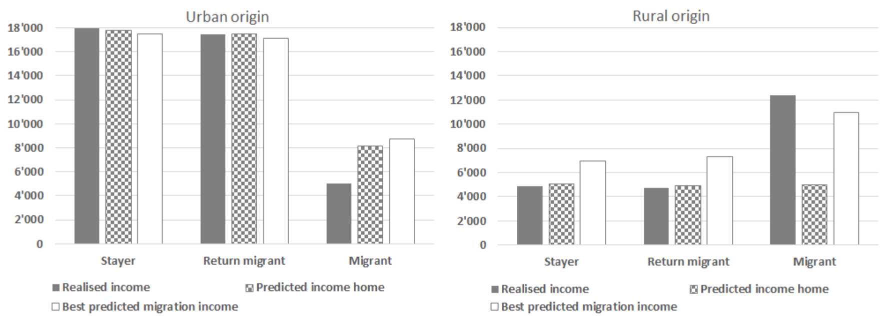

Figure 7: Realised and predicted incomes of stayers and migrants

The migration premium is positive and large (more than 100%) for rural migrants. The premium would also be positive for stayers and return migrants, though smaller at 40% and 55%, respectively. Despite a positive migration premium, these later groups have chosen to stay (or return) home. Migrants from an urban origin have a negative migration premium (-40%). Their migration premium is even more negative than the one of urban stayers and return migrants (both at -2%). Expected (instantaneous) income gains are not sufficient to explain observed migration decisions. Other direct and indirect benefits and costs, as well as dynamic considerations, must also be taken into account.

6.2 Net returns to migration and its decomposition

A comprehensive measure of returns to migration (RTM) is the difference in life-cycle welfare between the current migration-scenario (baseline) and a counterfactual setting without migration. I dissect life-cycle returns into all of its components, which include income, amenities, schooling, activity-switching and migration costs, and preference shock gains. A rational and forward-looking individual makes his education, migration and work decisions on the basis of these expected returns and contemporaneous shocks.

Figure 8 plots average life-cycle returns to migration (black line) and each component's contribution to it (bars). These returns represent the average expected returns over all individuals, not only migrants. In the counterfactual scenario individuals re-optimise their education and work choices in response to the prohibition of migration.

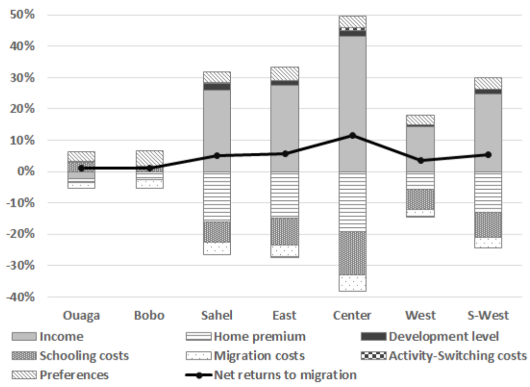

Figure 8: Net returns to migration and its decomposition

Net returns to migration differ across origins. In terms of size, they amount to 1% for urban individuals, and 3.5% to 11% for rural individuals. Compared to the estimated migration premia above, these net returns are modest.

Rural individuals reap RTM in the form of higher life-cycle income, which is around 75% larger than without migration (not shown) and increases welfare on average by 30%. RTM (and income gains) are highest for those from the Center (where farming income is lowest), and lowest for those from the West (where farming income is highest). However, individuals also lose welfare due to a reduced home premium, and higher schooling and migration costs. Direct migration costs are small compared to indirect migration costs (i.e. home premium loss). Moreover, part of these life-cycle income gains are obtained because rural individuals incur higher schooling costs and get more education when migration is possible. Education choices thus react in response to migration prospects.

RTM of urban individuals look different. Life-cycle income is lower under migration, in line with the negative migration premium found above. The positive contribution to net RTM arises from lower schooling costs and positive preference shocks. Migration provides alternative work opportunities for urban individuals with primary or no education, hereby rendering investment in education less attractive.

7 Local returns to education and self-selection into migration and locations

The previous analysis has produced estimates of migration premia and net returns to migration, but it disregarded *where migrants move to.* Yet, the destination choice is a key aspect of migration decisions because economic opportunities vary across locations and with a migrant's education level. This is the focus of this section. I present estimates of net returns to education and show how they can be decomposed. I discuss how these estimates relate to standard measures of returns to education and translate into education decisions.

7.1 Life-cycle returns to education and its decomposition

Education generally results in higher wages after school completion. There is a vast literature which attempts to estimate the (causal) effect of schooling on wages. In this paper, I employ a broader concept termed *life-cycle returns to education.* This structural estimate discounts returns to education by taking into account income gains, schooling costs, as well as other direct and indirect costs associated with going to school over the life cycle. It measures by how much life-time welfare increases compared to an alternative scenario in which education is not available and the individual re-optimises his dynamic location and work choices accordingly. Using a plausible alternative scenario is key to understanding education decisions and evaluating returns to education. Indeed, the alternative scenario of rural individual who attends school is not necessarily to stay at home as a farmer, but he might decide to migrate abroad where there is a high demand for low-skilled workers. This structural model allows us to produce an estimate of outcomes under a counterfactual scenario in which schooling is not available.

Figure 9 plots average realised *life-cycle returns to education* (black line) and its decomposition (bars) by final education level reached. Individuals decide where and when to go to school, but transition from one education level to the next is stochastic.

Realised life-cycle returns to education (abbreviated as *ex-post RTE*) are convex. Individuals with primary education have negative returns in life-time welfare of -25% (urban) and -22% (rural), those with secondary education see their life-time welfare increase by 41% (urban) and 32% (rural), and those who reach tertiary education realise on average returns of 140% (urban) and 120% (rural), respectively.

The negative life-cycle returns to primary education are disconcerting. In fact, primary education slightly increases discounted life-cycle income, but the increase is too

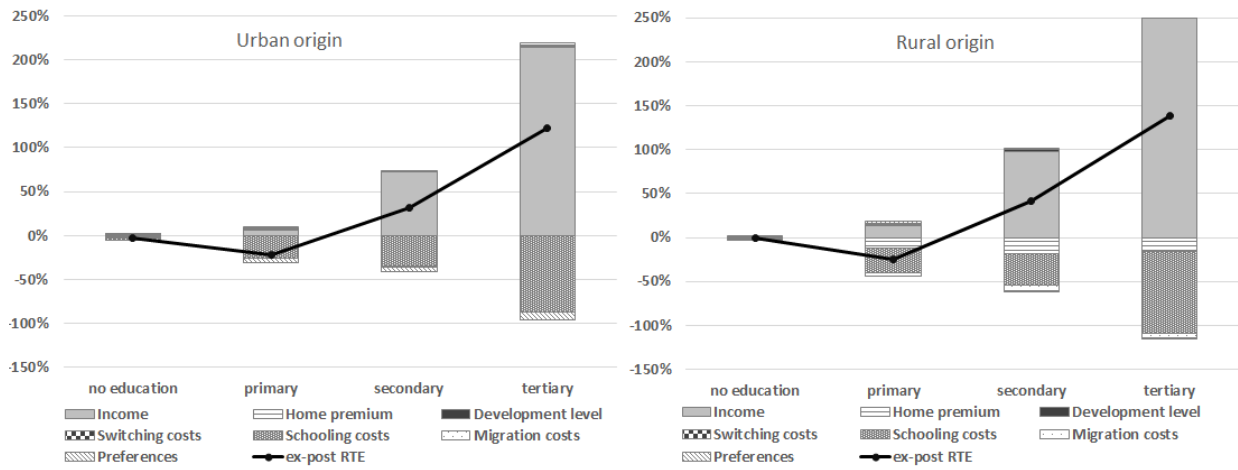

Figure 9: Decomposition of life-cycle returns to education

small to compensate incurred schooling costs. Discounted life-cycle income gains only grow large for those who reach secondary and tertiary education.

Urban and rural individuals reap similar returns to education over the life cycle. Yet, the decomposition of these returns reveals some important differences. Rural individuals have worse alternative economic options than urban individuals, and hence, they gain more in terms of income from going to school. At the same time, rural individuals face larger indirect costs: Because skilled work opportunities are only available in urban locations and abroad, rural individuals need to migrate and forgo the value of the home premium.

The previous figure relates to realised returns to education over the life cycle. However, individuals make their choice of whether to attend school or not under uncertainty with regard to graduation, work opportunities and preference shocks. Computing ex-ante returns to education thus helps to understand education decisions and selection into education. Figure 10 plots ex-ante returns to education (dotted line) and realised returns to education (black lines) by origin.

The difference (or slope) in ex-ante returns to education is informative about the selection process across education groups. The increasing returns point out that selection into schooling is positive. For rural individuals, we find that the higher the education level reached, the stronger the positive selection. Selection is also positive for urban individuals, but its degree varies only marginally among those with at least primary education.

The sign of ex-ante returns to education determines whether an individuals finds it worthwhile to attend school or not. All urban individuals have (on average) positive

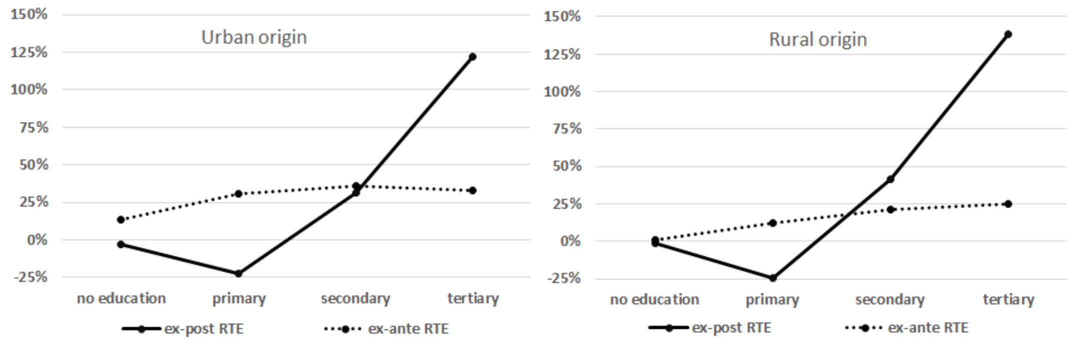

Figure 10: Ex-ante and realised returns to education

ex-ante life-cycle returns to education, varying from 13% to 36%. Therefore, more than 97% of all urban individuals attend school at some point in their life (not shown). Many reach primary, secondary or tertiary education, but some are 'unlucky' and do not successfully graduate and hence, remain without education. The picture looks different for individuals from a rural origin. In this case, those without education have (on average) ex-ante returns to education close to 0 and thus, around 70% choose not to attend school ever (not shown). Those who decide to go to school expect average returns in the order of 12% to 25%.

