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THE DETERMINANTS OF MIGRATION: HOUSEHOLD AND COMMUNITY NETWORKS

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Abstract

Despite the great efforts scholars have devoted to the study of migration a unified and coherent theory of international migration does not yet exist. Particularly, only in recent years, scholars have developed models of labor mobility to take into account social interaction across agents. Similarly, empirical analysis lacks an adequate approach to social interaction in migration, often using very rough measures as, for example, the stock of compatriots in the receiving country. The aim of this dissertation is to examine economic migrants decision to migrate, focusing specifically on potential migrants who can choose if and where to migrate, and which conditions facilitate their migration. It investigates how wealth, social networks and education interact in determining households' migration strategies and the aggregate dimension and composition of migration flows. Household income maximization strategy evaluates migration as a possible, but costly investment. In a context of underdeveloped financial and insurance markets, budget constraints play a key role in determining migration behavior. Poorer households have higher incentives, but fewer opportunities to migrate, whereas better-off households have fewer incentives, but greater possibilities of migrating. Social networks, reducing costs and risks of migration and thus counterbalancing budget constraints, mitigate this effect and allow new social strata to migrate. In the empirical analysis we examine Mexican migration to the U.S., proposing two new tools to apply in empirical analysis and showing that household and community networks act as complements in the probability of migration, and as substitutes in the optimal number of migrants. We also examine migration to the U.S. from five Central American countries, comparing findings with those obtained for Mexico.

Keywords: Migration, household, budget constraints, networks, education.

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Introduction

Whereas owners of production inputs or commodities, such as bricks or bottles of wine, can ordinarily ship them away (so as to maximize profits or utility) while themselves staying put, owners of labor must usually move along with their labor. Furthermore, owners of labor have both feelings and independent will. These simple observations divorce migration research from traditional trade theory as the former cannot be constructed from latter merely by effecting a change of labels.

Oded Stark, The Migration of Labor, 1991 Page 24

Migration has steadily climbed up the list of public and policy concerns. Policy-makers in receiving countries, facing increasing numbers of migrants, have recognized that migration can be affected by interventions in the areas of development policy and humanitarian assistance, as well as by wider policies and practices in the foreign and domestic spheres. Answers to the fundamental questions posed by policy-makers and public opinion as regards who and how many immigrants should be let in, and what their potential contribution to the receiving countries' economy and society could be are undoubtedly shaped by the varying political establishment and the socio-economic structure of the sending and receiving countries.[1] In order to produce accurate predictions of migration flows under different migration policies,[2] it is crucial to examine the causes and dynamics behind the decision to migrate.

The aim of this dissertation is to examine economic migrants decision to migrate, focusing specifically on potential migrants who can choose if and where to migrate, and which conditions facilitate their migration. It investigates how wealth, social networks and education interact in

[1] Borjas (1995:1) points out that: "*If* we are willing to maintain the hypothesis that immigration policy should increase the national income of natives, the government's objective function in setting immigration policy is well defined: maximize the immigration surplus net of the fiscal burden imposed by immigration on native taxpayers".

[2] Bauer et al. (2000) stress the importance of policy in immigration assimilation and in changing the attitudes of native populations towards immigrants. Boeri (2009) models the perception of migrants' contribution to the welfare system among natives, stressing the importance of psychology and economy more than ideology in negative attitudes toward migrants. Using European Social Survey data, Boeri (2009:29) finds that migrants in Europe are "overrepresented among beneficiaries of non-contributory transfers".

determining households' migration strategies and the aggregate dimension and composition of migration flows.

Why is forecasting migration and immigration policies of interest for economists? The United Nations estimate that about 214 million people are living in countries different from their own (United Nations, Department of Economic and Social Affairs, Population Division, 2009). While only 3.0 percent of the world's population is categorized as migrant, the percentage increases dramatically when we focus on Europe, North America and Australia. For example, in the period 1965 - 1990, the proportion of foreigners in the population of these three areas increased by an average of 2.7 percent, reaching about 7.6 percent (U.N., in Hatton et al. 2003). Data on foreign workers in the civil labor force show an even more significant trend.

In 2002, in terms of capital flows, migrants' remittances amounted to US$79 billion, exceeding official development aid by US$28 billion (Yang, 2008), with over 60 percent going to developing countries. In many of these countries remittances amount on average to 13 percent of their GDP, and often account for a much higher share, as in Somalia, where an estimated 25-40 percent of all families receive remittances from abroad.

