Migration, Education and Work Opportunities*

PRELIMINARY

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Abstract

This paper studies individual migration, education and work decisions in a dynamic life-cycle model in a developing context. I estimate the model exploiting long panel data on migrants and stayers in Burkina Faso, and cross-sectional data on permanent emigrants. I find that heterogenous individuals self-select into migration and migration destinations according to their education: those without education go abroad and while those with secondary and tertiary education migrate to urban centers. Differences in unemployment rates and returns to education are at the core of this. I further show that large rural-urban and rural-international income differences dwindle away when the risk of unemployment, risk aversion and migration costs are factored in. Similarly, returns to education are not as large as measures on wage earners would suggest. I uncover that the unemployment risk for labour market entrants is hump-shaped in education, leading to a re-evaluation of net returns to education. Direct and indirect migration costs further lower net returns to education of rural individuals. Together with higher rural schooling costs they explain a large fraction of the rural-urban education gap. Counterfactual policy simulation shows that a decrease in schooling costs in rural regions increases the probability of migration and leads to a re-direction of rural migration flows. Rather than migrating abroad, individuals now migrate to urban centres. Moreover, I find that migration policies have an (albeit small) impact on educational attainment in rural regions.

JEL: J61, O15, R58

Keywords: Migration, Education, Life-Cycle Model, Simulated Method of Moments, Burkina Faso

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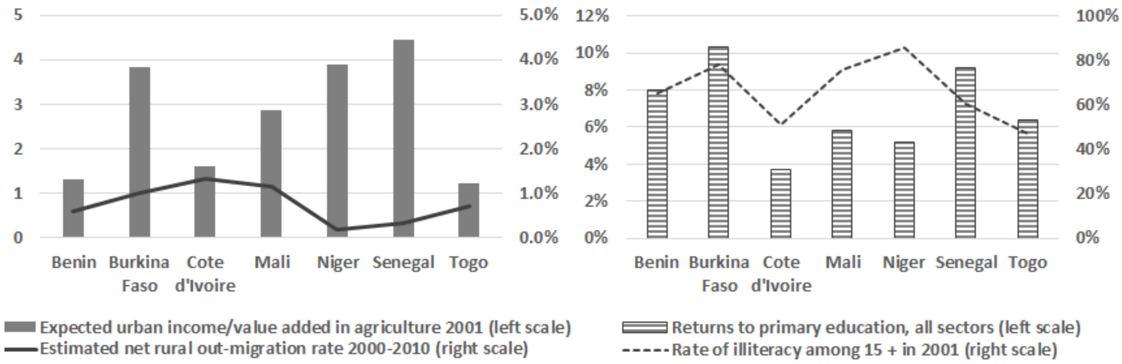
1 Introduction

Harris and Todaro (1970) set off to explain why high rural-urban migration could subsist in the presence of urban unemployment in less developed economies. Figure 1 (left panel) shows that the curiosity has reversed in recent years in West Africa: Why are rural-urban migration rates only moderate if income differences between rural and urban locations are so large? A similar question arises when comparing high illiteracy rates and returns to education in West Africa (Figure 1, right panel): Why is educational attainment so low if returns to education are so large?

These questions are linked in a country which is characterised by rural-urban disparities, that is where education opportunities are geographically concentrated and reaping returns to education requires migration to urban centers. The reason why rural individuals do not go to school is likely to be related to why migration to urban centers is relatively low.



Notes: Definition and sources are described in Appendix A.

Figure 1: Migration puzzle (left panel) and Schooling puzzle in West Africa (right panel)

This paper addresses all of these questions, and thus makes the following three contributions. First of all, I develop a dynamic life-cycle model with endogenous location, education and work choice. Second, I estimate the model and provide insight into returns to migration and returns to education over the life cycle, hereby shedding light on the migration and education puzzle. Third, I study the interaction of migration and education decisions. In West Africa, migration is common across different education groups, but their destinations varies. Using counterfactual education and migration policy simulations, I investigate how education shapes migration patterns and how migration prospects affect education decisions.

The first contribution of this paper is to develop a dynamic model of endogenous, repeated location, education and work choices of forward looking men over their life cycle. I model the mutual interdependencies and dynamic trade-offs between these decisions, allowing individuals to choose from a set of discrete locations and to decide their activity in the form of attending school, engaging in the labour force or being nonworking. By combining location and activity choices in the same dynamic framework, the paper brings two strands of the literature together. On the one hand, the model builds on the migration literature using a dynamic multi-location set-up and on the other hand, it integrates features from the literature on education and career choices in a dynamic setting.

Recent contributions on migration choices in a multi-location set-up with a life-cycle perspective include the seminal paper of Kennan and Walker (2011), Kennan (2010), Gemici (2011), Lessem (2009) and Lessem (2013). The former three papers look at internal migration in the US, the fourth one studies internal labour migration in Malaysia. Lessem (2013) presents an exception insofar as she studies Mexican-US migration of both husband and wife, considering several location choices in the US and in Mexico. My life-cycle model of location choice relies on a similar framework as Kennan and Walker (2011) and Kennan (2010)[1], but adapts it to a developing country context. This entails several extensions. First, the model distinguishes rural from urban work opportunities. These local work opportunities reflect the dual labour market structure found in developing countries which typically consists of (subsistence) farming in rural regions and a wage sector in urban centers. I introduce unemployment as a key element in the urban wage sector as suggested by the work of Harris and Todaro (1970)[2]. Another characteristic of the urban wage sector is that it offers work in different occupation levels. Unemployment rates and (relative) demand for different occupation levels vary across locations and education levels, thus creating differential migration incentives. Secondly, I model individuals with a constant relative risk aversion coefficient. Risk aversion is estimated along with the other parameters of the model. In absence of formal insurance (e.g. unemployment insurance) and social security, that is institutions limiting individual risk exposure, it is crucial that we correctly capture the degree of risk aversion of individuals (see Stark (1991)). Indeed, uninsured unemployment has more dramatic effects the higher the degree of risk aversion. Third, locations not only differ in their labour market structure, but also in terms of education opportunities and amenities. This creates further differential migration incentives.

This paper also draws on the literature which studies career choices in a dynamic context. Keane and Wolpin (1997) model how forward looking men in the US choose their career path, Attanasio et al. (2012) model the education versus work decision of teenagers in Mexico until 17. As in these previous contributions, I model the choice of education, work and nonworking activities over the life cycle. One major contribution is to extend the career path literature tp include the location dimension. By introducing migration decisions, I can study the effect of migration (prospects) on education and work choices, and vice versa. Indeed, Attanasio et al. (2012) point out in a footnote that returns to education for rural kids in Mexico are reaped by migrating from rural regions to urban centers. The dynamic location-activity framework I develop in this paper allows to quantify such effects.

A second contribution of the paper is empirical. I use detailed retrospective migration, education and employment histories of a representative sample of male internal migrants, temporary emigrants and never-movers, and cross-sectional data on permanent emigrants. Combining these two data sets allows me to simultaneously study *internal* and *international* migration patterns

[1] Kennan (2010) extends the model of Kennan and Walker (2011) to incorporate a simple schooling decision after completed high school (no college, some college and college) and before migrating. Kennan (2010) studies the effect of higher education subsidies and human capital mobility in this context. While the paper addresses the interaction of college education and migration decisions, it is targeted to a very different institutional background.

[2] Kennan and Walker (2011) analyse the effect of *expected* income differentials but abstract from unemployment in US states (and possible regional differences in it). Lessem (2009) takes unemployment into account. She finds no clear pattern with respect to education.

and how they relate to education patterns[3]. This is crucial insofar as returns to education vary across regions and thus lead to important self-selection mechanisms of migrants. In the estimation process, I identify the risk aversion parameter and all other parameters of the model in order to shed light on returns to migration and returns to education. A decomposition of these returns provides evidence on the quantitative importance of the different components. Overall, I find that returns to migration are not as large as rural-urban and rural-international income differences in farming and low-skilled occupations would suggest. Unemployment and risk aversion play a key role in correctly evaluating returns to migration from income differentials. Direct and indirect migration costs further reduce net returns to migration. I conclude that measuring returns to migration only in income differences of employed workers leads to biased results.

Returns to education are small for similar reasons. The probability of unemployment of labour market entrants is inverse U-shaped in education (peaking between primary and secondary education), thus considerably reducing returns to education for intermediate education levels. Attaining secondary and tertiary education is also costly because of foregone income while studying. Individuals from rural regions have lower opportunity costs of going to school, but at the same time their direct schooling costs are larger. In order to reap the returns to education, rural individuals have to migrate to urban centres. Large migration costs and the loss of the home premium when moving away from the origin are for most rural individuals not compensated by risk-adjusted returns to education, thus explaining their relatively low educational attainment. My results relate to the literature on private returns to education in Sub-Saharan Africa[4] and show that measuring returns to education on wage earners (even after controlling for sectoral selection) might lead to biased results, as there are many indirect components such as unemployment risk, schooling and migration costs which affect education decisions but do not show up in returns to education measured on wage earners.

The remaining part of this paper is structured as follows. Section 2 presents and discusses empirical evidence on the relationship between 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 risk-averse and 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. Section 8 studies the interaction of

[3] Lessem (2013) studies internal and international migration between Mexico and the US in a dynamic life cycle model. However, she does not link it to education patterns.

[4] There is an extensive literature on returns to education in Sub-Saharan Africa. 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. Recent contributions are: Schultz (2004), Kazianga (2004), Nordman and Roubaud (2009), Chirwa and Matita (2009), Oyelere (2010), Lassibille and Tan (2005), Appleton (2001) and Kuepie et al. (2009). Most of these studies find private returns to primary education of 5% to 10%. Oyelere (2010) finds lower private returns to education in Nigeria of around 2 to 5% by using an IV estimation approach. However, it is impossible to conclude from her analysis whether Nigeria represents a special case of low returns to education in Sub-Saharan Africa or if discrepancies with other Sub-Saharan estimates arise from different estimation methods (usually OLS). Oyelere (2010) highlights the importance of low returns to education leading to lower schooling attainment or emigration of highly educated individuals.

education and migration decisions in the light of an education reform. Finally, section 10 concludes.

2 Data and empirical evidence

2.1 Data

This paper combines several data sets in its empirical analysis. The main data sets are an exceptionally rich and representative retrospective life history data set on stayers, internal migrants, and temporary emigrants, complemented with cross-sectional data on permanent emigrants from Burkina Faso. Both data sets are part of the research project *'Migration Dynamics, Urban Integration and Environment Survey of Burkina Faso'* (henceforth, EMIUB[5]). 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)).

For the estimation part, I draw on migration, education and labour market histories of the EMIUB on the one hand, and cross-sectional data on the same outcomes for permanent emigrants on the other hand. As the EMIUB data set does not report wages or income but instead provides detailed data on occupation and status in employment[6], I draw on the ILO October Inquiry of the Laborsta data set for income data in Burkina Faso. One major advantage of this data set is that income data is given by occupations. By putting structure on the link between individual characteristics and outcomes in occupations, I can estimate occupation probabilities and hence, derive expected income for each individual[7]. For the income of (mostly subsistence) farmers I rely on detailed regional agricultural production data provided by the 'Direction Générale des Prévisisons et des Statistiques Agricoles du Burkina Faso' (DGSPA) and further agricultural data by the 'Food and Agriculture Organization' (FAO). Finally, I also draw on a retrospective community survey which was designed to complement the EMIUB. The community survey reports information on 600 towns and villages in Burkina Faso (Schoumaker et al. (2004)) and retrospectively collected data on the availability of schools and health centers, employment opportunities, agricultural characteristics, transportation, natural disasters and conflicts since 1960.

[5]The EMIUB survey was conducted by the 'Institut Supérieur des Sciences de la Population' (ISSP, formerly UERD (Unité d'Enseignement et de Recherche en Démographie)) 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'.

[6]Given the challenge of measurement error (for the relevant discussion please refer to section 4.4), we may doubt that reported retrospective data on income would have been of a sufficiently good quality to be used for the analysis.

[7]I use the 1990/1991 wave which has the best data availability. The wave in the early 1980s and another one around 2000 are less extensive. Notice that by using just one wave of income data, I cannot study how the relative wage of different occupation groups has changed over time and how that might have impacted migration and education patterns over time. However, I allow the occupation probabilities to change over time, thus one occupation might become relatively more accessible than another one and hence, expected incomes evolve over time.

2.2 Descriptive statistics

This uses data on men[8] who had lived in Burkina Faso at age 6 and who were aged between 15 and 48 in year 2000. The analysis is limited to location spells which have lasted for at least one year, intra-regional migration is excluded[9].

Table 1 presents sample statistics on migration, education and labour market outcomes of 3,800 men, among which 670 are permanent emigrants. Those men who are not permanent emigrants have either never migrated, are internal migrants or past emigrants who had returned to Burkina Faso by 2000.

	All	**Urban origin**	**Rural origin**
Summary statistics			
Number of individuals	3,804	919	2,885
Person-years		19,733	73,514
Mean age in 2000	29.51	26.47	30.48
Migration statistics			
Migrants	63.1%	36.9%	71.5%
Migration destination			
- Urban	35.2%	50.6%	32.4%
- Rural	30.5%	24.2%	31.6%
- Abroad	34.4%	25.2%	36.0%
Avg. migrations/migrant[10]		2.12	1.95
Avg. distance/migration (in km)		294	384
Avg. duration in destination (completed spell, in years)		6.87	6.86
Avg. duration in destination (incomplete spell, in years)		8.50	9.41
Avg. yearly migration rate		3.77%	6.02%
Education statistics			
Share ever gone to school	41.4%	82.3%	28.5%
Avg. education/student (in years)		7.64	7.17
Labour market statistics			
Students	8.2%	23.2%	3.5%
Labour force	90.6%	75.4%	95.5%
Nonworking	1.2%	1.4%	1.1%
Occupational statistics			
Rural labour force			
Share in farming		0.6%	66.0%
Share in salaried/non-agricultural occupation		0.3%	4.1%
Urban labour force			
Share in medium-high-skilled occupation		81.7%	23.1%
Share in low-skilled occupation		12.6%	5.9%
Share unemployed		4.9%	0.9%

Notes: Individuals are belonging to the rural or urban labour force according to their current residence. Permanent emigrants are classified by their last residence prior to emigration.

Table 1: Sample data

[8]Given the important gender differences in migration motives and migration behaviour, the analysis is restricted to men. Burkinabe women also migrate but their migration decisions are mostly motivated by family reasons, while male migrations are driven by economic reasons (work-, money- and study-motivated).

[9]We employ the same definition of regions as in Section **??**.

[10]Migrations per migrant might be downward biased because for most permanent emigrants we do not observe complete location histories.

63% of the Burkinabe population between 15 and 48 have migrated at least once since age 6 (71% among those from a rural origin). Migrations towards an urban center are quantitatively important (35% of all migrations have an urban destination) but so are migrations abroad (also 35%), and towards rural regions (30%). Many migrations with a rural destination are in fact return migrations (not shown). Overall, rural-urban moves account for less than 25% of total migrations[11]. These number clearly highlight the need for a migration framework which includes more than rural-urban migration.

As for educational attainment, we observe that men from a rural origin are far less likely to have ever gone to school than those from an urban origin (71% versus 18%). The schooling puzzle presented in Figure 1 seems to be mainly a rural concern. Interestingly, rural individuals are less likely to have gone to school than to migrate. The data further shows that the share of those without schooling is around 15pp higher among permanent emigrants than among the rest of the population (not shown). This evidence suggests that international migration from Burkina Faso attracts the less educated, contrary to what we would expect under the classic brain drain hypothesis.

2.3 Empirical evidence on the link between migration and education

This section briefly presents some descriptive statistics on migration behaviour by educational attainment. The upper panel of Table 2 shows migration probabilities and average moves per migrant for the current sample for the education level attained by year 2000[12]: no education (no), some primary education (Prim), some secondary education (Sec) and tertiary education (Tert).The lower panel presents the same statistics as above for the subsample who had completed education in year 2000. It documents how much migration is occurring while still in school and how much happened after completed education.

In terms of migration patterns by education level, Table 2 reveals three features for Burkina Faso. First, we observe that the probability of migration even without schooling is fairly large. It further increases with education. Secondly, conditional on being a mover, individuals with secondary/tertiary schooling migrate more often than their less educated peers. This difference is driven by migration during education. Migrants move during their education curriculum on average between 0.7 and 1.9 times. Last and most intriguingly, migration destinations change with education level. The number of migrations going to urban centers increases with education, while the one of those going abroad decreases (only ratio shown in lower panel). This pattern could indicate different returns to education, with the international location being relatively more attractive for individuals with no or primary education and urban locations being relatively more attractive for individuals with higher education.

[11] This fact has already been pointed out by Lucas (1997) in a survey on internal migration in developing countries. He also stressed that (representative) evidence on different forms of internal and international migration in developing countries is scarce.

[12] For permanent emigrants, the education level attained in year 2000 is not necessarily known. They are classified by their education level at emigration. Most permanent emigrants have completed their education by the time they emigrate. A small fraction of individuals go abroad in order to pursue university education which was not available in Burkina Faso until the mid-1970s. They are listed under secondary education.

	Urban origin				Rural Origin			
	No	Prim	Sec	Tert	No	Prim	Sec	Tert
All individuals								
Migrants	45.4%	35.6%	30.3%	78.0%	66.1%	77.1%	91.5%	100%
Moves per migrant	1.76	1.91	2.43	2.5	1.86	1.86	2.22	3.04
Mean age in 2000	31.3	26.2	24.3	30.6	30.7	30.1	29.0	35.0
Completed education in 2000	100%	92.9%	61.0%	82.9%	100%	95.1%	85.7%	73.6%
Individuals with completed education in 2000								
Migrants	45.4%	37.9%	39.8%	79.4%	66.1%	79.3%	93.2%	100%
- of which migrated only during education		2.7%	18.4%	22.2%		7.5%	26.9%	20.5%
Moves per migrant	1.76	1.92	2.56	2.62	1.86	1.87	2.38	3.56
- of which during education		0.25	0.69	1.33		0.28	0.81	1.90
Ratio urban/international migrations	0.86	1.40	3.10	4.00	0.41	1.24	4.88	5.57
Mean age in 2000	31.3	27.0	28.4	32	30.7	30.8	30.8	38.5

Table 2: Migration behaviour during and after completing education

2.4 Regional differences

The previous evidence has revealed a complex pattern of internal and international migration movements, suggesting that locations differ in their returns to education, but most likely also in terms of education opportunities and other factors. To study regional differences in Burkina Faso, I define 5 rural regions (Sahel, East, Center, West, South-West) and 2 urban centers (Ouagadougou, Bobo-Dioulasso)[13]. Table 3 summarises economic, geographical and infrastructural characteristics of Burkinabe locations. We also include Côte d'Ivoire (abbreviated 'CI') as it is the main recipient and sender of Burkinabe migrants.

[13]For a map of Burkina Faso and a definition of the different locations, see Figure 16 in Appendix B.

	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%	
Calibrated income in 1990/1991 (in 1,000 CFA/month)								
Farming income			5.3	5.7	4.7	6.5	5.8	
Income in low-skilled occupation	31.0	29.9						36.1
Income in medium-skilled occupation	52.6	52.6						72.2
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
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 19 in Appendix C.

