Essays on Migration, Education and Work Opportunities

Esther Mirjam Girsberger

Thesis submitted for assessment with a view to obtaining the degree of Doctor of Economics of the European University Institute

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Abstract

This thesis explores migration and education decisions in the context of a West African developing country, namely Burkina Faso.

The first chapter provides descriptive empirical evidence on migration motives, internal and international migration patterns, and the role of gender and family in observed migration patterns. I rely on a unique and rich life history data set on locations and activity spells and cross-sectional information on 9,000 men and women in Burkina Faso. The empirical analysis reveals that internal and international migration movements attract very different types of migrants, with education playing a key role. While male migrants without education are more likely to migrate abroad (i.e. to Côte d'Ivoire), their peers with secondary or higher education move to urban centers. I argue that restricting the analysis either to internal or international migration leads to wrong conclusions.

Chapter 2 studies migration, education and work choices in Burkina Faso in a dynamic life-cycle model. I estimate the model exploiting long panel data of migrants and non-migrants combined with cross-sectional data on permanent emigrants. I uncover that seemingly large returns to migration dwindle away once the risk of unemployment, risk aversion, home preference and migration costs are factored in. Similarly, I also show that returns to education are not as large as measures on wage earners would suggest. While education substantially increases the probability of finding a well-paid job in a medium-high-skilled occupation, I also find that the risk of unemployment for labour market entrants is inverse U-shaped in education, leading to a re-evaluation of net returns to education. Rural individuals need to move in order to reap returns to education, thus facing direct and indirect costs of migration which further lower net returns to education.

The last chapter investigates the interaction of education and migration decisions by simulating different policy regimes using the framework developed in the previous chapter. I analyse the effect of education on migration behaviour and show how migration prospects affect educational outcomes. I find that higher education not only leads to a higher incidence of migration (probability of migration, number of moves) but also redirects migrants from going abroad to urban centers. This finding is insofar important as it indicates how migration patterns will change as a result of education policies aiming at improving educational attainment in rural regions. The chapter also addresses the question of how migration

prospects change education incentives. I find that restricting emigration entails a positive (albeit small) effect on education, and a negative effect if restricting migration to urban centers.

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Contents

Introduction

This thesis explores migration and education decisions in the context of a West African developing country, namely Burkina Faso.

The first chapter provides descriptive empirical evidence on migration motives, internal and international migration patterns, and the role of gender and family in observed migration patterns. I rely on a unique and rich life history data set on locations and activity spells, and cross-sectional information on 9,000 men and women in Burkina Faso. The empirical analysis reveals that both internal and international migration movements are very prevalent, however, they attract very different types of migrants. I find that education plays a key role in the choice of migration destination. While male migrants without education are more likely to migrate abroad (i.e. to Côte d'Ivoire), their peers with secondary or higher education move to urban centers. This chapter further observes important gender differences in migration motives and patterns, with male migration being mainly driven by economic and education considerations and female migration being mostly motivated by family reasons.

Chapter 2 studies migration, education and work choices in Burkina Faso in a dynamic life-cycle model. It is estimated exploiting long panel data of migrants and non-migrants combined with cross-sectional data on permanent emigrants. I find that the seemingly large returns to migration from rural regions to urban centers or abroad dwindle away once the risk of unemployment, risk aversion, home preference and migration costs are factored in. Unemployment risk decreases the value of income differentials, the home premium and migration costs represent direct and indirect costs to migration which all contribute to lowering net returns to migration. Similarly, I also show that returns to education are not as large as measures on wage earners would suggest. While education substantially increases the probability of finding a well-paid job in a medium-high-skilled occupation rather than in a low-skilled occupation, I also find that the risk of unemployment for labour market entrants is inverse U-shaped in education, peaking between primary and secondary schooling. All these factors lead to a considerable re-evaluation of returns to primary and secondary education. Moreover, individuals of rural origin also face large indirect costs when getting education: In order to reap returns to education they need to move to an urban center or abroad, this involves paying migration costs and foregoing the home premium.

The last chapter investigates the interaction of education and migration decisions by

simulating different policy regimes using the framework developed in the previous chapter. I analyse the effect of education on migration behaviour and show how migration prospects affect educational outcomes. I find that higher education not only leads to a higher incidence of migration (probability of migration, number of moves) but also redirects migrants from going abroad to urban centers. This finding is insofar important as it indicates how migration pattern will change as a result of rural education policies which aim at increasing educational attainment in rural regions. The chapter also addresses the question of how migration prospects modify education incentives. I find that restricting emigration entails a positive (but small) effect on education, a negative effect results if migration to urban centers is restricted.

1 Migration motives and patterns: The role of education

1.1 Introduction

Human migration dates back to the cradle of humanity, and human beings have been on the move ever since. Reasons for migration are numerous: Climatic conditions, war and displacements, economic considerations, living conditions, family and clan links, and more recently also education opportunities. Reasons of migration are manifold, hence resulting migration patterns are complex. Potential migrants do not only decide whether to *migrate or stay*, but they will also choose *where to go*. Individuals who differ in observed and unobserved characteristics will make different choices and self-select into certain locations.

This chapter attempts to shed light on the following three questions related to migrations. Why do people migrate? Who migrates, how often and where to? And finally, what is the role of gender and family in migration patterns?

I study these questions in the context of a West African country, namely Burkina Faso, which has a long tradition of internal and international migration. An uncommonly rich and unique data set of life histories and cross-sectional information on more than 9,000 men and women allows us to investigate migration motives, migration behaviour and social interactions in migrations. One key contribution of this chapter is that it studies both internal and international migration movements. The empirical analysis shows that both forms of migration are very prevalent in Burkina Faso. However, they attract very different types of migrants, that is to say, migrants clearly self-select into certain locations. If we limited the analysis only to internal or international migrants, we would draw wrong conclusions on who migrates and why individuals migrate. I show that education plays a key role in the choice of migration destination.

The last 40 years of migration research have produced many insights into internal (mostly rural-urban) migration[1] in developing countries and emigration from developing countries[2].

[1]For a survey on internal migration in developing countries see Lucas (1997).

[2]The study of emigration from developing countries mostly looked at emigration of high-skilled labour from developing to developed countries, also referred to as 'brain drain'. For a recent survey on the brain drain

Yet, being constrained by the data sources on migration which were available, the literature has shamefully neglected to study these two migration phenomena *jointly*. A potential migrant will not only decide whether to migrate or not, but she will also choose her destination. The choice of location becomes important when we consider individuals differing in unobserved or observed skills (for example, in terms of education) who self-select into locations according to local returns to their skills (Borjas (1987)).

This chapter brings the strand of literature on internal migration together with the strand on emigration, building on very recent research which has shown that migration decisions should not be reduced to a stayer-mover decision but that the choice of destination is equally important. Examples of migration studies in a multi-location framework include Dahl (2002), Kennan and Walker (2011), Gemici (2011) and Kennan (2013) for internal migration between different locations in the US, and Fafchamps and Shilpi (2013) and Lessem (2009) for internal migration between different locations in Nepal and Malaysia, and Lessem (2013) for spousal migration between the US and Mexico. Unlike these previous papers, this chapter remains descriptive and confined to simple empirical analysis, preparing the ground for Chapter 2 which will introduce a dynamic life cycle model of migration, education and activity choices.

After providing evidence on migration motives, the current chapter moves on to studying internal and international migration patterns in Burkina Faso in the second half of the last century. I thus pick up on the comprehensive study of Cordell et al. (1996) on the (circular) migration system in West Africa between 1900 and 1970, extending the time line until 2000. One key aspect of this analysis is to identify the role of education in migration patterns. Indeed, there is evidence that better educated individuals are more likely to migrate and migrate more often[3], but they also choose different destinations. Migrants without education are relatively more likely to migrate abroad, while migrants with secondary and tertiary education are relatively more likely to migrate to urban centers. I interpret this finding in the light of large geographical (urban-rural-international) differences in economic opportunities, schooling facilities and other factors. In the spirit of Borjas (1987) and Dahl (2002), I argue that returns to education differ across locations, leading to self-selection of migrants.

The analysis on migration patterns is complemented by a short section on the incidence of seasonal and circular migration, a common feature of migration movements in West Africa (Cordell et al. (1996), Konseiga (2005)). In a last step, I also briefly discuss gender differences, social interactions and the role of the family in migration patterns (Stark (1991)). Both supplementary analyses will be helpful in guiding the modelling process in Chapter 2.

The remaining chapter is structured as follows. Section 1.2 gives some economic and

literature see Docquier and Rapoport (2012).

[3]This is a well known feature of individual migration in developed countries, an observation which goes back to Schwartz (1973) and Greenwood (1975) on internal migration of US men.

historical background information on Burkina Faso and the interaction with its neighbours. Section 1.3 introduces the data. I then present the empirical analysis in Sections 1.4 to 1.6 by looking at migration motives, internal and international migration patterns, and discussing the interplay of individual and family migration. Section 1.7 concludes.

1.2 A short introduction to Burkina Faso and its neighbours

1.2.1 Economic and historical background of Burkina Faso

Burkina Faso, with capital Ouagadougou, is a landlocked country in West Africa which became independent from French colonisation in 1960. It was formerly known as 'Republic of Upper Volta'. Burkina Faso had an estimated multi-ethnic population of 16 million in 2012 and belongs to the poorest and least developed countries in the world. Agriculture accounted for 35% of the GDP in 2012 while it employed more than 80% of the work force in 2005 (the shares for industry are 23% and 3% respectively). Burkina Faso has few natural resources such as gold, manganese which have only recently (that is, after the date of the survey) been exploited on a larger scale. In year 2012 the Burkinabe GDP per capita amounted to 1,554 PPP-adjusted dollars according to the World Bank, ranking 165 out of 182[4]. In terms of development, Burkina Faso ranked 181 out of 187 in the human development index of the United Nations of year 2013 (see United Nations (2014)).

Burkina Faso shares borders with Côte d'Ivoire in the South-West, Ghana, Togo and Benin in the South, Niger in the East and Mali in the North-West[5]. With the exception of Ghana, which was a British colony, all of these countries had been under French rule until 1960. With regard to economic conditions, Côte d'Ivoire and Ghana provide better conditions, while the other neighbours provide similar or even worse (Niger) economic conditions than Burkina Faso. The PPP-adjusted GDPs per capita of Ghana and Côte d'Ivoire are almost twice as high as the one of Burkina Faso (in year 2012 they amounted to 3,730 and 2,800, respectively[6]). Before the Ivorian civil war in 2002 and the recent fast economic growth of Ghana, Côte d'Ivoire was the leading economy in West Africa, its PPP-adjusted GDP per capita clearly exceeding the one of Ghana.

The period from Burkina Faso's independence until the 1980s was characterised by several coups d'état, changing governments and governmental forms (military, mixed civilian-military and civilian). Despite phases of political instability and social unrest since independence, Burkina Faso has, unlike many other Sub-Saharan African countries, not experienced a civil war[7].

[4] World Development Indicators database, World Bank. Accessed on July 25, 2014.
[5] For a map of Burkina Faso and its relative position in West Africa, see Figures 1.8 and 1.9 in the Appendix.
[6] World Development Indicators database, World Bank. Accessed on July 25, 2014.
[7] In 1985, Burkina Faso fought a five-day war with Mali over the supposedly resource-rich Agacher strip.

1.2.2 Historical view on migration in Burkina Faso

Long before colonial rule, Burkinabe pastoralists and crop farmers migrated on a seasonal basis (circular migration). Under French colonisation, migration patterns were altered[8] Burkinabe were hired (and often forced) to work on plantations and factories in Côte d'Ivoire. In order to escape restrictive French policies of forced labour, colonial taxes and conscripts being sent to Ivorian plantations, many Burkinabe migrated to the Gold Coast (now Ghana) which offered better working conditions and wages (Konseiga (2005)). By the end of World War II, Côte d'Ivoire received as many Burkinabe immigrants as Ghana (Kress (2006)). The insufficient inflow of migrants needed as plantation workers led in 1951 to the creation of an interprofessional trade union for the recruitment of labour in Côte d'Ivoire. In the following years until the 1990s, economic growth and favorable immigration policies in Côte d'Ivoire attracted many migrants from Burkina Faso, while emigration to Ghana slowed down, partly due to anti-immigration policies in Ghana. The years following the death of long-time Ivorian president Houphouet-Boigny in 1993 were characterised by social unrest and anti-Burkinabe sentiment, causing many Burkinabe to return home. Notwithstanding the crisis, Côte d'Ivoire continues to be an important destination of Burkinabe emigrants (Konseiga (2005), Kress (2006)). According to Wouterse (2011), migration out of the African continent (mostly to Italy[9]) has been on the rise since the 1990s. In comparison to emigration to Côte d'Ivoire, the absolute numbers of intercontinental emigrants remain small as only a specific ethnic group from the South-Center of Burkina Faso is concerned (mainly male Bissa).

1.3 Data and descriptive evidence

1.3.1 Data sources and definitions

Long panel data on migrants is, by the nature of migration itself, usually hard to come by. In order to track the complete migration path of an individual over years or decades, retrospective life history interviews provide an elaborate but rewarding strategy to collect such data. A nationally representative sample of individual life histories provides an insight into *internal* migration patterns. One of the main drawbacks of nationally representative and retrospective panel data is, however, the lack of information on permanent emigrants and thus on *international* migration patterns. If the purpose is to study both internal and international migration patterns, as is appropriate in the case of Sub-Saharan Africa where migration does not stop at country borders, one needs to complement retrospective life history data by another data source on permanent emigrants.

The war caused relatively few casualties, the disputed territory was divided equally.

[8] For a very detailed historical account of migration patterns in Burkina Faso from 1900 until the 1970s, please refer to Cordell et al. (1996).

[9] Somewhat surprisingly, the number of Burkinabe living in Italy (more than 30,000) is clearly larger than the one in France (around 5,000).

This paper uses an exceptionally rich and representative retrospective panel data set on stayers, internal migrants, and temporary emigrants and complements it 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[10]). 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)).

The EMIUB is composed of a household survey which collected data on all current household members, on emigrants, and on housing and economic conditions of the household, and a 4-module biographical survey for individuals aged 15 to 64. These modules include individual information on family origins and childhood, residence spells, economic activity spells (including education and inactivity spells) and marriage spells. For women, a fifth module records birth and brief outcome histories of all children given birth to. Residence and economic activity spells are limited to those incidences which have lasted for at least 3 months. This means that our data sets excludes any migration movement shorter than 3 months, such as prolonged visits, continuous wandering about of pastoralists or (unsuccessful) migration movements which were reversed before 3 months had elapsed.[11]. The availability of complete migration spells which lasted more than 3 months presents a major improvement over previously used representative (cross-sectional) survey data which recorded only current and previous residence. However, there remains scope for improvement for future studies on (very) short-term migration movements, an aspect on which the current analysis cannot provide any new insights.

1.3.2 Preliminary evidence

This section provides a brief introduction to the migration behaviour of Burkinabe. The sample includes men and women who were born between 1936 and 1985 of Burkinabe origin. This definition includes permanent emigrants of Burkinabe origin but excludes all individuals of foreign origin[12]. Permanent emigrants are those emigrants who had not returned to Burkina Faso by the time of the survey in year 2000. Some of these 'permanent' emigrants will return at a later date.

[10]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 environnement au Burkina Faso'.

[11]While the first two excluded migration forms are likely to take place within the same geographical unit (i.e. region), leading to underestimation of intra-regional migration, the last form of migration might lead to underestimation of rural-urban and urban-rural migration.

[12]The present sample is not representative for individuals of foreign origin, hence, I exclude them from the analysis.

Table 1.1 presents sample statistics on migration and education of more than 9,000 men and women by their place of origin, that is their residence at age 6[13]. Any move between two locations (village, town or city) which lasted for at least 3 months is considered a migration movement. Moves within the same village, town or city, however, are discarded. Notice that the information on the number of migrations of permanent emigrants prior to their emigration is incomplete. The statistics on moves per migrant, yearly migration rate and total migrations might be slightly downward biased. In a first step, I distinguish urban and rural locations. Ouagadougou, Bobo-Dioulasso and Banfora are classified as urban locations, all other towns and villages are classified as rural[14].

The representative sample data presented in Table 1.1 reveals that migration in Burkina Faso is quantitatively important. This affirmation holds true for men and women, as well as for individuals of different places of origin. Both internal and international destinations are headed for, indicating that a comprehensive analysis of migration patterns in Burkina Faso cannot limit itself to the study of internal migration movements. More than 1 male Burkinabe out of 4 has moved abroad without having returned by year 2000. The high return rates of 50% for urban migrants, and more than 2 moves per migrant further highlight the dynamic aspect of migration in Burkina Faso. The subsequent empirical analysis exploits the rich panel data on migration to provide a complete picture of internal and international migration patterns and their dynamics.

The objective of the empirical analysis in this chapter is to provide insight into migration motives and migration patterns, and finally to explore gender differences and the incidence of family versus individual migration in Burkina Faso.

[13]Location at age 6 is not necessarily known for permanent emigrants. It needs to be reconstructed from data provided by other current household members. For male permanent emigrants only 20% of origins are missing, while the share reaches 50% for female permanent emigrants. This discrepancy stems from the fact that male emigrants lived prior to emigration with their parents or an older brother who provide enough information to infer an emigrant's origin. In contrast, female emigrants stayed before emigration mostly with their in laws whose information on the emigrant is sparse. Whenever the origin of a permanent emigrant cannot be reconstructed from other household members' histories, I assume that the origin corresponds to the last location before emigration.