A key finding is the large discrepancy between ex-ante and ex-post returns to education over the life-cycle. Observed differences in realised returns to education are only marginally driven by selection (as shown by the small slope of ex-ante returns), but they depend crucially on whether an individual manages to graduate from university or not. In fact, the decision to attend school is primarily driven by the very large returns to tertiary education (and to a smaller extent: the returns to secondary education). For individuals reaching less than secondary education, realised returns to education are close to 0 or even negative.

7.2 Comparing structural and classic returns to education

The returns to education reported in the previous section were given by education level. However, most estimates on returns to schooling in the literature are given by years of education. To make comparison of the structural estimates with *classic* estimates on returns to schooling possible, I transform education levels into years of education.

Table 9 shows average returns to education measured in life-time welfare (columns 1 to 3) and life-time income (columns 4 to 6), as well as classic returns to schooling in wages (last column) for an additional year of primary, secondary and tertiary education, respectively. I estimate returns to education in life-time welfare and income for each type of individual and education level segment, and then aggregate them into overall returns to primary, secondary and tertiary education. Returns to primary education thus reflect average returns to primary education of all individuals who have attained at least primary education. Classic returns to schooling are taken from Kazianga (2004). He estimates returns to schooling for wage earners in Burkina Faso employing a Mincerian framework (see Mincer (1974)) and controlling for entry into the wage sector. The coefficients reported in this table are estimated on a sample of men working in the public or private sector for years 1994 and 1998 (see Table 7 in Kazianga (2004)).

	Life-time welfare			Life-time income			Wages Classic RTE
	Urban origin	Rural origin	All	Urban origin	Rural origin	All	All
Returns to 1 additional year of ... education							
Primary	-4.1%	-5.4%	-4.7%	3.6%	5.6%	4.5%	10.5%
Secondary	9.1%	23.1%	15.2%	19.1%	19.4%	19.2%	14.8%
Tertiary	21.2%	26.1%	22.7%	27.0%	26.7%	26.9%	22.9%
Cumulative returns to having ... education							
Primary	-24.3%	-32.4%	-28.1%	21.3%	33.5%	27.0%	63.0%
Secondary	39.3%	129.7%	78.4%	154.9%	169.4%	161.6%	166.6%
Tertiary	145.1%	260.0%	191.7%	289.9%	303.2%	296.3%	212.4%

Table 9: Structural and classic estimates of returns to education

Independent of whether measured in welfare, life-time income or wages, returns to education are convex. An additional year of primary education leads to a life-time welfare reduction of -4.7%, and an increase of 15.2% and 22.7% per year of secondary and tertiary education, respectively. When measured in terms of life-time income, returns to education appear larger. This effect is especially pronounced for primary education: An extra year of primary education increases life-time income by 4.5%, but it decreases life-time welfare by 4.7%. The income gains obtained because of primary education are more than eaten away by schooling costs, and the cost of higher mobility (in the case of rural workers).

Classic measures of returns to schooling suggest that a year of primary education increases wages by around 10.5% in Burkina Faso. Given these decent returns to education, it appears puzzling that enrollment rates are not larger. Schultz (2004) argues that imperfect information about the size of these returns or borrowing constraints could hinder individuals from getting their optimal level of education. The previous analysis suggests another channel: The direct and indirect cost of getting education are important. They are so important that income gains at primary education are not enough to compensate for them.

Welfare returns to education reveal another interesting aspect. While for primary and tertiary education, returns to education are similar for individuals from urban and rural origins, they differ a lot for secondary education. Again, the source for this difference are not differences in returns measured in (life-time) income, but direct and indirect costs. Taking a welfare rather than a pure income perspective is thus important for understanding education decisions.

7.3 Spatial differences in incomes, skilled work opportunities and unemployment

The previous sections presented returns to education over the life cycle and its decomposition, ignoring where these returns arise. Yet, incomes, skilled work opportunities and unemployment risk differ greatly across locations and education levels. These spatial differences are a key contributing factor to overall returns to education over the life cycle. In fact, not each location is equally attractive to heterogeneous individuals. Figures 11 and 12 show the cumulative distribution function (CDF) of predicted incomes in low and skilled occupations, respectively.[30] The CDF refers to predicted incomes in Ouagadougou (black lines), Bobo-Dioulasso (dashed lines) and Côte d'Ivoire (grey lines) of individuals who farm, work in rural regions or are in the urban/international labour force.[31] The panels from left to right increase from *no education* to *tertiary education*. Predicted incomes are refer to real monthly incomes in 1,000 CFA.

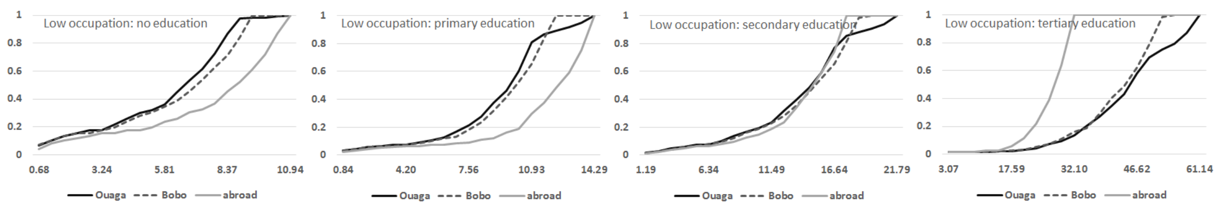

Figure 11: CDF of predicted incomes in low occupations by education

The CDFs of predicted incomes reveal that locations cannot be unambiguously ranked in terms of predicted incomes. In the case of workers with primary education and less, the predicted income-CDF for low occupations of Côte d'Ivoire first-order (FO) stochastically dominates the respective CDFs of Bobo and Ouaga. For workers with tertiary education, the ranking of locations is reversed. For secondary education,

[30]These predictions are obtained using the estimated coefficients from the Mincerian wage regressions as shown in Table 11.

[31]The CDFs are given across all workers, they do not necessarily hold for each individual worker. For example, a worker is originally from Bobo and therefore, he ends up in a higher percentile of the predicted income distribution in Bobo than he would in Ouaga.

not only the median income is (approximately) the same in all three locations, but the CDFs in general are fairly close. Overall, these results suggest that Côte d'Ivoire is very attractive for workers with primary education and less, but not at all for workers with tertiary education who work in low occupations.

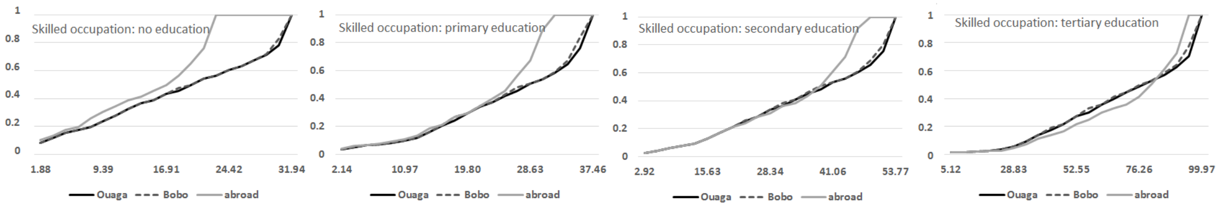

Figure 12: CDF of predicted incomes in skilled occupations by education

The CDF of predicted incomes earned from working in skilled occupations differs clearly from the ones shown for low occupations. In fact, the Ivorian CDFs of predicted incomes in skilled occupations for secondary education and less are FO stochastically dominated by the ones for Bobo and Ouaga. This is the reverse of what was found for low occupations above. For tertiary education, the median predicted income in Côte d'Ivoire is slightly higher than in Ouaga and Bobo, but the overall predicted income distribution is also more compressed. The lower part (i.e. when workers are young and have little work experience) of the Ivorian predicted income CDF dominates the ones for Ouaga and Bobo, while in the upper part, the converse is true. This shape is driven by the differential returns to age (or experience) in Burkina Faso and Côte d'Ivoire as estimated in the income equations which are reported in Table 11 in Appendix D.

Figure 13 shows the average realised income in low and skilled occupations (dotted and checkered bars, respectively) of employed workers by origin and education level. It also depicts by how average income would increase if all workers within a certain category migrated to (or stayed in) the location which offered the highest income.

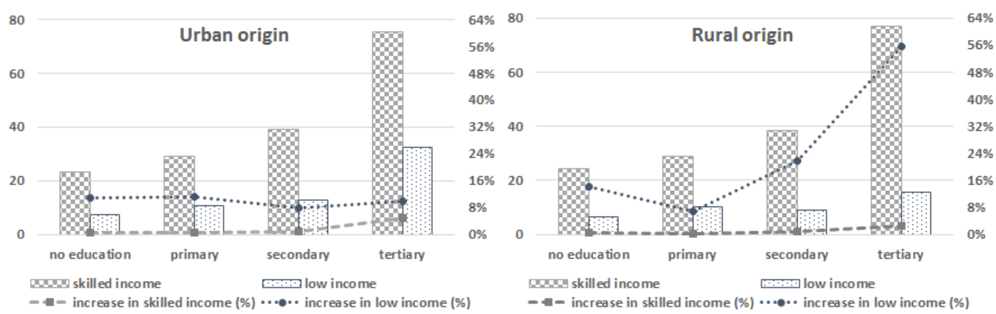

Figure 13: Average realised income (bars) and maximum income increase (lines) by occupation, education and origin

Workers who are employed in a skilled occupation would increase their income by 4% or less if they migrated to the location with the highest income. The situation presents itself differently for workers in low occupations. Across almost all education levels and origins, workers in low occupations could increase their incomes by at least 10% and up to 55% if they migrated to the location with the highest income. The highest income is oftentimes offered abroad (below tertiary education), the West region (without education), or in Bobo-Dioulasso (for tertiary education). Why do not more workers migrate to reap these potential income gains?