Table 3: Economic, geographical and infrastructural indicators by location

Overall, we find that urban centers and rural regions differ substantially in almost all respects: Labour market structure, income, education facilities and other infrastructural characteristics.

Urban centers are characterised by a relatively low share of employment in agriculture, unemployment, and nominal (low-skilled) incomes which are around 8 times larger than income from farming in rural regions[14]. They also have more schooling facilities, especially for secondary and tertiary education, and a generally higher development level.

The contrast between rural regions is less stark than with urban centers but nonetheless, important differences emerge. 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 centers between 1960 and 2000, while *grosso modo* preserving the regional ranking. Overall, the Sahel region is lagging behind in all dimensions: its development level is lower, it has fewer primary and secondary schools, it is farther from the urban centers and badly connected by public transportation. The Center and South-West are characterised by their closeness to an urban center and by better schooling facilities than the other rural regions. The South-West is also sharing a border with Côte d'Ivoire. Interestingly, income from farming is not perfectly aligned with regional rainfall, nor is it perfectly correlated with the 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 has a lower unemployment rate than urban centers, and is also characterised by a relatively high share of the labour force employed in agriculture. Côte d'Ivoire boasts large plantations and is a dominant exporter of agricultural produce (cacao, coffee and other products). It offers salaried employment in agriculture while Burkina Faso's agricultural sector is mainly composed of subsistence farming. We also note that the ratio of medium-skilled occupational wages to low-skilled wages is higher in Côte d'Ivoire than in Burkina Faso. This seems surprising in the light of large migration streams of uneducated workers towards Côte d'Ivoire.

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

The aim of this paper is to study individual migration, education and work decisions and their interaction in the presence of stark regional differences. For this purpose I develop a life-cycle model of endogenous location and activity choice. First of all, the model consists of several urban, rural and one international location. These locations provide different work opportunities, education facilities, geographical and infrastructural characteristics. Secondly, education, work and nonwork activities entail different income opportunities and costs in the present, but they

[14] Income in farming and low-skilled wages are calibrated from two different data sets. These income differences seem very large (also in the light of the income ration shown in Figure 1 in the introduction), they probably hide large living cost differentials between urban centers and rural regions or other differences in measurement of income. Indeed, the aggregate numbers shown in Figure 1 (left panel) in the Introduction suggest that rural-urban income differences in Burkina Faso should be smaller. I correct for this discrepancy in the model by introducing a 'living cost parameter'.

also affect future income, for example through the acquisition of education or an urban labour market status. Finally, the model features individuals who differ in (observed and unobserved) ex-ante characteristics and who make different choices over their life cycle. Schooling facilities are geographically concentrated, work opportunities and returns to education vary across locations. Each location and activity therefore provides distinct incentives to heterogeneous individuals. This induces a rich self-selection pattern of different individuals selecting 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 schooling and migration costs in different urban, rural and international 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:

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

where β denotes the discount factor, and E_t represents the expectation operator conditional on information available at the beginning of period t. The per-period utility of choosing l_{it} and d_{it} is given by:

$$u(l_{it}, d_{it}; \Omega_{it}) \quad = \quad g\left(\tilde{w}(l_{it}, d_{it}; \Omega_{it})\right) + b(l_{it}; \Omega_{it}) - c(l_{it}, d_{it}; \Omega_{it}) + \zeta(l_{it}, d_{it}; \Omega_{it}) \tag{2}$$

The individual derives utility from a non-linear function of stochastic income $g\left(\tilde{w}(l_{it}, d_{it}; \Omega_{it})\right)$, local amenity benefits $b(l_{it}; \Omega_{it})$, location- and activity-related costs $c(l_{it}, d_{it}; \Omega_{it})$ and location-activity-specific preference shocks $\zeta(l_{it}, d_{it}; \Omega_{it})$. Preferences shocks are assumed to be drawn from an i.i.d. extreme value type 1 distribution.

The individual makes his location and activity choice at the beginning of the period, that is before observing the income shocks of the period. To capture the effect of income risk and risk aversion on individual utility, I use the certainty equivalent of stochastic income $g(\tilde{w})$. It represents the certain monetary amount which yields the same utility level as stochastic income under constant relative risk aversion preferences[15]. Note that individuals cannot save or borrow[16].

[15]Formally, the certainty equivalent C is defined as follows: $C = U^{-1}\left(E\left[U(\tilde{w})\right]\right)$, where U^{-1} is the inverse of an increasing, concave von Neumann-Morgenstern utility function, E the expectation operator and $\tilde{w}$ a random variable, i.e. stochastic income.

[16]Only a very small percentage of individuals in the EMIUB data set declare that they save a fraction of their income. Most of them work in medium- or high-skilled occupations in urban centers and are well past their education and labour market entry, when income smoothing and income risk would matter most. Apart from financial savings, it has also been suggested that risk sharing and the use of livestock as buffer stocks could help smooth consumption in developing countries. Kazianga and Udry (2006) find little evidence of consumption smoothing over time or across household in Burkina Faso.

3.1 The location and activity choice

Each period the individual decides where to locate l_{it}. In this model, the location choice set comprises 2 urban locations (Ouagadougou, Bobo-Dioulasso), 5 rural locations (Sahel, East, Center, West, South-West) and one international location (Côte d'Ivoire).

Locations differ in several respects. First, I make a crucial distinction between urban and international locations on the one hand, and rural locations on the other. Urban and international locations offer different work and education opportunities, i.e. different activities, from rural locations. Secondly, each location has location-specific income risk and returns to education which translate into different local income distributions $\tilde{w}(l_{it})$. Finally, locations also differ in amenity benefits, schooling and migration costs.

At the same time as choosing the location, the individual must also choose one activity d_{it} among the following set of activities: education, work in the urban/international sector, farming, rural work, nonworking. Work activities are location-specific. Rural locations offer farming and rural work, urban and international locations offer work in the urban/international sector. These location-specific work activities are motivated by the large rural-urban differences in the economic structure. While agriculture is predominantly a rural phenomenon, unemployment and work opportunities in medium- or high-skilled occupations are mainly characteristics of the urban labour market (see Table 3 in Section 2.4). Thus, in the model farming is restricted to rural regions, and urban/international work is distinct from rural (low-skilled) work. In total, there are 29 location-activity combinations.

3.2 State space

At age t, an individual knows the variables which form his state space Ω_{it}. Some of these variables evolve over time, while others are time-invariant. The large heterogeneity in individuals is motivated by the main objective of explaining migration patterns, education and work choices of individuals with distinct characteristics in the absence of matched individual income data. Expected individual income is estimated from predicted labour market status and predicted occupational outcomes, and their corresponding wages, controlling for individual heterogeneity.

At the beginning of a period and before making the location-activity choice, an individual of age t knows his current location before migration l_{it-1}, his past labour market status lm_{it-1}, his past occupation level o_{it-1} (if applicable) 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 unobserved ability τ_i, home location hl_i, father's occupation of_i and birth-year cohort by_i. Table 4 summarises the choice and state variables.

Apart from age (in years), I abstract from explicitly including time (calender years) in the model. Instead, birth year cohort and age approximate the calender year. This procedure has two main advantages. First of all, modelling birth-year cohorts rather than calender years reduces the state space considerably. Secondly, because of measurement error in birth years and the timing of

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

Table 4: Overview of choice variables and state space

[a]To reduce the number of parameters estimated in the empirical analysis, I use school years rather than the discrete schooling levels when the underlying function is smooth in school years.

[b]In Burkina Faso, primary education lasts for 6 years, secondary education for 7 years and tertiary education 4 to 5 years. SY corresponds to the average (theoretical) number spent in school of an individual without schooling, with primary, secondary or tertiary education, respectively.Kabore et al. (2001)

location and activity episodes (see the relevant discussion in Section 4.4), it remains doubtful that calender years would provide more precise results than an analysis based on birth-year cohorts.

3.3 Attending school

An individual who decides to attend school $d_{it} = edu$ in location l_{it} derives the following utility from his choice:

$$u(l_{it}, edu; \Omega_{it}) = \underline{w} + b(l_{it}; \Omega_{it}) - c_{school}(l_{it}, edu; \Omega_{it}) - c_{mig}(l_{it}; \Omega_{it}) + \zeta(l_{it}, edu; \Omega_{it}) \quad (3)$$

His utility is composed of the following five components: A deterministic (subsistence) income $\underline{w}$, amenity benefits b, schooling costs c_{school}, migration cost c_{mig} (which can be zero) and a preference shock ζ. The subsistence income $\underline{w}$ is discussed in Section 3.4. Amenity benefits and migration costs shown in equation 3 are independent of the activity chosen, they are discussed in Section 3.8.

The cost of going to school c_{school} reflects the monetary and non-monetary costs of attending school for one year. An individual with schooling level s_{it} attends a school of the next-higher schooling level $j = s_{it} + 1$ and pays the corresponding schooling cost as given in:

$$c_{school}(l_{it}, edu; \Omega_{it}) = \delta_{0,j} + \delta_1(1 - S_j(l_{it}; t, by_i)) + \delta_2 t - \delta_3 by_i - \delta_4 \mathbf{1}(\tau_i = high) \quad (4)$$

The first component of the schooling cost is an education level-specific fixed cost. It captures direct costs such as tuition and material costs, but also indirect costs such as psychological and organisational entry costs. The second component is a variable cost which depends on the share of municipalities in location l_{it} which have schools offering education level j. Intuitively, fewer schools of level j imply higher costs of attending school in terms of transportation, social or psychological costs (see, for example, Lalive and Cattaneo (2009))[17]. Schooling cost also allows for potential effects of age, birth cohort and ability[18]. The effect of birth-year cohorts can be interpreted as a linear time trend. It measures the change in schooling costs over time.

At the end of a year, an individual with schooling level s_{it} is promoted with probability $\pi_{school}(s_{it} + 1 | l_{it}, edu; \Omega_{it})$ to the next higher schooling level $s_{it} + 1$. The transition is modelled as a first order Markov process conditional on age and the availability of the next higher schooling level in location l_{it}[19]. The transition rates from level s_{it} to $s_{it} + 1$ are calibrated from observed transition rates (see Section 4.2). Equation 5 shows how the time-variant characteristics in x_{it} evolve after a period of schooling:

[17] The share of municipalities with schools of type j is relevant for primary and secondary schooling cost in rural regions. Only a fraction of rural villages/towns have primary or secondary schools. The share for tertiary schools is either 1 if there is a university present in location l_{it}, or 0 otherwise.

[18] Instead of including the effect of ability on schooling costs I could have modelled the effect of ability on transition rates. The data does not allow to identify both effects at the same time. The modelling of ability in schooling costs is more straightforward and less cumbersome than introducing transition rates conditional on unobserved ability.

[19] For example, an individual with secondary education who continues to attend school in a location without a university will for sure keep his education level. His schooling cost is 0.

$$x_{it+1} = \begin{pmatrix} l_{it} & \\ lm_{it} = olf & \\ o_{it} = none & \\ s_{it+1} = s_{it} + 1 & \text{with } \pi_{school}\left(s_{it} + 1 | l_{it}, edu; \Omega_{it}\right) \\ s_{it+1} = s_{it} & \text{with } 1 - \pi_{school}\left(s_{it} + 1 | l_{it}, edu; \Omega_{it}\right) \end{pmatrix} \tag{5}$$

3.4 Working in the urban/international sector

The second activity choice refers to working in the urban or international sector. It is characterised by two distinct features. First, employment is not deterministic (or a choice) but subject to the risk of (involuntary) unemployment. Secondly, individuals who find work in the urban or international sector may be employed either in a low-skilled or in a medium-high-skilled occupation. Both the probability of employment and the occupation probabilities crucially depend on the individual's labour market status in the previous period and, if applicable, the past occupation level. They are following a first order Markov process.

The utility of an individual who decides to be part of the urban/international labour force $d_{it} = uiw$ in location l_{it} is given by:

$$u\left(l_{it}, uiw; \Omega_{it}\right) = g(\tilde{w}(l_{it}, uiw; \Omega_{it})) + b(l_{it}; \Omega_{it}) - c_{mig}(l_{it}; \Omega_{it}) + \zeta(l_{it}, uiw; \Omega_{it}) \tag{6}$$

In comparison to the utility of someone choosing to go to school, an urban/international labour force participant faces a different stochastic income process (and does not pay schooling costs). The decision to work in the urban/international sector can result in two different labour market status (employed or unemployed) and, conditionally on employment, in a low-skilled (low) or medium-high-skilled occupation (mh) outcome. The individual makes the location-activity decision before knowing his employment and occupation shocks. Assuming an isoelastic utility function of the form $U(w) = \frac{w^{1-\rho}}{1-\rho}$, where ρ is the constant relative risk aversion coefficient, and rearranging terms yields the certainty equivalent of urban/international labour income as shown in equation 7:

$$\begin{aligned} g(\tilde{w}(l_{it}, uiw; \Omega_{it})) = & \\ & \Big[p(ue|l_{it}; \Omega_{it})\underline{w}^{1-\rho} \\ & + (1 - p(ue|l_{it}; \Omega_{it}))(1 - p(mh|l_{it}; \Omega_{it}))\left(\frac{w_{low}(l_{it}; \Omega_{it})}{\lambda}\right)^{1-\rho} \\ & + (1 - p(ue|l_{it}; \Omega_{it}))p(mh|l_{it}; \Omega_{it})\left(\frac{w_{mh}(l_{it}; \Omega_{it})}{\lambda}\right)^{1-\rho}\Big]^{\frac{1}{1-\rho}} \end{aligned} \tag{7}$$

where $p(ue|l_{it}; \Omega_{it})$ is the probability of unemployment, $p(mh|l_{it}; \Omega_{it})$ the probability of medium-high-skilled occupation conditional on employment, $\underline{w}$ the fixed subsistence income[20], w_{low} and

[20] Given the absence of unemployment insurance in Burkina Faso, we assume that individuals without work

w_{mh} the location-specific incomes in low- and medium-high-skilled occupations, respectively. ρ is the constant relative risk aversion coefficient and λ the living cost differential between urban/international and rural locations. Due to high (but imperfect) persistence in labour market status and occupation levels, it is important to condition on previous occupation level and thus distinguish unemployed individuals, labour market entrants, past low-skilled and past medium-high-skilled workers.

3.4.1 Labour market status: Employment and unemployment

The probability of unemployment conditional on the previous labour market status status is given by equation 8:

$$p(ue|l_{it};\Omega_{it}) \ = \begin{cases} \omega_{EU} & \text{if } lm_{it-1} = e \\ \omega_{UU} & \text{if } lm_{it-1} = ue \\ 1 - \frac{1}{1+exp\left(-(\omega_{U,l}+\omega_{U,1}SY(s_{it})+\omega_{U,2}(SY(s_{it}))^2)\right)} & \text{if } lm_{it-1} = olf \end{cases} \tag{8}$$

where the first line refers to employment-unemployment transition (first line), the second line to unemployment-unemployment transition and the third line to labour market entrants. Entry into unemployment is parsimoniously parametrised. Unemployment rates differ across locations (as captured by the location-specific intercept $\omega_{U,l}$), and allow for a 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)).

3.4.2 Low- and medium-high-skilled occupations

Conditional on employment, an individual opting for work in the urban/international sector also faces uncertainty with respect to his occupation level. The probability of going into a medium-high-skilled occupation $p(mh|l_{it};\Omega_{it})$ depends on his past labour market status and past occupation. It is given in equation 9:

$$p(mh|l_{it};\Omega_{it}) \ =$$
$$\begin{cases} 1 - \frac{1}{1+exp\left(-(\omega_{E,l}+\omega_{E,1}\mathbf{1}(\tau_i=high)+\omega_{E,2}SY(s_{it})+\omega_{E,31}t+\omega_{E,32}t^2+\omega_{E,4}of_i+\omega_{E,5}by_i)\right)} & \text{if } lm_{it-1} = olf, ue \\ 1 - \frac{1}{1+exp\left(-(\omega_{mh,l}+\omega_{mh,1}(SY(s_{it}))^2+\omega_{mh,2}t^2)\right)} & \text{if } o_{it-1} = mh \\ 1 - \frac{1}{1+exp\left(-(\omega_{low,l}+\omega_{low,1}(SY(s_{it}))^2+\omega_{low,21}t+\omega_{low,22}t^2)+\omega_{low,3}by\right)} & \text{if } o_{it-1} = low \end{cases} \tag{9}$$

where the first line refers to labour market entrants and those unemployed in the past period, the second line to those who had a medium-high-skilled occupation in the last period and the third line to those with a past low-skilled occupation. The probability of a medium-high-skilled occupation (conditional on employment) of labour market entrants and unemployed depends

income get a fixed subsistence income of $\underline{w}$, for example through informal transfers.

on (unobserved) ability, father's occupation (potential network effects), birth-year cohort (time trends), school years and age[21]. Transition probabilities of previously employed workers are more parsimoniously parametrised. The reason is that transitions from one occupation level to another are relatively unlikely, thus by conditioning on previous occupation already explains a considerable part of occupation transitions.

The schooling parameter in each of the three cases is crucial in determining returns to education, i.e. the effect of schooling on occupation assignment and thus on income. A larger schooling parameter translates into larger returns to schooling. However, the schooling parameters in the different cases present also some interesting compensation interactions. For example, high returns to education may result either from a high medium-high-occupation probability upon entry (and a moderate low-medium-high transition rate) or from a moderate medium-high-occupation probability upon entry and high low-medium-high transition rates.

At the end of the period, time-variant characteristics x_{it} are updated to $xit+1$ as shown in equation 10:

$$x_{it+1} = \begin{pmatrix} l_{it} & \\ lm_{it} = e & \text{if employed with 1-probability as in (8);} \\ lm_{it} = ue & \text{if unemployed with probability as in (8)} \\ o_{it} = mh & \text{if employed and with probability as in (9);} \\ o_{it} = low & \text{if employed and with 1-probability as in (9);} \\ o_{it} = non & \text{if unemployed} \\ sit+1 = s_{it} & \end{pmatrix} \quad (10)$$

3.5 Farming

The farming activity is restricted to rural locations and captures subsistence farming, as crop farmers (mostly millet and sorghum), livestock herders or in market gardening. An individual who decides to farm $d_{it} = farm$ in location l_{it} derives the following utility from his choice:

$$u\left(l_{it}, farm; \Omega_{it}\right) = g(\tilde{w}(l_{it}, farm; \Omega_{it})) + b(l_{it}; \Omega_{it}) - c_{mig}(l_{it}; \Omega_{it}) + \zeta(l_{it}, farm; \Omega_{it}) \quad (11)$$

His utility is similar to the one of someone working in the urban/international with one important exception: Farming income follows a very different income process. Farming income is stochastic because of unforeseen weather shocks which cause bad harvests. I model farming income as a two-state income process with a good state (GS) when weather conditions are

[21] Notice that these probabilities not only include linear terms in age and years of schooling, but also quadratic terms. The reason for the introduction of quadratic age terms is that both entry into medium-high occupations and transitions from low to medium-high-skilled occupations increase with age until a certain point and then decrease. This is captured by the linear and non-linear age terms. Observed occupational transitions are highly non-linear in years of education. There is little difference in transition probabilities for those with secondary schooling and less, however these probabilities are clearly different for those with tertiary education. Aiming to be parsimonious while capturing the non-linear effect, I opt for quadratic terms in education.

normal/favourable and a bad state (BS) under adverse weather conditions. The certainty equivalent of farming income can be written as in equation 12.

$$g(\tilde{w}(l_{it}, farm; \Omega_{it})) = \left[(1 - \pi(BS|l_{it}))w_F(GS|l_{it}, t)^{1-\rho} + \pi(BS|l_{it})w_F(BS|l_{it}, t)^{1-\rho}\right]^{\frac{1}{1-\rho}} \quad (12)$$

where $\pi(BS|l_{it})$ denotes the probability of bad weather shock occurring in location l_{it}, $w_F(BS|l_{it}, t)$ the income under a bad weather shock of an individual aged t and $w_F(GS|l_{it}, t)$ the income under a good weather shock, respectively. ρ is the coefficient of constant relative risk aversion. The calibration of the probability of each weather state and the corresponding incomes are discussed in Section 5.