[14]In 2006, Ouagadougou and Bobo-Dioulasso had at least 5 times more inhabitants than other large towns such as Kaya, Koudougou or Ouahigouya which have been classified as rural (see Ministre de l'Economie et des Finances, Burkina Faso (2008)). Until year 2000, the structure of these later towns was 'rural' in the sense that they accommodated little industry and had high employment shares in agriculture. Despite being of similar size as Koudougou and Ouahigouya, Banfora has an 'urban' economic structure with less agriculture, more industry and services. Thus, Banfora was classified as urban.

[15]For permanent emigrants I only observe the education level prior to emigration. However, only very few children emigrate before school starting age. Thus, it is unlikely that the number is upward biased.

		Men		Women	
		Origin		Origin	
	All	Urban	Rural	Urban	Rural
Summary statistics					
Number of individuals	9,022	1,072	3,610	1,049	3,291
Mean age in 2000	33.35	29.15	34.94	28.93	34.39
Migration statistics					
Share of migrants		47.6%	79.6%	38.5%	78.9%
- of which: returned to origin by 2000		51.2%	25.2%	55.5%	9.9%
- of which: permanent emigrants		34.5%	24.4%	15.6%	5.5%
- of which: urban location other than origin in 2000		13.5%	36.6%	23.3%	37.4%
- of which: rural location other than origin in 2000		0.8%	13.9%	5.7%	47.2%
Average moves/migrant		2.31	2.32	2.16	1.85
Average yearly migration rate		4.54%	6.16%	3.47%	4.98%
Total migrations, of which		1,176	6,656	872	4,814
- urban destination		48.2%	26.5%	53.1%	27.7%
- rural destination		23.6%	42.1%	30.0%	58.2%
- international destination		28.2%	31.4%	16.9%	14.1%
Education statistics					
Ever gone to school[15]		70.5%	25.3%	61.6%	13.8%
Avg. years of schooling/student		7.46	6.74	7.16	6.21

Table 1.1: Sample data

1.4 Migration motives

1.4.1 Why do individuals migrate?

Figure 1.1 depicts migration motives of men and women of rural origin for different education levels, while Figure 1.2 shows migration motives of those from an urban origin. I distinguish work- and money-related, family, studies and return motives. Other motives relate to agriculture, land and housing, health, autonomy and others issues. Unknown motives are those migrations for which I do not observe a motive[16]. The education level corresponds to the education level attained by year 2000.

Altogether we can say that women predominantly migrate for family-related issues[17] while men migrate for more diverse reasons, among which work- and money-related motives dominate. The gender pattern holds independently of migrants' origin and seems to have been

[16]Migration motives for permanent emigrants who are sons or daughters of the household head (the majority) are observed to a large extent, however, migration motives for other permanent emigrants are not known. The information is also missing for some internal migrants.

[17]The most important one among these is marriage, followed by joining the spouse or another household member. Further motives include the death of a family member and divorce, followed by other family-related issues.

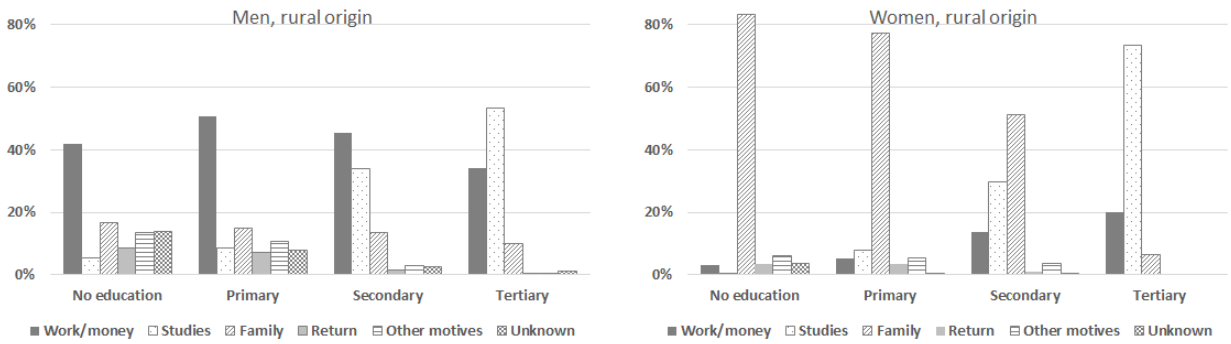

Figure 1.1: Migration motives of men (left panel) and women (right panel) of rural origin

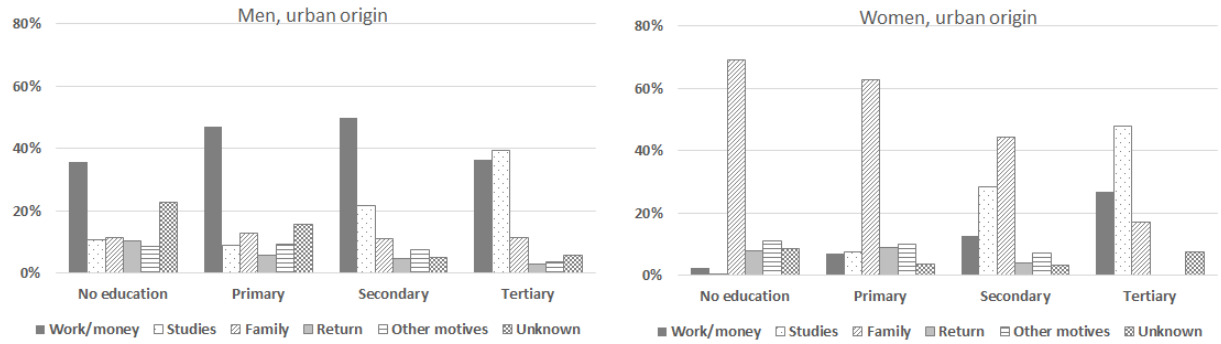

Figure 1.2: Migration motives of men (left panel) and women (right panel) of urban origin

stable over the last century[18]. However, with increasing education level gender differences in migration motives become less stark.

Figures 1.1 and 1.2 reveal another interesting fact of migration motives with respect to education: Individuals who have attained higher education levels have migrated for different reasons than those with less schooling. The higher the education level attained, the more migrations were motivated by study considerations and relatively fewer migrations were driven by work, financial or other motives[19]. This finding suggests that education and migration choices are both endogenous, some migrations being actually motivated by the desire to continue education. For individuals of rural origin I note a jump in the relative importance of education as migration motive between primary and secondary education, for individuals of urban origin two somewhat smaller jumps occur between primary/secondary and secondary/tertiary education. These jumps are possibly related to the availability of schools in different milieus. Rural regions have a (relatively) broad availability of primary schools but not so of secondary schools, while the two main urban centers in Burkina Faso had many secondary schools but did not have universities until the 1970s and 1990s. In fact, individuals who have reached these higher education levels may have been *required to migrate*

[18] See Cordell et al. (1996) for a description of male and female migration motives from 1900 until 1975.
[19] Notice that study motives also include migration for training on jobs, internships and apprenticeships.

in order to achieve their education levels.

1.4.2 Motives of first migration and return migration of men

Rather than pooling migration motives of all moves made as in the previous subsection, we can look at what motivates out-migration from the origin and why individuals return home. These two kinds of moves are likely to be motivated by different reasons. Figure 1.3 displays migration motives of men from a rural origin by final education level attained, distinguishing migration motives of the first move away from origin (left panel) and the motive of the last return migration home (right panel).

Figure 1.3: Migration motives for first migration (left panel) and last return migration home (right panel) of men of rural origin

We find that the first migration is usually motivated by work- or money-related issues for men with primary or lower education, and by studies for those with higher education. In terms of age at first migration (not shown), men with secondary or higher education had migrated on average for the first time at age 14, changing their location to pursue their studies. Those with low or no education were on average 4 to 7 years older at their first move. This difference in teenage migration experience could translate into different behaviour when individuals are older, constituting a possible channel for explaining why individuals with higher education have a different migration pattern than those with less education. We shall return to this point in the next section.

Migration reasons are often either classified as 'push' or as 'pull' factors. 'Push' factors relate to factors which push the individual out of the current location (such as low income, high unemployment rate, adverse living conditions) while 'pull' factors relate to factors which attract the individual to a new location (work opportunities, schooling facilities, attractive living conditions). I split work- and money-related motives into 'push' and 'pull' motives in order to understand whether individuals migrate to escape dire economic conditions or if they are attracted by better economic prospects[20]. Indeed, I find that more than 85% name a 'pull'

[20]Some motives cannot be classified as 'pull' or 'push', others are wrongly coded. They constitute the

factor as the motive for their first migration[21], while only 2 to 3% are motivated by 'push' factors (not shown).

While first moves are to a large extent motivated by work/money or by educational issues, the reasons for return migrations back to the origin are more varied. For those with low or no education, motives of work/money, family and return are almost equally important. For those with higher education, study motives dominate, followed by work/money and family considerations. The large share of study-motivated return migrations is driven by individuals who had migrated away from their origin to continue their education and return home once they have completed their education. In contrast to work/money-related first moves which are fuelled by hopes of improved economic conditions in a new location, more than half of work/money-motivated return migration are driven by push factors (not shown)[22]. This evidence suggests that while out-migration is mostly voluntary and optimistic, some of the return migration is based on unfulfilled expectations.

1.4.3 Are return migrations driven by target earning motives?

Return migration needs not necessarily be driven by disillusioned hopes, unexpected shocks (such as the death of a family member) but might have been anticipated since the beginning. Dustmann (2001) presents different reasons why it can be optimal for an individual to return home even if wages in the destination location continue to be higher than in the origin[23]. White and Lindstrom (2005) point out that some theoretical models on circular migration replace the assumption of income maximising behaviour of migrants by target earning, i.e. the migrant returns as soon as he has saved the targeted amount.

If target earning is a major explanation for return migration in Burkina Faso, I would need to develop a model which explicitly includes savings and differences in purchasing power and/or location-consumption complementarities. To quantify the incidence of target earning, I classify motives of return migrations into target earning[24], possible target earning[25] and non-target earning behaviour, I find a lower bound of 5% and an upper bound of 25% for target earning motives among return migration. All in all, the incidence of target earning behaviour in Burkina Faso seems to be relatively small, for individuals with higher education it is irrelevant.

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remainder.

[21] The most often cited 'pull' factors are namely, 'Look for work', 'Look for money and get to know life's difficulties', 'find a paying job' and 'learn a trade'.

[22] These push factors include the end of a limited-term contract, relocation, too low income or job loss.

[23] These include a combination of accumulation of human capital which is only earning-effective in the origin, differences in purchasing power and complementarities between consumption and the location of consumption.

[24] These include the following monetary motives: 'I have had what I wanted', 'I have had the necessary' and 'starting capital'.

[25] Unspecified return motives and marriage compose this group. If the individual knew that he wanted to get married (at home) and migrated to work for a higher wage in order to save the necessary amount to get married, we may consider it to be target earning.

1.5 Migration patterns

1.5.1 The quantitative aspect of migration

It is a well known feature that higher educated individuals in developed countries are more likely to migrate[26], and move more often[27]. Evidence on developing countries is scarcer, Lessem (2009) finds that both the probability of (internal) migration and the number of (internal) moves per migrant are increasing in education in Malaysia. Figure 1.4 presents the share of migrants (left panel) and the number of moves per migrant (right panel) of men in Burkina Faso.

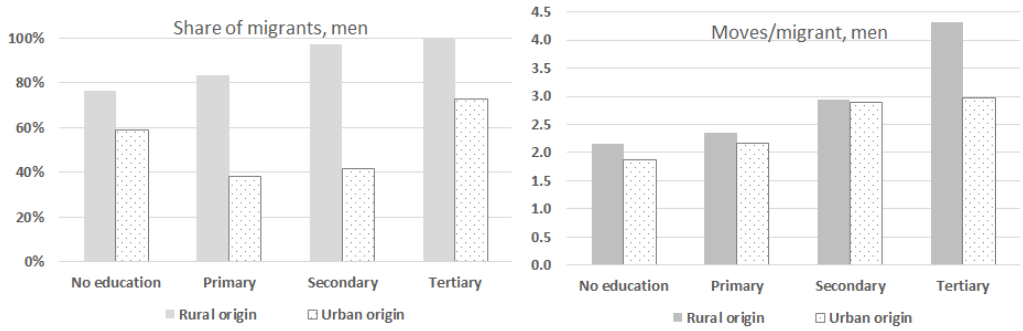


Figure 1.4: Share of migrants among men (left panel). Moves per migrant, men (right panel)

Overall, I find a positive relationship between migration and education. The probability of being a migrant increases with the education level of an individual, so does the average number of migrations per migrant. For individuals of urban origin, the migration probability is not monotonically increasing but slightly U-shaped, reaching a minimum for individuals with primary education. In order to check if this education-migration pattern is not driven by differences in education groups in terms of age, occupations, marital status and locations, I run a probit regression of the probability of having migrated between age 6 and year 2000 and these controls. The marginal effects of the different education levels and the corresponding baseline probability (no education is the baseline group) are shown in Table 1.2. As all individuals with tertiary education from a rural origin have migrated, I omit these observations from the estimation.

The estimation results in Table 1.2 lend support to the descriptive evidence in Figure 1.4. Migration probabilities are U-shaped for men of urban origin, and increasing for all other

[26] See Schwartz (1973) and Greenwood (1975) for early evidence in the US, and Kennan and Walker (2011) and Amior (2013) for more recent contributions. Amior (2013) discusses extensively why college- or postgraduate-educated men in the US are more likely to migrate than those with lower education. He shows that this difference is driven by differences in job-motivated migrations.

[27] Kennan and Walker (2011) find that the number of moves per migrant are U-shaped in education.

	Men		Women	
	Urban origin	Rural origin	Urban origin	Rural origin
Marginal effects				
Primary	−0.090**	0.024	0.004	0.145***
	(0.043)	(0.020)	(0.027)	(0.045)
Secondary	-0.010	0.210***	0.043	0.510***
	(0.050)	(0.0535)	(0.031)	(0.126)
Tertiary	0.116	omitted	0.188**	omitted
	(0.104)		0.081	
Baseline probability				
Baseline prob.	0.559	0.785	0.245	0.738

Baseline education category: No education. Other controls: Age in year 2000, indicator for different occupational groups (baseline: agriculture), indicator if married (baseline: not married), rural regional dummies (baseline: Center), urban center dummies (baseline: Ouagadougou).

Table 1.2: Marginal effect of education on the probability of being a migrant

individuals. However, the present analysis remains silent on where individuals migrate to. Indeed, especially the U-shaped migration probability for urban men suggests that returns to migration could be non-linear, possibly driven by different local returns to education. This non-monotone migration rate cannot be easily rationalised in a simple binary migration model with one-dimensional self-selection[28]. In the next subsection, I thus inspect if individuals with different education levels migrate to the same destinations or not.

1.5.2 Where do migrants go?

Figure 1.5 plots the relative share of urban, rural and international migration destinations by education level for men of urban origin (left panel) and of rural origin (right panel).

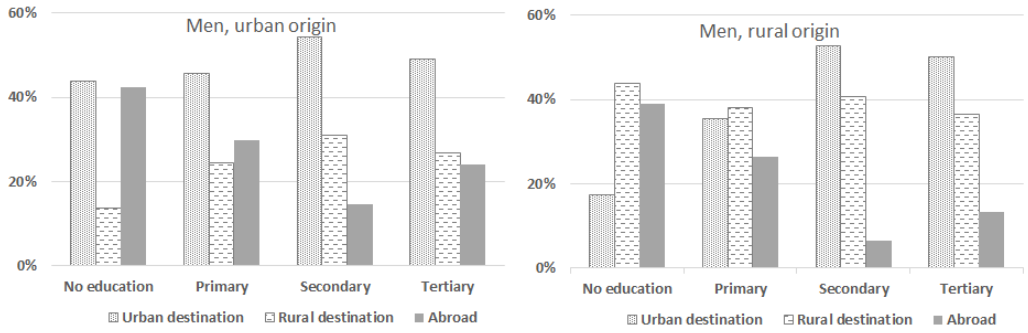


Figure 1.5: Migration destinations of men from urban origin (left panel) and rural origin (right panel)

[28]If individuals are only heterogeneous in one dimension (i.e. education), a simple binary location model cannot explain why those without education and those with tertiary education would migrate, but those with secondary education would not.

Figure 1.5 reveals an interesting qualitative feature of migration: Individuals with different education levels do not migrate to the same destinations. The relative importance of migration to urban centers increases with education while the relative importance of emigration decreases. For migrants of urban origin, the pattern of migration destinations is slightly U-shaped in education. The second surprising finding is related to emigration. Indeed, from the large literature on the brain drain in Sub-Saharan Africa we would have expected that emigration is much more prevalent among those with tertiary education than among those without any education. This does not seem to be the case for Burkina Faso.

Table 1.3 presents estimates of the marginal effect of education conditional on migrating to an urban center/abroad before year 2000 after controlling for age, occupation groups, marital status and regional indicators. It uses the same sample as above, that is, it includes only men.