To answer this question, remember that individuals make their migration (and activity) decision under uncertainty about the current labour market status and occupation level. Hence, expected income in each location is determining (among other factors and dynamic considerations) where an individual locates. In urban or international work, expected income is given by:

$$\begin{aligned} \mathrm{E}_t\left[\tilde{w}(l_{it};\Omega_{it})\right] = \pi_{ue}(l_{it};\Omega_{it})\underline{w} + (1-\pi_{ue}(l_{it};\Omega_{it}))\cdot \\ \cdot\left[(1-\pi_{occ}(l_{it};\Omega_{it}))\frac{w_1(l_{it};\Omega_{it})}{\lambda} + \pi_{occ}(l_{it};\Omega_{it})\frac{w_2(l_{it};\Omega_{it})}{\lambda}\right] \end{aligned} \tag{20}$$

Figure 14 presents the realised share in skilled occupations (dark grey line, left scale) and the realised rate of unemployment (light grey line, right scale), as well as the respective probabilities in the best location, i.e. the location with the highest income as defined above (dotted lines). The average gain in expected income of going to the best location is depicted by a black line (right scale).

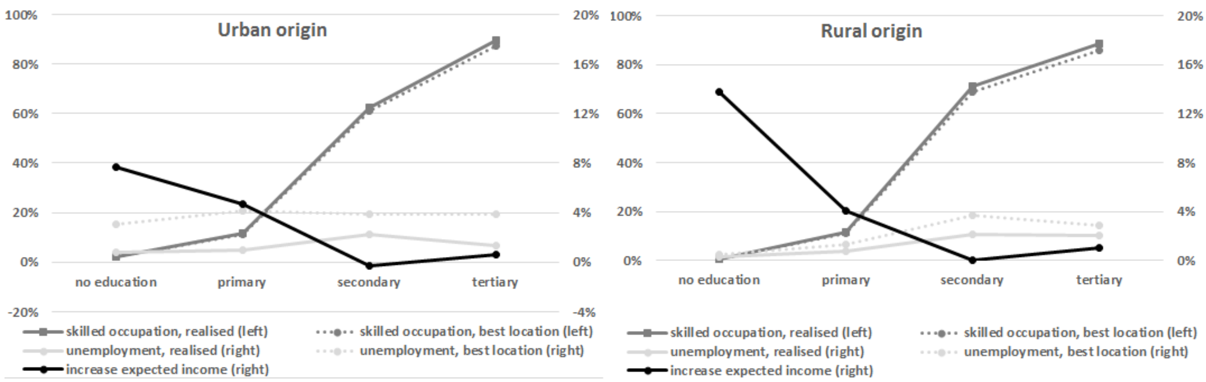

Figure 14: Skilled work opportunities, unemployment and gains in expected income by origin and education

We find that the best location is characterised by slightly lower chances of getting work in a skilled occupation (at secondary and tertiary education), and higher unemployment rates for all education levels. The differences amount to 2pp and less, yet they are consequential in lowering gains from expected income compared to maximum income increase presented above in Figure 13. For individuals with primary education, expected income gains from moving to the best location are less than 5%, and they are close to 0 for secondary and tertiary education.

Altogether, we find that workers with secondary education and above locate where skilled incomes are large and relatively many skilled work opportunities are available (Ouaga, and to a lesser extent Bobo), rather than going where low-occupation incomes are large but skilled work opportunities are limited or inexistant (as abroad or in the West region). Those workers with primary education and less who refrain from moving to the best location do so for different reasons. Their reluctance to move is driven by the fact that income gains obtained from moving do not compensate for the loss of the home premium. Remember that the home premium is equivalent to having an extra 3,800 CFA per month, which exceeds the average income gains of 28% and 23% for rural and 14% and 13% for urban workers with no and primary education, respectively.[32] Other factors such as migration and activity-switching costs, as well as dynamic considerations, also play a role - though less prominently as shown in Figures 8 and 9 above - in location choices of workers.

8 How do migration prospects affect education and location choices?

Since the 1960s there have been concerns that urban centres (namely, Ouagadougou and Bobo-Dioulasso) did not have the capacity to absorb the inflow of (rural) migrants, leading to unemployment and informal employment, and putting a strain on urban infrastructure and services. Several rural development policies - for example, building schools and roads in rural areas - have been implemented with the aim of curbing rural out-migration. Using a reduced-form regression framework, Beauchemin and Schoumaker (2005) find that these policies had small or even reverse (i.e. migration-enhancing) effects.[33] Rather than implementing indirect policies to affect migration patterns, policy makers could adopt policies which directly foster or impede certain forms of migration. However, such migration policies not only affect location decisions,

[32]These average income gains are computed from the numbers given in Figure 13 above, divided by the share of workers who are not currently living in their 'best' location. Among rural workers this share is around 30% to 50%, whereas among urban workers it is around 80% to 90%.

[33]In fact, the estimation results in this paper indicate that the development level improvements are little valued compared to expected income differences across locations. Hence, rural development are weak policy tools for curbing rural out-migration.

but they also have an impact on education choices of young individuals.

8.1 The effect of migration prospects on education

In this section, I study how different migration policies - and thus, migration prospects - impact education and location choices. To do so, I simulate the model for alternative migration scenarios, assuming that individuals are aware of migration costs and restrictions from age 6 onwards. These migration scenarios are then compared to the estimated baseline model of unrestricted but costly migration. Figure 15 plots the cumulative density functions (CDF) of educational attainment in year 2000 under different migration scenarios: Baseline (black line), no emigration (short dashes), no migration to Ouagadougou (long dashes), no urban migration (dashed-dotted), no migration (dotted), costless migration (grey line) and costless urban migration (light-grey line).[34] The left panel refers to individuals of urban origin, the right panel to those of rural origin.

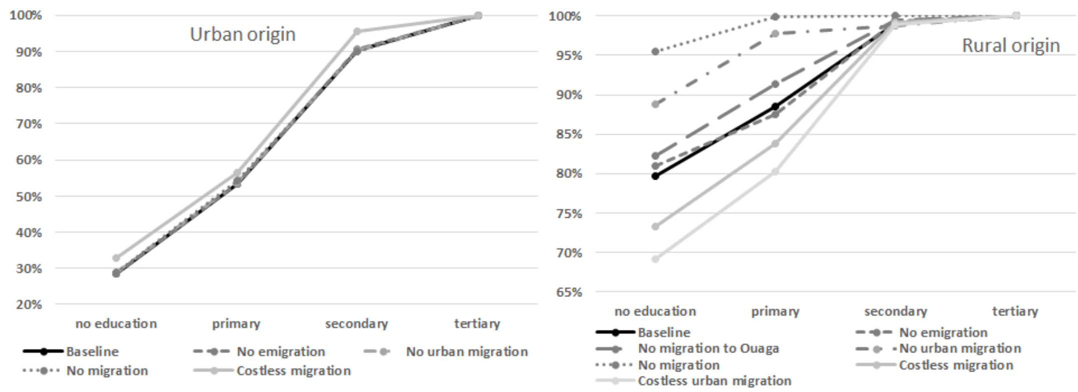

Figure 15: CDF of educational attainment under different migration scenarios

The left panel on urban individuals shows that their education decisions are left unaffected by restricted migration prospects. The converse is true for rural individuals. Restricting migration to one or all urban centres has large negative effects on educational attainment of rural individuals. The average years of education[35] drops from 2.07 years in the baseline scenario to 0.27 years when migration is not possible. This finding indicates that the (small) returns to education in rural work and preference shocks are not large enough to incite rural individuals to go to school. Prohibiting migration to one specific location (e.g. to Ouagadougou or abroad) has at most moderate effects on educational attainment. In fact, migration to urban centres and going abroad are (imperfect) substitutes for rural migrants. When one migration destination becomes unavailable, individuals tend to migrate elsewhere rather than refraining from migrating

[34] Return to one's urban home location is still possible.

[35] Average years of education are computed from the probability density function and the corresponding years of education of each education level.

altogether. I shall return to this point below.

The prospect of costless migration to any location has different effects on educational attainment of urban and rural individuals. Costless migration lowers average education from 8.04 years to 7.30 years for urban individuals. As direct migration costs are eliminated, migration to rural locations and abroad becomes less costly. These locations mostly provide farming and low-skilled work opportunities. Consequently, the incentive to get education falls among urban individuals. In contrast, costless migration boosts average education from 2.07 to 2.78 years among rural individuals. As locations with skilled work opportunities get less costly to reach, rural individuals adapt their behaviour by getting more education. The effect is even stronger (3.28 years) when costless migration is limited to urban destinations. In this case, there is only a positive incentive to increase education due to lower (zero) direct cost of reaching skilled work opportunities in urban centres, while low-skilled work opportunities abroad (and in other rural regions) - which have a negative education incentive- remain costly to reach.

Even when direct migration costs are zero, the urban-rural education gap still amounts to 4.5 years. This remaining gap is mainly driven by differences in initial conditions (parental background, birth cohort), local schooling costs and origin (not shown). Origin is insofar important as individuals have a strong preference for staying in (or returning to) their origin. This indirect migration cost leads individuals to make education choices which reflect local schooling costs, skilled work opportunities and returns to education found in their home location.

8.2 Substitution and complementarity in migration

Migration policies can restrict the set of destinations where an individual can migrate to. Nevertheless, the impact of a restrictive migration policy is not limited to its direct effect on the targeted location. For example, when rural individuals are impeded from migrating abroad, they might opt now for migrating to an urban centre. These indirect effects of a migration policy might have the same or a different sign from the direct effect. Indirect effects have the same sign as the direct effect when another form of migration is complementary to the restricted migration form, or it might have the reverse sign if two forms of migration are (imperfect) substitutes.