Note that weather shocks are assumed to be uncorrelated across years, hence the expectation of the current year's income does not depend on outcome of previous years or other individual characteristics except for age and location. By assumption, there returns to education in farming are zero[22]. Time-variant individual characteristics thus (trivially) evolve as shown in equation 13.

$$x_{it+1} = \begin{pmatrix} l_{it} \\ lm_{it} = olf \\ o_{it} = non \\ sit + 1 = s_{it} \end{pmatrix} \quad (13)$$

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 decides to work in the rural sector $d_{it} = rw$ in location l_{it} derives the following utility from his choice:

$$u\left(l_{it}, rw; \Omega_{it}\right) \quad = \quad g(\tilde{w}(l_{it}, rw; \Omega_{it})) + b(l_{it}; \Omega_{it}) - c_{mig}(l_{it}; \Omega_{it}) + \zeta(l_{it}, rw; \Omega_{it}) \quad (14)$$

Income in the rural sector is stochastic because an individual may remain without work, may find only seasonal work (from May to September) or work for a full year. The certainty equivalent of rural work income is given in equation 15.

[22] Schultz (1988) reviews several studies which find positive albeit small returns to schooling for farming productivity in low-income countries. Attanasio et al. (2012) find a small but insignificant 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 migrating to urban centers. As we do not observe individual farm output, we cannot identify returns to education in agriculture. The increasing migration rates by education level from rural regions to urban centers suggests that returns to education in rural areas are dwarfed by returns to education obtained in urban centers.

$$
\begin{aligned}
g(\tilde{w}(l_{it}, rw; \Omega_{it})) = \\
& \Big[(1-\pi(RW|l_{it}))\underline{w}^{1-\rho} \\
& + \pi(RW|l_{it})\pi(SW|l_{it}, RW)\left(\frac{5}{12}w_R(l_{it}, t)\right)^{1-\rho} \\
& + \pi(RW|l_{it})(1-\pi(SW|l_{it}, RW))w_R(l_{it}, t)^{1-\rho}\Big]^{\frac{1}{1-\rho}} \qquad (15)
\end{aligned}
$$

Let $\pi(RW|l_{it})$ denote the probability of finding rural work in location l_{it}, $\pi(SW|l_{it}, RW)$ the probability of seasonal work conditional on finding rural employment, $\underline{w}$ the subsistence income and $w_R(l_{it}, t)$ the income of an individual aged t working for a full year in the rural sector in location l_{it}. The calibration of the probability of rural work, the probability of seasonal work and the rural work income are discussed in Section 5.

The probability of finding rural work is assumed to be independent of last year's work outcome or education[23]. Time-variant individual characteristics evolve as under the choice of farming (see equation 13).

3.7 Nonworking

An individual may also decide to be nonworking $d_{it} = nw$, thus he neither goes to school nor engages in any work activity. He derives the following utility from his choice:

$$
u\left(l_{it}, nw; \Omega_{it}\right) \quad = \quad \underline{w} + b(l_{it}; \Omega_{it}) - c_{mig}(l_{it}; \Omega_{it}) + \zeta(l_{it}, nw; \Omega_{it}) \qquad (16)
$$

Nonworking does not involve any activity-specific costs or benefits, nor does it have any special effect on individual characteristics in the future. At the end of a period of nonworking, time-variant individual characteristics evolve as under the choice of farming (see equation 13).

3.8 Amenity benefits and migration costs

No matter which activity an individual chooses, he derives utility from local amenities and pays migration costs when moving. These last two components of utility are described in what follows.

Amenities $b(l_{it}; \Omega_{it})$ represent non-pecuniary and activity-independent benefits obtained by being in location l_{it}. The amenity value b is given in equation 17.

$$
b(l_{it}; \Omega_{it}) = \gamma_1 \mathbf{1}(l_{it} = hl_i) + \gamma_2 DI(l_{it}; t, by_i) \qquad (17)
$$

b includes a home premium (as in Kennan and Walker (2011)) and a single-valued index of

[23]This simplifying assumption can be motivated by the fact that some rural work relates to salaried work in agriculture. When weather shocks are uncorrelated over time, and then the work availability in paid salaried work will also be uncorrelated over time.

development level $DI(l_{it}; t, by_i)$[24]. The home premium encompasses monetary and non-monetary benefits of living in one's home location, where the individual is likely to have family or is part of a social network. The home premium captures different aspects which are not explicitly modelled in the current framework. This could include the strength of family and clan ties, the preference for living and marrying within one's own ethnic group or language, or access to informal insurance[25]. The development level index ranges from 0 to 1, with 1 being the highest development level.

The migration cost $c_{mig}(l_{it}; \Omega_{it})$ reflects monetary and non-monetary costs of migrating. The cost of migrating from the beginning-of-period location l_{it-1} to a new location l_{it} is given by equation 18. The structure builds on Kennan and Walker (2011) and Schultz (1982).

$$c_{mig}(l_{it}; \Omega_{it}) = \left[\phi_0 + \phi_1 D(l_{it-1}, l_{it}) - \phi_2 T(l_{it-1}, t, by_i) - \phi_3 t + \phi_4 t^2\right] \mathbf{1}\left(l_{it} \neq l_{it-1}\right) \tag{18}$$

The cost of moving from location l_{it-1} to l_{it} includes a fixed moving cost and a variable cost. Migration cost are any direct and indirect costs which accrue when moving, namely also expenses incurred to find a place to live, opportunity costs (time/money) of finding a job, psychic/social costs of relocating. These indirect costs may either be estimated as part of the fixed cost of moving or be part of the variable cost. The variable cost depends on distance[26], public transportation in the point of origin l_{it-1}[27] and age. The inclusion of public transportation $T(l_{it-1}, t, by_i)$ in the origin 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, which are not explicitly modelled but vary over the life cycle. These costs might decrease for certain age spans but increase for others, hence I opt for age terms. Migration cost is likely to be larger for less autonomous individuals (children, young teenagers) or for individuals with more family obligations (after age 30).

4 Calibration and Estimation

Given the combined use of panel data on local migrants and non-migrants, and cross-sectional data on permanent emigrants, I estimate the proposed life cycle model by Simulated Method of Moments (SMM)[28].

[24] The development level index is an (unweighted) average of eight indicators. They include health centers/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.

[25] Lessem (2009) explicitely accounts for in-kind-payments for labour migration decisions in Malaysia.

[26] 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 alone is often used as a proxy for migration cost (see, for example, Beauchemin and Schoumaker (2005)).

[27] Public transportation captures the effect of remoteness on out-migration cost and the cost of information in other locations. The more remote a location is, the less information about other places will reach it.

[28] If it was not for the use of cross-sectional data on permanent emigrants, the model could also be estimated by maximum likelihood. Another advantage of Simulated Method of Moments over maximum likelihood is discussed in

Several preparatory steps are required before proceeding with estimation. These steps are presented in the first part of this section. Namely, I discuss the calibration of the income distributions and schooling transition rates, and explain which parameters were exogenously set to achieve identification[29]. In the second part, the identification scheme used for the estimation of the structural parameters is outlined. The last part describes the numerical implementation and estimation.

4.1 Calibration

4.1.1 Income distributions

Due to the lack of income and wage data in the EMIUB data set, I calibrate the various income distributions from macroeconomic data. Table 5 gives an overview of the income distributions, that is urban and international work income by occupation level, the farming income distribution, the rural work income distribution and the subsistence income $\underline{w}$. For all details concerning data sources and methodology of calibrating these distributions, please refer to Appendix D.

	Ouaga	Bobo	Sahel	East	Center	West	South-West	Côte d'Ivoire
Urban/international work income								
$w_{low}(l)$	31.0	29.9						36.1
$\min(w_{mh}(l))$	52.6	52.6						72.2
$\max(w_{mh}(l))$	79.2	79.2						110.0
Farming income								
$w_F(GS,l)$			5.33	5.71	4.69	6.54	5.84	
$w_F(BS,l)$			4.09	4.16	3.31	4.53	4.00	
$\pi(BS\|l)$			10.81%	8.08%	6.86%	6.88%	3.77%	
Rural work income								
w_R			14.49	14.49	14.49	14.49	14.49	
$\pi(RW\|l)$			84.02%	30.88%	61.73%	77.10%	82.63%	
$\pi(NS\|l)$			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	0.40	0.40	0.40

Notes: $w_{low}(l)$ is the monthly income in a low-skilled occupation in location l, $w_{mh}(l)$ the income in a medium-high-skilled occupation. $w_F(GS,l)$ refers to the farming income in location l in a good weather state, $w_F(BS,l)$ in a bad state. $\pi(BS|l)$ denotes the probability of a bad weather state. w_R is the work income for a year-round employment in the rural sector. $\pi(RW|l)$ is the probability of finding work (seasonal or for a full year) in the rural sector. $\pi(NS|l)$ refers to the probability of getting work for a full year conditional on finding work. $\underline{w}$ is the subsistence income of students, nonworking and unemployed individuals.

Table 5: Calibrated income distributions (1'000 CFA/month, before living cost adjustment)

We find that income differences between rural locations (in farming and rural work) compared to low-skilled incomes in the urban sector are very large. Côte d'Ivoire's income level is even arger, being between 15% and 40% higher than in Ouagadougou and Bobo-Dioulasso.

Section 4.4.

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

However, notice that this data is not yet corrected for living cost differences and possible scaling differences between the two data sources. Together with the other parameters of the model, I also estimate a living cost parameter to transform these nominal income differences into real differences. Given the different data sources for farming and rural work income, the living cost parameter is also used to correct rural work incomes in the estimation procedure.

4.1.2 Scale parameter

The scale parameter σ_G of the extreme value type I distribution is calibrated at $\sigma_{G,rural} = 0.17$ for individuals with a rural home location and at $\sigma_{G,urban} = 0.22$ for individuals with an urban home location. Identification of $\sigma_{G,rural}$ can be achieved exploiting the (known) riskiness of different work (and nonworking) alternatives in rural locations and the corresponding share of individuals choosing each alternative. For a rigorous derivation of the identification scheme, please refer to Appendix E.

4.1.3 Final age and discount factor

The parameter A is set to 56. It is derived from the remaining life expectancy at age 5 in Burkina Faso conditional on reaching age 5. [30]

I set the discount factor to 0.95[31].

4.2 Identification

In what follows, I present the identification scheme of the remaining 46 parameters. The proposed moment conditions are mainly conditional means or ratios of means on migration behaviour, educational attainment and labour market performance. All moments relying on migration behaviour use both the panel data of the EMIUB data set (abbreviated as 'PS') and the cross-section data on permanent emigrants (abbreviated as 'CS'), while moments related to education attainment and labour market performance use solely the panel data set. Due to the low number of observations of older individuals, the moments consider only men aged 6 to 38. After age 38, migration is relatively low (below 2%), no one goes to school and the work situation remains stable (no new labour market entries)[32].

[30] I derive this statistic based on the World Development Indicator data base of the World Bank. While life expectancy at birth increased by 25% between 1960 and 1985, the remaining life expectancy at age 5 conditional on reaching age 5 remained *grosso modo* constant. The substantial increase in life expectancy at birth over the last decades can thus be (almost fully) attributed to lower infant and young child mortality rates. They do not enter the current analysis.

[31] The estimation of the discount factor β often poses a challenge. In a model without borrowing and saving β does not only capture how much individuals disregard the future but it may also reflect liquidity constraints which are potentially important in a developing country (see Attanasio et al. (2012)). Magnac and Thesmar (2002) point out that in dynamic discrete models, structural parameters are often not identified unless the discount factor is set. An exception are Attanasio et al. (2012) who manage to estimate the discount factor by grid search. They find a discount factor of 0.89 for Mexico. Kennan and Walker (2011) for the U.S. and Lessem (2013) for Mexico fix the discount factor at 0.95. We leave it as a robustness check for a future version to re-estimate the model assuming a lower discount factor.

[32] I solve a simplified model for age 39 to 55 and compute recursively the continuation value for age 38. This continuation value is then inserted into the full maximisation problem of men aged 38. In the simplified model, men are no longer able to go to school and nonworking in rural locations is not allowed. However, individuals can migrate facing the same migration cost structure as in the full model, and they experience labour market status and

Table 6 and Table 7 summarise the identification scheme applied. Each parameter to be estimated (column 1) is identified by one or several corresponding moments given in column 2. The number of moments used is given in parenthesis. The last column states which data sets were used to compute the moments.

Parameter	Moment	Data set
Amenity value		
Home premium: γ_1	Proportion returned migrants in 2000 by home location (7)	PS + CS
Development level: γ_2	Share of net migration in 70s, 80s, 90s by location (21)	PS + CS
Schooling cost parameters		
Primary: δ_P	Proportion never-schoolers in 2000 by home location (7)	PS
Secondary: δ_S	Proportion secondary conditional on primary in 2000 by home location (7)	PS
Tertiary: δ_T	Proportion tertiary conditional on secondary in 2000 by home location (7)	PS
Schools: δ_1	Proportion primary + at age 10 in 60s by home location (7)	PS
	Proportion primary + at age 10 in 70s, 80s, 90s in rural (3)	PS
Age: δ_2	Proportion students at age 7, 12, ..., 27 in urban, rural (10)	PS
Birth year: δ_3	Proportion primary + at age 10 in 70s, 80s, 90s in urban (3)	PS
Ability: δ_4	Ratio of avg school years of emigrants, urban migrants to avg school years of locals by home location, cohort group (10)	PS
	Avg school years of locals by home location, cohort group (4)	PS
Schooling transition of students (calibrated)		
No educ.-primary	Theoretical no educ.-primary transition rate in BF = 0.3, derived from avg. years of schooling in primary (3.5 years) [33] [34]	PS
Primary-secondary	Theoretical primary-secondary transition rate in BF = 0.14, derived from avg. years of schooling in secondary (10.5 years)	PS
Secondary-tertiary	Secondary-tertiary transition rate in BF = 0.165 derived from avg. years of schooling in tertiary (16 years)	PS
Migration cost parameters		
Fixed cost: ϕ_0	Proportion never-migrants in 2000 by home location (7)	PS + CS
Distance: ϕ_1	Ratio of migrations to closest to farthest destination by location (7)	PS + CS
Transportation: ϕ_2	Out-migration rates (aged 17 to 26) in 70s, 80s, 90s by rural location (15)	PS + CS
Age, age^2: ϕ_3, ϕ_4	Migration rates at age 7, 12, ..., 37 in urban, rural (14)	PS + CS
Probability of high ability		
Probability: π	Ratio urban migrants to emigrants in 2000 by home location (7)	PS + CS

Notes: 'PS' refers to the panel data set. 'CS' refers to the cross-sectional data on permanent emigrants.

Table 6: Moments identifying amenity, schooling cost and transition, migration cost, high ability parameters

To identify the amenity, schooling and migration cost parameters, I compute means, conditional means and ratios of means of migration and education outcomes, respectively. Migration moments include the proportion of returned migrants, net migration shares, the proportion of

occupation transitions.

[33] These numbers match the education system in Burkina Faso: Primary education is from grade 1 to 6, secondary from grade 7 to 13, followed by another 4-6 years of tertiary education (see Kabore et al. (2001)).

[34] If no school offers the next-higher schooling level in a certain location, then the probability of keeping schooling level s is equal to 1. There is also an upper age limit of moving from primary to secondary (17 years) and from secondary to tertiary (25 years). Beyond these age limits, individuals keep their current education level.

never-migrants and out-migration rates by age. Education moments include the proportion of never-schoolers, different measures of educational attainment and the proportion of students by age.

As ability is unobserved, identification of ability-related parameters relies on self-selection patterns by ability: Individuals with low ability tend to select into the international labour market while highly able individuals tend to select into the urban labour market (Ouagadougou, mostly). The reason for this self-selection is that the probability of finding work in medium-high-skilled occupations is significantly lower in Côte d'Ivoire than in Burkina Faso[35]. Thus, to reap the benefits of higher ability or higher education, individuals can only do so in urban labour markets and hence, positively self-select into the Burkinabe labour market.

For example, to identify the effect of ability on schooling cost I propose the ratio of educational attainment of individuals migrating to urban centers to the one of locals. While a general decrease in schooling cost affects education decisions of all individuals, a decrease of schooling costs for high ability individuals only translates into changed education behaviour of individuals migrating to urban centers.

To identify the labour market parameters related to unemployment and occupation assignment as well as the relative risk aversion coefficient and living cost differentials, I use conditional means, ratios of means and transition rates of labour market choices, unemployment and occupation outcomes. Unemployment upon labour market entry parameters can be identified without bias by using transition rates into unemployment of those who had not previously been employed[36]. Identification of occupation assignment parameters of labour market entrants uses conditional transition rates into different occupation levels. The ability parameter is identified following the same line of argument of self-selection of migrants as for the ability parameter in schooling cost. Positive self-selection in urban labour markets allows us to determine the effect of ability on occupation assignment by comparing occupation assignment of local labour market entrants with occupation assignment of migrants from a rural home location.

Occupation assignment parameters upon transition are identified using observed transition rates. Due to the relatively low number of employment-unemployment transitions and unemployment-unemployment (especially in Côte d'Ivoire), the parameters are calibrated ex-ante to match observed transition rates.

4.3 Numerical implementation and estimation

The proposed model features a large but manageable state space. At each age, the time-variant characteristics of an individual are given by 68 variant states: 17 past location-occupation alternatives $\times$ 4 schooling levels = 68 variant states. Apart from time-varying states, an individual is also characterised by a set of initial conditions, namely, unobserved ability, home location,

[35]Results from a reduced form regression, using as instrumental variables the interaction of migrant-status and origin (rural/urban) for ability, suggest that the probability of obtaining a medium-high-skilled occupation in Côte d'Ivoire is significantly lower than in Ouagadougou and Bobo-Dioulasso/Banfora.

[36]OLS estimates which instrument for ability by the interaction of migrant status and origin did not find any significant effect of 'ability' on unemployment.