	Urban migration		**International migration**	
	Urban origin	Rural origin	Urban origin	Rural origin
Marginal effects				
Primary	-0.027	0.015**	−0.193***	−0.053*
	(0.026)	(0.007)	(0.048)	(0.032)
Secondary	0.063**	0.018**	−0.379***	−0.168***
	(0.026)	(0.009)	(0.063)	(0.065)
Tertiary	0.072	0.026	-0.200	-0.282
	(0.054)	(0.017)	0.123	(0.190)
Baseline probability				
Baseline prob.	0.161	0.036	0.468	0.510

Baseline education category: No education. Other controls: Age in year 2000, indicator for different occupational groups (baseline: agriculture), indicator if married (baseline: not married), rural regional dummies (baseline: Center), urban center dummies (baseline: Ouagadougou).

Table 1.3: Marginal effect of education on the probability of migrating to an urban center or abroad (men)

The results shown in Table 1.3 confirm our descriptive results. The better educated a Burkinabe migrant is, the less likely he is to move abroad. The relative attractiveness of urban locations for educated individuals is also reflected in return rates of migrants. Return rates increase with education for individuals of urban origin and decrease for those of rural origin (shown in Table 1.4 in the Appendix.).

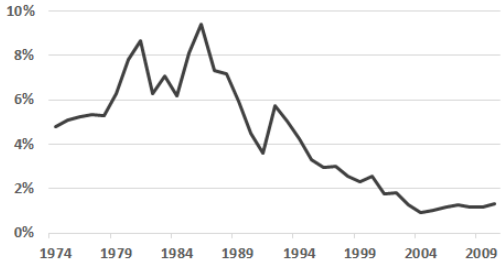
Despite the clear pattern between migration and education, the presented results cannot be interpreted as causal links. The present analysis ignores the interaction of migration and education decisions. For example, tertiary education was not widely available during the time period considered. Until the 1970s, all Burkinabe desiring to pursue tertiary education had to leave the country, later on they needed to migrate to an urban center (Ouagadougou or

Bobo-Dioulasso). Hence, we cannot argue that education is exogenous to migration decisions, nor the converse, for that matter. Chapter 2 and 3 of this thesis will explore the interaction of migration and education decisions in more detail.

1.5.3 International migration

Given the quantitative importance of international migration, I shall briefly discuss some characteristics of emigration from Burkina Faso. According to Konseiga (2005) Burkina Faso is the West African country with the largest share of international migration flows. Between 1988 and 1993, he estimates that 70% of Burkinabe migration flows were international and only 30% were internal[29]. The largest share of these emigrations are directed towards Côte d'Ivoire, that is 60% to 80% of all emigrations[30] (see Table 1.6 in the Appendix), the leading economy in West Africa during the second half of the 21st century. Côte d'Ivoire's export-based agricultural sector attracted many low-skilled migrants from its neighbours, especially from Burkina Faso.

Two global indicators which quantify the importance of international migration for Burkina Faso are estimated remittances of migrants over GDP and the number of Burkinabe living abroad. Figure 1.6 depicts the volume of estimated received remittances over GDP in Burkina Faso from 1974 until 2009.



Source: Own calculations based on World Development Indicators, World Bank. Accessed on July 25, 2014

Figure 1.6: Estimated received remittances over GDP

Figure 1.6 shows that the volume of received remittances over GDP increased in the 1970s, reaching a peak of more than 7% in the 1980s, only to decline to 1% of GDP in 2003. In recent years it has stabilised around 1%. As for the number of Burkinabe living in Côte d'Ivoire, it was estimated to lie between 2 and 3 million before the break-out of the Ivorian crisis (Konseiga (2005), Kress (2006)), at this time Burkina Faso's population was estimated at

[29] Konseiga (2005) builds on the NESMUWA survey carried out in 1993 in seven West African countries. A slightly different migration definition (spells of 6 months at least) and the specific survey period might explain the differences with respect to our data set which finds that 40% of all migration flows are international.

[30] An exception present emigrants with tertiary education who are more likely to migrate to another African country or even leaving the continent. However, their overall number is very small and many have returned to Burkina Faso by year 2000.

around 12 million. Net emigration from Burkina Faso to Côte d'Ivoire has slowed down since the end of the 1980s, according to these authors it was mainly due to increased return migration.

The presented numbers suggest the following. First of all, the evolution of remittances is related to the economic situation in Côte d'Ivoire, reflecting the Ivorian growth miracle in the 1970s, the dip in Ivorian GDP in the early 1980s (caused by recession and drought) and increased political instability of Côte d'Ivoire since the death of Houphouet-Boigny in 1993. Secondly, the share of Burkinabe living in Côte d'Ivoire in the late 1990s was very high at almost 1 emigrant per 4 Burkinabe. Together with the share of remittances over GDP they highlight the importance of emigration for Burkinabe.

As already discussed in the previous subsection, not all Burkinabe are attracted to move abroad. Figure 1.7 depicts the probability of being an emigrant conditional on being a migrant and return rates from abroad.

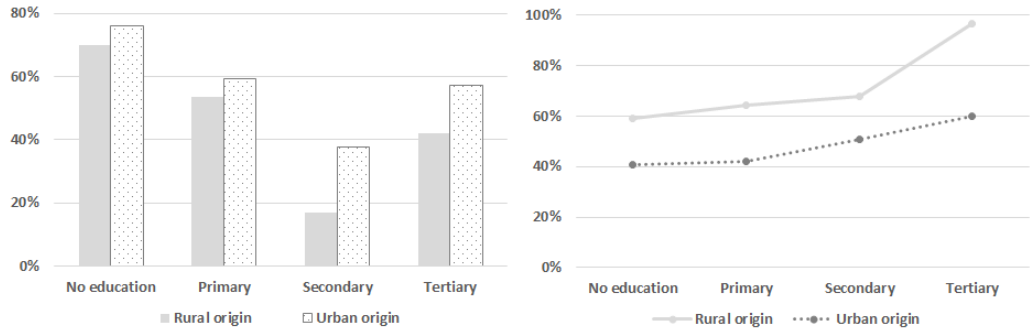


Figure 1.7: Share of emigrants among male migrants (left panel). Rate of return of male emigrants to Burkina Faso until 2000 (right panel).

The U-shape of the share of emigrants among migrants in education reflects the interaction of two different migration motives. While individuals without or with low education move to Côte d'Ivoire because of economic opportunities for low-skilled workers, those with higher final education levels migrate in order to pursue their studies. Because their migration was driven by the purpose of acquiring education, they are more likely to return home after education completion than those who migrated for economic opportunities. International migration from Burkina Faso abroad is not driven by brain drain but rather by the sustained demand for low-skilled workers in Côte d'Ivoire. I study the implications of the high demand for low-skilled workers on educational achievement in Chapter 3 of this thesis.

1.5.4 The incidence of seasonal and circular migration

Many authors have highlighted the importance of seasonal or circular migration in West Africa and Burkina Faso (see, for example, Cordell et al. (1996), White and Lindstrom (2005) for West and Sub-Saharan Africa, Konseiga (2005) and Kress (2006) for Burkina Faso). Kress

(2006) notes that international migration originating from Burkina Faso is often not seasonal but rather happens in a several year cycle. This habit had already been formed during colonial times. While some studies use the term of 'seasonal' and 'circular' migration interchangeably, I distinguish the two concepts. In this chapter I employ the term *seasonal migration* if an individual migrates from a village/town and returns to the same location within 12 months. Seasonal migration is mostly thought of as rotation between rural zones and Côte d'Ivoire. Burkinabe farmers spend some time of the year working in the service industry abroad while cultivating their land at home during the rainy season (May to September). *Circular migration* are moves from a village/town and the subsequent return to the same location (without any time constraint as to the return date).

Table 1.7 in the Appendix shows that the incidence of seasonal migration is very low, while 15% of all migrations of men are circular. Circular migration seems to be dominantly a characteristic of male migration, the respective shares for women are clearly lower (not shown in the table). Circular migration is most common between different rural areas or towards an international destination. However, there is relatively little circular movement to urban centers. The average duration in the destination is around 3 to 4 years, clearly above the 2-year cycle suggested by Kress (2006). No clear pattern with respect to the education level is discernible.

All in all, I conclude that seasonal migration is present in Burkina Faso but of little (quantitative) importance. Restricting the analysis to yearly observations, as is done in Chapter 2 and 3 of this thesis, should be of little consequence to our results. Circular migration, in contrast, is a key characteristic of Burkinabe migration patterns.

1.6 Gender differences and social interactions in migration

1.6.1 How does female migration behaviour differ from men's?

We have already discussed in Section 1.4.1 that women mostly migrate for family-related reasons, while men's migration behaviour is generally motivated by work-, money- or study-related reasons. The previously described pattern between migration and education holds as well for women (see Table 1.5 in the Appendix). Nonetheless, some sizeable quantitative differences emerge between male and female migration patterns in terms of migration age (women are on average up to 3 years younger), migration frequency (slightly lower) and migration destinations. Women with secondary education or higher education resemble their male peers' migration pattern. In contrast, women without education are much less likely to choose an international destination when migrating. The share migrating abroad among migrants is more than 20pp lower than for men, in line with Cordell et al. (1996). Female migration behaviour is very different from their male peers' migration behaviour for low education levels, yet, gender differences shrink or even disappear for higher education levels.

1.6.2 Family versus individual migration

Different authors have suggested that migration decisions might not be at the discretion of the individual but rather made by the family or the clan (see Sandell (1977), Mincer (1978), Bhattacharyya (1985), Stark and Lucas (1988) and more recently, Gemici (2011)). Some of this research focuses on joint migration of husband and wife, while other research explores *partial* migration when one or several family members leave the household temporarily and return to it at a later date.

Joint migration is present in Burkina Faso but, especially for men, less frequent than individual migration. For men, only 1 out of 4 migrations is joint with other individuals, for women the share amounts to 1 out of 2. Migration of husband and spouse (and possibly, children) is the most common form of joint migration, but I also observe a considerable share of joint migration with parents or other family members, especially among men.

Rather than opting for joint migration, a household can also send one or several of its members temporarily away as a strategy to insure against income risk or to overcome credit constraints (see Stark and Lucas (1988), Stark (2003) and Stark (2009)). In a setting of partial migration and risk sharing, we should observe remittances from the migrant to its household of origin. Morten (2013) finds that 20% of households in rural India have at least one temporary migrant whose remittances represent more than half of the household income. Her data suggests that partial migration is the dominant form of migration in rural India.

For Burkina Faso, the numbers seem to be rather different. In our sample, the share of households who have at least one migrant amounts to 90%, but remittances are likely to be substantially lower than in rural India. Konseiga (2007) finds that among households with seasonal migrants in drought-affected villages in the north of Burkina Faso migrant remittances represent one quarter of their cash income in 2000. In villages surveyed by ICRISAT in 2002, Wouterse and Taylor (2008) estimate remittances from migrants in Côte d'Ivoire at 2% to 8% of household income and at 0 to 10% for intercontinental remittances. However, neither of these two studies is based on nationally representative data for Burkina Faso, as both seasonal migration and intercontinental migration are relatively rare migration phenomena for the overall Burkinabe population (see Sections 1.5.3 and 1.5.4). Reardon and Taylor (1996) find that in year 1983/1984 remittances from seasonal migration accounted for 1% to 7.5% of household income. During the year 1984/1985, which was characterised by a serious drought, seasonal migrants' remittances represented 2% to 10% of household income.

All in all, previous research shows that Burkinabe migrants remit to their family, yet the moderate (or rather relatively small) size of remittances suggests that risk sharing remains of minor importance. In the subsequent analysis in Chapter 2 and 3 I thus abstract from possible interactions between the family/clan and the individual, and instead develop a model of individual utility maximisation.

1.7 Conclusion

This chapter has presented descriptive evidence on the question of why people migrate and what the resulting migration patterns look like. It has also briefly discussed evidence on gender differences and social interactions in migration behaviour.

The analysis on migration motives has revealed that migration and education decisions are endogenous to each other. Indeed, a considerable part of migrations in teenage years and those in their early twenties are driven by education plans, individuals migrate in order to continue their studies. Many of them return once they have completed their education. One key finding of this chapter is that not only higher migration probabilities and more moves per migrant are associated with higher education, education also impacts migration destinations. The better educated an individuals is, the more likely he is to migrate to an urban center rather than to migrate abroad. I interpret this finding in the light of the economic structure of Côte d'Ivoire which has a strong demand for low-skilled labour in its export-oriented agricultural sector.

Education thus shapes both the reasons why people migrate but also their migration pattern in terms of migration probability and migration destination. Chapter 2 of this thesis develops a dynamic life-cycle model of joint migration and education choices, while Chapter 3 proceeds by investigating how migration and education decisions affect each other.

Appendix

Source: http://cred.columbia.edu/2012/01/19/burkina retrieved on July 25, 2014

Figure 1.8: Burkina Faso in West Africa

Source: http://fr.wikipedia.org/wiki/Burkina_Faso retrieved on July 25, 2014

Figure 1.9: Burkina Faso: National capital (Ouagadougou) and regional capitals

	Urban origin				Rural Origin			
	No	Prim	Sec	Tert	No	Prim	Sec	Tert
Summary statistics								
Number of individuals,	312	335	362	48	2,689	520	321	69
in percent	29.5%	31.7%	34.2%	4.5%	74.7%	14.4%	8.9%	1.9%
Mean age in 2000	34.6	27.4	25.5	34.1	35.8	32.9	30.4	38.3
Migration statistics								
Movers	59.0%	38.2%	41.7%	72.9%	76.3%	83.5%	97.2%	100%
Avg migrations/migrant	1.88	2.17	2.89	2.97	2.15	2.35	2.95	4.32
Avg distance/migration (in km)	530	416	266	328	362	372	379	458
Mean age at migration	22.6	21.1	22.7	24.7	24.2	22.5	20.7	23.1
Returned to origin in 2000	45.7%	52.3%	59.6%	60.0%	29.8%	23.0%	3.8%	0%
Residence of migrants in 2000								
Urban	54.3%	64.8%	80.1%	77.1%	25.2%	50.5%	80.1%	95.7%
Rural	0.5%	0.8%	1.3%	0%	46.0%	30.4%	14.4%	2.9%
International	45.1%	34.4%	18.5%	22.9%	28.8%	19.1%	5.4%	1.4%

Table 1.4: Migration statistics of men

	Urban origin				Rural Origin			
	No	Prim	Sec	Tert	No	Prim	Sec	Tert
Summary statistics								
Number of individuals,	401	307	308	28	2,831	273	169	10
in percent	38.4%	29.4%	29.5%	2.7%	86.2%	8.3%	5.1%	0.3%
Mean age in 2000	33.5	27.0	24.9	30.9	35.1	30.4	28.9	34.9
Migration statistics								
Movers	39.4%	34.9%	37.7%	71.4%	76.7%	89.4%	97.0%	100%
Avg migrations/migrant	1.96	2.11	2.41	2.60	2.75	2.12	2.74	3.00
Avg distance/migration (in km)	267	248	235	396	348	373	362	450
Mean age at migration	20.8	20.2	19.6	22.7	21.2	19.0	19.7	23.1
Returned to origin in 2000	55.1%	7.9%	58.6%	35.0%	10.6%	9.0%	3.0%	0%
Residence of migrants in 2000								
Urban	73.4%	83.2%	83.6%	80%	29.6%	70.1%	87.2%	100%
Rural	8.2%	3.7%	5.2%	0%	64.2%	27.9%	11.6%	0%
International	18.4%	13.1%	11.2%	20%	6.2%	2.0%	1.2%	0%

Table 1.5: Migration statistics of women

	Urban origin				Rural Origin			
	No	Prim	Sec	Tert	No	Prim	Sec	Tert
Permanent and temporary emigrants								
Number of migrants	184	128	151	35	2,051	434	312	69
Share emigrants among migrants	76.1%	59.4%	37.7%	57.1%	70.1%	53.7%	17.0%	42.0%
Share emigrants returned to BF by 2000	40.7%	42.1%	50.9%	60.0%	58.9%	64.4%	67.9%	96.6%
Average length of emigration spells (in years)								
Completed spells	4.49	2.47	2.62	3.60	3.78	3.78	5.28	5.23
Unfinished spells (until June 2000)	7.14	8.11	5.08	4.65	6.50	5.98	4.25	n.a.
Emigration destinations								
Cote d'Ivoire	83.0%	79.5%	57.8%	16%	83.5%	86.3%	63.3%	32.5%
Other West African countries	10.2%	10.8%	18.8%	12%	13.7%	9.6%	21.7%	20%
Other African countries	4.1%	0%	10.9%	32%	1%	0.4%	6.7%	10%
Other countries, unknown	2.7%	9.6%	12.5%	40%	1.8%	3.7%	8.3%	37.5%

Table 1.6: Statistics of male emigrants

	Urban origin				Rural Origin			
	No	Prim	Sec	Tert	No	Prim	Sec	Tert
Circular and seasonal migration								
Total migrations, of which	345	278	436	104	4,412	1,020	919	298
circular migration	15.7%	7.9%	15.6%	13.5%	18.5%	16.7%	16.3%	22.1%
seasonal migration	0.6%	2.9%	0.5%	0%	1.8%	0.2%	1.3%	0.7%
Destination of circular migration								
Urban	37.0%	n.a.	44.1%	n.a.	5.1%	2.4%	28%	27.3%
Rural	22.2%	n.a.	26.5%	n.a.	57.1%	45.9%	56%	24.2%
Abroad	40.7%	n.a.	29.4%	n.a.	37.7%	51.8%	16%	48.5%
Average duration in destination (in years)								
Circular migration	3.35	2.76	2.99	1.92	3.08	3.56	3.03	3.89

Table 1.7: Seasonal and circular migrations of men

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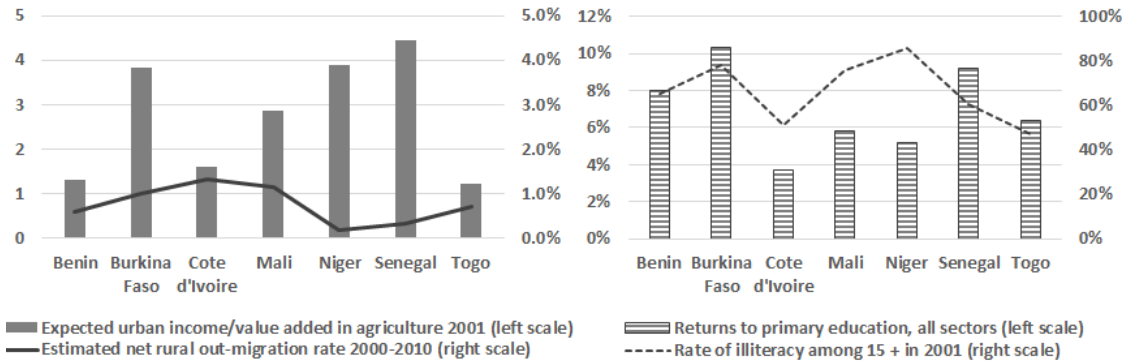
2 Migration, Education and Work Opportunities

2.1 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. The curiosity has reversed in recent years in West Africa, as shown in Figure 2.1 (left panel): 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 2.1, right panel): Why is educational attainment so low if returns to education are so large?