Migration studies are particularly challenging for researchers, who require ample knowledge regarding not only the borders of the single specific branch of economic literature, but must also be conversant with research related to different areas of social studies, such as sociology, anthropology and political science. Research belonging to various areas of social science has contributed to the construction of a general and comparative framework of reference which, in my opinion, positively influenced the elaboration of hypotheses and analytical tools for this thesis.

As pointed out by Massey et al. (1993), despite the great efforts scholars have devoted to the study of migration a unified and coherent theory of international migration does not yet exist. However there are many different theories, largely developed in isolation from each other, and not always divided by the usual boundaries in discipline. These theories are not necessarily mutually exhaustive, and they would be more powerful if they were examined together, for proper understanding of the complex nature of modern migration.

There are several empirical findings which puzzle economic research of international labor mobility. In the standard economic approach, for example, migration does not occur in the absence of differences in wage levels across countries, although some scholars have observed migrant flows in the absence of wage gaps, absence of flows in presence of wage gaps, and flows of migrants going in the opposite direction from those indicated by wage gaps.[3] In addition the high ethnic concentration of migrants in some locations, economic development going hand-in-hand with migration, and unclear results obtained in self-selection analysis, are not explained by standard approaches.

To deal with these findings, in recent years, scholars have developed new models of labor mobility to take into account social interaction across agents. As pointed out by Radu (2008) "the incorporation of positive social interactions implies the existence of 'social multipliers' and allows small changes in exogenous variables to transform into large changes in the endogenous variable". Specifically, migration choices are influenced either endogenously by actions taken by a group of peers, or by a series of specific group characteristics (contextual effect). As Radu notes, there have been few attempts explicitly to model the social structure in migration studies, and some developments have produced fruitful results only recently. Similarly, empirical analysis lacks an adequate approach to social interaction in migration. Whenever it implements the social network structure, it does it through very rough measures as, for example, the stock of compatriots in the receiving country.

Borrowing from neoclassical labor migration theory as well as from the New Economy of Labor Migration (NELM), this dissertation identifies household income maximization as potential migrants' main motivation to migrate. It also identifies in internal and external household social interactions the means by which to overcome budget constraints binding migration.

The literature review focuses on the importance of the relation wealth-costs-budget constraints, and how social capital (specifically migrants' networks) can modify households' migration strategy. It moves from identification of the main decisional units (from single subjects to households), continues with the definition of the objective function to be optimized (income

[3] Unpredicted phenomena have been observed by Myrdal (1944) for the U.S., by Faini et al. (1997) for the southern European region, and by Hunt (2000) and Fidrmuc (2004) for Eastern European countries

maximization vs. income risk minimization) and concludes by focusing on the interaction of potential migrants with the social environment.

Chapter 2 models household migration decisions in a dual economy, following the model developed by McKenzie and Rapoport (2007). Household income maximization strategy evaluates migration as a possible, but costly investment. In a context of underdeveloped financial and insurance markets, budget constraints play a key role in determining migration behavior. Poorer households have higher incentives, but fewer opportunities to migrate, whereas better-off households have fewer incentives, but greater possibilities of migrating. Two divergent economic forces generate this phenomenon: the pulling effect of higher incomes in destination countries, and the binding effect of budget constraints. This generates an inverted U-shaped relation between wealth and migration which, in this dissertation, is called the “composite wealth effect”. Social networks, reducing costs and risks of migration and thus counterbalancing budget constraints, mitigate this effect.

Chapter 3 examines Mexican migration to the U.S., proposing two new tools to apply in empirical analysis. Whenever scholars empirically investigate migration, they have to face two main problems: sample selection and endogeneity. As it is well established in the literature that migrants are a select group, it is necessary to apply a methodology of analysis which corrects for selectivity. Networks of migrants appear to be crucial in household decision-making,[4] but they are both the cause and the effect of the decision to migrate, so that a method solving for endogeneity is required. While previous literature focused generally only on one of the two above aspects, I apply a Three-Step procedure along the lines of Mroz (1987) and an Instrumental Variable Poisson approach to solve simultaneously for sample selection, endogeneity and count data. These empirical approaches confirm and strengthen previous literature findings on the inverted U-shaped relation between wealth and migration. In addition, the analysis shows that household and community networks act as complements in the probability of migration, and as substitutes in the optimal number of migrants. Community-level networks are determinant in the migration path of poorer social strata, but do not seem to be significant in richer ones. Therefore, household and