Parameter	**Moment**	**Data set**
Unemployment upon labour market entry		
BF: $\omega_{U,l12}$	Proportion unemployed in BF by education level (4)	PS
CI: $\omega_{U,l8}$	Proportion unemployed in CI by education level (2)	PS
Schooling: $\omega_{U,1}$	Same as above	
Schooling^2: $\omega_{U,2}$	Same as above	
Occupation assignment upon labour market entry (conditional on employment)		
Ouaga: $\omega_{E,l1}$	Proportion mh among local entrants in Ouaga by education (3)	PS
	Same moments for rural migrants (3)	PS
Bobo: $\omega_{E,l2}$	Proportion mh among local entrants in Bobo by education (2)	PS
	Same moments for rural migrants (3)	PS
CI: $\omega_{E,l8}$	Proportion mh among rural migrants without schooling in CI (1)	PS
Ability: $\omega_{E,1}$	Same as above	
Schooling: $\omega_{E,2}$	Same as above	
Age: $\omega_{E,3}$	Proportion mh among local entrants of older cohorts with secondary education in BF by age group (3)	PS
Father's occ.: $\omega_{E,4}$	Proportion mh among 17-26 aged local entrants with secondary education by cohort group, father's occupation (4)	PS
Birth year: $\omega_{E,5}$	Same as above	
Employment-unemployment transition (calibrated)		
BF/CI: ω_{EU}	Employment-unemployment transition rate = 0.00506	PS
Occupation transition (conditional on employment)		
BF: $\omega_{T,l12}$	Low-mh transition rate in BF by education (3)	PS
CI: $\omega_{T,l8}$	Low-mh transition rate in CI by education (2)	PS
Schooling: $\omega_{T,1}$	Same as above	
Occupation: $\omega_{T,2}$	mh-mh transition rate in BF if secondary education (1)	PS
Birth year: $\omega_{T,3}$	Low-mh transition rate in BF with secondary education by cohort group (3)	PS
Unemployment-unemployment transition (calibrated)		
BF/CI: ω_{UU}	Unemployment-unemployment transition rate = 0.732	PS
Relative risk aversion coefficient		
Risk aversion: ρ	Ratio of log shares of farming to rural work by rural location (5)	PS
Living cost differentials		
Living cost: λ	Same moments as above: Rural-urban differences in migration, education	

Notes: 'PS' refers to the panel data set. 'CS' refers to the cross-sectional data on permanent emigrants.

Table 7: Moments identifying labour market, risk aversion, living cost parameters

father's occupation and birth-year cohort: 2 ability levels $\times$ 7 home locations$\times$ 2 levels of father's occupation $\times$ 7 birth-year cohorts = 196 types.

In total, for every age the value function is of size: 68 $\times$ 196 = 13,328 states.

Estimation by Simulated Method of Moments involves the following steps:

1. I first make an initial guess of the parameter vector[37].
2. Given the parameter vector, the model is then numerically solved by backward induction starting from the last period moving forward to age 6. The model solution delivers the value function and probabilistic decision rules.
3. Based on the value function and decision rules obtained under step 2, I simulate the model to produce a simulated panel data set.
4. Finally, I use this simulated data set to construct the moment conditions outlined previously and compare them to the same moment conditions from the observed data set. I then calculate the value of the loss function.

Using the Nelder-Mead algorithm, I repeat steps 2 to 4 with new parameter sets until the loss function meets the convergence criteria. The optimal parameter estimate $\hat{\theta}_{SMM}$ solves:

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

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.

A small note regarding the estimation of the risk aversion coefficient ρ is in order. The outlined procedure revealed itself to be very sensitive to the value of ρ. Instead of estimating ρ along with the other parameters, I produced a grid of ρ values for which I run the estimation procedure separately. The final $\hat{\theta}_{SMM}$ is the one for which the conditional loss function is minimised.

4.4 Measurement error

Apart from the combined use of panel and cross-sectional data, the proposed estimation method of Simulated Method of Moments with moment conditions relying essentially on means presents another advantage over Maximum Likelihood: (Partial) Immunity to measurement errors.

Given the retrospective data collection method in a country with high illiteracy, our data set certainly suffers from measurement error. Indeed, the histogram of declared age in 2000 reveals

[37] For all labour market parameters we use OLS estimates of the corresponding equations, using migrant status as a proxy to control for unobserved ability.

spikes for ages 15, 20, 25, ..., 55. I estimate that around 15% of all men misreport their birth year[38]. We shall distinguish and briefly discuss two kinds of misreporting: The error of dating events and the failure to report residence, employment or education spells.

As already illustrated by the birth year example above, the data set suffers from misreporting of dates. Previous research on long-term recall in Malaysia has shown that dates and other numerical information is less precisely recalled the further back the event lies (Beckett et al. (2001)). In our case, misreporting of dates within a year does not pose a problem as we only consider yearly data frequency. Most misreporting across years should be washed out, either because of aggregation into 5-year birth cohorts (instead of the precise birth year) or because of both under- and over-reporting cancelling 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[39].

Failure to recall residence, employment or education changes is supposedly less likely than misreporting of dates, but also more consequential. Beckett et al. (2001) find that more salient events are more likely to be remembered correctly; 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 or abroad, occupation level changes, school attendance versus work alternatives, I believe (but cannot prove) that failure to report these events should be small.

Overall, I acknowledge that the data suffers from some measurement error. However, the chosen estimation method, proposed moment conditions and other research design settings circumvent the issues related to possible measurement error. In a maximum likelihood estimation framework, I would have to explicitly model the measurement error.

5 Estimation results

5.1 Amenities, schooling and migration cost estimates

Tables 8 to 10 present estimation results for amenities, schooling cost and migration cost, as well as the probability of high ability. They display the parameter estimates (column 2) and corresponding asymptotic standard errors (column 3), and are complemented by a related figure (right panel) providing a graphical interpretation of the estimates. Estimated parameters (except for the probability of high ability) are given in 1,000 CFA and can be directly compared to the

[38] 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, thus it is very probable that the true distribution is less smooth than its estimated approximation.

[39] We 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.

income data shown in Table 5.

5.1.1 Amenity parameter estimates

Table 8 shows the estimation results for the amenity parameters.

	$\hat{\theta}$	$\hat{\sigma}_{\hat{\theta}}$
Amenity parameters		
Home premium: γ_1	3.994	0.130
Development level: γ_2	0.425	0.153

Table 8: Amenity parameter estimates (1,000 CFA)

Amenities are much valued, especially staying in the origin. Staying in one's home location is worth an additional (risk-free) 3,990 CFA income, approximately equivalent to 70% of farming income in rural locations. Living in a location with a development level of 1 (like in urban locations in 2000) is evaluated at 425 CFA extra income. The interpretation of the large home premium is not straightforward. It could capture different aspects such as social or economic ties to the family/clan (including norms or access to informal insurance), informal networks in one's origin, a preference for one's own ethnic group, or other factors linked to the origin.

5.1.2 Schooling cost parameter estimates

Table 9 displays the estimated schooling cost parameters and the estimated probability of high ability, accompanied by average incurred schooling costs for different schooling cycles (primary, secondary and tertiary) in urban and rural locations, and abroad (Figure 2).

	$\hat{\theta}$	$\hat{\sigma}_{\theta}$
Schooling cost parameters (1,000 CFA)		
Fixed primary: δ_P	3.514	0.651
Fixed secondary: δ_S	1.025	0.761
Fixed tertiary: δ_T	14.101	1.018
Schools (variable): δ_1	6.536	0.364
Age: $\delta_2/10$	0.013	0.530
Birth year: δ_3	-0.850	0.059
Ability: δ_4	-3.019	1.164
Probability of high ability		
Probability: π	0.134	0.104

Table 9: Estimated schooling cost parameters

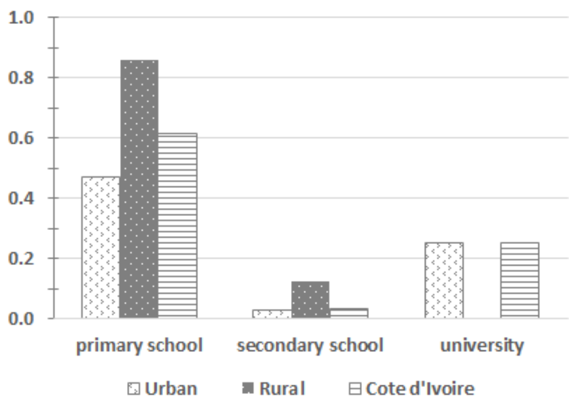


Figure 2: Average incurred schooling costs (1,000 CFA)

The J-shape of fixed schooling costs by education level is not reflected in incurred average schooling costs[40]. The entry cost of attending school (i.e. the schooling cost of those without any

[40] Average schooling costs were calculated as the mean of paid schooling costs of individuals attending school conditional on the current schooling level. Individuals going to school in locations which do not allow progressing to

education attending primary school) is fairly high. Once the individual has completed primary education, schooling costs become small(er), only to increase again for tertiary education. Interestingly, average incurred schooling costs at tertiary are smaller than the ones for primary. This indicates that entry costs into school are very large. However, this results also hides some simple selection: While both older and younger cohorts have gone to primary school, it is mostly younger cohorts who have gone to university. They face much lower schooling costs than older cohorts did (captured by the decreasing cohort effect δ_3). Between 1965/1975 and 1985/1995, schooling costs have decreased by more than 30%, the decrease being largest for primary costs (not shown).

As for the share of highly able individuals, we find a probability of 13%, which is not precisely estimated.

5.1.3 Migration cost parameter estimates

Figure 3 presents the estimated migration cost parameters (left panel), together with a graphical representation of average migration costs for different internal and international moves (right panel). Notice that the cost of a move is total cost given in 1,000 CFA, while income data is given in 1,000 CFA per month.

	$\hat{\theta}$	$\hat{\sigma}_\theta$
Migration cost parameters (1,000 CFA)		
Fixed cost: ϕ_0	9.489	0.145
Distance: $\phi_1/100$	0.436	0.042
Transportation: ϕ_2	-2.798	0.207
Age: ϕ_3	0.350	0.011
Age^2: $\phi_4/100$	0.489	0.026

Table 10: Estimated migration cost parameters

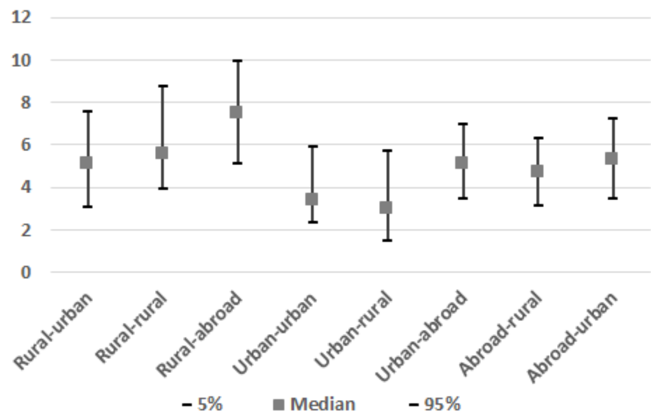


Figure 3: Average migration costs (1,000 CFA)

Overall, we find that the median cost per move depends on the origin and destination, but it also entails a sizeable fixed cost. The median cost amounts on average to 3,000 to 8,000 CFA, corresponding to one to two monthly incomes from rural farming. Moves from a rural origin are on average 50% to 80% more costly than those from an urban origin, reflecting the fact that most rural locations are more remote than urban centers and less well connected in terms of transportation. Migration costs also vary greatly over the life cycle. The relatively large terms on age and age squared indicate that lower returns from migration at older ages (because of shorter remaining life expectancy) do not sufficiently explain lower migration rates.

the next higher schooling level were excluded. Notice that these are net average schooling costs, i.e. monetary and non-monetary costs minus non-monetary benefits (such as status gain).

5.2 Labour market estimates

If it was not for unobserved ability and the endogeneity of schooling, migration and work decisions, the labour market equations laid out in equations 8 to 9 could be separately estimated by OLS and would yield unbiased estimates. Yet, ability is unobserved and assumed to affect schooling costs as well as occupation assignment upon labour market entrance, hence unemployment and occupation assignment coefficients ω_U, ω_E, ω_{low} and ω_{mh} must be jointly estimated with the other parameters of the model. Tables 11 to 14 present the estimation results of the labour market parameters, the relative risk aversion coefficient and the living cost differentials.

5.2.1 Estimates of unemployment upon labour market entrance

Table 11 shows the parameter estimates of the unemployment upon entry equation and Figure 4 the predicted unemployment probabilities upon labour market entry in different urban centers and abroad for the four education levels.

	$\hat{\theta}$	$\hat{\sigma}_\theta$
Unemployment upon entry parameters		
Intercept Ouaga: $\omega_{U,l1}$	-3.201	0.083
Intercept Bobo: $\omega_{U,l2}$	-3.129	0.280
Intercept CI: $\omega_{U,l8}$	-6.327	2.397
Schooling: $\omega_{U,1}$	0.266	0.038
Schooling^2: $\omega_{U,2}/10$	-0.220	0.033

Table 11: Estimated unemployment parameters

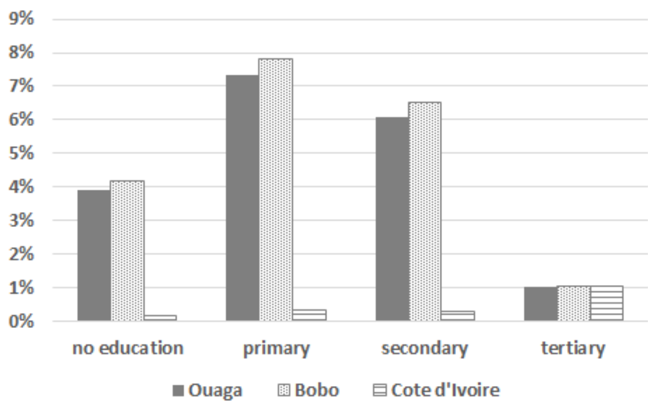


Figure 4: Predicted unemployment probabilities by education

The probability of unemployment upon labour market entrance is inverse U-shaped in education. It first increases with education, reaching a maximum for primary education, and then decreases again for secondary and tertiary education. This inverse U-shape of unemployment in schooling is a feature also found for other West African capitals such as Abidjan, Bamako, Niamey and Dakar (see Brilleau et al. (2004)). The estimated unemployment probability of unschooled individuals is around 4% in Burkina Faso, compared to less than 1% in Côte d'Ivoire. Having primary or secondary education (versus no schooling) increases the unemployment probability in Burkina Faso by 3pp, and 2pp, respectively. The higher job insecurity for primary and secondary education will translate in lower expected returns to education, relaxing incentives to get education.

5.2.2 Estimates of occupation assignment upon labour market entrance

Table 12 presents the estimated parameters of the occupation assignment equation for labour market entrants. Figure 5 provides the predicted probability of being assigned a medium-high-skilled occupation for different education levels[41].

	$\hat{\theta}$	$\hat{\sigma}_\theta$
Occupation assignment upon entry		
Intercept Ouaga: $\omega_{E,l1}$	-11.820	0.334
Intercept Bobo: $\omega_{E,l2}$	-12.185	0.412
Intercept CI: $\omega_{E,l8}$	-13.446	0.624
Ability: $\omega_{E,1}$	0.826	0.131
Schooling: $\omega_{E,2}$	0.370	0.025
Age: $\omega_{E,31}$	0.559	0.024
Age^2: $\omega_{E,32}$	0.010	n.a.
Father's occ.: $\omega_{E,4}$	0.762	0.440
Birth cohort: $\omega_{E,5}$	0.031	0.045

Table 12: Estimated parameters of occupation assignment upon entry

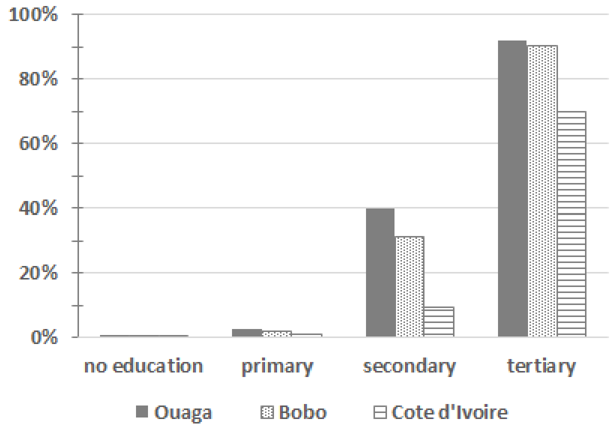


Figure 5: Predicted probability of medium-high occupation upon labour market entry

For labour market entrants, the probability of being offered a medium-high-skilled occupation (conditional on being employed) in the urban/international labour market increases with ability, schooling and if the father of the entrant has also worked in a medium-high-skilled occupation. The probability of a medium-high-skilled occupation steeply increases with age until 28, after which it decreases. The birth year cohort effect is not significant.

We observe that *ceteris paribus* it is significantly more difficult to be assigned a medium-high-skilled occupation in Côte d'Ivoire than in Burkina Faso, the difference being largest for secondary education. The respective probability is 40% in Ouagadougou as compared to 10% in Côte d'Ivoire, for tertiary education the respective shares are 90% and 70%. The probability of a medium-high-skilled occupation depends crucially on education. An individual with primary schooling or less has virtually no chance of getting hold of a medium-high-skilled job. Those with secondary education face a moderate probability while those with tertiary education are almost sure to be assigned a medium-high-skilled occupation.

5.2.3 Estimates of occupation assignment upon labour market transition

Table 13 presents parameter estimates of the labour market transition equations (i.e. individuals who had been employed in the previous period in the urban or international sector). The upper panel of the table refers to transition from low-skilled occupations, the lower panel to transition from medium-high-skilled occupations. Figure 6 depicts the predicted probability of a medium-high-skilled occupation after transition from a low-skilled occupation (left panel) or from a medium-high-skilled occupation (right panel).

For labour market transitions, we find that the current occupation level is mainly determined by the previous occupation level. Workers in Côte d'Ivoire are less likely to get into or stay

[41] The probabilities are evaluated at the mean age of labour market entrance, mean birth year cohort, and weighted according to share of father's occupation levels and the probability of being of high ability for each education level.