Even if not immediately apparent, these questions are linked in a context of large rural-urban differences where returns to education are only reaped in urban centers and where education opportunities are geographically concentrated. The reasons why individuals (especially rural) do not go to school may be similar to the ones of why they do not migrate.



Notes: Definition and sources are described in Appendix A.

Figure 2.1: Migration puzzle (left panel) and Schooling puzzle in West Africa (right panel)

This and the next chapter address all of these questions, thus making the following three contributions. First, I develop a dynamic life-cycle model with endogenous location, education and activity choice. Secondly, I estimate the model and provide insight into returns to migration and returns to education, hereby shedding light on the migration and education

puzzle. Third, I study the interaction of migration and education decisions in great detail and show how migration prospects affect education decisions and how education shapes migration behaviour. To do so, I simulate different migration and education policy regimes and document the impact on migration and education patterns. While this chapter makes the first two contributions, the study of the interaction of education and migration decisions is relegated to the third chapter.

The first contribution of this chapter is to develop a dynamic model of endogenous, repeated location, education and work activity choices of forward looking men over their life cycle. I model the mutual interdependencies and dynamic trade-offs between these three decisions, allowing individuals to choose from a set of discrete locations and to decide whether to attend school, engage in the labour force or be nonworking. By combining location and activity choices in the same dynamic framework, the chapter brings two strands of the literature together. On the one hand, this model builds on the migration choice literature using a multi-location set-up and on the other hand, the model 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[1] include the seminal paper of Kennan and Walker (2011), Kennan (2010), Lessem (2009) and Lessem (2013). The former two papers look at internal migration in the US, the third one studies internal labour migration in Malaysia. Lessem (2013) presents insofar an exception 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)[2], 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 a wage sector in urban centers and (subsistence) farming in rural regions (Harris and Todaro (1970)). I introduce unemployment as a key element in the urban wage sector as suggested by the work of Harris and Todaro (1970)[3]. 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

[1] Fafchamps and Shilpi (2013) estimate a static model of migration destination choice conditional on migration for Nepal.

[2] 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.

[3] 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.

coefficient which is then 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 the degree of risk aversion of individuals in a developing country is correctly captured (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 amenities and education opportunities. This creates further differential migration incentives.

This chapter also draws on the literature which studies career choices in a dynamic context. Similar to the paper by Keane and Wolpin (1997), in which forward looking men in the US choose a career path, and Attanasio et al. (2012), who model the education versus work decision of teenagers in Mexico until 17, my model allows individuals to endogenously choose their education and work activity. By introducing migration decisions into this framework, I can now study the effect of migration prospects on education and work choices. Indeed, Attanasio et al. (2012) mention that returns to education for rural kids in Mexico are reaped by migrating from rural regions to urban centers. My framework allows to quantify such effects.

A second contribution of the chapter 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 and how they relate to education patterns[4]. This is insofar crucial 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 the other parameters of the model in order to shed light on returns to migration and returns to education. A decomposition of these returns helps us to determine 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 would suggest. Unemployment and risk aversion play a key role in correctly evaluating returns to migration from income differentials. Similarly, I find that direct and indirect migration costs 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 areas have lower opportunity cost of going to school, but at the same time their direct schooling costs are larger. In order to reap the

[4] 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.

returns to education, rural individuals have to migrate to urban areas. Large migration costs and the loss of the home premium when moving away from the origin are for most individuals not compensated by risk-adjusted returns to education, thus explaining the extremely low educational attainment of rural residents. My results relate to the literature on private returns to education in Sub-Saharan Africa[5] 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 cost which affect education decisions but do not show up in returns to education measured on wage earners.

The remaining part of this chapter is structured as follows. Section 2.2 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 2.3 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 2.4 discusses the estimation procedure and presents the estimation results. The following two sections use the estimated model to provide an in-depth-analysis of returns to migration and returns to education in Burkina Faso. The final section concludes this chapter.

2.2 Data and empirical evidence

2.2.1 Data

This chapter combines several data sets in its empirical analysis. The first and main data set used is the EMIUB data set introduced in the previous chapter (see Section 1.3). 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

[5]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.

[6]Given the challenge of measurement error (for the relevant discussion please refer to Section 2.4.4 in this chapter), I doubt that reported retrospective data on income would have been of a sufficiently good quality to be used for the analysis.

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.

2.2.2 Descriptive statistics

This chapter uses a subset of the individuals studied in Chapter 1, namely 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 2.1 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.

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 all migrations[11]. These number clearly highlight the need for a migration framework which

[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.

[8] Section 1.4 in the first chapter of this thesis has shown that while both Burkinabe men and women migrate, their reasons for doing so are very different. While men migrate primarily for economic reasons (work-, money- and study-motivated), most women migrate for family reasons, among which most migrations involve following the spouse. These findings suggest that male and female migration should not be modelled in the same way.

[9] The same definition of regions as in Section 2.2.4 is employed.

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

[11] This fact has already been pointed out by Lucas (1997) in a survey on internal migration in developing

	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 2.1: Sample data

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 2.1 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.

2.2.3 Empirical evidence on the link between migration and education

This section briefly revisits some stylised findings from Chapter 1 on migration behaviour by educational attainment for the data sample used in this chapter. The upper panel of Table 2.2 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 2.2 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.

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 2.2: Migration behaviour during and after completing education

2.2.4 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 2.3 summarises economic, geographical and infrastructural characteristics of Burkinabe locations. I also include Côte d'Ivoire (abbreviated 'CI') as it is the main recipient and sender of Burkinabe migrants.

Overall, I 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,

[13]For a map of Burkina Faso and a definition of the different locations, see Figure 2.14 in Appendix B.

[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 ratio shown in Figure 2.1 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 2.1 (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'.

	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 2.16 in Appendix C.

Table 2.3: Economic, geographical and infrastructural indicators by location

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.

2.3 A life-cycle model of location, education and activity choices

With the objective of studying the interaction of migration, education and work decisions[15] in the presence of regional disparities, I develop a life-cycle model of endogenous location, education and activity choice. This life-cycle model has two distinct features. First of all, it features several urban, rural and one international location which differ in terms of work opportunities, education opportunities, geographical and infrastructural characteristics. Under sizeable locational differences, returns to migration are potentially large. Secondly, the locational specificities provide distinct incentives to heterogeneous individuals, inducing various self-selection patterns such as educated individuals migrating to urban centers. The unequal dispersion of schooling facilities across regions and locational differences in returns to education also create migration incentives.

The life-cycle model tracks men from early boyhood at age 6 until the end of their life A [16]. At the beginning of each period, the individual maximises expected lifetime utility by

[15] Dustman and Glitz (2011) extensively discuss the interaction of migration and education choices, mostly in the context of developed countries.

[16] In the empirical analysis, life ends at age 56. Final age A was derived from demographic data on remaining

trading off current and future income opportunities and amenities with costs of schooling and migration in different urban, rural and international locations. He chooses where to locate l and, depending on the choices available in this location, in which activity to engage d. The Bellman equation of the individual's maximisation problem who is characterised by state x and who faces shocks ζ can be written as follows:

$$\begin{aligned} V(x,\zeta) &= \max_{l,d}\left[u(x,l,d)+\beta\sum_{x'}p(x'|x,l,d)\,\mathrm{E}_{\zeta'}\left[V(x',\zeta')\right]+\zeta(x,l,d)\right] \\ &= \max_{l,d}\left[g(\tilde{w}(x,l,d))+b(x,l)-c(x,l,d)+\beta\sum_{x'}p(x'|x,l,d)\,\mathrm{E}_{\zeta'}\left[V(x',\zeta')\right]+\zeta(x,l,d)\right] \end{aligned} \tag{2.1}$$

where $V(x,\zeta)$ is the value function given x and ζ, β denotes the discount factor, and E represents the expectational operator. Each period, an individual chooses a location l and an activity d. He derives utility from a non-linear function of stochastic income $g(\tilde{w}(x,l,d))$[17], local amenity benefits $b(x,l)$ and pays costs $c(x,l,d)$. Utility is separable in these components and depends on the location choice, the activity choice and individual characteristics. The non-linear function of stochastic income g computes the certainty equivalent of stochastic income $\tilde{w}$, that is, the certain amount which gives the same utility as stochastic income[18]. Individuals also have preference shocks towards each location-activity alternative $\zeta(x,l,d)$, they are drawn from an iid extreme value distribution.

In what follows we inspect location and activity choices more closely, specifically in terms of the value of income, benefits and costs, and how they affect individual characteristics in the future.

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life expectancy at age 5 in Burkina Faso conditional on reaching age 5. This indicator was produced by the author 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 the last decades in life expectancy at birth can thus be (almost fully) attributed to lower infant and young child mortality rates. These do not intervene in this analysis.

[17]Note that individuals cannot save to smooth income over time (by assumption). In the data, only a very small percentage of individuals declare that they can save a fraction of their income (mostly those in medium- or high-skilled occupations). Apart from financial savings, it has also been suggested that risk sharing and the use of livestock as buffer stocks could smooth consumption in developing countries in years of severe drought. Kazianga and Udry (2006) find little evidence of consumption smoothing over time or across households. I am thus confident that the assumed specification is a reasonably good approximation.

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

2.3.1 The location choice

Individuals decide each period where to locate l. The set of location choices 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/international locations offer different work and education opportunities, that is to say different activities, than rural locations. Secondly, each location has a different income distribution $\tilde{w}$ and is characterised by number of other factors which impact benefits and costs associated with being in this specific location. These regional differences in economic opportunities, benefits and costs present different trade-off possibilities to heterogeneous individuals, entailing a variety of internal and international migration movements between locations.

2.3.2 The activity choice

In terms of activities, the individual must choose one activity d among the following set of activities: education, work in the urban/international sector, farming, rural work, non-working. Note that work activities are location-specific. Rural locations offer farming and rural work, while urban and international locations offer work in the urban/international sector.

The motivation for restricting some activity choices to certain locations is based on the observation that urban centers and rural regions differ greatly in their respective economic structure (see Table 2.3). Agriculture is predominantly a rural phenomenon, while urban centers offer work for different occupational levels but also feature unemployment risk. As a consequence of this I restrict farming to rural regions, and distinguish urban/international work from rural work.

Apart from the locational trade-off mentioned above, a second trade-off is presented to individuals in the choice of the activity: Individuals must decide whether to go to school, to work or to be nonworking. These activities entail different incomes and costs in the present, but they also affect future income, for example through the acquisition of education or an urban occupation.

2.3.3 Individual characteristics

At any time an individual is characterised by a set of individual characteristics x. Some of these characteristics evolve over time, while others are time-invariant (i.e. initial conditions). The introduction of several control variables is motivated by the main objective of explaining migration patterns of individuals with distinct characteristics in the absence of individual wage/income data. As income is not directly observed, it has to be inferred from observed occupation data. In order to predict occupations well, it is necessary to control for several

relevant individual characteristics.

At the beginning of a new period (i.e. before choosing location l and activity d), an individual of age a is characterised by his previous location l_{-1}, previous occupation o_{-1} (if applicable) and schooling level s. Initial conditions include unobserved ability τ, home location hl, father's occupation of and birth-year cohort by. All these variables constitute x.

Previous location l and home location hl take values from 1 to 8, corresponding to the previously defined locations. I define four categorical values for occupation o: 'mh' for medium-high-skilled occupations, 'low' for low-skilled occupations, 'U' for unemployment and 'OLF' otherwise, where 'OLF' stands for 'out of the *urban/international* labour force'. Schooling level s spans no schooling, some primary, some secondary and some tertiary education, ranging from 0 (no schooling) to level 3 (tertiary)[19]. When estimating the model, I do not estimate an education parameter for each education level, but transform the achieved schooling level into average years of education at this schooling level, i.e. $SY(s)$. Following Kabore et al. (2001), I define $SY(s=0)=0$ (no schooling), $SY(s=1)=3.5$ (some primary), $SY(s=2)=10$ (some secondary) and $SY(s=3)=16$ (some tertiary). Ability τ can either be high or low. Ability is known by the individual and the (potential) employer but not reported in the data. To solve the proposed model, I need to make assumptions about the ability distribution. For reasons of parsimony, I model ability as an iid Bernoulli random variable which is independent of other initial conditions. The probability of being of high ability $\pi(\tau=\tau_{high})$ is estimated as a parameter. Father's occupation of indicates if the father last worked in a medium-high-skilled occupation or not. Finally, by groups individuals according to their birth year into 5-year-cohorts. I define the following seven cohorts: 1952-1956, 1957-1961, ..., and 1982-1985.

I abstract from explicitly including time (calender years) in the model. Instead, the combination of information on the birth year cohort and age allows us to infer the approximate calender year. This procedure has two main advantages. First of all, the exclusion of an additional variable 'time' keeps the size of the state space within manageable limits. Secondly, because the exact year of observations is likely to suffer from measurement error (see the relevant discussion in Section 2.4.4 of this chapter), it remains doubtful that the additional inclusion of calender years would increase the precision of the results.

2.3.4 Attending school

An individual who decides to attend school $d=EDU$ in location l derives the following utility from his choice:

[19] Modelling educational attainment as four discrete schooling levels rather than as the number of school years is motivated by three reasons. First, different schooling levels allow us to model discontinuous jumps between levels. Second, due to high repetition rates in Burkina Faso, the attained education level is more informative about an individual's education than the number of years spent in school. (Some individuals have not completed primary school after 10 years spent in school.) Third, the four levels present a sizeable computational advantage in terms of smaller state space.

$$u\left(x,l,d=EDU\right) \quad = \quad \underline{w}+b(x,l)-c_{school}(x,l,d=EDU)-c_{mig}(x,l)+\zeta(x,l,d=EDU) \tag{2.2}$$

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} (if he moves) and a preference shock ζ. Let us focus on schooling cost as the distinctive component of the utility of someone choosing to attend school. The subsistence income $\underline{w}$ is discussed in Section 2.3.5. Amenity benefits and migration costs shown in equation 2.2 are independent of the activity chosen, they are discussed in Section 2.3.9.

The cost of going to school c_{school} reflects the monetary and non-monetary costs of attending school for one year. It depends on the location of the individual, his current schooling level and other individual characteristics. It is given in equation 2.3. The first line refers to the cost of primary education (P) for individuals without any schooling, the second to secondary (S) for those with primary education and the last to tertiary (T) for those with secondary or tertiary education.

$$c_{school}(x,l,d=EDU) = \begin{cases} \delta_{0,P}+\delta_1(1-S_P(x,l)) & +\delta_2 a-\delta_3 by-\delta_4\mathbf{1}(\tau=\tau_{high}) \quad \text{if } s=0 \\ \delta_{0,S}+\delta_1(1-S_S(x,l)) & +\delta_2 a-\delta_3 by-\delta_4\mathbf{1}(\tau=\tau_{high}) \quad \text{if } s=1 \\ \delta_{0,T} & +\delta_2 a-\delta_3 by-\delta_4\mathbf{1}(\tau=\tau_{high}) \quad \text{if } s=2 \\ 0 & \quad \text{if } s=3 \end{cases} \tag{2.3}$$

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 varies relative to share of municipalities in location l which have schools offering schooling 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))[20]. Schooling cost also allows for potential effects of age, birth cohort and ability[21]. The linearity of birth year cohorts implies that the corresponding coefficient can be interpreted as a linear time trend. It measures how schooling costs have changed over time. Obviously, higher education choices

[20]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. Urban and international locations have perfect availability of primary and secondary schools, i.e. their respective share are 100%.

[21]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. Hence, I opt for the former modelling strategy.

are restricted to locations offering the respective level. For example, before the opening of secondary schools in the Sahel, Sahelian children faced prohibitively high secondary schooling costs in their home region, requiring them to end their education or move away.

At the end of a year, the schooling level s of the individual stochastically increases to the next higher schooling level. The evolution is modelled as a first order Markov process conditional on age and the availability of the next higher schooling level[22]. The transition rates from level s to $s+1$ are calibrated from observed transition rates (see Section 2.4.2 in this chapter). Equation 2.4 shows how the time-variant characteristics in x evolve after one year of schooling:

$$x' = \begin{pmatrix} a+1 \\ l \\ o = OLF \\ s' = s+1 \text{ or } s' = s \end{pmatrix} \tag{2.4}$$

Age increases by one year, current location becomes previous location in the next period. Previous occupation is updated to out of the urban/international labour force (OLF). Finally, the schooling level can increase by one unit to the next higher schooling level or remain the same. Initial conditions do not change.