Figure 16 plots how the share of migrants and different forms of migration would change if emigration (left panels) or if migration to Ouaga for non-natives was prohibited (right panels). The black line shows the share of individuals who have migrated in the baseline until year 2000, the dotted black line in the *no emigration* or *no migration* *to Ouaga* scenarios. The grey (small-dashed or long-dashed) lines in each panel show the total change in migration movements and its decomposition into the various forms of migration. The total change is the product of the share of migrants and moves per migrant.

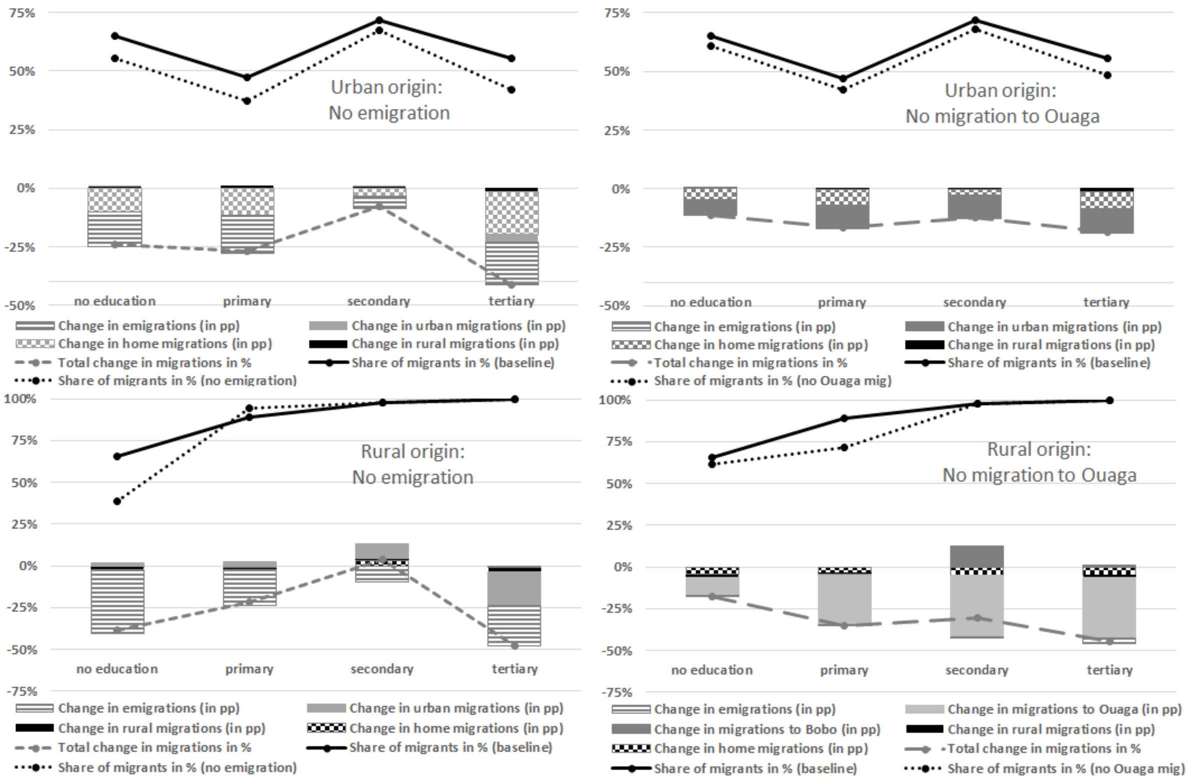

Figure 16: Share of migrants and changes in moves by destination under different migration scenarios

I find that a *no emigration* policy would have the largest effect on the migration behaviour of individuals at the extremes of the education distribution, while it would leave the migration behaviour of those with secondary education unaffected. In the *no migration to Ouaga* scenario the reduction in total migrations increases with education. These findings reflect the self-selection patterns into locations.

Figure 16 also provides insights into how these total changes obtain. For urban individuals I find strong complementarity between emigration/migration to Ouaga and return migration (i.e. migration home). Every reduced move to Ouaga or abroad leads to another 0.7 reduction in home migration. Total migration thus drops by more than the direct reduction induced by the migration restriction.

This does not hold for individuals of rural origin. For rural individuals with primary education and less, the total effect of migration policies is close to the direct effect.

There is neither substitution nor complementarity in different migration forms. For those with secondary education, we see a substitution from the prohibited form of migration to urban migration (Ouagadougou and/or Bobo). In the case of prohibited emigration, around 90% of emigrations are replaced by migrations to urban centres. Under prohibited migration to Ouagadougou, the share redirected to Bobo is around 33%. Urban centres are thus deemed a valid alternative. Finally, we find that rural individuals with tertiary education consider emigration and urban migration to be complements. For example, in the *no emigration* scenario the 24pp drop migration abroad is accompanied by another 20pp drop in urban migration. For urban individuals, the effect is even larger. The complementarity in emigration-urban migration is driven by two factors. Firstly, there is migration for higher education to Côte d'Ivoire. Secondly, incomes in skilled occupations are higher abroad when workers are young, while they are higher in Burkina Faso for older workers. Both of these factors make emigration at young age and return to urban centres later in life a worthwhile migration strategy for some individuals.

Why are migrations to urban centres a substitute or complement for emigration, that is, migration to urban centres reacts when emigration is prohibited, but not vice versa? The reason are migration costs which depend on distance. An individual in the baseline scenario picks the location with the highest expected utility, which crucially depends on expected income. The second best location alternative offers on average slightly lower expected income. If an individual is prevented from emigrating, he can still go to an urban centre where both expected income and migration costs are lower. However, an individual who is prohibited from migrating to an urban centre will not necessarily compensate by migrating abroad. Migration abroad not only has lower expected income but also higher migration costs. Thus, he might find it more profitable to compensate by refraining from migrating or by migrating to another urban centre.

8.3 Distinguishing true from observed effects

The previous analysis has presented the 'true' effects of the different migration policies on education and migration choices. *True* because these effects are measured on the full sample, taking into account the effect on permanent emigrants (i.e. individuals who were abroad in year 2000). However, the *observed effect* of these policies would be different due to the sample attrition of permanent emigrants.

Figure 17 plots both the true and observed effect of the main migration policies studied on the CDF of educational attainment of rural individuals. The true effects are given by full or dashed lines, while the observed effects are given by double-lines.

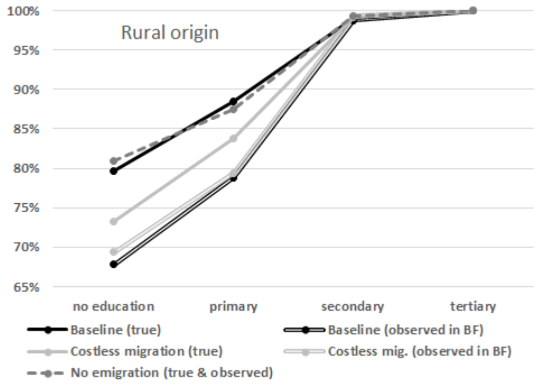

Figure 17: CDF of educational attainment under different migration scenarios

We find that the observed educational attainment is an overestimate of the true educational attainment both in the baseline and costless migration scenario. This results from high (permanent) emigration among rural individuals with no education or primary education (i.e. 'brawn drain'). However, the degree of brawn drain is not the same in all migration scenarios. In fact, brawn drain is very large among rural individuals in the baseline model, but less pronounced in the costless migration scenario. The difference is large enough to change the interpretation of the effect. The impact of costless migration (compared to the baseline) on observed educational attainment is very small and negative (3.47 versus 3.31 years of education). However, once permanent emigrants are taken into account, we find a large and positive effect of costless migration (from 2.07 to 2.78 years of education).

While true and observed effects differ substantially for rural individuals, they are very similar (not shown) for urban individuals. The small share of permanent emigrants among urban individuals and the small (if any) effects of restrictive migration policies drive this result.

9 Conclusion

In this paper, I develop and estimate a dynamic life-cycle model of endogenous location, education and work choices using rich panel and cross-sectional data on individuals from Burkina Faso. The analytical context allows me to separately estimate returns to migration and returns to education, and to dissect them into their various components.

Spatial income differences overstate net returns to migration, which are on average 1% for urban and 10% for rural individuals. The option to migrate increases life-cycle income of rural individuals by around 80%, but these gains come at a cost. Rural migrants face direct migration costs, large indirect migration costs (loss of welfare by moving from home) and they invest more in education. Depending on the economic opportunities in the rural home (i.e. farming income), certain individuals, such as those from the Center, have large returns to migration, while others (like those from the West) have much lower returns. Urban individuals, in contrast, react to positive migration shocks and get less education (and lower incomes).

Getting education is costly and can result in negative returns. Education directly and indirectly increases income (through higher employment rates in skilled occupations) in urban and international locations. At the same time it makes labour market entry harder, because unemployment is hump-shaped in education. In addition, going to school entails substantial direct and indirect costs. These indirect costs are especially large for rural individuals who need to migrate in order to reap returns to education. At primary education, life-cycle income gains are too small to outweigh these costs, resulting on average in a 28% welfare loss. This corresponds to returns of -5% per year of primary education, while classic estimates of returns to primary education amount to 10% (see Kazianga (2004)). These negative returns to primary education measured in welfare (partially) explain low school enrollment rates in rural regions. Moreover, they suggest that policies which render primary education compulsory can have a detrimental effect on rural individuals.

Migration prospects are key for education decisions in rural regions. If rural individuals could not migrate, average education would drop by 85%, that is from 2.07 years to 0.27 years. The prospect of zero (direct) migration costs, in contrast, increases rural education by 35%. If only migration to urban centres was costless, the increase would be even larger (60%). Migration policies have important effects on the incentive of getting education, not just on migration decisions. Prohibiting or restricting migration to urban centres - or any location which provides skilled work opportunities and returns to education - can backfire in terms of lower educational attainment.