	$\hat{\theta}$	$\hat{\sigma}_{\theta}$
Occupation transition from low occupation		
Intercept Ouaga: $\omega_{low,l1}$	-12.545	5.410
Intercept Bobo: $\omega_{low,l2}$	-15.951	13.803
Intercept CI: $\omega_{low,l8}$	-13.641	4.644
Schooling^2: $\omega_{low,1}$	0.018	0.011
Age: $\omega_{low,21}$	0.579	0.379
Age^2: $\omega_{low,22}$	-0.220	n.a.
Birth cohort: $\omega_{low,3}$	-0.019	0.315
Occupation transition from mh-occupation		
Intercept BF: $\omega_{mh,l12}$	3.528	0.466
Intercept CI: $\omega_{mh,l8}$	0.976	0.398
Schooling^2: $\omega_{mh,1}/100$	0.043	0.170
Age^2: $\omega_{mh,2}/100$	0.014	0.069

Table 13: Estimated parameters of occupation assignment upon transition

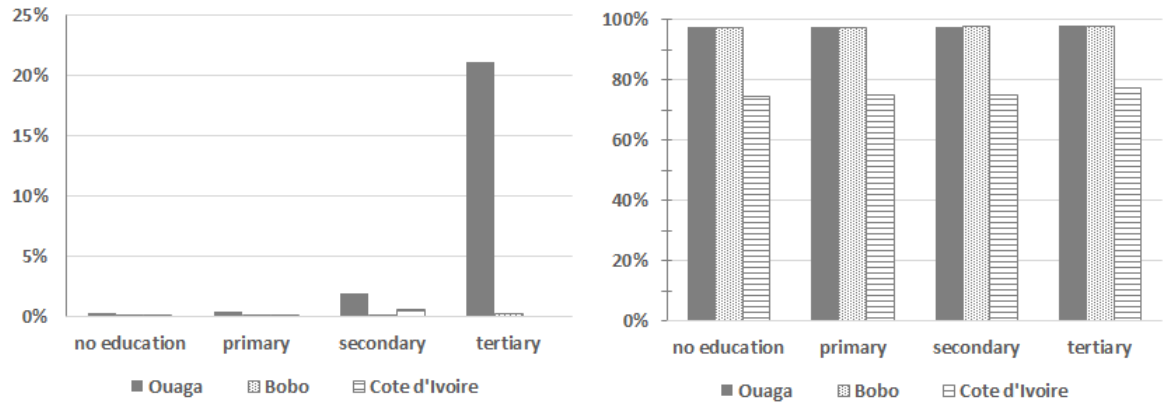


Figure 6: Predicted probability of medium-high occupation conditional on previous low occupation (left panel) and previous medium-high occupation (right panel, different scale)

in a medium-high-skilled occupation: The probability of upward transition (from low-skilled to medium-high-skilled) is virtually zero, while the downward transition probability is around 25%. Burkina Faso offers better occupation security for those who have previously worked in a medium-high-skilled occupation (downward transition rates are below 5%), but also slightly higher upward transitions rates for those in low-skilled occupations (20% probability for those with tertiary education). Overall, occupation transition from one level to another is not much influenced by education, nor by age or birth cohort.

5.2.4 Risk aversion and living cost estimates

Finally, Table 14 presents estimates of the relative risk aversion coefficient and living cost differentials.

Estimating the proposed model for a grid of fixed values for the risk aversion coefficient ρ, I find that the parameter solution for $\rho = 1.65$ gives the lowest loss function value. The moderate size of the risk aversion coefficient is in line with what Aldermann and Paxson (2012)

	$\hat{\theta}$	$\hat{\sigma}_{\hat{\theta}}$
Risk aversion: ρ	1.65	n.a.
Living cost: λ	3.731	0.046

Table 14: Relative risk aversion coefficient and living cost differential

report for other developing countries. The living cost differential of factor 3.7 indicates large living cost differences between urban/international and rural locations. In fact, urban and international incomes given in Table 5 need to be adjusted by this factor. This leaves an urban-rural real income premium of 20% to 70%[42], and an Ivorian-rural income premium of 50% to 100%.

All in all, the labour market findings can be summarised as follows. First, we find that unemployment probabilities of labour market entrants are inverse U-shaped in education, peaking at primary education. Secondly, we note that Côte d'Ivoire is characterised by much lower unemployment risk for labour market entrants than urban centers in Burkina Faso. Third, the probability of finding work in medium-high-skilled occupations is also clearly lower in Côte d'Ivoire than in Burkina Faso. The interaction of lower unemployment risk and lower medium-high-skilled occupation probability of Côte d'Ivoire is analysed further ahead in the context of returns to migration and migrant selection.

5.3 Goodness of fit

The model features 46 parameters, of which 6 are calibrated ex-ante while the remaining 40 parameters are estimated by Simulated Method of Moments relying on more than 200 moments on migration, education and labour market outcomes. For 56% out of 206 moments we cannot reject equality of the observed sample moments and the moments computed from the simulated data set at the 95% confidence level (65% at the 99% confidence level). Overall, the model does very well in matching labour market moments, while the fit achieved for education and migration moments is somewhat less good. This is not surprising because the labour market specification includes location intercepts, which capture local labour market differences, while migration and education patterns over time and regions are matched relying on observed regional differences in incomes, schools and other geographical characteristics and global time trends (in schooling and migration costs). I turn to briefly discussing the fit of labour market, migration and education moments.

Labour market moments are very well matched. That is, for more than 70% of labour market moments we cannot reject equality of observed and simulated moments at the 95% confidence level. The good fit of labour market moments is required to precisely evaluate returns to migration and education in terms of income, which then allows to estimate migration and schooling costs parameters to fit migration and education behaviour. The simulated labour market moments fit well the observed pattern of unemployment and occupation assignment for different education levels. However, the overall level of unemployment is clearly too low in Ouagadougou and most rural regions have a too high share of farming with respect to rural work.

[42]We calculate the real income premium between real income in low-skilled occupations in urban centers/Côte d'Ivoire with respect to real rural farming income in the good weather state.

For 40% of the migration moments we cannot reject equality of observed sample moments and simulated moments at the 95% confidence level (66% at the 99% confidence level). While the model matches well the overall level of migration, it underpredicts out-migration from the West and South-West (the rural regions with higher farming income) and slightly overpredicts it for urban centers. In terms of migration destinations, the model predicts too little emigration relative to migration to urban centers. We shall bear this in mind when evaluating the effect of the education reform on changes in migration patterns (see Section 8).

Education moments have an intermediate fit (for 48% we cannot reject equality of observed and simulated education moments at the 95% confidence level). The model does well in matching the stark difference in never-schooler rates of urban centers and rural regions, while educational attainment conditional on going to school and the share of students over age are slightly less well matched. The model does also well in matching the average educational attainment of different migrant and non-migrant groups. This is insofar important, as I rely on self-selection patterns of migrants to motivate the identification scheme of unobserved ability.

For detailed results on observed and matched simulated moments and a more elaborate discussion, please refer to Tables 22 to 43 and the relevant discussion in Appendix F.

6 Returns to migration

One main objective of this paper is to estimate returns to migration and to decompose them into their various components, hereby shedding light on the migration puzzle of large income differentials and moderate migration rates. There are several possible ways of calculating returns to migration. These range from the most basic comparison of incomes of migrants and incomes of stayers to the elaborate evaluation of life-time welfare of migrants and non-migrants, simulating the welfare of migrants if they had not migrated. The welfare evaluation takes into account (risk-adjusted) income differences but also considers other location-related benefits and costs such as amenity benefits and migration costs. While basic income comparison can be done using relatively straightforward regression techniques, the welfare evaluation and decomposition of returns to migration require a more elaborate framework. The proposed model allows me to evaluate not only risk-adjusted life-cycle gains in income, but it also enables me to quantify the different direct and indirect costs associated with migration. As we will see, they are crucial in explaining the migration puzzle. In the following sections, I will step by step compute these different measures of returns to migration and discuss what new insights we can gain from life-cycle welfare analysis with respect to simple income comparison.

6.1 Incomes and estimated migration premia of migrants and stayers

The most straightforward way of computing returns to migration is given by comparing incomes of those who have migrated with incomes of those who have not migrated. For Table 15 we use the simulated model to compute the average income of migrants who are not in their home location and average income of stayers in year 2000[43]. We also show the income difference in %.

	Ouaga	Bobo	Sahel	East	Center	West	S-West
Migrants	8.4	9.1	11.0	11.6	11.1	12.0	11.5
Stayers	13.5	11.5	4.8	5.3	4.0	6.1	5.5
Difference in %	-37.9%	-20.9%	130.6%	120.7%	176.3%	95.1%	109.5%

Table 15: Living-cost adjusted incomes of migrants and stayers (in 1,000 CFA/month)

We find that migrants from a rural origin earn on average at least twice as much as those who have stayed at home. However, the picture for urban migrants looks very different as their migration premium is negative, meaning that urban migrants earn less than urban stayers. The negative migration premium suggests that a simple income comparison is biased because of self-selection. Indeed, our results (not shown) indicate that migrants from a rural origin are on average more educated and are more likely to be of high ability than those who stayed behind (positive selection), while in urban centers the converse is true (negative selection).

Rather than comparing incomes of migrants and non-migrants, we should take selection into account and compute a counterfactual outcome for each group. In Figure 7 we show the migration premia of migrants and stayers for year 2000. The migration premium of migrants is computed as the difference of realised incomes of migrants with what they would have earned at home (counterfactual), analogous to an 'average treatment effect on the treated'. The migration premium for stayers is calculated as the difference between how much they would have earned if they had migrated (counterfactual) as compared to the realised income at home, analogous to an 'average treatment effect on the non-treated'. Given that these migration premia correct for selection in migration, we would expect a positive migration premium for migrants and a negative premium for stayers.

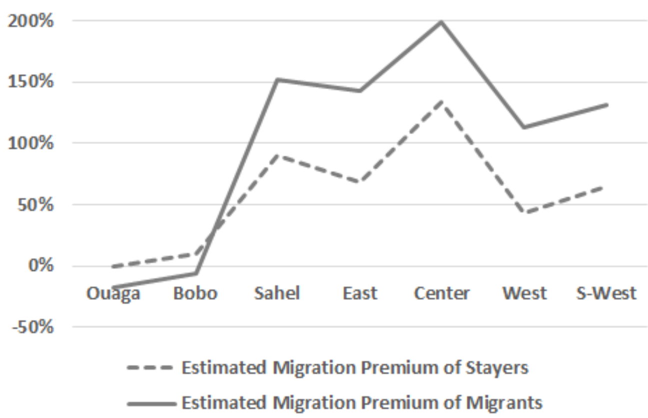


Figure 7: Average estimated migration income premia of migrants and stayers

Figure 7 brings some interesting findings to our attention. First of all, I find that the migration

[43]Unless otherwise specified, whenever we refer to 'averages' in this and the next section, we refer to averages across all individuals in year 2000. This allows us to directly compare the numbers with matched moments such as the share of migrants by year 2000 or other cross-sectional statistics.

premium in rural regions is not only positive for migrants, but also for stayers. However, the positive migration premium is not enough to incentivise stayers to migrate, indicating that either expected life cycle returns from income are not as large as the migration premium suggests (for example, because of unemployment and risk aversion) or that direct and indirect costs of changing location outweigh the expected benefits. Secondly, I find that in urban centers the migration premium is slightly negative for migrants. Similar to the case of the migration premium in rural regions, I shall explore how unemployment and risk aversion, as well as other direct and indirect benefits shape returns to migration.

6.2 Comparing risk-adjusted incomes over the life cycle

The previous comparison of incomes of wages earners does not only neglect unemployment and the effect of risk aversion, but also leaves out the dynamic aspect of incomes. For example, a migrant who has arrived in a new location might face a lower employment probability in the beginning than after some years. The same might be true for promotion in occupation levels. When such costs or returns are accruing over time, the analysis of returns to migration should be extended to include risk-adjusted incomes over the life cycle rather than limiting it to instantaneous income differentials.

Figure 8 displays average estimated returns to migration in life cycle income as grey bars (RTM, left scale). Returns are measured as the difference of risk-adjusted life cycle income in the estimated model under migration and a counterfactual situation in which migration is prohibitively costly, a fact of which individuals are aware and which they take into account accordingly. The figure also plots the average probability of unemployment of migrants in their home location (black line, right scale) and in their migration destination (dashed line, right scale).

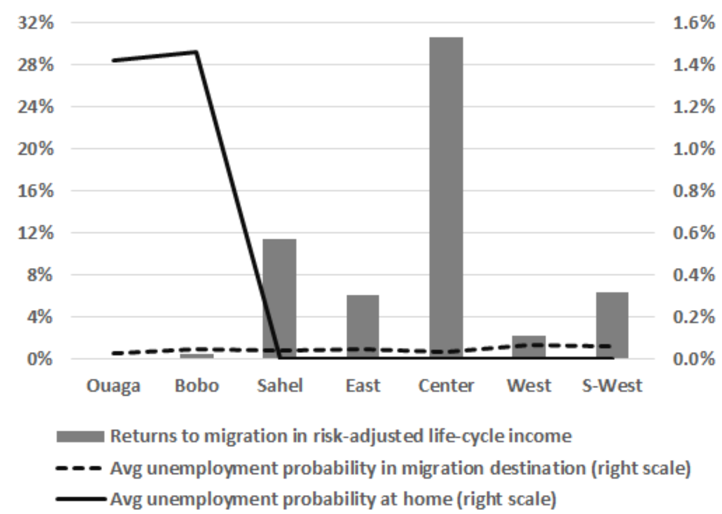


Figure 8: Returns in risk-adjusted life cycle income and unemployment probabilities at home and away

Compared to Figure 7 which indicated that migrants from a rural origin touched incomes which were around twice as high as those in their origin, we now find that returns to migration in terms of risk-adjusted life cycle incomes are virtually 0 in urban centers and between 5% to 30% for migrants from rural regions. Accounting for unemployment risk when individuals are risk-averse but not insured through formal unemployment insurance modifies returns to migration. Indeed, we note that urban migrants receive smaller incomes in their destination than they would at home (see Figure 7) but at the same time, their average unemployment probability is also lower. The reduction in unemployment risk through migration counterbalances lower instantaneous incomes in migration destinations. For rural migrants, the reasoning is reversed. While rural migrants get much higher income in their destination than at home, they also face more unemployment risk when moving abroad or to urban centers. This greatly depresses returns to migration from risk-adjusted life cycle income in comparison to migration premia shown before.

6.3 Net returns to migration and its decomposition

The most complete evaluation of returns to migration is given by adding amenity benefits, schooling and migration costs to the previously determined sum of risk-adjusted income stream. Rational and forward looking individuals will make their migration decisions based on their expectation of these net returns. Figure 9 plots average returns to migration of migrants as estimated from the simulated model (grey bars). As before, I calculate returns to migration as the difference in discounted life-time welfare with respect to a counterfactual setting in which migration is prohibitively costly. I also plot the share of migrants as observed in the true data in year 2000.

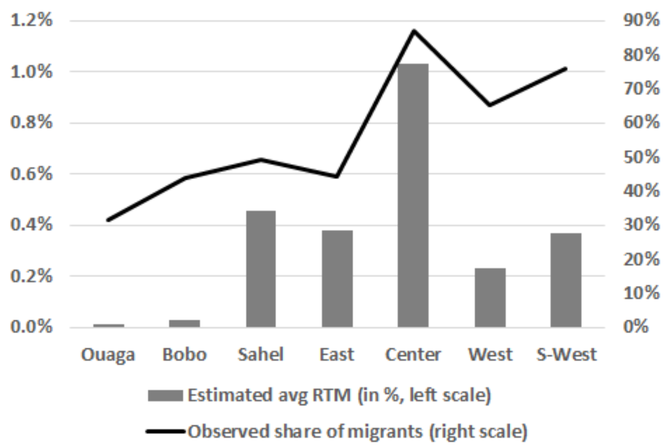


Figure 9: Net estimated returns to migration and observed share of migrants

We find that overall net gains from migration vary substantially across locations, in line with regional shares of migrants[44]. Average net gains of migration are much smaller than previously shown returns from risk-adjusted life cycle income. Net returns to migration range from 1.0% in the Center to 0% in Ouagadougou. In order to reconcile the low net returns to migration with the moderate returns from risk-adjusted life cycle income, we will provide a decomposition of the net migration gains. Figure 10 calculates overall net migration gains, including the contribution of each of its components: risk-adjusted life cycle income, home premium, development level, schooling and migration costs. A positive contribution to net gains is given by positive bars,

[44]Notice that average gains from migration need not necessarily be in line with regional shares of migrants. If migration gains are very unequally distributed, regions with very extreme benefits from migration will feature a smaller share of migrants than a region in which migration benefits are more equally spread.

while a negative contribution is given by negative bars. The difference between the sum of these contributions are net migration gains, shown by a black line.

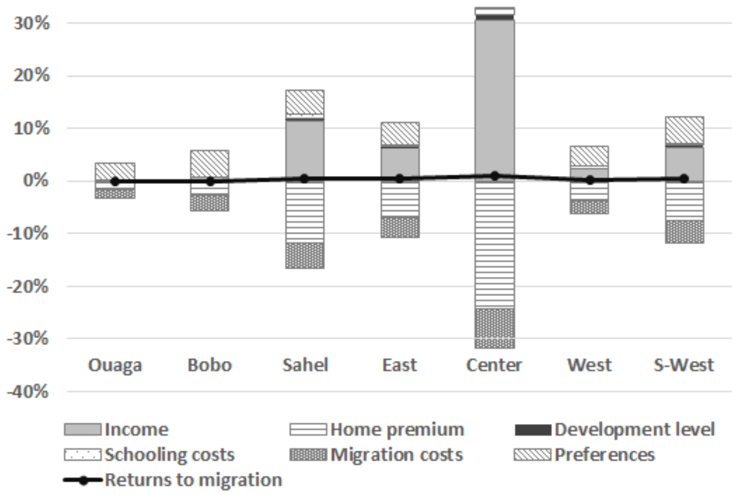


Figure 10: Net estimated returns to migration and observed share of migrants

Indeed, the decomposition shown in Figure 10 indicates that gains in risk-adjusted life cycle income from migration are counterbalanced by the loss of the home premium and migration costs when moving. For rural migrants income gains and the loss of the home premium co-move strongly, the reason being that they are correlated through the number of years not spent in the home location. Indeed, for each year in which an individual lives in a location different from his origin, he can increase his income potential at the detriment of the home premium. Overall, once all potential benefits and costs from migration are factored in, we are left with migration returns which are small.

The largest impact on net returns to migration in terms of welfare is given by factoring in unemployment and risk aversion. This change leads to a re-evaluation of the value of migration gains, lowering the contribution of income to returns to migration from more than 100% to less than 30%. This explains why migration rates are not higher despite large income differences between urban wage earners and rural farmers. We also note that differences in preference shocks play a non-negligeable role in returns to migration, especially for urban centers. Unless individuals face a (slightly) positive shock to migration, risk-adjusted income gains are not enough to compensate for the loss of the home premium and migration costs of moving away.

7 Returns to education

As a second objective of this paper, I want to shed light on why high illiteracy rates persist despite sizeable returns to education. Kazianga (2004) finds evidence of promising returns to education in the order of 11% for primary education and 23% for tertiary education of wage earners in Burkina Faso, yet these estimates are hard to reconcile with effective schooling choices. Indeed, potential income gains from better education are substantial (as suggested by income differences shown in Table 5) but measuring returns to education on wage earners hides the risk of unemployment. In what follows, I start by presenting average predicted incomes by education level and then move on to discussing the importance of risk in relation to returns to education. In the last section, I decompose net returns to education over the life cycle into its various components. In the current analysis I focus on education decisions, mentioning the interaction with migration decisions only when necessary.

7.1 Income patterns by education and migrant status

As a first piece of evidence on returns to education, the estimated model can be used to predict incomes for migrants and stayers of different education levels. Figure 11 shows average predicted incomes of employed migrants (light bars) and stayers (dark bars) in year 2000. The left panel refers to men from an urban origin, the right panel to men of rural origin.