2.3.5 Working in the urban/international sector

The second activity choice relates to working in the urban or international sector which is characterised by two distinct features. First, employment is not deterministic (or a choice) but subject to the potential risk of unemployment. Secondly, I model different occupation levels among employed individuals. Both the probability of employment and the occupation assignment 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 $d = UIW$ in location l is given by:

$$u\left(x, l, d = UIW\right) = g(\tilde{w}(x, l, d = UIW)) + b(x, l) - c_{mig}(x, l) + \zeta(x, l, d = UIW) \tag{2.5}$$

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 one of three different outcomes: unemployment (U), employment in a low-skilled occupation (low) or

[22]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, the corresponding schooling cost being 0.

employment in a medium-high-skilled occupation (mh). Given that the individual decides upon entrance before knowing the labour market outcome, we can write the certainty equivalent of urban/international labour income as in equation 2.6. To do so, I assume a constant relative risk aversion utility in income[23] and rearrange terms.

$$
\begin{aligned}
g(\tilde{w}(x,l,d=UIW)) = & \\
& \Big[p(U,x,l)\underline{w}^{1-\rho} \\
& + (1-p(U,x,l))(1-p(mh,x,l))\left(\frac{w_{low}(x,l)}{\lambda}\right)^{1-\rho} \\
& + (1-p(U,x,l))p(mh,x,l)\left(\frac{w_{mh}(x,l)}{\lambda}\right)^{1-\rho}\Big]^{\frac{1}{1-\rho}}
\end{aligned} \tag{2.6}
$$

I denote by $p(U)$ the probability of unemployment, by $p(mh)$ the probability of getting a medium-high-skilled occupation conditional on employment, $\underline{w}$ the fixed subsistence income, w_{low} and w_{mh} the location-specific incomes in low- and medium-high-skilled occupations, respectively. ρ is the risk aversion coefficient and λ the living cost differential between urban/international and rural locations. Due to high (but imperfect) persistence in unemployment and occupation levels, it is important to condition on previous occupation level and thus distinguish labour market entrants, past low-skilled, past medium-high-skilled workers and previously unemployed individuals. In what follows I describe how I model the unemployment probability and the occupation assignment conditional on past labour market status.

Unemployment

Given the absence of unemployment insurance in Burkina Faso, I assume that individuals without work income get a fixed subsistence income of $\underline{w}$, for example through informal transfers[24]. The probability of unemployment conditional on the previous occupational status is given by equation 2.7:

$$
\begin{aligned}
p(U,x,l) \; = & \\
& \begin{cases}
p(EU) = \omega_{EU} & \text{if } o_{-1} = mh, low \\
p(UU) = \omega_{UU} & \text{if } o_{-1} = U \\
p(U) = 1 - \frac{1}{1+exp\left(-(\omega_{U,l}+\omega_{U,1}SY(s)+\omega_{U,2}(SY(s))^2)\right)} & \text{if } o_{-1} = OLF
\end{cases}
\end{aligned} \tag{2.7}
$$

where $p(EU)$ denotes the probability of an employment-unemployment transition (first line), $p(UU)$ denotes the probability of an unemployment-unemployment transition (second

[23] The used utility function is of the form $u(w) = \frac{w^{1-\rho}}{1-\rho}$

[24] In the context of CRRA utility, individuals cannot have zero consumption. As income is assumed to equal consumption (savings are not modelled and assumed to be zero), we must ensure that all individuals have an income strictly larger than 0. This is achieved through the subsistence income $\underline{w}$.

line) and $p(U)$ denotes the location- and individual-specific unemployment probability of labour market entrants (third line). Unemployment probability is parsimoniously parametrised and allows 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)). The location-specific intercepts allow the baseline level of unemployment to differ between locations.

Occupation Assignment

If an individual is employed, he also faces uncertainty with respect to his occupation level[25]. The probability of being assigned a medium-high-skilled occupation $p(mh, x, l, x)$ conditional on the previous occupational status and employment in the current period is given in equation 2.8:

$$p(mh, x, l) \;=$$
$$\begin{cases} p(mh, mh) = 1 - \frac{1}{1+exp\left(-(\omega_{mh,l}+\omega_{mh,1}(SY(s))^2+\omega_{mh,2}a^2)\right)} & \text{if } o_{-1} = mh \\ p(low, mh) = 1 - \frac{1}{1+exp\left(-(\omega_{low,l}+\omega_{low,1}(SY(s))^2+\omega_{low,21}a+\omega_{low,22}a^2)+\omega_{low,3}by\right)} & \text{if } o_{-1} = low \\ p(mh) = 1 - \frac{1}{1+exp\left(-(\omega_{E,l}+\omega_{E,1}\mathbf{1}(\tau=high)+\omega_{E,2}SY(s)+\omega_{E,31}a+\omega_{E,32}a^2+\omega_{E,4}of+\omega_{E,5}by)\right)} & \text{if } o_{-1} = U, OLF \end{cases} \tag{2.8}$$

where $p(mh, mh)$ designates the transition probability from mh to mh occupations, $p(low, mh)$ the corresponding upward transition probability and $p(mh)$ the probability of getting a medium-high-skilled occupation of labour market entrants (E), always conditional on being employed in the current period. The occupation assignment of labour market entrants (third line) controls for many different individual characteristics x with the objective of predicting the occupational assignment with good precision. It includes an indicator for (unobserved) ability, as well as other initial conditions (father's occupation[26], birth year cohort[27]), but also education and age[28]. The transition probabilities of previously employed workers are more

[25] The choice of modelling the unemployment-employment assignment and the occupation assignment in two separate steps, rather than as an ordered variable is motivated by the fact that occupation levels and unemployment cannot be ranked as required for an ordered random variable. For example, an individual with more education is more likely to get a medium-high-skilled occupation but he is also more likely to be unemployed than a less educated peer.

[26] This parameter could capture potential network effects.

[27] Analogous to the effect of birth cohort in schooling costs, this parameter accounts for time trends in changing occupational requirements due to, for example, increasing average schooling level or later entry into the labour market.

[28] Notice that some specifications 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 labour market transitions $p(mh, mh)$ and $p(low, mh)$ 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

parsimoniously parametrised. The reason is that transitions from one occupation level to another are relatively unlikely, thus by conditioning on previous occupation the model 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 mh-occupation probability upon entry (and a moderate low-mh transition rate) or from a moderate mh-occupation probability upon entry and high low-mh transition rates. There is more than one path leading to a medium-high-skilled occupation.

At the end of the period, time-variant characteristics x are updated to x' as shown in equation 2.9:

$$x' = \begin{pmatrix} a+1 \\ l \\ o = mh, \text{ or } o = low, \text{ or } o = U \\ s' = s \end{pmatrix} \tag{2.9}$$

2.3.6 Farming

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

$$u\left(x, l, d = F\right) \quad = \quad g(\tilde{w}(x, l, d = F)) + b(x, l) - c_{mig}(x, l) + \zeta(x, l, d = F) \tag{2.10}$$

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 normal/favourable and a bad state (BS) under adverse weather conditions. The certainty equivalent of farming income can be written as in equation 2.11.

$$g(\tilde{w}(x, l, d = F)) = \left[(1 - \pi(BS, l))w_F(GS, a, l)^{1-\rho} + \pi(BS, l)w_F(BS, a, l)^{1-\rho}\right]^{\frac{1}{1-\rho}} \tag{2.11}$$

where $\pi(j, l)$ denotes the probability of weather state j occurring in location l, $w_F(j, a, l)$ the corresponding income of an individual aged a and ρ the coefficient of relative risk aversion.

different for those with tertiary education. Aiming to be parsimonious while capturing the non-linear effect, I opt for quadratic terms in education.

The calibration of the probability of each weather state and the corresponding incomes are discussed in Section 2.4 of this chapter.

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 are no returns to education in farming[29]. Time-variant individual characteristics thus (trivially) evolve as shown in equation 2.12.

$$x' = \begin{pmatrix} a+1 \\ l \\ o = OLF \\ s' = s \end{pmatrix} \tag{2.12}$$

2.3.7 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 $d = RW$ in location l derives the following utility from his choice:

$$u\left(x, l, d = RW\right) \quad = \quad g(\tilde{w}(x, l, d = RW)) + b(x, l) - c_{mig}(x, l) + \zeta(x, l, d = RW) \tag{2.13}$$

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 2.14.

$$\begin{aligned} g(\tilde{w}(x, l, d = RW)) = & \\ & \Big[(1 - \pi(RW, l))\underline{w}^{1-\rho} \\ & + \pi(RW, l)\pi(S|RW, l)\left(\frac{5}{12} w_R(a, l)\right)^{1-\rho} \\ & + \pi(RW, l)(1 - \pi(S|RW, l))w_R(a, l)^{1-\rho}\Big]^{\frac{1}{1-\rho}} \end{aligned} \tag{2.14}$$

Let $\pi(RW, l)$ denote the probability of finding rural work in location l, $\pi(S|RW, l)$ the probability of seasonal work conditional on finding rural work, and $w_R(a, l)$ the income of an

[29] 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 I do not observe individual farm output, I cannot identify returns to education in agriculture and hence, I must assume that they are close to 0 in Burkina Faso. 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.

individual aged a working for a full year in the rural sector in location l. The calibration of the probability of rural work, the probability of seasonal work and the rural work income are discussed in Section 2.4 of this chapter.

The probability of finding rural work is assumed to be independent of last year's work outcome or education[30]. Time-variant individual characteristics evolve as under the choice of farming (see equation 2.12).

2.3.8 Nonworking

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

$$u\left(x, l, d = NW\right) \quad = \quad \underline{w} + b(x, l) - c_{mig}(x, l) + \zeta(x, l, d = NW) \tag{2.15}$$

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, individual characteristics x evolve like those of someone choosing to farm.

2.3.9 Amenity benefits and migration costs

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

Amenities $b(x, l)$ represent non-pecuniary and activity-independent benefits obtained by being in location l. Kennan and Walker (2011) model amenity value to include a home premium and climate, Lessem (2009) accounts for in-kind-payments. The amenity value b is given in equation 2.16.

$$b(x, l) = \gamma_1 \mathbf{1}(l = hl) + \gamma_2 DI(x, l) \tag{2.16}$$

b includes a home premium and a single-valued index of development level $DI(x, l)$[31]. 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 be part of a social network. The home premium captures different aspects which are not explicitly modelled in the current

[30] This simplifying assumption can be motivated by two aspects. First, rural work constitute only about 10% of rural labour force and is thus quantitatively not of great consequence. Secondly, some rural work relates to salaried work in the agriculture. Weather shocks are uncorrelated over time, as argued above, and thus the work availability in paid salaried work will also be uncorrelated over time.

[31] 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.

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. The development level index ranges from 0 to 1, with 1 being the highest development level.

The migration cost $c_{mig}(x, l)$ accrues whenever an individual changes his location. It reflects monetary and non-monetary costs of migrating. The cost of migrating from the beginning-of-period location l_{-1} to a new location l is given by equation 2.17. The structure builds on Kennan and Walker (2011) and Schultz (1982).

$$c_{mig}(x, l) = \left[\phi_0 + \phi_1 D(l_{-1}, l) - \phi_2 T(x) - \phi_3 a + \phi_4 (a)^2\right] \tag{2.17}$$

The cost of moving from location l_{-1} to l 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[32], public transportation in the point of origin l_{-1}[33] and age. The inclusion of public transportation $T(x)$ 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 a certain ages but increase for others, hence I opt for a quadratic structure in age. For example, individuals in their late teens and early twenties probably face the lowest migration costs. They are more autonomous than younger individuals and often not yet married. Migration cost is likely to be larger for less autonomous individuals or for those with more family obligations.

2.4 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)[34].

[32] Distance between two locations is measured as the average great circle distance between all departmental capitals in location l_{-1} and all departmental capitals in location l. In the literature, distance alone is often used as a proxy for migration cost (see, for example, Beauchemin and Schoumaker (2005)).

[33] 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.

[34] 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 Section 2.4.4.

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[35]. 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.

2.4.1 Calibration

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 2.4 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 2.4: Calibrated income distributions (1'000 CFA/month, before living cost adjustment)

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

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 larger, being between 15% and 40% higher than in Ouagadougou and Bobo-Dioulasso.

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.

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.

I set the discount factor to 0.95[36].

2.4.2 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)[37].

[36]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. I leave it as a robustness check for a future version to re-estimate the model assuming a lower discount factor.

[37]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 occupation transitions.

Table 2.5 and Table 2.6 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.

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 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[40]. 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[41]. Identification of occupation assignment parameters of labour market entrants uses

[38]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)).

[39]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.

[40]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.

[41]OLS estimates which instrument for ability by the interaction of migrant status and origin did not find

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) [38] [39]	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 2.5: Moments identifying amenity, schooling cost and transition, migration cost, high ability parameters

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 2.6: Moments identifying labour market, risk aversion, living cost parameters

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.

2.4.3 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, 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[42].
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:

$$\hat{\theta}_{SMM} = \arg\min \left(\hat{\mu}(\theta) - \hat{m}\right)' W \left(\hat{\mu}(\theta) - \hat{m}\right) \tag{2.18}$$

where $\hat{m}$ is the vector of empirical moments (i.e. the sample estimate of the unknown

any significant effect of 'ability' on unemployment.

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

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.

2.4.4 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, the data set certainly suffers from measurement error. Indeed, the histogram of declared age in 2000 reveals spikes for ages 15, 20, 25, ..., 55. I estimate that around 15% of all men misreport their birth year[43]. I 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 the present case, misreporting of dates within a year does not pose a problem as I 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[44].

[43] 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.

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

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.

2.5 Estimation results

2.5.1 Amenities, schooling and migration cost estimates

Tables 2.7 to 2.9 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 income data shown in Table 2.4.

Amenity parameter estimates

Table 2.7 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 2.7: 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.

Schooling cost parameter estimates

Table 2.8 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 2.2).

	$\hat{\theta}$	$\hat{\sigma}_\theta$
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 2.8: Estimated schooling cost parameters

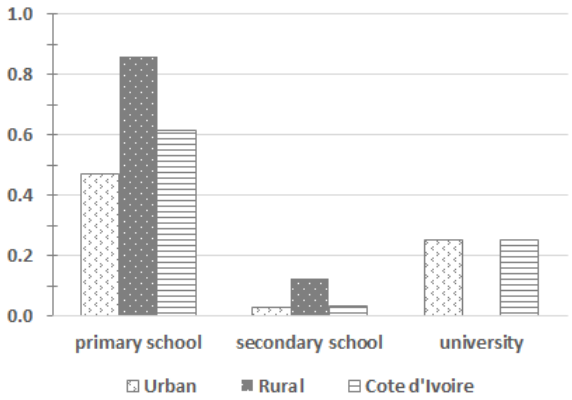

Figure 2.2: Average incurred schooling costs (1,000 CFA)

The J-shape of fixed schooling costs by education level is not reflected in incurred average schooling costs[45]. The entry cost of attending school (i.e. the schooling cost of those without any 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, I find a probability of 13%, which is not precisely estimated.

[45] 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 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).

Migration cost parameter estimates

Figure 2.3 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 2.9: Estimated migration cost parameters

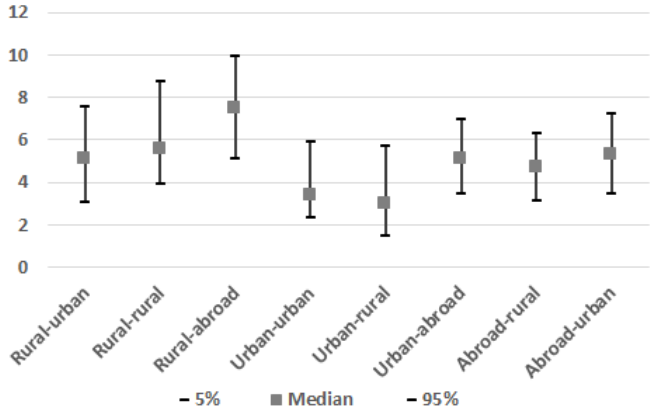

Figure 2.3: Average migration costs (1,000 CFA)

Overall, I 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.

2.5.2 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 2.7 to 2.8 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 2.10 to 2.13 present the estimation results of the labour market parameters, the relative risk aversion coefficient and the living cost differentials.

Estimates of unemployment upon labour market entrance

Table 2.10 shows the parameter estimates of the unemployment upon entry equation and Figure 2.4 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 2.10: Estimated unemployment parameters

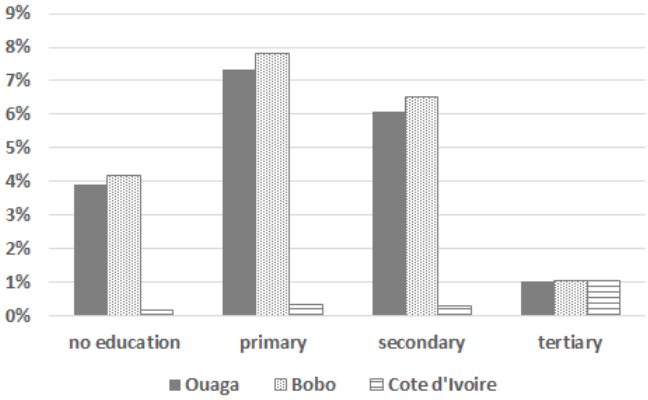

Figure 2.4: Predicted unemployment probabilities by education

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.