Notwithstanding, even when direct migration costs are zero, rural individuals acquire less education than those in urban centres. Without any attachment to the origin average rural education would increase by 130% and as a consequence, the rural-urban education gap would shrink to 2.6 years. Unless rural regions become attractive for educated workers (or attachments to the origin get weaker), rural educational attainment will remain low.

Appendix

A Map and definition of locations

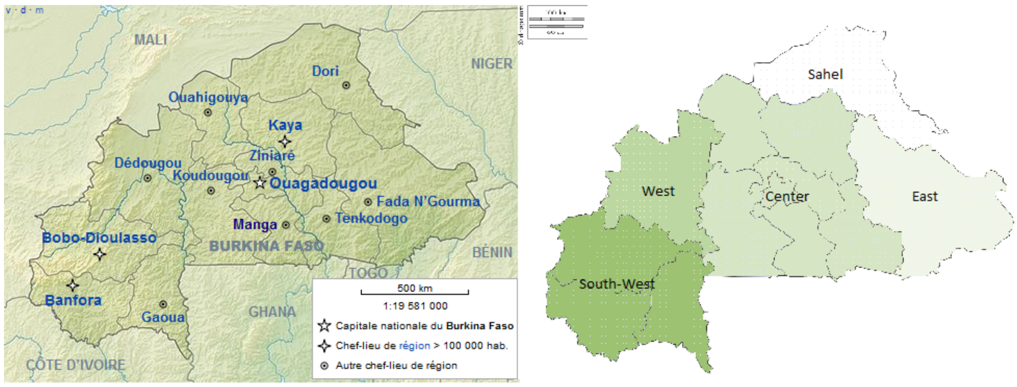

Figure 18: Map of Burkina Faso: Main cities (left panel) and definition of rural regions (right panel)

The two urban centres in the model are: **Ouagadougou**, the capital in the centre of the country and **Bobo-Dioulasso/Banfora** (referred to as Bobo), the two large cities in the South-West of the country. Because of few observations, small distance and similar economic and ethnic structure, the last two cities are regrouped into one urban centre in the model.

The five rural regions in the model are: **Sahel**, **East**, **Center**, **West**, and **South-West**. Each of these regions regroups one or several administrative regions with regional capitals. In the model, the respective capitals of these regions are Dori, Fada N'Gourma, Koudougou, Dédougou and Orodara.

The international location in the model is **Côte d'Ivoire**, Burkina Faso's neighbour to the South-West, with administrative capital Yamoussoukro.

B Data sources of location indicators

Indicator	Data sources
Employment share of agriculture	BF: Computed by the author, using RPGH-06 data published by INSD (Institut national de la Statistique et Démographie), Burkina Faso
	CI (year 2003): FAOSTAT, FAO of the UN, Accessed on September 20, 2014
Occupation shares	Ouaga, Bobo: RPGH-06 as above
Unemployment	BF: RPGH-06 as above
	CI: World Development Indicators, World Bank, Accessed on September 20, 2014
Share of villages/towns with	
- agric./non-agric. paid employment	Community survey data set
- primary/secondary schools	Community survey data set
- public transportation	Community survey data set
Income from farming	See Appendix D
Income by occupation group	See Appendix D
Average rainfall (in mm)	Regions in BF (1960-1990): SDRN-FAO, Rome
	CI (1988-1992): Aquastat, FAO, Accessed on September 20, 2014
Population of largest town 2000	BF: Interpolated by author, using demographic statistics of towns provided by INSD (Institut national de la Statistique et Démographie), Burkina Faso
	CI (1998): Wikipedia.fr, accessed on August 31, 2011
Main ethnic group (> 50%)	BF: Community survey data set, RPGH-06
Average distance to Ouaga/Bobo/CI	Computed by the author using online maps
Transportation	Community survey data set
University since	University websites
Development indicator	Computed by the author, using community survey data set. It includes health centres, infrastructure (water, electricity, telephone), leisure facilities (bar, cinema), diseases and internal conflicts.

Table 10: Data sources of location indicators

C Calibrating school transition rates

The transition rates in school are given by the following equation:

$$\pi_{school}\left(s_{it}+1|l_{it},1;\Omega_{it}\right)=\begin{cases}0.14 & \text{if } s_{it}=0,\ S_{prim}(l_{it};t,by_i)>0,\ t\leq 20\\ 0.125 & \text{if } s_{it}=1,\ S_{sec}(l_{it};t,by_i)>0,\ t\leq 23\\ 0.14 & \text{if } s_{it}=2,\ S_{tert}(l_{it};t,by_i)>0,\ 14\leq t\leq 30\\ 0 & \text{otherwise}\end{cases} \tag{21}$$

where the first three lines refer to school-level transition of individuals without, with primary and secondary education, respectively. These numbers are calibrated to match average years spent in each education level (i.e. $\frac{1}{0.14}=7.1$ years in primary and tertiary education, $\frac{1}{0.125}=8$ years in secondary education). To have a positive probability of transition at the end of a school year, an individual needs to attend school in a location which offers the next-higher education level at a certain time (the second condition). Individuals also need to be younger than a certain age limit (third condition). If one of these conditions is not met, then the probability of attaining the next-higher education level is 0 (last line).

D Income estimation and calibration

Estimating urban/international work incomes

Table 11 shows the estimation results of the Mincerian-like income equation for low and skilled occupations in Burkina Faso and Côte d'Ivoire. The dependent variable is monthly log-income. The sample used for the estimation are men and women active in the labour force with positive income, who are aged between 20 and 56 years. For both occupation levels, I drop the lowest income percentile. I also drop the highest income percentile if education is below primary. When monthly income is given in brackets (Côte d'Ivoire), I use the median value of an income bracket. To take into account the differential returns to education and experience (i.e. age) for locals and foreign-born individuals in Côte d'Ivoire, I add interaction terms in the Ivorian specification.

	Low occupations		Skilled occupations	
	BF	CI	BF	CI
Ouaga intercept	7.554***		8.408***	
	(0.263)		(0.313)	
Bobo intercept	7.629***		8.399***	
	(0.274)		(0.319)	
CI intercept		8.246***		8.204***
		(0.174)		(0.291)
Primary	0.256***	0.239***	0.150**	0.403***
	(0.059)	(0.043)	(0.067)	(0.064)
Secondary	0.426***	0.482***	0.364***	0.757***
	(0.102)	(0.059)	(0.055)	(0.052)
Tertiary	1.037***	1.887***	0.623***	0.671***
	(0.322)	(0.325)	(0.059)	(0.042)
Age	0.123***	0.070***	0.116***	0.104***
	(0.018)	(0.011)	(0.020)	(0.018)
Age^2	-0.0017***	-0.0011***	-0.0013***	-0.0010***
	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Women	-1.063***	-0.330***	-0.098*	-0.114***
	(0.053)	(0.029)	(0.052)	(0.042)
Ouaga-native	0.255***		0.016	
	(0.058)		(0.048)	
Bobo-native	0.037		-0.002	
	(0.107)		(0.096)	
Foreign		0.030		-0.314
		(0.363)		(0.879)
Foreign-Primary		0.043		-0.100
		(0.094)		(0.144)
Foreign-Secondary		-0.276**		-0.345**
		(0.141)		(0.160)
Foregin-Tertiary		-1.29***		0.045
		(0.495)		(0.167)
Foreign-Age		0.026		0.040
		(0.023)		(0.051)
Foreign-Age^2		-0.0003		-0.0008
		(0.0004)		(0.0007)
Observations	1,547	8,391	699	1,739
R-squared	0.2923	0.1024	0.4373	0.4824

Notes: *Low* occupations include agricultural and non-agricultural low-skilled workers such as artisans, domestic servants, manual workers, workers in transportation and other unskilled workers. *Skilled* occupations regroup medium- and high-skilled workers. Medium-skilled workers are clerks, public employees, security forces, administrative and technical personnel. High-skilled workers are liberal professions, managers, directors and executives in the public and private sector.

Table 11: Urban/international log-income estimation results

Based on the estimation results presented above, Table 12 shows predicted urban and international monthly income of men at age 22 by origin and education level.

	Low occupation			Skilled occupation		
	Ouaga	Bobo	CI	Ouaga	Bobo	CI
No education						
Ouaga native	11.3	9.4	12.8	21.0	20.5	16.7
Bobo native	8.8	9.8	12.8	20.7	20.5	16.7
Rural origin	8.8	9.4	12.8	20.7	20.5	16.7
Primary education						
Ouaga native	14.6	12.2	16.9	24.4	23.8	22.6
Bobo native	11.3	12.6	16.9	24.0	23.8	22.6
Rural origin	11.3	12.2	16.9	24.0	23.8	22.6
Secondary education						
Ouaga native	22.4	18.7	23.8	35.1	34.3	34.1
Bobo native	17.3	19.4	23.8	34.6	34.2	34.1
Rural origin	17.3	18.7	23.8	34.6	34.2	34.1
Tertiary education						
Ouaga native	63.0	52.6	37.7	65.5	63.9	69.8
Bobo native	48.8	54.6	37.7	65.0	63.8	69.8
Rural origin	48.8	52.6	37.7	65.0	63.9	69.8

Table 12: Predicted urban/international monthly income (1,000 CFA)

Calibrating farming income

Farming income $\tilde{w}_F(l)$ is average income per worker from agricultural activity in rural regions. It is location-specific and subject to unforeseen weather shocks. Agricultural activity includes crop farming, market gardening and livestock farming. The relative importance of these farming activities varies between regions, in line with climatic conditions.

To calculate the contribution of each agricultural activity to farming income by region, I combine different data sets provided by the FAO and the 'Direction Générale des Prévisisons et des Statistiques Agricoles du Burkina Faso' (DGSPA) on production and market prices.[36] Table 13 gives an overview over the value of these different agricultural activities by location.

As the incidence of bad harvests (i.e. drought) in 1991 is negligibly small, the average farming income is used as an estimate for farming income in a good state, $w_F(GS, l)$.[37]

[36]These include: crop farm production by regions (DGPSA), national vegetables production (FAO), national livestock production (FAO), prices of crops, vegetables and livestock (FAO), regional shares for vegetables and livestock production (DGPSA) and agricultural workers by regions (DGPSA).