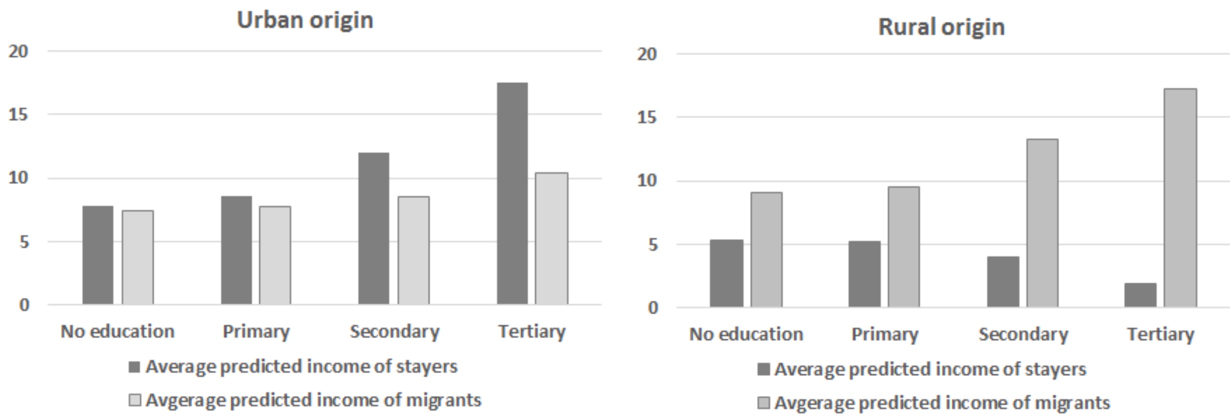


Figure 11: Average predicted incomes of migrants and stayers by final education level (1,000 CFA/month)

The steepness of the respective incomes of migrants and stayers in education level indicates that urban stayers have on average larger unconditional returns to education than migrants of urban origin. For individuals of rural origin, the converse is true. This is not surprising as the only means of reaping returns to education for an individual of rural origin is given (by assumption) by migrating to an urban center or abroad.

The results shown in Figure 11 cannot be interpreted as net returns to education for three main reasons. First of all, individuals self-select into education like they self-select into migration. Observed differences in predicted income are not necessarily due to returns to education but potentially only reflecting different selection based on (unobserved) characteristics. Secondly, unemployment risk is not monotonically decreasing in education but inverse U-shaped (as shown in Figure 4). Similarly, the occupation risk also primarily increases for those with better education: Those with no education already now that it is extremely unlikely that they will end up in a medium-high-skilled occupation. The interaction of unemployment risk and occupation risk will lead to a re-evaluation of returns to education. Lastly, the income pattern by education and migrant status shown in Figure 11 suggests that there might be an important interaction of these decisions. Individuals from rural origin need to migrate in order to take advantage of their education level.

The next section studies the effect of self-selection, unemployment and occupation risk on returns to education.

7.2 Unemployment and occupational uncertainty under risk aversion

Our model captures two sources of income uncertainty in the urban/international labour market: the risk of unemployment and the uncertainty in occupational assignment. The labour market estimates have revealed that unemployment rates are inverse U-shaped in education and that individuals with secondary and higher education face more occupational uncertainty than those without schooling. The higher exposure to risk for better educated individuals leads to a correction in returns to education and hereby lowers education incentives. In what follows, we are thus interested in quantifying the effect of unemployment and occupational uncertainty on returns to education.

In order to assess the importance of returns to education from risk-adjusted income streams over the life cycle, and to quantify the impact of unemployment risk and occupational uncertainty, I simulate life-cycle trajectories of individuals who have gone to school in our estimated model and under an alternative scenario in which education is not available. Figure 12 depicts average returns to education from risk-adjusted life cycle income (grey bars, left scale), unemployment rates (black lines, right scale) and probabilities of working in medium-high-skilled occupations (grey lines, left scale) after school completion. The solid lines refer to the estimated model 'educ', while 'no educ' relates to the restricted scenario in which education is unavailable (dashed lines).

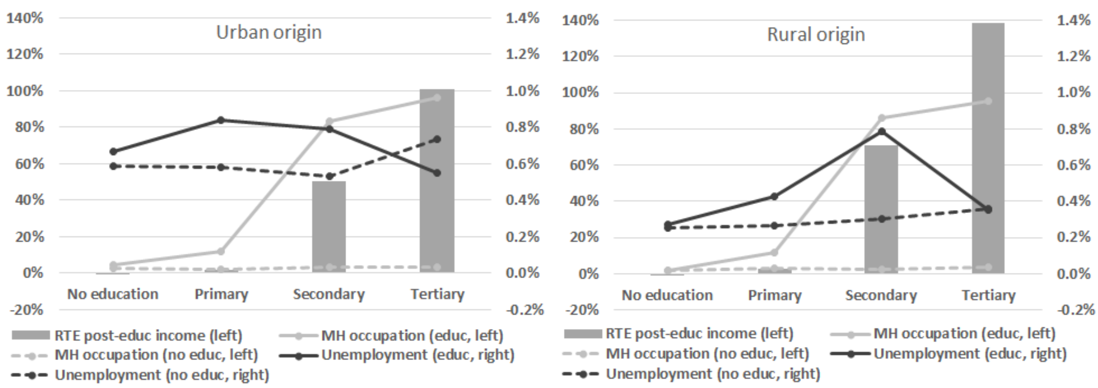


Figure 12: Returns to education from risk-adjusted life cycle incomes, unemployment rates and probability of medium-high occupations by origin

I find that gains in terms of higher risk-adjusted income only accrue at secondary and higher education, for primary education and no education they are virtually 0. Differences in unemployment risk and occupational assignment rates explain this finding. Individuals with primary and secondary education face higher unemployment rates than they would if they had not gone to school. The probability for medium-high-skilled occupations is low for those with primary schooling and less, and jumps to 80% and more for those with secondary and tertiary education. For those with primary education the value increase derived from higher probability of medium-high-skilled occupation assignment is just enough to compensate the loss in risk-adjusted income due to higher unemployment rates, no positive net returns to education result. Analogously, those with secondary education reap returns to education in terms of income half the size of those from tertiary education despite similar occupational probabilities, the reason again being differences in unemployment rates.

The inverse U-shape of unemployment rates in education is a key element when evaluating returns to education. In a situation of monotonically decreasing unemployment rates, education serves as insurance against unemployment and hence, returns to education measured on wage earners underestimate 'true' returns to education. In a situation of increasing or inverse U-shaped unemployment rates, education does not help insure against unemployment risk. Returns to education calculated on wage earners overestimate 'true' returns to education. This is crucial in explaining the education puzzle.

7.3 Net returns to education and its decomposition

Education entails higher (risk-adjusted) income streams after school completion, often referred to as 'returns to education'. However, a complete evaluation of net returns to education should also take into account the opportunity cost of going to school (i.e. the income losses incurred while in school) and schooling costs, as well as other direct and indirect costs associated with going to school or working after school completion. Individuals aiming at higher education supposedly face direct and indirect migration costs, as education facilities and work opportunities for better educated workers are geographically concentrated.

Figure 13 plots average returns to education (black line) and its decomposition (bars) for individuals who have gone to school by their final education level reached[45]. We use the model to simulate students' counterfactual outcome in a setting where going to school is not available. The difference between the estimated baseline and the simulated counterfactual of each welfare component determine its respective contribution to net returns to education.

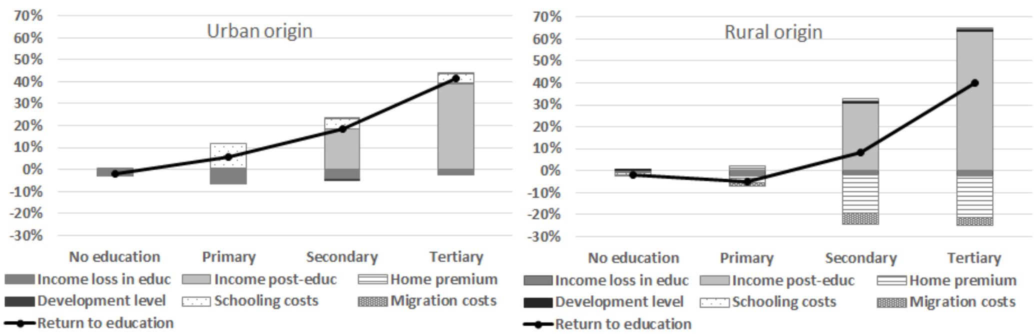


Figure 13: Decomposition of net estimated returns to education

Returns to education are mainly driven by higher risk-adjusted income streams of those with secondary or tertiary education. Individuals from a rural origin with secondary or higher education

[45]Notice that due to the probabilistic transition from one schooling level to the next, some individuals have gone to school but fail to attain primary education.

have larger income gains than those from an urban origin. However, these gains can only be realised by migrating to an urban or international location, entailing migration costs and, more importantly, the loss of the home premium.

Direct net schooling costs and the opportunity cost of going to school (the income loss before school completion) are relatively small. Indeed, we estimate that average schooling costs are positive for those who have gone to school, suggesting that non-monetary gains associated with school attendance dominate direct monetary costs. They are larger for urban individuals and dominate returns to education at the primary level. Opportunity costs of school attendance are also larger for urban individuals, reflecting better economic alternatives than in rural regions, but they are more than compensated by the positive contribution of schooling costs.

To simplify the comparison of our estimates of net life cycle returns to education with estimates reported in the literature, we transform education levels into years of education. The left panel of Table 16 thus shows average net returns to education for an additional year of primary, secondary or tertiary schooling (conditional on having the respective level), while the right panel depicts respective (gross) returns to education in terms of income measured only on wage earners.

	Net RTE			RTE on wage earners		
	primary	**secondary**	**tertiary**	**primary**	**secondary**	**tertiary**
Urban origin	0.97%	1.81%	4.61%	1.14%	5.73%	8.56%
Rural origin	-0.80%	1.86%	6.34%	-0.49%	8.86%	9.84%

Table 16: Yearly net returns to education

Net returns to education are found to be convex, in line with the pattern in different Sub-Saharan African countries reported by Schultz (2004). The comparison of net returns to education with returns to education in income measured on wage earners shows that the latter are substantially higher for individuals with secondary and tertiary education. The inclusion of income risk, as well as other benefits and costs associated with getting education lead to a considerable re-evaluation of returns to education, suggesting that returns to education measured on wage earners overestimate net returns to education.

In comparison with Kazianga (2004)'s estimates of returns to education for wage earners in Burkina Faso, which amount to 11% for an additional year of primary schooling, 15% for secondary schooling and 23% for tertiary education[46], the returns to education on wage earners presented above are much lower. The use of different data sets might account for some part of this difference.

It is important to note that the returns to education presented above refer to those individuals who have chosen to attend school at some point in their lives. While a large fraction of urban individuals has attended school (82%), a much smaller fraction of rural individuals has ever gone to school (28%). Given that students are positively selected (i.e. they are more likely to be of high ability and from a better paternal background), they face lower schooling costs and better

[46]Kazianga (2004) estimates of returns to education employing a Mincerian framework (see Mincer (1974)), controlling for entry into the wage sector and endogenous choice of public versus private sector.

future income prospects than those who have not gone to school. When educational opportunities among rural students are expanded (as in the reform in the next section), they do not necessarily reap the same returns as those who also go to school in absence of a reform.

8 How does educational attainment shape migration behaviour?

Understanding how education impacts migration behaviour is crucial when evaluating the effects of reforms in education policy aimed at increasing educational attainment, such as the efforts made to meet the universal primary education goal of the Millennium Development Goals 2015. While the impact of education reforms on changes in educational attainment is often thoroughly studied beforehand and desired, these reforms also contribute to reshaping migration patterns. This secondary effect is usually neglected when such policies are put into practice, possibly because of the difficulty to quantify them ex-ante. Hence, the third major contribution of this framework of joint education and migration decisions is that it allows us to assess the effect of educational reforms on migration behaviour.

In this section I analyse how a 'school building policy' translates into changes in migration pattern for individuals of rural origin. The education reform under consideration is one in which children in rural areas face the same availability of primary and secondary schools as their peers in urban centers, that is, their schooling costs are the same as in urban centers. This education reform would double the average level of education in the Center, triple education in the East, West and South-West and quadruple education in the Sahel. After the reform, average educational attainment in rural regions would be between 5 and 6 years, while it is approximately 7 years in Ouagadougou and Bobo-Dioulasso.

8.1 The quantitative effect on migration

One important question as to how the education reform affects migration is quantitative: How does the share of migrants change? And how often do migrants move on average? Figure 14 provides the share of migrants (lines) and the average number of moves per migrant (bars) in the baseline scenario (solid) and under the school building policy (dashed/stripes).

This simulation analysis confirms that the association of increasing rates of migrants and more moves per migrant with increasing education level described in Section 2.3 is not driven by self-selection of migration but is indeed caused by higher educational attainment. This finding confirms that the causal relationship of education on migration established for developed countries (Malamud and Wozniak (2012), Machin et al. (2012)) is also valid for (some) West African developing countries.

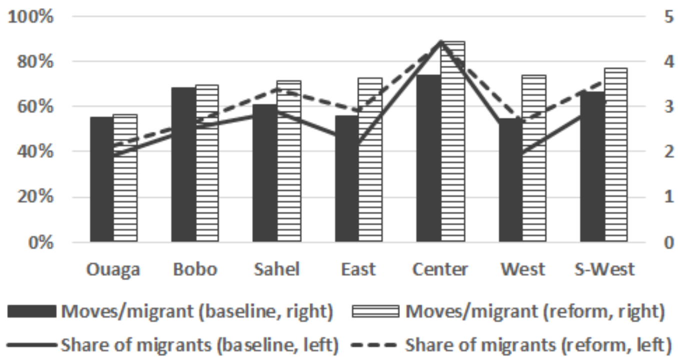


Figure 14: Share of migrants and moves/migrant in baseline and reform scenario

8.2 Do migration destinations change with education?

The descriptive analysis in Section 2.3 suggested that migration destinations change as the level of education increases, shifting from destinations abroad to migration to urban centers. Picking up on previous results which showed that an increase in education led to more migration, I now investigate how the relative importance of emigration to urban migration changes. In case of a relative reduction in emigration, we can also check if emigration decreases in absolute terms[47].

Table 17 presents the relative share of migration destinations of urban centers, rural regions and abroad in the baseline scenario and under the school building policy (i.e. the reform). It distinguishes individuals from urban and from rural origin.

	Migration destination		
	Urban	**Rural**	**Abroad**
Migration destinations			
Urban origin (baseline)	63.0%	27.3%	9.6%
Urban origin (reform)	62.1%	29.0%	8.8%
Rural origin (baseline)	41.0%	31.4%	27.6%
Rural origin (reform)	54.4%	30.8%	14.8%

Notes: This table considers all migrations in the baseline scenario and simulated reform scenario which occurred between age 7 and age 38 (or year 2000, whichever occured first) and classifies them according to their destination.

Table 17: Benchmark characteristics in terms of migration and education

I find that the reform has a negligeably small impact on migration patterns of urban individuals (whose education level remains basically constant), while it redirects a considerable part of out-migration from rural regions destined to Côte d'Ivoire to urban centers. Indeed, the migration pattern of rural individuals becomes much more like the one of urban individuals, with relatively

[47] As discussed in Section 5.3, the estimated model overpredicts urban migration and underpredicts emigration, thus the relative size of these two migration types should be taken with caution. However, in this analysis we are interested in the sign of the change (notably, if emigration has become relatively less attractive as education has increased) which should not be biased even if the quantitative size could be imprecise. Most importantly, the estimated baseline model predicts well the fact that migrants going to urban centers are relatively more educated than those going abroad (see Table 27 in the Appendix). Hence, the simulation of increased education reveal the correct substitution of one migration destination for another even if the estimated quantity may be imprecise (lower bound).

little emigration and a large share of urban migration. Migration movements abroad decrease also in absolute terms (not shown).

Altogether, it is important to recall that the previously given number of an increase of 25% of migration related to the total number of migrations. Given that emigrations remain constant or even decrease, migration to urban centers increases by more than 25%. As the estimated baseline version overpredicted urban migration at the expense of emigration, the estimates of an increase in urban migration should be interpreted as a lower bound. When educational attainment in rural regions reaches three quarters of urban levels (as in the school building policy), migration to urban centers increases by more than the projected 25%[48].

9 Do migration prospects affect education choices?

Policy makers can not only implement education reforms but they might also have in mind migration policies aimed at redirecting migration flows to a level and pattern considered optimal from a social point of view[49]. This section investigates the effect of three extreme migration policies on educational attainment and on the substitution of one migration destination for another. The benchmark comparison is the estimated model of unrestricted but costly migration. I compare the education and migration outcomes in the baseline with the respective outcomes in different scenarios of restricted migration.

Table 18 recapitulates basic characteristics of the simulated population in terms of migration behaviour and educational attainment by year 2000. These numbers serve as a benchmark when evaluating the effect of different migration policy regimes.

Overall, individuals of rural origin are more likely to be migrants than those from an urban origin. While almost all migrants from an urban origin migrate to an urban destination at some point in their life, less than 1 out 3 ever goes abroad. Rural migrants are about equally likely to emigrate and to go to an urban center (except for migrants from the East and West who are less likely to go abroad). In terms of educational achievement, we observe that individuals of urban origin have on average much more education than those of rural origin. The difference is primarily driven by differences in enrollment rates (i.e. the share of those who have ever gone to school) and less so by educational attainment of students.

[48] Of course, such a massive increase in migration to urban centers will entail general equilibrium effects leading to a depression in urban incomes, higher unemployment rates, and an increase in urban living costs. There might also be interactions in the marriage market because of gender imbalances in urban centers, either stimulating female migration to urban centers or increasing return of male migrants to rural regions where the ratio of women to men is more favorable for finding a wife. Given the partial equilibrium framework, these general equilibrium effects cannot be assessed.

[49] Several policies have been implemented in Burkina Faso since the 1960s in order to slow down rural out-migration (see Beauchemin and Schoumaker (2005)). The main concern was that urban centers (Ouagadougou and Bobo-Dioulasso) did not have the capacity to absorb the inflow of migrants, causing unemployment and informal employment and putting a strain on urban infrastructure and services.

	Ouaga	Bobo	Sahel	East	Center	West	South-West
Migration							
Migrants	38.6%	51.0%	57.8%	44.3%	88.9%	39.3%	62.2%
Share of migrants to							
- urban destination	94.5%	94.6%	73.2%	73.7%	76.2%	75.8%	68.2%
- destination abroad	18.8%	32.8%	60.8%	43.4%	76.7%	34.2%	64.4%
Educational attainment							
Ever gone to school	89.5%	88.1%	22.3%	29.0%	37.1%	30.2%	32.5%
Avg. years of education	7.39	6.58	1.23	1.55	2.23	1.47	1.69
Avg. years of education—student	8.26	7.47	5.52	5.36	6.24	4.87	5.22

Notes: 'Migrants' denotes the share of individuals who have migrated between age 6 and year 2000. 'Urban destination' gives the share of migrants who have migrated at least once to an urban destination. 'Destination abroad' is the share of migrants who have emigrated at least once. 'Ever gone to school' denotes the share of individuals who have gone to school. 'Avg. years of education' is the average population education level in years achieved by year 2000. 'Avg. years of education—student' stands for the average education level in years of those who have gone to school.