Estimates of occupation assignment upon labour market entrance

Table 2.11 presents the estimated parameters of the occupation assignment equation for labour market entrants. Figure 2.5 provides the predicted probability of being assigned a medium-high-skilled occupation for different education levels[46].

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

[46]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 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 2.11: Estimated parameters of occupation assignment upon entry

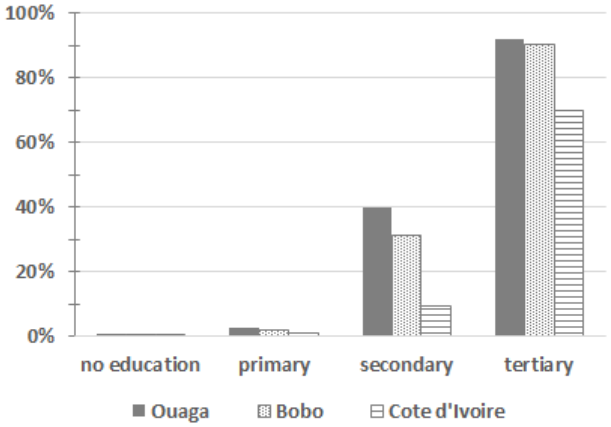

Figure 2.5: Predicted probability of medium-high occupation upon labour market entry

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.

Estimates of occupation assignment upon labour market transition

Table 2.12 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 2.6 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, I 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 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

	$\hat{\theta}$	$\hat{\sigma}_\theta$
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 2.12: Estimated parameters of occupation assignment upon transition

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.

Risk aversion and living cost estimates

Finally, Table 2.13 presents estimates of the relative risk aversion coefficient and living cost differentials.

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

Table 2.13: Relative risk aversion coefficient and living cost differential

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) 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 2.4 need to be adjusted by this factor. This leaves an urban-rural real income premium of 20% to 70%[47], and an Ivorian-rural income premium

[47]I calculate the real income premium between real income in low-skilled occupations in urban centers/Côte

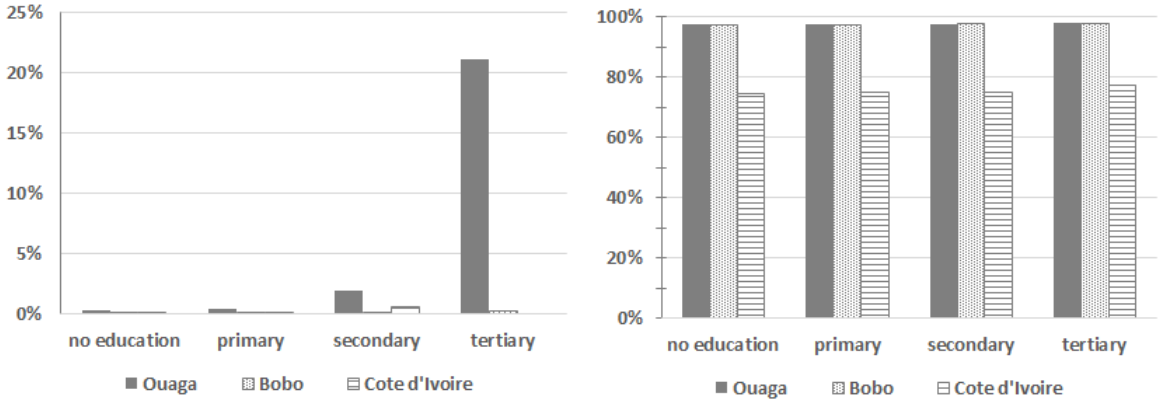

Figure 2.6: Predicted probability of medium-high occupation conditional on previous low occupation (left panel) and previous medium-high occupation (right panel, different scale)

of 50% to 100%.

All in all, the labour market findings can be summarised as follows. First, I 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.

2.5.3 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 I 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

d'Ivoire with respect to real rural farming income in the good weather state.

market moments I 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.

For 40% of the migration moments I 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 emigration prospects on educational attainment in chapter 3.

Education moments have an intermediate fit (for 48% I 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 2.19 to 2.40 and the relevant discussion in Appendix F.

2.6 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.

2.6.1 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 2.14 I 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[48]. I 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 2.14: Living-cost adjusted incomes of migrants and stayers (in 1,000 CFA/month)

I 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, the 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 2.7 I 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

[48]Unless otherwise specified, whenever I refer to 'averages' in this and the next section, I 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 for migrants and a negative premium for stayers.

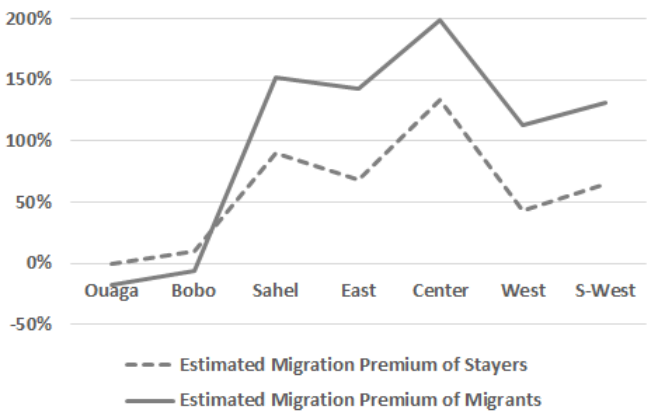

Figure 2.7: Average estimated migration income premia of migrants and stayers

Figure 2.7 brings some interesting findings to our attention. First of all, I find that the migration 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.

2.6.2 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 2.8 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).

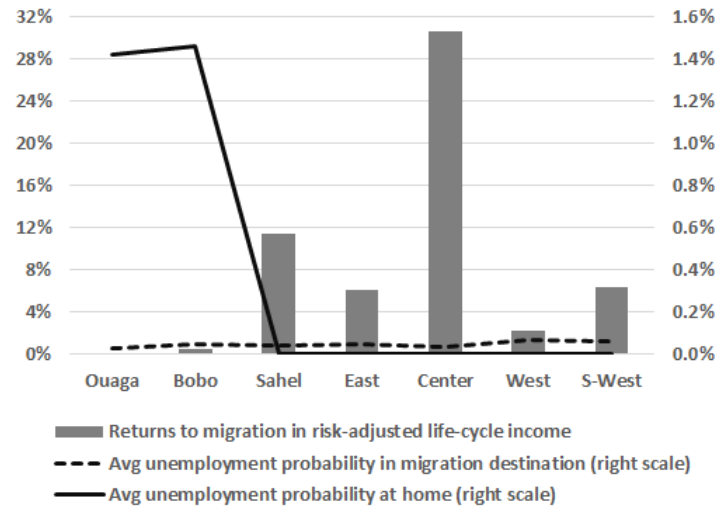

Figure 2.8: Returns in risk-adjusted life cycle income and unemployment probabilities at home and away

Compared to Figure 2.7 which indicated that migrants from a rural origin touched incomes which were around twice as high as those in their origin, I 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 2.7) 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.

2.6.3 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 2.9 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.

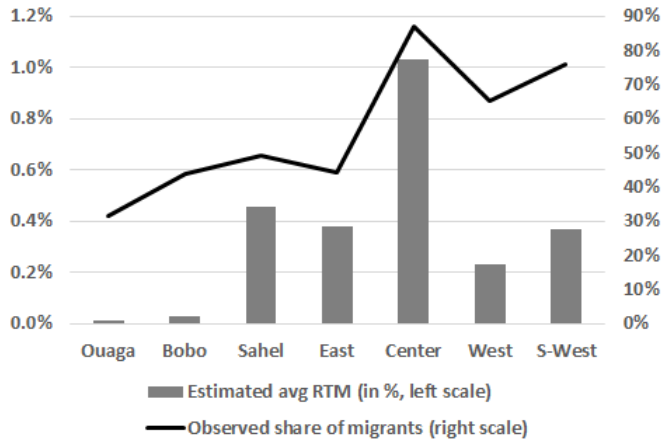

Figure 2.9: Net estimated returns to migration and observed share of migrants

I find that overall net gains from migration vary substantially across locations, in line with regional shares of migrants[49]. 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, I will provide a decomposition of the net migration gains. Figure 2.10 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, 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.

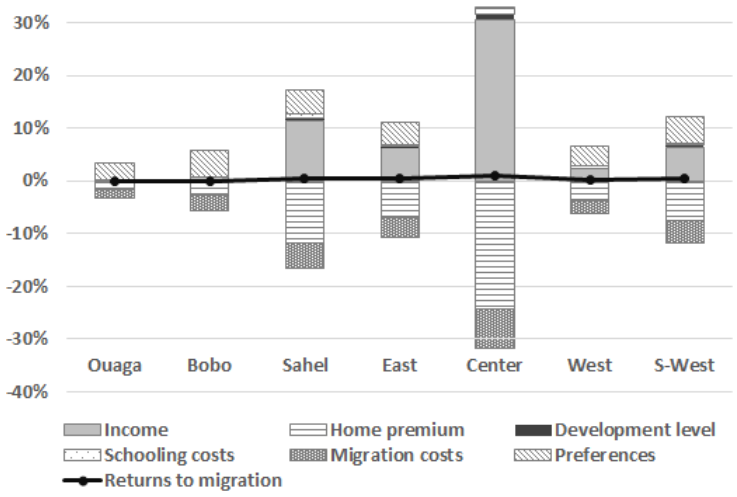

Figure 2.10: Net estimated returns to migration and observed share of migrants

[49]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.

Indeed, the decomposition shown in Figure 2.10 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.

2.7 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 2.4) 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. Chapter 3 presents a more complete joint analysis of migration and education decisions and their interactions.

2.7.1 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 2.11 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.

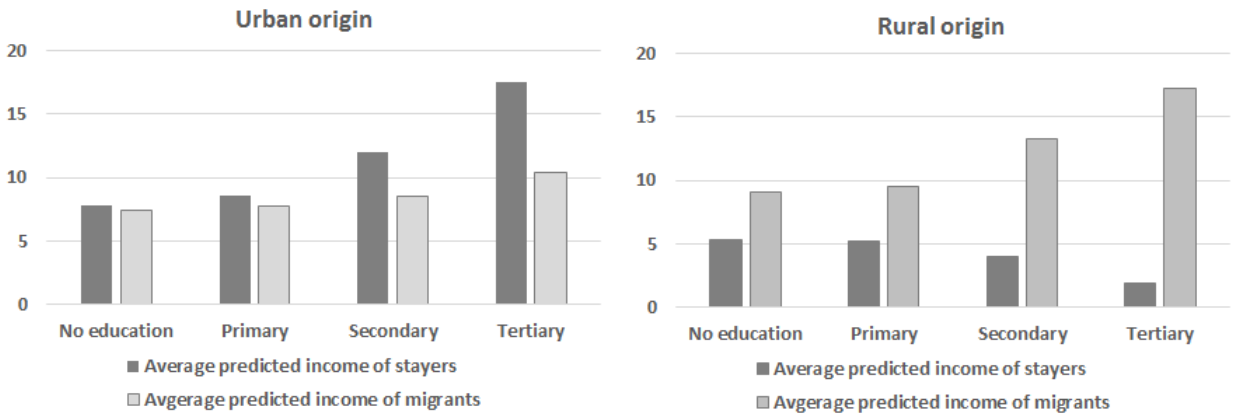

Figure 2.11: Average predicted incomes of migrants and stayers by final education level (1,000 CFA/month)

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 2.11 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 2.4). 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 2.11 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.

2.7.2 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, I am 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 the estimated model and under an alternative scenario in which education is not available. Figure 2.12 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).

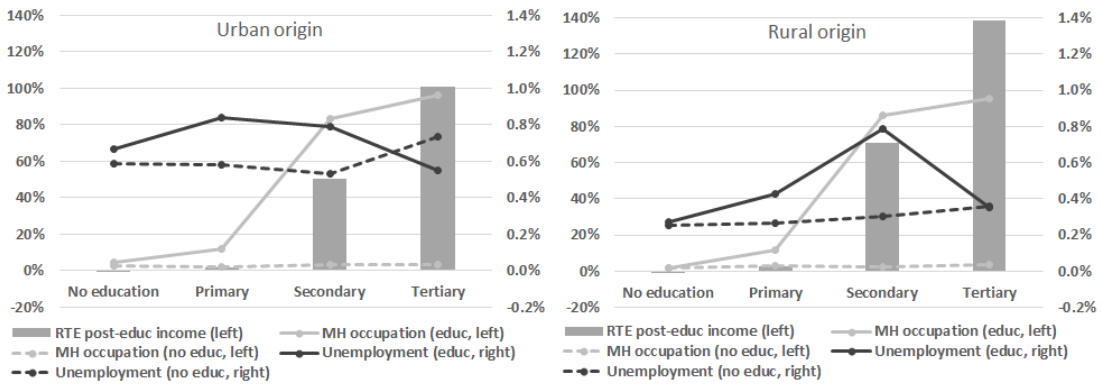

Figure 2.12: Returns to education from risk-adjusted life cycle incomes, unemployment rates and probability of medium-high occupations by origin

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.

2.7.3 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 2.13 plots average returns to education (black line) and its decomposition (bars) for individuals who have gone to school by their final education level reached[50]. I 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.

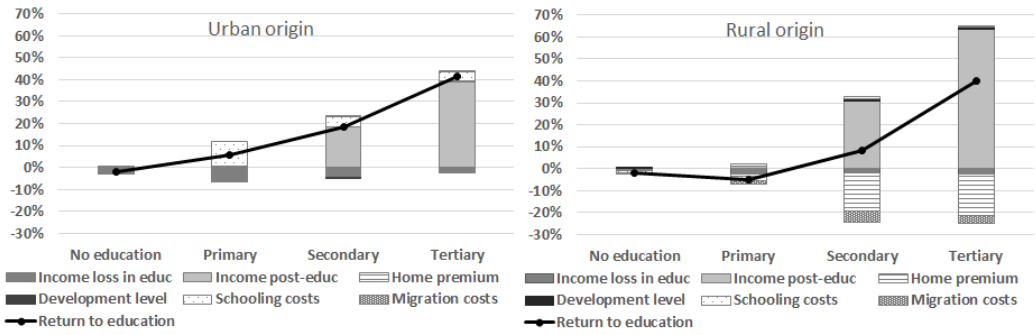

Figure 2.13: Decomposition of net estimated returns to education

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 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.

[50]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.

Direct net schooling costs and the opportunity cost of going to school (the income loss before school completion) are relatively small. Indeed, I 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 the estimates of net life-cycle returns to education with estimates reported in the literature, I transform education levels into years of education. The left panel of Table 2.15 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 2.15: 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[51], 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

[51] 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.

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 future income prospects than those who have not gone to school. Section 3.2.1 in Chapter 3 extends on this by analysing the effect of different alternative education policies aimed at increasing educational attainment in rural regions.

2.8 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.

While this chapter has modelled migration and education choices jointly, it has provided an analysis of returns to migration and returns to education mostly abstracting from potential interactions of migration and education choices. I have presented some evidence on how migration patterns change with education and vice versa. The next chapter uses the estimated model to simulate different migration and education policy regimes. This allows me to study the interaction of migration and education choices in more detail.

Appendix

A Definitions and data sources: Migration puzzle and Education puzzle

Figure 2.1 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. I use this series and transform it first into current US dollars, then into current CFA. For Niger, I only have data on year 2005. I use this year and transform it into current US dollars. I 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. I calculate it as the excess growth of urban population over rural population growth, assuming that rural and urban population grow at the same rate.[52] 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 estimated returns to primary education refers to average returns to primary education in all sectors from 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.

[52] 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 2.14: 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. Given the geographical and ethnic closeness, I integrate Banfora into Bobo-Dioulasso. This increases the number of observations in this subsample.

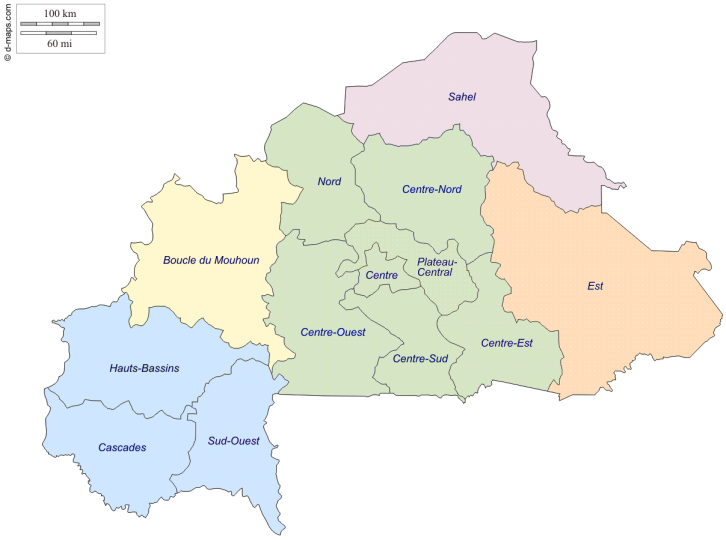

Figure 2.15: Map of Burkina Faso: Definition of rural regions

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)[53],

[53] In the analysis I use Koudougou as the regional capital of the Center.

the **West**, the administrative region of the Boucle du Mouhoun 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 and Banfora)[54].