[37]In each rural region, 5% of villages/towns or less declare having had a bad harvest in 1991. Further, the production of all main crops for each rural region in 1991 does not show any incidence of bad harvests either.

	Sahel	East	Center	West	S-West
Main crops	2.19	3.38	3.12	5.01	4.53
Main vegetables	0.02	0.03	0.32	0.16	0.35
Livestock	3.12	2.29	1.26	1.37	0.96
Total	5.33	5.71	4.69	6.54	5.84

Table 13: Monthly farming income per worker 1991 (1'000 CFA)

The pattern of (relatively) high per capita income in the South-West, medium per capita income in the Sahel and low income in the Center is in line with Fafchamps (1993) who uses detailed data of per capita income of agricultural households in Burkinabe villages from the Sahel, Center and South-West area from 1981 to 1983.

The probability of bad harvest shocks is obtained from the community survey data. Each village/town in the sample reports in which years they suffered bad harvests. I compute an indicator of average incidence of bad harvests from this data, which I use as the probability of bad harvest $\pi(BS, l)$ in the farming income equation. The probability of bad harvests is inversely related to the average rainfall shown in Table 5.

Using the community survey information on bad harvests and the DGPSA data on crop production, it is possible to find an approximate value of farming income in a bad state $w_F(BS, l)$. I find that the main crops' production decreases by approximately 35% in years of bad harvest. In times of bad harvest, livestock breeding is also affected by a shortage in grass. According to FAO data, livestock production decreased by approximately 20% in 1973 (a year of very bad harvests) but in recent years of bad harvests it was left almost unaffected. For lack of better data, I set the negative effect of bad harvests on livestock breeding to 15%.

Calibrating rural work income

The income from rural work w_{rw} is estimated from the DSA-EP-94 in Burkina Faso for those without education and those with at least primary education. However, the availability of rural work varies between regions and is often only seasonal (from May to September). The availability of paid employment observed in the community data set is used to approximate $\pi(rw|l)$ and the share of non-seasonal employment is used for $1 - \pi(srw|l)$.

Subsistence income

The subsistence income $\underline{w}$ is calibrated so as to match the work shares of farming and nonworking in rural areas. Table 14 summarises calibrated farming, rural work and subsistence income.

	Sahel	East	Center	West	S-West
Farming income					
$w_F(GS, l_{it})$	5.33	5.71	4.69	6.54	5.84
$w_F(BS, l_{it})$	4.09	4.16	3.31	4.53	4.00
$\pi(BS\|l_{it})$	10.81%	8.08%	6.86%	6.88%	3.77%
Rural work income					
$w_{RW}(s_{it} = 0)$	18.1	18.1	18.1	18.1	18.1
$w_{RW}(s_{it} \geq 1)$	23.9	23.9	23.9	23.9	23.9
$\pi(rw\|l_{it})$	84.02%	30.88%	61.73%	77.10%	82.63%
$1 - \pi(srw\|l_{it})$	5.26%	48.66%	56.00%	7.85%	15.27%
Income of students, nonworking and unemployed					
$\underline{w}$	0.40	0.40	0.40	0.40	0.40

Notes: $w_F(GS, l_{it})$ is farming income in a good weather state, $w_F(BS, l_{it})$ in a bad state. $\pi(BS|l_{it})$ denotes the probability of a bad weather state. w_{rw} is the monthly rural work income if employed for a year. $\pi(rw|l_{it})$ is the probability of finding work in a rural region. $\pi(srw|l_{it})$ is the probability of seasonal employment conditional on finding rural work. $\underline{w}$ is the subsistence income.

Table 14: Calibrated farming, rural work and subsistence income (1'000 CFA/month)

While expected rural work income (conditional on employment) is in the same range as low-skilled incomes in urban centres, farming income is considerably lower. However, once the (un-)availability and seasonality of rural work are factored in, expected rural work income shrinks substantially. Returns to education are present in rural work, but they are relatively low compared to those obtained in urban centres and abroad.

E Estimation results

This section presents all estimation results. Calibrated parameters have standard errors marked as 'n.a.'. The first section presents the estimation results of the labour market parameters (Tables 15 to 16), the second section presents the estimation results of the location- and activity-related parameters (Table 17).

Results: Labour market parameters

Parameter		$\hat{\theta}$	$\hat{\sigma}_{\hat{\theta}}$
Labour market entrants			
Intercept Ouaga	$\omega_{U,l1}$	-3.48	0.19
Intercept Bobo	$\omega_{U,l2}$	-3.96	0.18
Intercept CI	$\omega_{U,l8}$	-4.96	4.09
School years	$\omega_{U,11}$	0.36	0.03
School years^2/100	$\omega_{U,12}$	-1.93	0.58
Transition out and into unemployment			
U-U rate stayer	$\omega_{UU,1}$	0.749	n.a.
U-U rate migrant	$\omega_{UU,2}$	0.414	n.a.
E-U rate stayer	$\omega_{EU,1}$	0.004	n.a.
E-U rate migrant	$\omega_{EU,2}$	0.050	n.a.

Table 15: Unemployment parameter estimates

Table 15 presents estimated and calibrated unemployment parameters for labour market entrants (upper panel), as well as transition rates into and out of unemployment of the labour force (lower panel). The estimation results on unemployment parameters of labour market entrants show that the baseline unemployment risk is highest in Ouaga, intermediate in Bobo and lowest in Côte d'Ivoire. It increases with school years up to 9.2 years (lower secondary education) and then decreases. Most unemployment equation parameters are statistically significant at any conventional significance level. An exception presents the intercept of Côte d'Ivoire which is very imprecisely estimated.

Table 16 presents estimated and calibrated occupation parameters for labour market entrants and unemployed workers (upper panel), for employed workers in a low occupation (middle panel) and for employed workers in a skilled occupation (lower panel). All occupation equation parameters are statistically significant at any conventional significance level. For labour market entrants (upper panel), the results indicate that the probability of finding work in a skilled occupation are highest in Ouaga, somewhat lower in Bobo and much lower abroad in Côte d'Ivoire. It increases with high ability, schooling, age (up to 26 years), parental background and among more recent birth cohorts. The effect of high ability is approximately equivalent to having 5 years more education, and

Parameter		$\hat{\theta}$	$\hat{\sigma}_{\hat{\theta}}$
Labour market entrants			
Intercept Ouaga	$\omega_{o0,l1}$	-9.94	0.10
Intercept Bobo	$\omega_{o0,l2}$	-10.22	0.17
Intercept CI	$\omega_{o0,l8}$	-11.32	0.55
Ability	$\omega_{o0,1}$	1.55	0.13
School years	$\omega_{o0,2}$	0.30	0.02
Age	$\omega_{o0,31}$	0.44	0.01
$\text{Age}^2/100$	$\omega_{o0,32}$	-0.85	n.a.
Father's occupation	$\omega_{o0,4}$	1.21	0.31
Birth cohort	$\omega_{o0,5}$	-0.13	0.03
Occupational transition from low occupation			
Intercept Ouaga	$\omega_{o1,l1}$	-33.03	0.64
Intercept Bobo	$\omega_{o1,l2}$	-32.98	0.53
Intercept CI	$\omega_{o1,l8}$	-36.05	3.41
School years	$\omega_{o1,1}$	0.31	0.03
Age	$\omega_{o1,21}$	2.14	0.06
$\text{Age}^2/100$	$\omega_{o1,22}$	-4.46	n.a.
Birth cohort	$\omega_{o1,3}$	0.32	0.07
Occupational transition from skilled occupation			
Intercept Ouaga/Bobo	$\omega_{o2,l12}$	1.99	0.16
Intercept CI	$\omega_{o2,l8}$	0.72	0.06
School years	$\omega_{o2,1}$	0.07	0.02
Age	$\omega_{o2,2}$	0.05	0.01

Table 16: Skilled occupation parameter estimates

it is larger than the effect of good parental background (i.e. father in a skilled occupation). The change over time is relatively small: The difference between the youngest and oldest cohorts equals $6*0.13 = 0.78$, less than the effect of ability or parental background.

Transition from a low to a skilled occupation is fairly unlikely as suggested by the large negative location intercepts (middle panel). Occupational upgrading is a bit more likely in urban centres than abroad. It (slightly) increases with education and age (up to 24 years). It has decreased among recent birth cohorts. Transition out of skilled occupations is much more likely abroad than in Ouaga and Bobo (lower panel). It decreases with education and age. Overall, these results suggest that occupational downgrading and upgrading do not occur frequently, but they may happen at some point of an individual's work life. Furthermore, the estimation results indicate that workers face much better skilled work opportunities in urban centres in Burkina Faso than abroad in Côte d'Ivoire: The entry probability into skilled occupations of labour market entrants is higher, occupational upgrading is somewhat more likely and occupational downgrading is clearly less likely.

In section 5.1 in the main text I use these estimates to predict unemployment rates and occupation outcomes and discuss them in a more descriptive manner.

Results: Location and activity parameters

Table 17 presents the estimation results which mostly relate to location- and activity-related benefits and costs. These include amenities, schooling cost, migration cost, activity-switching cost, living cost differentials and the probability of high ability. Notice that amenities and cost parameters are given in 1,000 CFA (for a year). They can be compared to the (monthly) income data shown in Table 14 and Table 12 in the Appendix. I start by discussing the estimate of the living cost differential. It allows us to interpret the size of the benefit and cost parameters and compare it to farming incomes and real (rather than nominal) urban/Ivorian work income.