Table 18: Benchmark characteristics in terms of migration and education

9.1 Overall effects on education

In what follows, I propose three different scenarios of restricted migration. In the first scenario, emigration to Côte d'Ivoire is prohibited, in the second scenario urban migration is prohibited (except for returning to one's origin). In the last scenario, any form of migration is prohibited. The first scenario allows me to investigate if the low-skilled labour demand in Côte d'Ivoire has negative incentive effects on education. If this is the case, we should see average education increase with a ban on international migration. In the second scenario of restricted urban migration, I study how the prospect of migrating to urban centers affects education decisions. The third scenario is provided as a comparison to see how educational attainment would change if any internal and international movement was prohibited. In all three scenarios, the individual knows of the respective migration restriction since the beginning, he can thus fully re-optimise his education choice to match the alternative circumstances.

Figure 15 displays the average educational achievement by origin. It is measured in years on the left scale (grey bars). The three lines correspond to the percentage change in average education of each alternative scenario with respect to the baseline (right scale). The dotted line refers to the 'no emigration' scenario, the dashed line to 'no urban migration' scenario and finally, the black line to no migration at all.

I find that changes in average education are moderate to small in all three different scenarios. Education decisions of individuals from an urban origin are virtually immune to changes in the migration regime. Being in an urban location provides urban individuals with good schooling facilities (except for, in earlier decades, university) and returns to education can be reaped in form of better paid work in medium- and high-skilled occupations. This finding is in line with the decomposition of returns to migration in Figure 10 which showed that returns from migration of urban individuals are not stemming from income gains but are mainly driven by preference shocks.

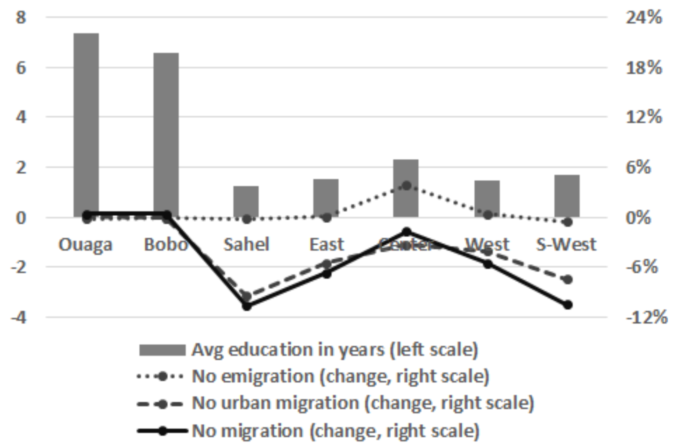


Figure 15: Baseline education and respective changes in alternative scenarios

In contrast, individuals from a rural origin re-adapt their educational attainment in view of alternative migration prospects. In absence of emigration possibilities, individuals from the Center slightly increase their education while individuals from other rural regions keep their education level constant. When urban migration possibilities are banned, individuals from a rural origin lower their average years of education by up to 10%. This effect is mostly driven by fewer years spent in school, enrollment rates remain almost constant (not shown). Nonetheless, these overall changes seem rather small in the light of such extreme migration policy changes.

10 Discussion and 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 Burkina Faso. The analytical context allows me to estimate returns to migration and returns to education, dissecting them into their various components. Hereby, I shed light on the migration and education puzzle.

Regarding the 'migration puzzle', the analysis reveals that urban/international-rural income differences overestimate net returns to migration, which in turn explain moderate rural out-migration rates. Two main factors contribute to this re-evaluation. First, urban and international labour markets are characterised by (uninsured) unemployment and occupation risk, which both lead to a substantial downward revision of returns to migration. Under the estimated moderate degree of risk aversion, individuals try to avoid the risk of unemployment even if it occurs only with a (relatively) low probability. The second factor relates to direct and indirect migration costs. While direct migration costs are large (especially for migration from remote rural regions), indirect migration costs are quantitatively even more important. The strong preference for staying in one's home location represent indirect migration costs which greatly contribute to reducing returns to migration and hence, (out-)migration movements from the origin.

As for the 'education puzzle', I show that measuring returns to education on wage earners is problematic as it overestimates net returns to education. Indeed, the model identifies two opposed effects of education. On the one hand, higher education in urban centers or abroad substantially increases the probability of being offered a well-paid job in a medium-high-skilled occupation instead of a low-skilled occupation. This probability jumps from 0.5% without schooling to above 80% with tertiary education, seemingly indicating very large returns to education. On the other hand, I also find that the probability of unemployment upon labour market entrance is inverse U-shaped in schooling, reaching a maximum between primary and secondary education. Given that unemployment is persistent and no unemployment insurance exists, this risk greatly lowers returns to education. In addition, individuals in rural regions face higher schooling costs, and have to incur direct and indirect migration costs when wanting to reap returns to education. All these factors explain why educational attainment is relatively low (especially in rural regions) despite large income differences between farming, low-skilled and medium-high-skilled occupations.

Finally, I show that an education reform aimed at increasing rural educational attainment would also have a considerable impact on migration patterns in Burkina Faso. The simulated reform not only leads to an increase in total migration movements, but it also re-directs migration flows from rural regions abroad to migration from rural regions to urban centers. The change in migration patterns as a consequence of changes in educational attainment of (potential) migrants is a key factor which needs to be taken into account by policy makers. On the converse, I also show that migration policies have an impact on educational attainment in rural regions. Their effect however is relatively small.

Appendix

A Definitions and data on migration and education puzzle

Figure 1 shows the migration puzzle of West Africa in the left panel and the schooling puzzle in the right panel.

The figure related to the migration puzzle displays the ratio of expected income in the capital of each country to the value added in agriculture in year 2001 (grey bars). The data on expected income in each capital is computed as the product of the average unemployment rate and average income of employed individuals (in West African French Franc (CFA)). The data comes from Brilleau et al. (2004). The information on value added in agriculture per worker (in 2005 constant US dollars) is given in the World Development Indicators Databank of the Worldbank, accessed on September 24, 2014. We use this series and transform it first into current US dollars[50], then into current CFA. For Niger, we only have data on year 2005. We use this year and transform it into current US dollars. We believe that this overestimates the value added in agriculture per worker in 2001, hence the presented ratio of expected urban income to value added in agriculture per worker is a lower bound estimate.

The black line depicts an estimate of yearly rural-urban net migration between 2000 and 2010. We calculate it as the excess growth of urban population over rural population growth, assuming that rural and urban population grow at the same rate.[51] The estimate uses data on urban, rural and total population from the World Development Indicators, accessed on September 24, 2014.

The figure on the schooling puzzle shows estimated returns to primary education and the illiteracy rate on the population aged 15 and more in year 2001. The data on returns to primary education refers to average returns to primary education in all sectors as estimated in Kuepie et al. (2009). Notice that Kuepie et al. (2009) highlight the convexity of returns to education, that is, they would increase with secondary and tertiary education. Kuepie et al. (2009) use the same data source as Brilleau et al. (2004). The illiteracy rate was defined as the inverse of the literacy rate on the population aged 15 and more in year 2001 extracted from the World Bank Development Indicators on September 24, 2014.

[50]To do this, we divide the value added (VA) in agriculture per worker by the constant dollar VA in agriculture and multiply it by the current dollar VA in agriculture.

[51]According to Potts (2009) and Potts (2012), this assumption is plausible for Sub-Saharan Africa. Urban centers have lower fertility rates and lower death rates than rural areas, these cancel each other out. Thus, any 'excess' population growth in urban centers can be roughly attributed to net rural-urban migration.

B Map and definition of locations

Figure 16: Map of Burkina Faso: Main cities

The two urban centers in the model are: **Ouagadougou**, the capital in the center of the country and **Bobo-Dioulasso/Banfora** (referred to as Bobo), the two urban centers in the South-West of the country.

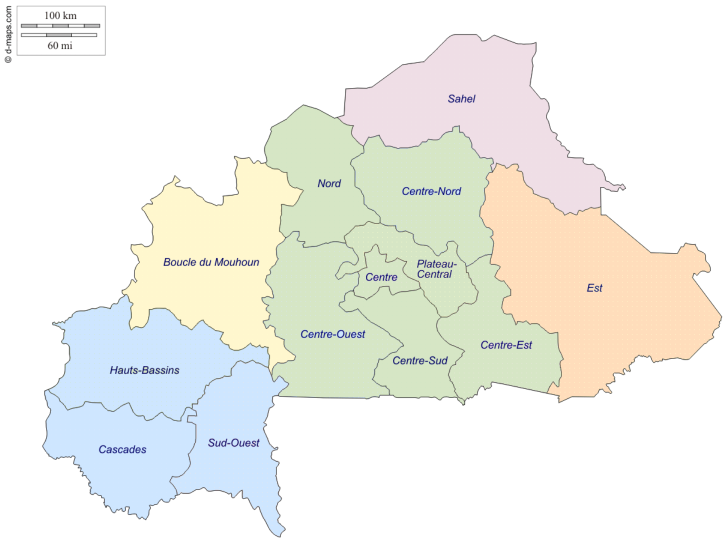


Figure 17: Map of Burkina Faso: Definition of rural regions

The five rural regions in the model are the **Sahel**, the administrative region in the North of the country with regional capital Dori, the **East**, the administrative region in the East of the country with regional capital Fada N'Gourma, the **Center**, the central region composed of several administrative regions with corresponding capitals (among which Ouagadougou)[52], the **West**, the administrative region of the Boucle du Mouhon in the West of the country with Dédougou as regional capital, and finally the **South-West**, the administrative regions of the Hauts-Bassins, Cascades, South-West and their corresponding regional capitals (among which Bobo-Dioulasso

[52]In the analysis we will use Koudougou as the regional capital of the Center.

and Banfora)[53].

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

[53]In the analysis we will use Orodara as the regional capital.

C 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 C
Income by occupation group	See Appendix C
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 centers, infrastructure (water, electricity, telephone),
	leisure facilities (bar, cinema), diseases and internal conflicts.

Table 19: Data sources of location indicators

D Calibrated income distributions

Summary of calibrated income distributions

In what follows, we carefully describe how we calibrate each income distribution and which data sources we use to do so. Table 20 is the same as shown in subsection 4.1.1 and serves as a visual reference for the description in this Appendix.

	Ouaga	Bobo	Sahel	East	Center	West	South-West	Côte d'Ivoire
Urban/international work income								
$w_{low}(l)$	31.0	29.9						36.1
$\min(w_{mh}(l))$	52.6	52.6						72.2
$\max(w_{mh}(l))$	79.2	79.2						110.0
Farming income								
$w_F(GS, l)$			5.33	5.71	4.69	6.54	5.84	
$w_F(BS, l)$			4.09	4.16	3.31	4.53	4.00	
$\pi(BS\|l)$			10.81%	8.08%	6.86%	6.88%	3.77%	
Rural work income								
w_R			14.49	14.49	14.49	14.49	14.49	
$\pi(RW\|l)$			84.02%	30.88%	61.73%	77.10%	82.63%	
$\pi(NS\|l)$			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	0.40	0.40	0.40

Notes: $w_{low}(l)$ is the monthly income in a low-skilled occupation in location l, $w_{mh}(l)$ the income in a medium-high-skilled occupation. $w_F(GS, l)$ refers to the farming income in location l in a good weather state, $w_F(BS, l)$ in a bad state. $\pi(BS|l)$ denotes the probability of a bad weather state. w_R is the work income for a year-round employment in the rural sector. $\pi(RW|l)$ is the probability of finding work (seasonal or for a full year) in the rural sector. $\pi(NS|l)$ refers to the probability of getting work for a full year conditional on finding work. $\underline{w}$ is the subsistence income of students, nonworking and unemployed individuals.

Table 20: Calibrated income distributions (1'000 CFA/month, before living cost adjustment)

Urban and international work income

Urban and international work income $w_{low}(l)$ and $w_{med}(l)$ are computed as the (weighted) average monthly wage paid in low- and medium-high-skilled occupations in Ouagadougou, Bobo-Dioulasso and Côte d'Ivoire. It uses ILO data on prevailing occupational wages in Burkina Faso and minimum/maximum occupational wages in Côte d'Ivoire in 1990/1991[54].

Monthly wages of approximately 110 occupations are regrouped into low-skilled and medium-high-skilled. 'Low-skilled' refers to agricultural and non-agricultural occupations including artisans, domestic services, transportation and other unskilled workers. 'Medium-skilled' refers to non-agricultural occupations including clerks, public employees, security forces, administrative and

[54] It would be preferable to have time series data on wages, in order to analyse how changing wage dynamics have impacted migration decisions. Unfortunately, occupational wages in Burkina Faso are only widely available for year 1991. Some limited data is available for years 1985 and 2000. This data might be used in a later stage of the project to investigate the effect of wage dynamics. In this first step, I must work with the - arguably strong - assumption that the evolution of real wages in different occupations, rural working and farming have been subject to the same trend.

technical personnel. 'High-skilled' refers to non-agricultural occupations including liberal professions, managers, directors and executives in the public and private sector. The weight of an occupational wage within each skill group corresponds to its relative employment share as observed in the (representative) EMIUB data in 1991[55].

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, not least because of differences in 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[56]. Table 21 gives an overview over the value of these different agricultural activities by location.

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

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, $w_F(GS, l)$[57]. 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. The data allows to compute an indicator of average incidence of bad harvests used as the probability of bad harvest $\pi(BS, l)$ in the farming income equation. Notice that the probability of bad harvests is inversely related to the average rainfall shown in Table 3.

Using the community survey information on bad harvests and the DGPSA data on crop

[55] The EMIUB data is not representative for low-skilled occupations in Côte d'Ivoire (i.e. agricultural sector is over-represented). Instead of using employment shares as weights to determine $w_{low}(l = 8)$, I have used an average ratio of Ivorian to Burkinabe low-skilled occupational wages equal to 1.2.

[56] 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).

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

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%.

Rural work income

The income from rural work w_{rural} is calibrated from ILO hourly wage data and average hours worked on crop field farm workers in 1987. Crop field farm workers earned approximately 14,490 CFA per month. However, availability of agricultural employment 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 $\pi(NS|l)$.

Subsistence income

The subsistence income $\underline{w}$ is calibrated from the work shares of farming and nonworking in rural areas. Its identification is analogous to the one of the relative risk aversion coefficient and the scale parameter as described in Appendix E.

E Identification of the relative risk aversion coefficient and the scale parameter

In rural locations, individuals face two different work alternatives, farming and rural work, with known but differing income distributions. Deriving and rewriting the choice probabilities of farming F and rural work RW in location l, we find that the difference in logarithms of the probabilities of these work choices is equal to the difference of the fundamental values of each choice:

$$\ln\left(\text{prob}(F \times l|x)\right) - \ln\left(\text{prob}(RW \times l|x)\right) = \frac{v(x, F \times l) - v(x, RW \times l)}{\sigma_G} \tag{20}$$

Given that the continuation value of farming and rural work in location l are the same, as well as the corresponding amenity value and potential migration costs (which are location-dependent but activity-independent), the difference in the fundamental values of farming and rural work in location l reduces to the difference in the certainty equivalent value of the stochastic income of each work alternative:

$$\begin{aligned} &\ln\left(\text{prob}(F \times l|x)\right) - \ln\left(\text{prob}(RW \times l|x)\right) = \\ &\frac{\left[\text{E}_{\tilde{w}(x,F\times l)}\left[\tilde{w}(x, F \times l)^{1-\rho}\right]\right]^{\frac{1}{1-\rho}} - \left[\text{E}_{\tilde{w}(x,RW\times l)}\left[\tilde{w}(x, RW \times l)^{1-\rho}\right]\right]^{\frac{1}{1-\rho}}}{\sigma_G} \end{aligned} \tag{21}$$

In a large sample, the choice probability $\text{prob}(m|x)$ can be approximated by the share of individuals choosing m given x. The moment conditions for the relative risk aversion coefficient are thus the difference of the logarithms of the shares of farming and rural work of individuals aged 16 to 38 in location l.

Using the same identification scheme, one can also identify the scale parameter. Given that we have 5 rural regions, we have enough degrees of freedom to identify both the scale parameter and risk aversion. For values of risk aversion ρ (between 1 and 5), I find that $\sigma_{G,rural}$ should be between 0.15 and 0.2. For this first estimation, I adopt $\sigma_{G,rural} = 0.17$. Individuals from an urban origin have a slightly higher net present value, thus larger shocks are needed to match the observed location, education and work choices. We thus calibrate $\sigma_{G,urban} = 0.22$. Translating this approach to the differences in shares between farming and nonworking in rural areas, we can derive the level of subsistence income $\underline{w} = 400$ CFA/month.

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.

Fit: Migration moments identifying amenity parameters

Table 22 shows the fit of the migration moments which identify the amenity parameters.

	Ouaga	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-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	0.863	0.814	0.339	0.535	0.183	0.704	0.568
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	0.070	0.018	-0.032	-0.006	-0.312	0.001	-0.018
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	0.032	0.020	-0.022	-0.008	-0.113	0.000	-0.013
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	0.030	0.018	-0.016	-0.008	-0.068	-0.005	-0.016

Table 22: Fit: Migration moments identifying amenity parameters

Table 22 depicts migration moments which identify the home premium (return migration rates) and the development parameter. Overall, the pattern of return migration rates is well matched. For some locations (Bobo, West, South-West) the simulated return migration is clearly too high. The net share of migrants in the 1970s is extremely well matched. However, the net share of migrants is less well matched for the 1980s and 1990s, matching the qualitative but not the quantitative pattern.

Fit: Education moments identifying schooling cost parameters

Tables 23 to 27 show the fit of moments related to education.

All in all, schooling moments are fairly well matched. The overall education distribution in each location is rather well matched (see Table 23). The model also succeeds in predicting the stark difference in never-schooler rates between urban centers and rural regions. As shown in Tables 24 and 25, the changing pattern of primary education in urban locations over decades is also well matched. However, the fit for rural locations is not very good, primary education is underpredicted in the 1960s and overpredicted in the 1990s (notice that the observed primary share dipped in the 1990s). The age pattern of students (see Table 26) shows that we underpredict the share of students in rural regions. At age 17 and 22, the simulated rate of students in urban centers is clearly too low compared to the observed rate.

The education moments measuring the average years of education of different migrant types and stayers are very well matched. Most importantly, we match the observed pattern of emigrants being on average much less educated than those migrating to urban centers (the ratio of these two moments). It is crucial that the (qualitative) selection pattern be well matched, because we base the identification scheme of parameters relating to unobserved ability on the self-selection pattern of migrants.