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

[54]In the analysis I 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 establishment date	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 2.16: Data sources of location indicators

D Calibrated income distributions

Summary of calibrated income distributions

In what follows, I carefully describe how I calibrate each income distribution and which data sources I use to do so. Table 2.17 is the same as shown in subsection 2.4.1 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 2.17: 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.

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 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 the 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 across 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 2.18 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 2.18: 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.

[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 harvest either.

The probability of bad harvest shocks is obtained from the community survey data. Each village/town in the sample reports in which years it has suffered a bad harvest. 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 2.3.

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

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 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, I 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:

$$\ln\left(\text{prob}(F \times l|x)\right) - \ln\left(\text{prob}(RW \times l|x)\right) = \frac{v(x, F \times l) - v(x, RW \times l)}{\sigma_G} \tag{2.19}$$

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:

$$\begin{aligned} &\ln\left(\text{prob}(F \times l|x)\right) - \ln\left(\text{prob}(RW \times l|x)\right) = \\ &\frac{\left[\text{E}_{\tilde{w}(x,F\times l)}\left[\tilde{w}(x, F \times l)^{1-\rho}\right]\right]^{\frac{1}{1-\rho}} - \left[\text{E}_{\tilde{w}(x,RW\times l)}\left[\tilde{w}(x, RW \times l)^{1-\rho}\right]\right]^{\frac{1}{1-\rho}}}{\sigma_G} \end{aligned} \tag{2.20}$$

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, I can also identify the scale parameter. Given that there are 5 rural regions, there are 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. I thus calibrate $\sigma_{G,urban} = 0.22$. Translating this approach to the differences in shares between farming and nonworking in rural areas, I 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 2.19 shows the fit of the migration moments which identify the amenity parameters.

	Ouaga	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-West**
Return migration							
Observed	0.011	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 2.19: Fit: Migration moments identifying amenity parameters

Table 2.19 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 2.20 to 2.24 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 2.20). The model also succeeds in predicting the stark difference in never-schooler rates between urban centers and rural regions. As shown in Tables 2.21 and 2.22, 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 2.23) shows that the share of students in rural regions is underpredicted. 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, I 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 the identification scheme of parameters relating to unobserved ability is based 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 2.20: 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 2.21: 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 2.22: 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 2.23: 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 2.24: Fit: Schooling moments identifying schooling cost parameters 4

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

Tables 2.25 to 2.28 show the fit of the moments identifying the migration cost parameters. Table 2.29 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 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 2.25: 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 2.26: 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 2.27: 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 2.28: 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 2.29: Fit: Migration moments identifying share of high-ability

Fit: Labour market shares identifying risk aversion

Table 2.30 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 2.30: Fit: Rural labour market shares identifying risk aversion coefficient

Fit: Labour market shares identifying labour market entrance parameters

Tables 2.31 to 2.34 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%) for 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 Section 2.6 on identification, I 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 do 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 2.31: 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 2.32: 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 2.33: 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 2.34: Fit: Labour market moments identifying labour market entrance parameters 4

Fit: Labour market shares identifying labour market transition parameters

Tables 2.35 to 2.39 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 2.37 and 2.38 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 2.35: Fit: Labour market moments identify labour market transition parameters 1

Probability of mh occupation by age				
	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 2.36: 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 2.37: 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 2.38: 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 2.39: Fit: Labour market moments identifying labour market transition parameters 5

Fit: Labour market shares identifying unemployment parameters

Table 2.40 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 2.40: Fit: Unemployment moments

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3 Studying Migration and Education Interactions using Policy Simulations

3.1 Introduction

Following the exploration of the migration puzzle and the schooling puzzle, we now direct our attention towards the interaction of migration and education decisions. Indeed, in the presence of large local differences in returns to education and education opportunities like they are found in Burkina Faso, these two decisions influence each other. In this context, we are interested in understanding the following three main questions. First, what drives rural-urban differences in educational attainment? Secondly, how does educational attainment shape migration behaviour, that is the probability to migrate, number of moves and migration destinations? And lastly, we would like to understand if and how migration prospects affect educational attainment in the first place.

The global contribution of this chapter is to study the interaction of migration and education decisions using the dynamic framework of migration and education decisions developed in the previous chapter. This analysis distinguishes itself from previous contributions by providing a general framework to study the effect of education on migration and vice versa. It does not need to rely on data for a specific reform which has taken place, but uses simulation techniques based on the proposed framework. In this chapter, I simulate the effect of different alternative education and migration policies on migration behaviour and educational attainment. While these policies are unlikely to be implemented by policy makers in the extremeness proposed in this chapter, they nonetheless provide very valuable insight on their quantitative effects and reveal potential unexpected side effects. Using these simulation techniques, this chapter hereby makes the following three contributions.

First, I start the analysis by looking at how education opportunities of young children affect their educational outcomes. We are notably interested in understanding why children in rural regions are much less likely to go to school (lower enrollment rates) and get slightly lower education levels conditional on having gone to school. I study and compare the effect of three education policies on educational outcome in rural regions. The first education policy targets initial conditions (family background), the second one lowers schooling costs in rural regions, and the last one provides free migration to urban centers. The literature on education

choice in developing countries has amply investigated the role of selection into education, for example by family background and ability (see Akresh et al. (2010) and Akresh et al. (2011) for Burkina Faso), the importance of the number of schools (see, for example, Duflo (2001)), and the opportunity cost of going to school in terms of foregone income from working (Attanasio et al. (2012)). The contribution of this chapter is to explicitly quantify the effect of costly migration when education opportunities and returns to education are geographically concentrated[1], and to compare it to the effect of initial conditions and schooling costs on educational attainment. I find that fully subsidising migration to urban centers has a positive effect on educational attainment in rural regions, yet the effect is smaller than for aligning rural schooling costs to urban levels.

I make a second contribution to the literature on education and migration decisions by providing evidence on how education shapes migration behaviour. One of the first observations related to migration incidence which differ by education level dates back to the early 1970s when Schwartz (1973) and Greenwood (1975) noted that educated men in the US were more likely to move than those with less education. Some recent contributions on the US (Malamud and Wozniak (2012)) and on Norway (Machin et al. (2012)) have shown that the effect of education on migration probability is causal. To investigate how education affects migration behaviour, I rely on the same education policy of lowering rural schooling costs as in my first policy contribution and analyse how it would change migration patterns of rural individuals in Burkina Faso. Hereby, I extend on the previous work in two dimensions. First, I focus on migration in developing countries rather than on migration in developed countries and secondly, I consider not only the effect on migration probabilities but also on *migration destinations*. To the best of my knowledge, I am the first to study how education affects migration destinations in a developing country. The simulation results suggest that an increase in educational attainment in rural regions not only leads to an overall increase in migrations, but it also redirects migration streams directed abroad to urban centers. This leads to an overproportional increase of urban migration.

Finally, as both returns to education and education opportunities are geographically concentrated, I also shed light on how migration prospects shape education decisions in the first place. Previous research has investigated how emigration prospects impact educational attainment of those left behind (Batista et al. (2012), Chand and Clemens (2008) and McKenzie and Rapoport (2011)) or how a reform in the accessibility to urban loca-

[1] Attanasio et al. (2012) briefly discuss a similar issue for Mexico. Like in Burkina Faso returns to education in Mexico are (mostly) concentrated in urban centers to which educated individuals need to migrate if they want to reap returns to education. Attanasio et al. (2012) only focus on modelling education versus work choices of teenagers, abstracting from explicitly modelling potential migration decisions after completing education. Unlike this chapter, they assume that the terminal value function at age 18 only depends on the education level achieved but not on other individual characteristics. In this framework ,however, allows for interactions of education and migration decisions through unobserved ability which affects both the cost of going to school and returns to education in the urban/international sector.

tions in China affected schooling outcomes (Pan (2014)). Pan (2014) exploits a reform on the Hukou system in China, Chand and Clemens (2008) use a quasi-experiment, Batista et al. (2012) and McKenzie and Rapoport (2011) use instruments for individual migration. This framework allows me to study the effect of both urban and international migration prospects on educational attainment without having to rely on a specific reform. This is insofar important as Burkinabe choose different migration destinations and one migration destination might be an (imperfect) substitute for another location. Indeed, I find some evidence that individuals adjust their education behaviour as certain destinations become unavailable, and some few rural individuals even substitute one migration destination for another.

The remains of this chapter are structured as follows. Section 3.2 conducts three simulations which affect initial conditions, schooling costs and migration costs to quantify their contribution in rural-urban differences in educational attainment. Section 3.3 exploits the previously introduced policy reform on lowering rural schooling costs to analyse how educational attainment shapes migration behaviour. We finally turn to studying how migration prospects affect educational attainment and substitution between destinations in Section 3.4. The final section concludes.

3.2 What drives differences in educational attainment between urban and rural individuals?

In this first section of Chapter 3 I study why children from rural areas have much lower educational attainment than children of urban origin and which policy might be best adapted for narrowing the rural-urban education gap[2]. Using simulation techniques, I quantify the impact of differences in initial conditions, and calculate the effect of two alternative policies thought of increasing educational attainment.

3.2.1 Initial conditions, schooling and migration costs

More specifically, I investigate how differences in initial conditions, schooling costs and migration costs affect educational outcomes of rural individuals. In order to quantify the effect of each of these components, I simulate the model under three different scenarios and compare the resulting average educational attainment in years of education. While the first scenario illustrates the component which cannot directly be affected by (contemporaneous) policy, the second and third scenario present two alternatives schemes available to policy makers. The

[2]Burkina Faso committed to the Millennium Development Goals (MDGs) in 2015. One of the eight MDGs stipulates universal primary education for boys and girls. According to an intermediate report on the MDGs in 2013 (see United Nations (2013)), Burkina Faso has made impressive improvement in terms of the primary enrollment rate from less than 40% in 1990 to more than 60% in 2010. However, there remains a large gap to cover to the targeted 100% primary completion rates.

three alternative schemes are the following.

The first scenario simulates the outcomes of individuals of rural origin assuming they had the same initial conditions as individuals of urban origin. This scenario measures the effect of differences in parental background and age structure on education outcomes. Rural children are on average less likely to have a father with medium-high-skilled occupation and belong to older cohorts. Controlling for these factors should increase educational attainment of rural children. The second scenario studies how educational outcomes would change if children in rural areas faced the same availability of primary and secondary schools as in urban centers, that is, if their schooling costs were the same as in urban centers. This scenario allows me to quantify the impact of higher rural schooling costs than in urban centers on educational outcomes. The third scenario looks at the effect of costless migration to urban centers. This scenario captures the deterring effect of costly migration on getting education. Indeed, because migration is costly and returns to education can only be reaped in urban centers or abroad, the cost of migration might be crucial in keeping rural children from getting educated. Finally, the fourth and last simulation combines all three previous scenarios to determine the size of the joint effect.

Figure 3.1 presents the average education level reached in the baseline scenario by black bars. The dotted bars refer to the 'same initial conditions' scenario, the striped bars to the 'same schooling cost' scenario, while the patterned bars refer to the 'free migration to urban centers' scenario. The results of the fourth simulation, which combines all three previous scenarios, is given by grey bars.

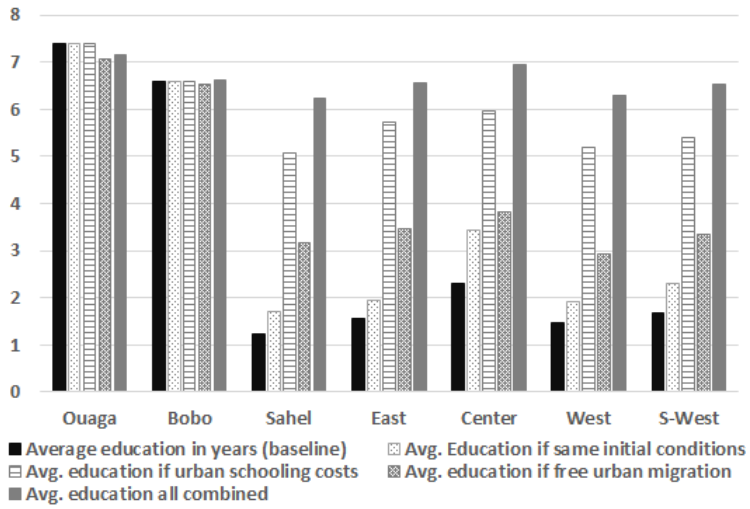

Figure 3.1: Average educational attainment in baseline and alternative scenarios

First of all, I find that all three factors suspected of explaining lower rural educational attainment are relevant, though their respective magnitudes differ. Differences in schooling facilities and consequently, in terms of schooling costs, between urban centers and rural regions are the most important factor. If rural individuals had the same education opportunities up

to secondary school as urban children, their average level of education would at least double (Center), but may even triple (Sahel). These large effects may justify substantial efforts in school building. Henceforth, I shall refer to it as the 'school building policy'.

Migration costs are the second most important factor explaining lower education outcomes in rural regions. The remote regions of the Sahel and East would see educational attainment double if migration to urban centers was costless. Costless migration to urban centers has two opposing effects on education. On the one hand, lower migration costs to urban centers increase net returns to education of rural individuals as they decrease indirect costs which need to be incurred in order to reap returns to education. On the other hand, lower migration costs to urban centers increase the opportunity cost of going to school for rural individuals. Migration to urban centers also offers new work opportunities for those without education, hereby raising the opportunity cost of going to school. The effect presented in Figure 3.1 should thus be interpreted as a net effect of costless urban migration on educational attainment.

Compositional differences in initial conditions (i.e. in the age structure and father's occupational level) explain a non-negligeable part of lower rural educational attainment. However, their contribution is much smaller than either one of the previously discussed policies. This result is insofar encouraging for policy makers, as it suggests that policies which substantially lower schooling costs or eliminate migration costs have a higher impact on educational outcomes than initial conditions which cannot be (directly) affected by policy.

Finally, the last simulation scenario combines the two policies and eliminates differences in initial conditions. The resulting average education levels in rural regions are very close to the ones in urban centers.

3.2.2 Evaluating the effectiveness and cost of alternative policies

The previous analysis revealed that the school building policy raises rural educational attainment by more than costless urban migration policy. In order to rank these policies, it is also necessary to know more about whom they affect and how much they would cost. Calculating the cost of building as many schools in rural regions as to provide the same education opportunities as in urban centers goes beyond the scope of this paper. However, I can draw on the estimated structural cost parameters from Section 2.5.1 of Chapter 2 to evaluate the total cost of each policy as perceived by the individual.

The total cost for the school building policy is the difference between rural schooling costs and urban schooling costs, possibly paid in form of transfers (school cost subsidies) to rural students. The total cost of the free urban migration policy amounts to the sum of estimated migration costs to urban centers. Both of these estimations represent an upper bound estimate to the effective cost of each policy. For example, building schools in rural regions might be less costly than paying school cost subsidies. Table 3.1 shows the estimated

cost and effectiveness of the school building policy in the upper panel, while the lower panel refers to the free urban migration policy. The first three lines of each panel represent the estimated cost of the policy, the additional educational attainment measured in years and an education-cost ratio, which relates how many extra years of education can be achieved on average by an additional input of 10,000 CFA. In terms of effectiveness, I show the overall additional educational attainment in school years (line 2 and 7), as well as its decomposition into the effect on the share who has ever gone to school (line 4 and 9) and the effect on the average education level attained by students measured in years per student (line 5 and 10). The results are given for the whole sample, as well as disaggregated by the region of origin.

	All	**Ouaga**	**Bobo**	**Sahel**	**East**	**Center**	**West**	**South-West**
School building policy								
Estimated cost (in 10,000 CFA)	5,283	13	7	943	696	2,423	862	340
Additional education (in years)	10,847	1	4	1,633	1,302	4,245	1,757	1,904
Education-cost ratio	2.1	0.1	0.6	1.7	1.9	1.8	2.0	5.6
Δ Share gone to school		0.1%	0.3%	243.4%	179.1%	116.4%	153.3%	136.1%
Δ Avg. education years|student		-0.1%	-0.1%	20.4%	32.2%	19.0%	39.3%	35.3%
Costless urban migration policy								
Estimated cost (in 10,000 CFA)	6,583	839	762	877	569	2,214	563	758
Additional education (in years)	4,548	-162	-15	827	594	1,756	695	854
Education-cost ratio	0.7	-0.2	-0.0	0.9	1.0	0.8	1.2	1.1
Δ Share gone to school		-0.3%	0.3%	105.0%	71.5%	39.8%	48.1%	47.7%
Δ Avg. education years|student		-4.0%	-0.8%	26.2%	29.8%	18.1%	35.1%	34.3%

Notes: 'Estimated cost' reflects an upper bound estimate of the cost of the policy, measured from the individual's perspective. 'Additional education' stands for the overall additional educational attainment measured in years. The 'education-cost ratio' is a measure of efficiency, calculated as the ratio of 'additional education' over 'estimated cost'. 'Δ Share gone to school' and 'Δ Avg. education years|student' are the % changes in the share of those ever gone to school and the average years of education per student, respectively.

Table 3.1: Cost and effectiveness of two policies

Overall, the school building policy is not only more effective in raising educational attainment than the costless urban migration policy, it is also less costly. Its main effect comes through the large increase in the share of those who have ever attended school (extensive margin). The effect on the average education level attained (intensive margin), in contrast, is similar to the costless urban migration policy. In the following sections, I thus focus on the school building policy when analysing the heterogeneous effects on educational attainment and on migration patterns.