Parameter		$\hat{\theta}$	$\hat{\sigma}_{\hat{\theta}}$
Living costs			
Living cost differential	λ	1.98	0.04
Amenities (1,000 CFA)			
Home premium	γ_1	45.71	1.10
Development	γ_2	13.10	2.65
Schooling cost (1,000 CFA)			
Fixed cost primary	δ_P	38.46	3.68
Fixed cost secondary	δ_S	135.89	6.82
Fixed cost tertiary	δ_T	767.06	19.08
School density	δ_1	63.96	7.41
Age	δ_2	4.14	0.45
(7-Birth cohort)	$-\delta_3$	-9.61	0.78
Father's occupation	$-\delta_4$	-114.50	21.31
Ability	$-\delta_5$	-11.75	5.49
Migration cost (1,000 CFA)			
Fixed cost	ϕ_0	140.53	1.44
Distance/100km	ϕ_1	1.65	0.44
Transportation	$-\phi_2$	-41.50	2.11
Age	$-\phi_{31}$	-8.43	0.32
Age^2/100	ϕ_{32}	21.07	n.a.
Activity-switching cost (1,000 CFA)			
Switching cost	κ	24.64	3.60
Probability of high ability			
Share high-ability	π_τ	0.152	0.076

Table 17: Location and activity parameter estimates

The living cost differential is estimated to be 1.98. This means that monthly urban, Ivorian and rural work incomes need to be divided by a factor 2 to be comparable to farming incomes (see Tables 12 and 14). After living cost adjustment urban incomes at age 22 in a low occupation without education are slightly lower (4,400 to 4,700 CFA for non-natives) than good-state farming incomes (between 4,700 and 6,500 CFA). Those in Côte d'Ivoire remain slightly higher (6,400 CFA), except compared to the West region

(6,500 CFA).

Amenities are much valued, especially staying in the origin. I estimate a home premium of 45,700 CFA per year. For a rural individual, living in one's origin is thus equivalent to having around 66% more farming income. This home premium captures the value of different aspects such as social or economic ties to the family/clan (i.e. access to informal insurance), a preference for one's own ethnic group (i.e. norms), or other factors linked to the origin. Amenities from better development level are smaller, but still considerable. An urban centre with a development level of 1 provides an amenity value of 13,100 CFA, more than two months of low-occupation income (after living cost adjustment) for someone without education. In a rural area with development level 0.5, the amenity value amounts to 6,500 CFA, more than one month of farming income.

I find that fixed schooling costs are very large and convex. Schooling costs are especially large for individuals who do not come from an advantageous parental background (i.e. father not working in a skilled occupation), who are not of high ability and who live in a rural region with a low school density. In these cases, the cost of schooling more than exceeds the cost of migration at prime migration age (see below), making migration a more worthwhile investment than education. For example, in the mid-1960s in a rural area with a school density of 20% the primary schooling cost of a 10-year old 'disadvantaged' individual (i.e. low ability-low parental background) would amount to 121,400 CFA, almost 2 times the yearly farming income! This number is very large, but indeed, enrollment rates in rural regions at the time were extremely low. In an urban centre, the same individual would have faced a cost of 70,200 CFA. Education decisions are greatly driven by parental background. Children from an advantageous parental background face schooling cost which are more than 114,500 CFA lower. This large cost gap translates into large educational inequalities, which then affect labour market outcomes. Schooling costs have substantially decreased over time (by 9,600 CFA every five years as indicated by the birth cohort term) and because of higher school density in rural regions. In the mid-1990s, the primary schooling cost of the individual above would be approximately 28,500 CFA in a rural region (assuming a primary school density of 75%) and 12,600 CFA in an urban centre.

The migration cost is composed of a large fixed cost of 140,500 CFA, yet the overall cost varies substantially with age and transportation. The effect of distance is small: migrating 100km further increases the cost by less than 1,700 CFA. The migration cost is U-shaped with a (calibrated) minimum at age 20. At age 20, migration cost range from 16,600 CFA to 66,900 CFA depending on the distance and the availability of transportation. Direct migration costs thus amount to something between 20% and 1.5

times the annual farming income at age 20. Within 5 years to the optimal migration age, migration cost increase by less than 5,300 CFA compared to the minimum migration cost. At age 30 migration cost increase by 21,100 CFA compared to age 20 and at age 40 by more than 84,000 CFA, explaining why few migrations take place after age 35. Moreover, we note that indirect migration cost such as the loss of the annual home premium of 45,700 CFA and the activity-switching cost of 24,600 CFA may outweigh the direct migration cost.

The cost of switching from one activity to another amounts to 24,600 CFA. This corresponds roughly to 4 months of farming income, indicating that switching costs are neither negligibly small nor prohibitively large, but moderate. However, given that real income differences (at low education levels) are relatively small, they are large enough to make a large fraction of individuals (around 90%, except for nonworking) stay in their current activity.

The share of high-ability individuals is estimated at 15.2%.

F Goodness of fit

This section contains detailed tables on the goodness of fit of the model. Each table shows the observed sample moment, the standard error of the observed sample moment and the simulated moment. I start by discussing the goodness of fit of the labour market parameters and then turn to discussing the fit of the amenity, schooling cost, migration cost and other parameters.

Fit: Unemployment moments identifying unemployment parameters

Table 18 shows the fit for moments related to the unemployment probability of labour market entrants.

The fit of the unemployment moments is very good. The model reproduces the hump-shaped pattern of unemployment rates in education. It also matches the spatial differences in unemployment rates.

	No educ	Prim	Sec	Tert
Unemployment rates in Ouaga				
Observed	0.048	0.078	0.173	0.067
Std. Err.	0.012	0.017	0.023	0.046
Simulated	0.029	0.073	0.139	0.074
Unemployment rates in Bobo				
Observed	0.027	0.038	0.089	
Std. Err.	0.012	0.017	0.026	
Simulated	0.021	0.061	0.079	
Unemployment rates in Côte d'Ivoire				
Observed	0.007	0.039		
Std. Err.	0.003	0.022		
Simulated	0.014	0.062		

Table 18: Fit: Unemployment rates among labour market entrants

Fit: Labour market moments identifying occupational parameters of labour market entrants

Tables 19 to 21 show observed and simulated moments on (skilled) occupational outcomes of labour market entrants.

Overall, the model matches well the observed patterns of labour market entrants in skilled occupations with respect to locals versus migrants, by education and by parental background (see Table 19), while the overall share is slightly too high. The model captures local differences in shares in skilled occupations, both for locals and migrants, but it overpredicts the skilled occupation rates in Ouaga. In terms of education patterns (Table 20) the model matches the convex pattern of the share of skilled occupations by education, even though the absolute simulated values are somewhat different from the observed ones. Similarly, the model also matches fairly well the share of skilled occupations by parental background (Table 21).

The model is less successful in matching the age and cohort patterns. The share of skilled occupations at the main age of labour market entry in the model (age 18 to 22, see Table 22) is precisely matched. However, at younger age the model overpredicts and at older age the model underpredicts the share in skilled occupations. Note that few labour market entries occur after age 23, and thus, little weight is put on matching these moments well. As for the cohort pattern, the model fails to produce the slight downward trend which is observed in the data.

	Ouaga	Bobo	Côte d'Ivoire
Share in skilled occupations (locals)			
Observed	0.107	0.092	
Std. Err.	0.015	0.018	
Simulated	0.166	0.106	
Share in skilled occupations (migrants)			
Observed	0.249	0.238	0.032
Std. Err.	0.017	0.025	0.007
Simulated	0.317	0.230	0.060

Table 19: Fit: Share in skilled occupations across locations (labour market entrants)

	No educ	Prim	Sec	Tert
Observed	0.032	0.044	0.338	0.892
Std. Err.	0.005	0.009	0.020	0.036
Simulated	0.016	0.093	0.281	0.615

Table 20: Fit: Share in skilled occupations by education (labour market entrants)

	Low	High
Observed	0.110	0.343
Std. Err.	0.007	0.029
Simulated	0.154	0.323

Table 21: Fit: Share in skilled occupations by parental background (labour market entrants)

	13-17	18-22	23-27	28-32	33-37
Observed	0.084	0.322	0.525	0.543	0.545
Std. Err.	0.023	0.032	0.042	0.085	0.109
Simulated	0.210	0.330	0.392	0.321	0.237

Table 22: Fit: Share in skilled occupations by age group (labour market entrants)

	1952-1956	1957-1961	1962-1966	1967-1971	1972-1976
Observed	0.168	0.221	0.165	0.142	0.112
Std. Err.	0.021	0.022	0.018	0.017	0.014
Simulated	0.133	0.164	0.198	0.195	0.206

Table 23: Fit: Share in skilled occupations by birth cohort (labour market entrants)

Fit: Labour market moments identifying occupational transition parameters

Tables 24 to 30 show observed and simulated moments which identify the parameters on occupational transitions, that is occupational upgrading and downgrading. The former four tables refer to occupational upgrading, the later three tables to occupational downgrading.

The fit of occupational upgrading and occupational downgrading moments is very good. The model reproduces well location differences, as well as the education, age and time pattern.

	Ouaga	Bobo	Côte d'Ivoire
Observed	0.006	0.006	0.001
Std. Err.	0.001	0.001	0.001
Simulated	0.008	0.005	0.002

Table 24: Fit: Upward occupational transition rate across locations

	No educ	Prim	Sec	Tert
Observed	0.003	0.003	0.019	0.125
Std. Err.	0.001	0.001	0.003	0.069
Simulated	0.001	0.003	0.014	0.121

Table 25: Fit: Upward occupational transition rate by education

	13-17	18-22	23-27	28-32	33-37
Observed	0.004	0.006	0.010	0.005	0.003
Std. Err.	0.001	0.001	0.002	0.001	0.001
Simulated	0.001	0.013	0.012	0.003	0.000

Table 26: Fit: Upward occupational transition rate by age group

	1952-1956	1957-1961	1962-1966	1967-1971	1972-1976
Observed	0.008	0.007	0.004	0.006	0.005
Std. Err.	0.002	0.002	0.001	0.002	0.001
Simulated	0.007	0.006	0.004	0.006	0.011

Table 27: Fit: Upward occupational transition rate by cohort

	Burkina Faso	Côte d'Ivoire
Observed	0.983	0.961
Std. Err.	0.003	0.022
Simulated	0.982	0.903

Table 28: Fit: Downward occupational transition rate across locations

	Prim	Sec	Tert
Observed	0.963	0.981	0.997
Std. Err.	0.012	0.004	0.003
Simulated	0.979	0.981	0.985

Table 29: Fit: Downward occupational transition rate by education

	13-17	18-22	23-27	28-32	33-37
Observed	0.917	0.963	0.979	0.983	0.990
Std. Err.	0.058	0.012	0.006	0.005	0.004
Simulated	0.971	0.973	0.981	0.986	0.987

Table 30: Fit: Downward occupational transition rate by age group

Fit: Education moments identifying schooling cost parameters

Tables 31 to 36 show the fit of moments which identify the schooling cost parameters.