	Ouaga	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-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	0.103	0.117	0.754	0.699	0.470	0.696	0.664
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	0.608	0.580	0.327	0.280	0.510	0.205	0.274
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	0.232	0.074	0.084	0.067	0.128	0.034	0.045

Table 23: Fit: Schooling moments identifying schooling cost parameters 1

	Ouaga	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-West**
Share primary at age 13 in 1960s							
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	0.660	0.604	0.017	0.044	0.101	0.042	0.040

Table 24: Fit: Schooling moments identifying schooling cost parameters 2a

Share primary at age 13						
	1970s		1980s		1990s	
	urban	**rural**	**urban**	**rural**	**urban**	**rural**
Observed	0.741	0.267	0.874	0.330	0.922	0.251
Std. Err.	0.029	0.017	0.017	0.018	0.018	0.029
Simulated	0.792	0.109	0.892	0.318	0.887	0.500

Table 25: Fit: Schooling moments identifying schooling cost parameters 2b

Students by age										
	age 7		age 12		age 17		age 22		age 27	
	urban	**rural**	**urban**	**rural**	**urban**	**rural**	**urban**	**rural**	**urban**	**rural**
Observed	0.823	0.281	0.688	0.230	0.401	0.109	0.155	0.027	0.021	0.006
Std. Err.	0.013	0.009	0.015	0.009	0.015	0.008	0.012	0.005	0.005	0.003
Simulated	0.757	0.164	0.699	0.155	0.136	0.052	0.051	0.027	0.024	0.015

Table 26: Fit: Schooling moments identifying schooling cost parameters 3

Avg years of education, by cohort groups				
	Emig/ local	**OMig/ local**	**BMig/ local**	**Local**
	Rural origin			
Older cohorts				
Observed	1.77	6.55	5.82	0.72
Std. Err.	0.32	1.02	0.97	0.11
Simulated	1.44	6.33	4.36	0.24
Younger cohorts				
Observed	0.86	4.45	4.60	1.12
Std. Err.	0.12	0.50	0.56	0.11
Simulated	1.27	4.90	3.78	0.98
	Emig/ local	**UMig/ local**		**Local**
	Urban origin			
Older cohorts				
Observed	1.19	1.80		4.33
Std. Err.	0.19	0.22		0.41
Simulated	0.49	1.04		5.18
Younger cohorts				
Observed	0.72	1.12		6.29
Std. Err.	0.07	0.11		0.24
Simulated	0.69	0.98		7.23

Table 27: Fit: Schooling moments identifying schooling cost parameters 4

Fit: Migration moments identifying migration cost parameters and high ability share

Tables 28 to 31 show the fit of the moments identifying the migration cost parameters. Table 32 shows the fit of moments identifying the share of high ability. We also present observed moments and simulated moments on the share of permanent emigrants among migrants for different education levels. These moments have been introduced to ensure that the share of permanent emigrants is matched. This is important as most labour market moments and education moments do not include permanent emigrants.

On the whole, the model matches the overall level of migration fairly well. However, it underpredicts out-migration from the West and South-West. These rural regions are characterised by higher farming income than the Sahel and East, but also by higher migration rates, a feature which the model does not match well. When it comes to migration destinations, the model generally predicts too little emigration compared to other types of migration. This can be seen in the too low ratio of migrations to the farthest location (Côte d'Ivoire in most cases) to migration to the closest location, the slightly underestimated shares of permanent emigrants among migrants (especially for urban), and the ratio of migrants who have settled in urban locations (which is not their home location) to the number of permanent emigrants by home location (which is used to identify the share of high ability). The migration rates by age are relatively well matched for until age 22, however, they overestimate the probability to migrate afterwards.

	Ouaga	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-West**	**CI**
Never-migrants by home location								
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	0.614	0.490	0.422	0.557	0.111	0.607	0.378	
Migrants from ... to farthest location by migrants to closest location								
Observed	0.961	0.070	7.360	3.656	0.770	3.101	0.030	1.366
Std. Err.	0.111	0.036	1.572	0.731	0.047	0.402	0.013	0.186
Simulated	0.684	0.137	0.644	0.538	1.066	1.008	0.032	0.067

Table 28: Fit: Migration moments identifying migration cost parameters 1

	Sahel	East	Center	West	South-West
Out-migration rate 17-26 years old in 70s					
Observed	0.059	0.037	0.148	0.123	0.092
Std. Err.	0.010	0.010	0.011	0.015	0.012
Simulated	0.050	0.039	0.195	0.050	0.075
Out-migration rate 17-26 years old in 80s					
Observed	0.059	0.049	0.173	0.092	0.115
Std. Err.	0.008	0.008	0.010	0.009	0.011
Simulated	0.063	0.047	0.178	0.057	0.085
Out-migration rate 17-26 years old in 90s					
Observed	0.068	0.076	0.205	0.111	0.156
Std. Err.	0.008	0.010	0.010	0.009	0.012
Simulated	0.065	0.061	0.183	0.080	0.086

Table 29: Fit: Migration moments identifying migration cost parameters 2

Migration rate at age 7, 12, 17, 22, 27, 32, 37							
	urban origin						
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	0.003	0.010	0.038	0.057	0.080	0.077	0.066
	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	0.004	0.016	0.046	0.089	0.102	0.115	0.140

Table 30: Fit: Migration moments identifying Migration cost parameters 3

Share of permanent emigrants among migrants				
	No educ	**Prim**	**Sec**	**Tert**
	Urban origin			
Observed	0.436	0.286	0.134	0.087
Std. Err.	0.057	0.042	0.031	0.060
Simulated	0.062	0.074	0.021	0.005
	Rural origin			
Observed	0.359	0.209	0.054	0.100
Std. Err.	0.013	0.022	0.013	0.056
Simulated	0.470	0.372	0.012	0.012

Table 31: Fit: Migration moments on permanent emigrants

	Ouaga	Bobo	Sahel	East	Center	West	South-West
Ratio permanent urban migration vs. permanent emigration							
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	1.227	1.124	0.709	1.510	0.460	2.502	0.911

Table 32: Fit: Migration moments identifying share of high-ability

Fit: Labour market shares identifying risk aversion

Table 33 gives the logarithm of the ratio of the share of farming to the share of rural work in rural regions. The model slightly overpredicts farming with respect to rural work in rural regions (except for the Sahel).

	Sahel	**East**	**Center**	**West**	**South-West**
Logarithm share F - logarithm share RW					
Observed	2.35	2.37	1.76	2.31	2.06
Std. Err.	0.05	0.06	0.04	0.06	0.05
Simulated	2.24	2.78	1.97	2.94	2.50

Table 33: Fit: Rural labour market shares identifying risk aversion coefficient

Fit: Labour market shares identifying labour market entrance parameters

Tables 34 to 37 show observed and simulated moments on labour market outcomes of labour market entrants.

The model matches the predicted probability of medium-high-skilled occupations of labour market entrants over different education levels very well. Indeed, the simulated moments show negligeably small probabilities of medium-high-skilled occupations for labour market entrants without or with primary education, intermediate probabilities for those with secondary education and high probabilities (around 80%) of those with tertiary education. The model also predicts the difference in the probability of medium-high-skilled occupation between locals (20%) and rural migrants (40%) for secondary education. In the section 7 where we discuss identification, we argue that this difference derives from differences in ability composition of locals and rural migrants, allowing us to identify the effect of unobserved ability.

The simulated moments does not reflect a clear age or cohort pattern for labour market entrants. However, due to the small number of observations, the observed moments themselves are not very precisely measured and thus, little weight is put on matching these patterns well.

Probability of mh occupation of local LM entrants by education level								
	Ouaga	**Bobo**	**Ouaga**	**Bobo**	**Ouaga**	**Bobo**	**Ouaga**	**Bobo**
	no educ.		primary		secondary		tertiary	
Observed	0.025	0.012	0.029	n.a.	0.195	0.181	0.833	n.a.
Std. Err.	0.017	0.009	0.017	n.a.	0.033	0.046	0.112	n.a.
Simulated	0.005	0.044	0.028	n.a.	0.260	0.189	0.776	n.a.

Table 34: Fit: Labour market moments identify labour market entrance parameters 1

Probability of mh occupation of rural migrant entrants by education									
	Ouaga	**Bobo**	**CI**	**Ouaga**	**Bobo**	**Ouaga**	**Bobo**	**CI**	**Ouaga**
	no educ.			primary		secondary			tert.
Observed	0.045	0.109	0.015	0.109	0.061	0.443	0.475	0.077	0.903
Std. Err.	0.013	0.028	0.005	0.027	0.035	0.035	0.056	0.053	0.054
Simulated	0.023	0.013	0.003	0.108	0.111	0.410	0.321	0.078	0.856

Table 35: Fit: Labour market moments identify labour market entrance parameters 2

Probability of mh occupation of locals by age			
	age 12-16	**age 17-21**	**age 22-26**
Observed	0.158	0.333	0.211
Std. Err.	0.086	0.076	0.096
Simulated	0.164	0.290	0.417

Table 36: Fit: Labour market moments identifying labour market entrance parameters 3

Probability of mh occupation by cohort & father's occ.				
	cohort 1 & 2	**cohort 3 & 4**	**cohort 5 & 6**	**cohort 5 & 6**
		$of = low$		$of = mh$
Observed	0.417	0.188	0.125	0.292
Std. Err.	0.149	0.070	0.045	0.095
Simulated	0.297	0.312	0.258	0.453

Table 37: Fit: Labour market moments identifying labour market entrance parameters 4

Fit: Labour market shares identifying labour market transition parameters

Tables 38 to 42 show observed and simulated moments identifying the parameters on labour market transition probabilities. The first two tables describe labour market transitions conditional on a previous medium-high-skilled occupation, while Tables 3 and 4 relate to transitions from a low-skilled occupation.

Labour market transitions from a medium-high-skilled occupation are very persistent and well matched. Labour market transitions from a low-skilled to a medium-high-skilled occupation are rare with probabilities close to 0, except for those with tertiary education. This characteristic is well matched.

Probability of mh occupation by education				
	No educ	**Prim**	**Sec**	**Tert**
Observed	0.962	0.981	1.000	0.947
Std. Err.	0.013	0.004	0.003	0.053
Simulated	0.977	0.975	0.981	0.826

Table 38: Fit: Labour market moments identify labour market transition parameters 1

Probability of mh occupation by age (conditional on secondary)				
	17-21	**22-26**	**27-31**	**32-36**
Observed	0.970	0.978	0.973	0.993
Std. Err.	0.017	0.008	0.008	0.005
Simulated	0.975	0.973	0.974	0.980

Table 39: Fit: Labour market moments identifying labour market transition parameters 2

Probability of mh occupation of rural migrant entrants by education										
	Ouaga	**Bobo**	**CI**	**Ouaga**	**Bobo**	**CI**	**Ouaga**	**Bobo**	**CI**	**Ouaga**
	no educ.			primary			secondary			tert.
Observed	0.003	0.005	0.000	0.004	0.001	0.003	0.018	0.023	0.008	0.200
Std. Err.	0.001	0.001	0.111	0.001	0.001	0.003	0.003	0.006	0.008	0.107
Simulated	0.002	0.000	0.000	0.003	0.000	0.000	0.009	0.000	0.000	0.127

Table 40: Fit: Labour market moments identifying labour market transition parameters 3

Probability of low-mh transition by cohort			
	cohort 1 & 2	**cohort 3 & 4**	**cohort 5 & 6**
Observed	0.022	0.025	0.020
Std. Err.	0.011	0.009	0.008
Simulated	0.011	0.032	0.002

Table 41: Fit: Labour market moments identifying labour market transition parameters 4

Probability of mh occupation by age				
	17-21	**22-26**	**27-31**	**32-36**
Observed	0.005	0.048	0.016	0.017
Std. Err.	0.005	0.019	0.007	0.006
Simulated	0.000	0.012	0.019	0.012

Table 42: Fit: Labour market moments identifying labour market transition parameters 5

Fit: Labour market shares identifying unemployment parameters

Table 43 shows the fit for moments related to the unemployment probability of labour market entrants.

We find that the simulated moments on unemployment reflect the inverse U-shape pattern of unemployment rates in education. However, the simulated probability is less steep in education than the observed one. It especially underestimates the unemployment probability in Ouagadougou for those with secondary and tertiary education, and in Côte d'Ivoire for primary education.

	no educ	prim	sec	tert
Unemployment share in Ouaga				
Observed	0.048	0.078	0.173	0.067
Std. Err.	0.012	0.017	0.023	0.046
Simulated	0.040	0.058	0.061	0.021
Unemployment share in Bobo				
Observed	0.027	0.038	0.089	
Std. Err.	0.012	0.017	0.026	
Simulated	0.044	0.067	0.057	
Unemployment share in CI				
Observed	0.007	0.039		
Std. Err.	0.003	0.022		
Simulated	0.000	0.001		

Table 43: Fit: Unemployment moments

References

Aldermann, H. and Paxson, C. H. (2012). Do the poor insure? a synthesis of the literature on risk and consumption in developing countries. Agricultural and Rural Development Department, The World Bank, Working Paper Series 1008.

Appleton, S. (2001). Education, Incomes and Poverty in Uganda. CREDIT Research Paper 01/22, University of Nottingham.

Attanasio, O., Meghir, C., and Santiago, A. (2012). Education Choices in Mexico: Using a Structural Model and a Randomized Experiment to evaluate Progresa. *Review of Economic Studies*, 79:37–66.

Beauchemin, C. and Schoumaker, B. (2005). Migration to Cities in Burkina Faso: Does the Level of Development in Sending Areas Matter? *World Development*, 33(7):1129–1152.

Beckett, M., Vanzo, J. D., Sastry, N., Panis, C., and Peterson, C. (2001). he Quality of Retrospective Data: An Examination of Long-Term Recall in a Developing Country. *The Journal of Human Resources*, 36(3):593–625.

Brilleau, A., Roubaud, F., and Torelli, C. (2004). L'emploi, le chômage et les conditions d'activité dans les principales agglomérations de sept Etats membres de l'UEMOA - Principaux résultats de la phase 1 de l'enquête 1-2-3 de 2001-2002. Document de Travail, DIAL, Développement, Institutions and Analyses de Long Terme.

Chirwa, E. W. and Matita, M. M. (2009). The rate of return on education in malawi. Working Paper No. 2009/01, Department of Economics, University of Malawi.

Dustman, C. and Glitz, A. (2011). Migration and education. Discussion Paper, CREAM, University College London.

Fafchamps, M. (1993). Sequential Labor Decisions Under Uncertainty: An Estimable Household Model of West-African Farmers. *Econometrica*, 61(5):1173–1197.

Fafchamps, M. and Shilpi, F. (2013). Determinants of the choice of migration destination. *Oxford Bulletin of Economics and Statistics*, 7(1):388–409.

Gemici, A. (2011). Family Migration and Labor Market Outcomes. Unpublished Manuscript, Department of Economics, New York University.

Harris, J. R. and Todaro, M. P. (1970). Migration, Unemployment and Development: A Two-Sector Analysis. *American Economic Review*, 60(1):126–142.

Kabore, I., Kobiane, J.-F., Pilon, M., Sanou, F., and Sanou, S. (2001). Le Burkina Faso - Politiques éducatives et système éducatif actuel. In Pilon, M. and Yaro, Y., editors, *La demande d'éducation en Afrique - Etat de connaissances et perspectives de recherche*, pages 99–116. UEPA and UAPS.

Kazianga, H. (2004). Schooling Returns for Wage Earners in Burkina Faso: Evidence from the 1994 and 1998 National Surveys. Economic Growth Center, Yale University, Center Discussion Paper no. 892.

Kazianga, H. and Udry, C. (2006). Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso. *Journal of Development Economics*, 79:413–446.

Keane, M. P. and Wolpin, K. I. (1997). The Career Decisions of Young Men. *Journal of Political Economy*, 105(3):473–522.

Kennan, J. (2010). Higher education subsidies and human capital mobility. Unpublished, University of Wisconsin-Madison.

Kennan, J. and Walker, J. R. (2011). The effect of expected income on individual migration decisions. *Econometrica*, 79(1):211–251.

Kuepie, M., Nordman, C. J., and Roubaud, F. (2009). Education and earnings in urban west africa. *Journal of Comparative Economics*, 37:491–515.

Lalive, R. and Cattaneo, M. A. (2009). Social interactions and schooling decisions. *The Review of Economics and Statistics*, 91(3):457–477.

Lassibille, G. and Tan, J.-P. (2005). The Returns to Education in Rwanda. *Journal of African Economies*, 14(1):92–116.

Lessem, R. (2009). Labor Migration in Malaysia. Unpublished Manuscript, University of Wisconsin-Madison.

Lessem, R. (2013). Labor Migration in Malaysia. Unpublished Manuscript, Tepper School of Business, Carnegie Mellon University.

Lucas, R. E. B. (1997). Internal Migration in Developing Countries. In Rosenzweig, M. R. and Stark, O., editors, *Handbook of Population and Family Economics*, volume 1B, chapter 13, pages 721–798. Elsevier Science B.V., Amsterdam.

Machin, S., Pelkonen, P., and Salvanes, K. G. (2012). Education and Mobility. *The Journal of the European Economic Association*, 10(2):417–450.

Magnac, T. and Thesmar, D. (2002). Identifying Dynamic Discrete Decision Processes. *Econometrica*, 70(2):801–816.

Malamud, O. and Wozniak, A. (2012). The Impact of College on Migration- Evidence from the Vietnam Generation. *The Journal of Human Resources*, 47(4):913–950.

Mincer, J. A. (1974). *Schooling, Experience, and Earnings.* Columbia University Press.

Nordman, C. J. and Roubaud, F. (2009). Reassessing the gender wage gap in madagascar: Does labor force attachment really matter? *Economic Development and Cultural Change*, 57(4):785–808.

Oyelere, R. U. (2010). Africa's education enigma? the nigerian story. *Journal of Development Economics*, 91:128–139.

Poirier, J., Piche, V., Jeune, G. L., Dabire, B., and Wane, H. R. (2001). Projet d'étude des stragégies de reproduction des populations sahéliennes à partir de l'enquête 'Dynamique migratoire, insertion urbaine et environnement au Burkina Faso'. *Cahiers québécois de démographie*, 30(2):289–309.

Potts, D. (2009). Rural-urban and urban-rural migration flows as indicators of economic opportunity in sub-saharan africa: What do the data tell us? Working Paper No. 9, Migrating out of Poverty, King's College London.

Potts, D. (2012). What do we know about urbanisation in sub-saharan africa and does it matter? *International Development Planning Review*, 34(1):v–xxi.

Psachoropoulos, G. (1994). Returns to Investment in Education: A Global Update. *World Development*, 22(9):1325–l343.

Rosenzweig, M. R. (1988). Labor Markets in Low-income Countries. In Chenery, H. and Srinivasan, T. N., editors, *Handbook of Development Economics*, volume 1, chapter 15, pages 713–762. Elsevier Science Publishers B. V., Amsterdam.

Schoumaker, B., Dabire, B., and Gnoumou-Thiombiano, B. (2004). La collecte de biographies communautaires pour l'analyse des determinants contextuels des comportements démographiques. L'expérience d'une enquête au Burkina Faso. *Les trauvaux de L'UERD*, 14(38).

Schultz, T. P. (1982). Lifetime Migration within Educational Strata in Venezuela: Estimates of a Logistic Model. *Economic Development and Cultural Change*, 30(3):559–593.

Schultz, T. P. (1988). Education Investments and Returns. In Chenery, H. and Srinivasan, T. N., editors, *Handbook of Development Economics*, volume 1, chapter 13, pages 543–630. Elsevier Science Publishers B. V., Amsterdam.

Schultz, T. P. (2004). Evidence of Returns to Schooling in Africa from Household Surveys: Monitoring and Restructuring the Market for Education. *Journal of African Economies*, 13(supp. 2):ii95–ii148.

Stark, O. (1991). *The Migration of Labor*. Basil Blackwell, Cambridge (Massachusetts).