Two important factors contribute to the lower effectiveness per cost of the urban migration policy. First, the policy entails a positive cost in urban centers, while having a negative impact on urban education levels. By subsidising migration to urban centers, individuals from

Ouagadougou face lower migration costs to Bobo-Dioulasso, where returns to education are lower, thus slightly lowering incentives to get education. In order to circumvent this undesired side effect, the costless urban migration policy should be restricted to individuals of rural origin. Secondly, by lowering the cost of migration to urban centers, the policy not only increases net returns to education (in the future) but also increases the opportunity cost of going to school today by making new and better paid work opportunities available. Policy makers could restrict migration cost subsidies to students or target rural individuals with at least primary or secondary education to reduce the adverse effect of increasing opportunity costs associated with costless migration.

3.2.3 Who benefits most from the school building policy?

In this subsection, I show how different subgroups of rural individuals would increase their average level of education if they faced the same schooling costs as in urban centers. Figure 3.2 shows the change in average years of education for different subgroups. Young and old cohorts are distinguished by the colour (grey versus black symbols) and the low and medium-high paternal occupation levels by different symbols (squares versus diamonds). The average change is depicted by a black line.

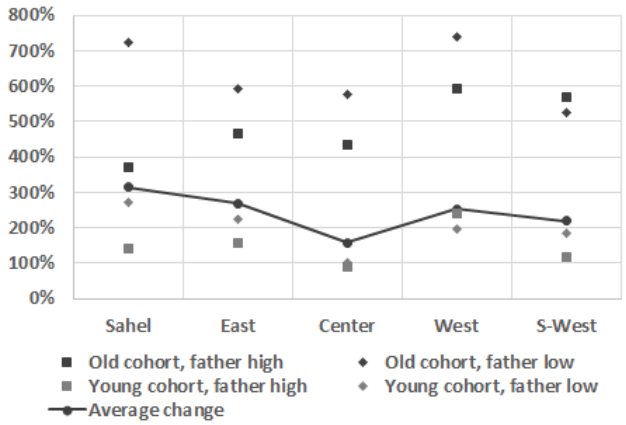

Figure 3.2: Change in average educational attainment for subgroups

Older cohorts show a larger increase in average educational attainment than younger cohorts, and those with a father in a low occupation level increase their education by more than those with a father in a medium-high-skilled occupation. The education reform in schooling costs would also lower differences in educational attainment between subgroups. The first finding was expected as the availability of schooling facilities in rural regions has greatly improved over time. Given the heterogeneous reactions in educational attainment, we would also expect that the proposed reform of lower schooling costs has the strongest impact on migration patterns of older cohorts with a low paternal background.

3.3 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. Hence, a second 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 the 'school building policy' studied in the previous section translates into changes in migration pattern for individuals of rural origin.

3.3.1 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 3.3 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).

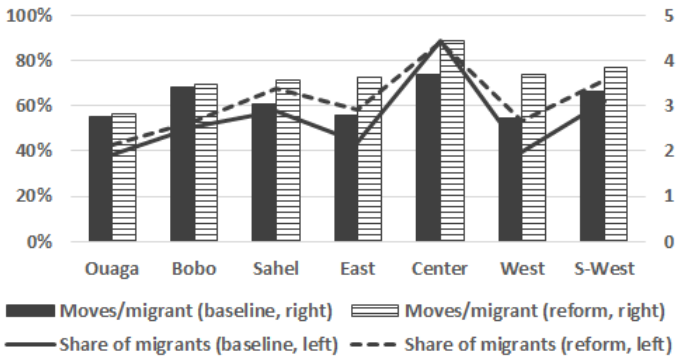

Figure 3.3: Share of migrants and moves/migrant in baseline and reform scenario

The school building policy increases migration both on the extensive margin (i.e. the share of migrants) and the intensive margin (i.e. the number of moves per migrants), thus leading to an overall increase in the total number of migrations[3]. The effect for individuals of rural origin are, as expected, rather large. The share of migrants from rural origin increases on average by more than 6pp and 2 out of 3 migrants move on average once more (i.e. moves per migrant increase by 0.65 move). In the East and in the West, rural regions which were

[3]The total number of migrations is calculated as the product of the share of migrants, the number of moves per migrant and the total number of individuals (which remains constant under the alternative policies).

previously characterised by the lowest shares of migrants, the quantitative increase in total migrations is the largest at 71% and 83%, respectively (this composed effect is not directly shown in Figure 3.3). The changes for individuals of urban origin are modest, the share of migrants increasing by 3pp and the number of moves per migrant by 0.06. Overall, I find that the total number of migrations of Burkinabe would increase by more than 25% (not shown).

In terms of subgroups, those of the older cohorts with a father in a medium-high-skilled occupation clearly increase their number of migrations by the largest amount (more than 60% both in rural regions and urban centers, not shown). This is somewhat surprising because they are not the subgroup which saw their levels of education increase the most due to the reform (see Figure 3.2). Yet, the (still substantial) change in education level is sufficient to incentivise many individuals of older cohorts and high paternal background to migrate while they would have stayed in their origin under the baseline scenario. However, the global effect is not driven by this subgroup who is quantitatively small, but by the younger cohort with fathers in low-skilled occupations. The school building reform also leads to a clear increase in their share of migrants, and a smaller increase in the number of moves per migrant. Altogether, they are responsible for a large fraction of the increase in migration movements.

This simulation analysis confirms that the association of increasing rates of migrants and more moves per migrant with increasing education level described in Section 2.2.3 of Chapter 2 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) developing countries.

3.3.2 Do migration destinations change with education?

The descriptive analysis in Section 1.5 of Chapter 1 and in Section 2.2.3 of Chapter 2 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, I can also check if emigration decreases in absolute terms[4].

Table 3.2 presents the relative share of migration destinations of urban centers, rural

[4]As discussed in Section 2.5.3 of Chapter 2, the estimated model overpredicts urban migration and underpredicts emigration, thus the size of these two migration types should be taken with caution. However, in this analysis I am interested in the sign of the change (notably, if emigration becomes relatively less attractive as education increases) which should not be biased even if the quantitative size is 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 2.24 in the Appendix of Chapter 2). Hence, the simulation of increased education reveals the correct substitution of one migration destination for another even if the estimated quantity may be imprecise (lower bound).

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 occurred first) and classifies them according to their destination.

Table 3.2: 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 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%[5].

[5]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 attracting female migration to urban centers or increasing the return rate 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.

3.4 Do migration prospects affect education choices?

The previous section analysed the effects of a schooling building policy on migration patterns. However, policy makers might not only envisage 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[6]. 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 from Chapter 2. I compare the education and migration outcomes in the baseline with the respective outcomes in different scenarios of restricted migration.

We start by recapitulating some basic characteristics of the simulated population in terms of migration behaviour and educational attainment by year 2000. These numbers are summarised in Table 3.3 and serve as a benchmark when evaluating the effect of different migration policy regimes.

	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 3.3: Benchmark characteristics in terms of migration and education

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

[6]Several policies have been implemented in Burkina Faso since the 1960s in order to slow down rural outmigration (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.

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.

3.4.1 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 3.4 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.

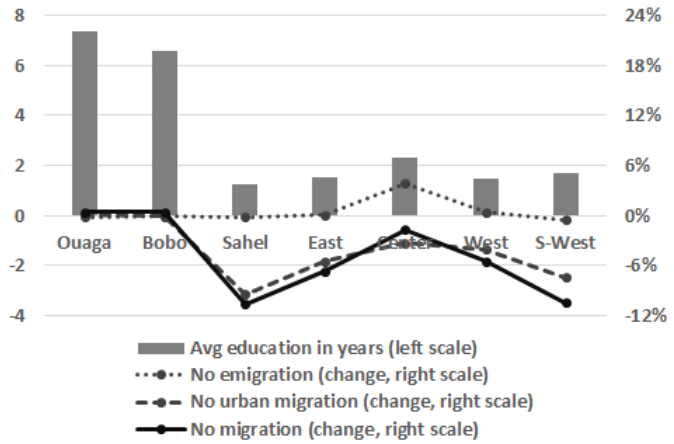

Figure 3.4: Baseline education and respective changes in alternative scenarios

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 2.10 of Chapter 2 which showed that returns from migration of urban individuals are not stemming from income gains but are mainly driven by preference shocks.

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. In the present analysis it remains unclear if the effects are very small for all individuals or if some subgroups show larger reactions which are potentially counterbalanced by other groups. To shed more light on this issue, I now turn to inspecting how these effects vary for different subgroups and to what extent emigration and migration to urban centers is substituted for each other.

3.4.2 Heterogeneous effects

The small predicted effect of emigration prospects on educational attainment could be downward biased because the estimated model slightly underpredicts emigration and overpredicts urban migration. By looking at behavioural changes of different subgroups who are most exposed to the policy regime change, we might get a better idea of how these individuals are affected. Indeed, we observe that migrants are in general older than their non-migrating peers. Migrants going abroad have on average also lower education, are more likely to be of low ability and to have a father with a low-skilled occupation. Migrants going to urban centers, instead, have higher average education, are more likely to be of high ability and to be the child of a medium-high-skilled father. This suggests that the effect of these policy changes should be strongest among older cohorts, and should differentially impact individuals of different ability levels and father's background.

Figure 3.5 shows the effect of the absence of emigration possibilities (left panel) and the absence of urban migration possibilities (right panel) on the average educational response of individuals of a certain subgroup. Older cohorts are indicated by a black mark (younger ones by a grey mark), and those with a father in a medium-high-skilled occupation by small squares versus small diamonds for the others. The dotted and dashed lines correspond to the average effect of the 'no emigration' and 'no urban migration' scenarios shown in Figure 3.4.

Indeed, I find that the zero impact of migration policy changes on educational attainment is virtually the same across all groups from urban origin, while individuals from rural origin are very differentially affected. In general we observe stronger reactions of education to migration

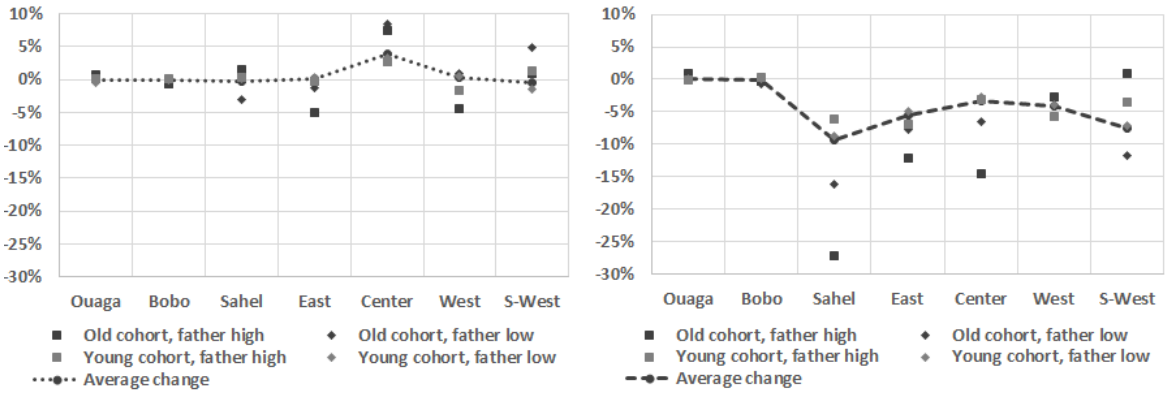

Figure 3.5: Changes in educational achievement in 'no emigration' scenario (left panel) and 'no urban migration' scenario (right panel) for different subgroups

policies for older cohorts. However, apart from cohort effect, I cannot identify any other clear pattern of subgroups. Interestingly, some rural regions like the Sahel and the Center have a large disparity of adjustments in educational attainment. For example, Sahelian of older cohorts and with a father in a medium-high-skilled occupation would reduce their education attainment by almost 30% if their urban migration prospects disappeared. For individuals from the rural Center, the reduction would be of 15%.

We thus conclude that while migration prospects seem to have small effects on overall educational attainment, individuals of different subgroups might react very differently and in a substantial way to a change in migration possibilities.

3.4.3 Are urban and international destinations substitutes?

Another question which arises as a consequence of the relatively low global impact of migration prospects on educational attainment is whether urban and international destinations are substitutes. In terms of labour market structure they are fairly similar, however, they differ in their unemployment rates and transition in occupations. If urban and international destinations are (imperfect) substitutes, we should observe that a part of the migration which would have been destined to the restricted location is redirected to another location.

Figure 3.6 shows the share of migrants in the baseline model of unrestricted migration (black bars) and the relative share of emigrants to migrants going to urban centers in the baseline scenario (grey bars). The left panel refers to the alternative scenario of restricted emigration. It depicts the change in the share of migrants (black dotted line) and the change in migrants going to urban centers (grey dotted line). The panel on the right refers to the scenario of restricted urban migration. It also depicts the change in the share of migrants (black dashed line) and the change in emigrants (grey dashed line).

I find that overall migration decreases in each alternative scenario (indicated by the black

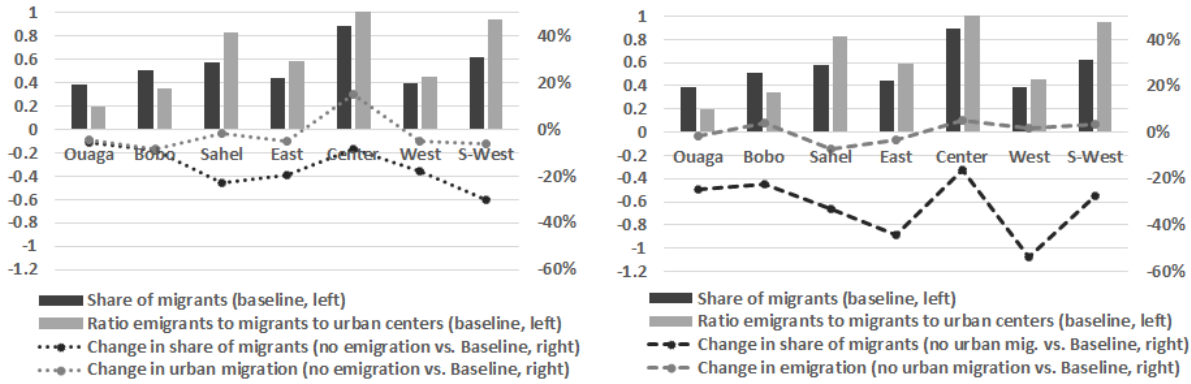

Figure 3.6: Changes in migration behaviour in 'no emigration' scenario (left panel) and 'no urban migration' scenario (right panel)

lines), however, the impact is much stronger in the case of restricted urban migration. This does not come as a surprise because urban migration is more prevalent than emigration in most regions in the baseline scenario (indicated by grey bars). Interestingly, I find almost no evidence of substitution effects between urban and international locations. The respective grey lines are close to 0 in both scenarios. An exception represents the Center in which individuals substitute to urban migration when emigration becomes unavailable. They slightly increase their educational attainment (as previously shown in Section 3.4.1) and then substitute from emigration to urban migration. The converse, however, is not true.

3.5 Conclusion

In this chapter I have investigated how education and migration decisions interact. More specifically, I have looked at what drives rural-urban differences in educational attainment, how education shapes migration behaviour and how migration prospects affect educational attainment. These questions are investigated using different policy simulations based on the dynamic life-cycle model of endogenous location and education choice developed in Chapter 2.

I find that rural-urban differences in educational attainment are most importantly affected by differences in schooling costs. However, migration costs also play a non-negligeable role in lowering incentives of going to school in rural regions. The second analysis shows that increases in average education lead to changes in migration behaviour. In particular, education not only increases the incidence of migration (such as the probability of migration and the number of moves per migrant) but also shifts migration movements destined abroad towards migration to urban centers. The results presented in this chapter are likely to be a lower bound estimate for how much migration would be redirected from abroad to urban centers because the baseline model estimated in Chapter 2 underpredicts the incidence of emigration

in the first place[7]. The last analysis reveals that changes in migration prospects indeed translate into changes in education outcomes. However, the overall effects are relatively small but heterogeneous across different population subgroups.

Put in a nutshell, the simulation results in this chapter show that migration patterns are greatly affected (both quantitatively and qualitatively) by changes in educational composition in the population, while extreme changes in migration regimes only have minor effects on educational attainment.

The main contribution of this chapter is to exploit the framework developed in Chapter 2 to analyse the interactions of migration and education decisions. Previous research has relied on specific policy reforms, quasi-experiments or on instrumental variable techniques to understand the effect of migration prospects on education. This framework has the advantage that it can identify and quantify the education incentives of different migration destinations and analyse also the reverse.

One main finding related to the role of Côte d'Ivoire, as the preferred destination of international migrants, should be highlighted. Previous research by Batista et al. (2012) and Chand and Clemens (2008) has found a positive effect of emigration prospects on educational attainment. In the case of Burkina Faso, I find a negative (albeit small) effect of emigration prospects. Reducing emigration costs to Côte d'Ivoire lowers incentives to get education in rural regions. Policy makers should avoid subsidising or facilitating emigration to Côte d'Ivoire as this may backfire in terms of lower education outcomes. A country which is among the lowest ranked in the world in terms of educational attainment is unlikely to be overeducated. However, as the analysis in the second chapter uncovers, the risk associated with getting education must be reduced in order to render education more attractive. This might be the most promising path for getting on the track of economic development.

[7]Indeed, if I simulate a model of costless emigration, the relative importance of emigration with respect to urban migration would reverse and average educational attainment would drop by 15% in certain rural regions.

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