All in all, the goodness of fit for educational attainment and schooling decisions is satisfactory, but the overall educational attainment is slightly too low. The model generally matches the large urban-rural differences in educational outcomes (see Table 31), the increase in primary education over time (see Tables 32 and 33), schooling attendance by age (see Table 34) and educational attainment by parental background (see Table 35). The general patterns are matched by the model, but many moments are under- or overpredicted. For example, the share of never-schoolers is too high in urban centres and the Western and South-Western regions, but too low in the other rural regions.

On key purpose of the model is to reproduce the sorting of individuals into locations by education. Generally, migrants moving to urban centres are positively selected in terms of education, and those moving abroad are negatively selected (see Table 36).

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Share of never-schoolers							
Observed	0.132	0.187	0.869	0.766	0.592	0.671	0.669
Std. Err.	0.015	0.021	0.018	0.026	0.016	0.025	0.025
Simulated	0.272	0.301	0.768	0.721	0.544	0.843	0.732
Share secondary conditional on primary							
Observed	0.615	0.590	0.191	0.484	0.589	0.438	0.650
Std. Err.	0.024	0.030	0.058	0.063	0.025	0.045	0.044
Simulated	0.692	0.608	0.651	0.620	0.669	0.633	0.658
Share tertiary conditional on secondary							
Observed	0.080	0.098	0.111	0.065	0.147	0.094	0.103
Std. Err.	0.017	0.023	0.111	0.045	0.024	0.041	0.035
Simulated	0.293	0.080	0.016	0.029	0.076	0.021	0.036

Table 31: Fit: Educational attainment by home location

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Observed	0.651	0.615	0.084	0.080	0.281	0.308	0.213
Std. Err.	0.053	0.068	0.031	0.039	0.029	0.053	0.046
Simulated	0.374	0.376	0.232	0.171	0.423	0.015	0.138

Table 32: Fit: Share with primary education at age 13 by home location (1960s)

	Urban origin			Rural origin		
	1970s	1980s	1990s	1970s	1980s	1990s
Observed	0.741	0.874	0.922	0.267	0.330	0.251
Std. Err.	0.029	0.017	0.018	0.017	0.018	0.029
Simulated	0.508	0.647	0.678	0.106	0.112	0.232

Table 33: Fit: Share with primary education at age 13 over time

	Urban origin					Rural origin				
	7	12	17	22	27	7	12	17	22	27
Observed	0.823	0.688	0.401	0.155	0.021	0.281	0.230	0.109	0.027	0.006
Std. Err.	0.013	0.015	0.015	0.012	0.005	0.009	0.009	0.008	0.005	0.003
Simulated	0.810	0.765	0.554	0.234	0.011	0.260	0.278	0.063	0.016	0.000

Table 34: Fit: Share of students by age

	Urban origin		Rural origin	
	Low	High	Low	High
Observed	5.72	8.79	2.01	8.95
Std. Err.	0.17	0.27	0.08	0.40
Simulated	5.48	7.98	1.93	8.32

Table 35: Fit: Avg. years of education by parental background

	Urban origin			Rural origin			
	Migration to ...			Migration to ...			
	Abroad	Urban	Local	Abroad	Ouaga	Bobo	Local
Older cohorts							
Observed	5.14	7.79	4.33	1.27	4.70	4.18	0.72
Std. Err.	0.64	0.57	0.41	0.13	0.24	0.33	0.11
Simulated	1.77	4.45	4.21	0.40	3.89	2.32	0.01
Younger cohorts							
Observed	4.51	7.04	6.29	0.96	4.97	5.13	1.12
Std. Err.	0.42	0.65	0.24	0.09	0.23	0.34	0.11
Simulated	3.61	5.59	6.30	1.80	5.32	3.86	0.19

Table 36: Fit: Avg. years of education by migration status

Fit: Migration moments identifying amenity and migration cost parameters

Tables 37 to 40 show the fit of the migration moments identifying the migration cost parameters, Table 41 presents the fit of the moments which identify the amenity parameters.

Overall, the goodness of fit of migration moments is mixed. Generally, the model predicts too much migration (both out-migration and return migration) of urban individuals (see Tables 37 and 41). Migrants from and return migration to the Center are very precisely matched, while the other rural regions either have too much or too little migration. The model struggles to match the migration pattern of the West. The share of stayers and return migrants are both too high. Farming income in the West is clearly higher than in other rural regions, at the same time, the West has the third highest migration rate. The model cannot match this feature of the data.

The model matches the hump-shape of migration rates by age. However, the peak of maximum migration is to high, and it happens too early for urban migration and too late for rural migration.

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Observed	0.684	0.563	0.507	0.558	0.131	0.347	0.242
Std. Err.	0.020	0.025	0.024	0.028	0.010	0.022	0.019
Simulated	0.435	0.325	0.281	0.325	0.132	0.624	0.323

Table 37: Fit: Share of stayers by home location

	Ouaga	Bobo	Sahel	East	Center	West	S-West	Côte d'Ivoire
Observed	1.374	1.043	7.360	3.656	0.770	3.101	1.811	1.613
Std. Err.	0.175	0.124	1.572	0.731	0.047	0.402	0.174	0.213
Simulated	0.705	0.833	1.077	1.025	1.053	0.579	1.077	0.844

Table 38: Fit: Ratio of migrations farthest to closest destination by origin

	Sahel	East	Center	West	S-West
Out-migration rate in 1970s					
Observed	0.059	0.037	0.148	0.123	0.092
Std. Err.	0.010	0.010	0.011	0.015	0.012
Simulated	0.054	0.061	0.076	0.073	0.083
Out-migration rate in 1980s					
Observed	0.059	0.049	0.173	0.092	0.115
Std. Err.	0.008	0.008	0.010	0.009	0.011
Simulated	0.082	0.075	0.115	0.108	0.108
Out-migration rate in 1990s					
Observed	0.068	0.076	0.205	0.111	0.156
Std. Err.	0.008	0.010	0.010	0.009	0.012
Simulated	0.100	0.108	0.137	0.140	0.137

Table 39: Fit: Rural out-migration rates of 17-26 years old

	Urban origin						
	7	12	17	22	27	32	37
Observed	0.014	0.012	0.025	0.057	0.020	0.010	0.009
Std. Err.	0.004	0.004	0.006	0.011	0.008	0.007	0.009
Simulated	0.006	0.037	0.117	0.097	0.060	0.014	0.003
	Rural origin						
Observed	0.012	0.022	0.084	0.112	0.082	0.035	0.036
Std. Err.	0.002	0.003	0.006	0.009	0.010	0.008	0.010
Simulated	0.016	0.036	0.045	0.062	0.146	0.199	0.031

Table 40: Fit: Migration rates by age

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Return migration							
Observed	0.731	0.446	0.579	0.486	0.137	0.357	0.249
Std. Err.	0.035	0.038	0.034	0.043	0.011	0.027	0.022
Simulated	0.882	0.841	0.131	0.140	0.128	0.501	0.213
Net share of migration in 70s, 80s, 90s							
Observed	0.127	0.048	-0.015	-0.004	-0.240	-0.043	-0.055
Std. Err.	0.021	0.015	0.012	0.008	0.024	0.014	0.014
Simulated	0.033	0.017	-0.014	-0.006	-0.101	0.004	-0.007
Observed	0.130	0.032	-0.015	-0.005	-0.162	-0.018	-0.048
Std. Err.	0.015	0.012	0.008	0.007	0.015	0.010	0.011
Simulated	0.025	0.004	-0.034	-0.018	-0.111	-0.008	-0.024
Observed	0.110	0.020	-0.019	-0.019	-0.167	-0.052	-0.067
Std. Err.	0.012	0.011	0.008	0.007	0.013	0.009	0.010
Simulated	0.024	0.007	-0.027	-0.021	-0.081	-0.008	-0.032

Table 41: Fit: Return migration and net share of migration

Fit: Moments identifying remaining parameters

Tables 42 to 45 shows the fit of the remaining moments, which identify the activity-switching cost and the probability of high ability, or which relate to sample selection properties.

The shares of individuals who do not switch their activity are well matched (except for nonworking, where the model predicts too much switching). Similarly, the fit of the ratio of shares of farming and rural work is also good. The ratio of urban residence over residence abroad in 2000 is not well matched. Finally, the model underpredicts permanent emigration from urban origin, but it predicts well the U-shape of permanent emigrants over education from a rural origin.

	School	Urban/ rural work	Farming	Nonworking
Observed	0.925	0.909	0.894	0.584
Std. Err.	0.002	0.002	0.002	0.035
Simulated	0.877	0.907	0.917	0.043

Table 42: Fit: Share staying in same activity as last period

	Sahel	East	Center	West	S-West
Observed	2.355	2.372	1.761	2.312	2.062
Std. Err.	0.053	0.061	0.039	0.055	0.054
Simulated	1.490	2.396	1.295	2.543	1.424

Table 43: Fit: Ratio logarithm share farming and share rural work

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Observed	0.500	0.552	0.266	0.718	2.553	0.769	0.880
Std. Err.	0.164	0.122	0.073	0.178	0.200	0.115	0.105
Simulated	1.718	1.634	0.235	0.322	0.294	1.859	0.368

Table 44: Fit: Ratio urban residence (not home) over residence abroad in 2000 (by home location)

	Urban origin				Rural origin			
	none	prim	sec	tert	none	prim	sec	tert
Observed	0.436	0.286	0.134	0.087	0.359	0.209	0.054	0.100
Std. Err.	0.057	0.042	0.031	0.060	0.013	0.022	0.013	0.056
Simulated	0.020	0.032	0.011	0	0.750	0.361	0.007	0.451

Table 45: Fit: Share of permanent emigrants among migrants

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