[4] See, for example, Bauer and Zimmermann (1997).

community networks may convey different kinds of information, and/or variables used to describe their contribution may capture some other effects, such as the migration development stage.[5]

Chapter 4 examines migration to the U.S. from five Central American[6] countries, comparing findings with those obtained for Mexico. It tests whether the same fundamentals apply to countries different from Mexico, but having many characteristics in common with it. Conditional on the small sample of migrant households, the analysis reveals the fact that community-level networks have a larger effect on potential Mexican migrants (particularly rural Mexicans) than in the other five Central American countries. This differential is partially explained by the small spread of migrant networks in these five countries and in urban areas. Nonetheless, fundamentals identified the behind migration decision appear to be similar across the region.

Chapter 5 is co-authored with Luca Ferretti,[7] and moves back to theoretical modeling to analyse one important aspect emerging from the empirical chapters: the correlation between wealth and education and its influence on household migration decisions. Education appears not to be significant or only slightly positively correlated with the propensity to migrate, when wealth and its square are both taken into consideration. Instead, when wealth squared is excluded from the analysis, its negative influence is captured by education. The overlapping generation model developed along the lines of Lowry (1981) demonstrates how, even in cases of extreme positive selection, the negative cohort effect is a normal observable phenomenon. This simple model explains the unclear results obtained in analysis of the so-called "quality of migrants" as the effect of the correlation between wealth and education.

Lastly, conclusions and future developments are presented.

[5] The data do not allows us to go further in tracing the origin of this difference; nonetheless, this result opens a new field of research.
[6] Costa Rica, Dominican Republic, Guatemala, Haiti and Nicaragua.
[7] Universitad Autonoma de Barcelona.

Chapter 1 Literature Review

1.1 Introduction

Since the seminal work of Roy (1951), many economists have investigated the causes of labor mobility. Several prominent scholars have concentrated their analysis on the relation between migration expected returns, costs, risks, networks and social capital. Borjas (1994, 1995), reviewing the literature on immigration to the US, focused on the quality of migrants (self-selection and cohort effect), their wage convergence path, their contribution to the welfare state, and second-generation migrants. Ghatak et al. (1996, pag:1), presenting "a critical survey of theories of migration, their welfare and policy implication and their empirical relevance", show that international labor migration is not the immediate response to wage differentials. Massey et al. (1993) provide the most complete review of migration theories, carefully labeling them in eight different groups, discussing their empirical evidence, pros and cons, and promoting a process of convergence. More recently, Hatton and Williamson (2003), summarizing the literature, look specifically at empirical studies on the economic and demographic fundamentals driving world migration, whereas de Hann (2006) analyses the literature on migration and its links with development studies. Lastly, Radu (2008) reviews migration literature, looking specifically at the effect of social interactions on migration and how they have been treated in theoretical and empirical research.

The relation between wealth and migration is the starting point for economists in studying the determinants of migration flows. For neoclassical theory, migration is the result of the aggregation of rational choices made by single potential migrants trying to maximize their income in response to wage gaps across countries. The rationality of their choices and the possibility of not undertaking migration lie at the basis of voluntary labor migration (Sjaastad, 1962).

In the presence of positive wage gaps, higher than migration costs, rational agents move from relatively poorer to relatively richer areas. However, if this were the whole truth, we should observe much larger migration flows than those observed in reality (Clemens, 2008). Moreover, several contributions in the literature observe migrant flows going in the opposite direction to wage gaps, migrant flows without wage gaps and, more in general, a series of unexplained phenomena.

A partial explanation of these discrepancies between theoretical predictions and empirical observations is due to the presence of borrowing constraints, usually not taken into consideration in theoretical models. Budget constraints are in fact one of the main elements limiting migration. Nonetheless, budget constraints and imperfect financial markets can only explain why we observe relatively low levels of migration even in the presence of large wage gaps (Hatton and Williamson, 1992), but they cannot explain other empirical findings, such as the high ethnic concentration of migrants in some specific areas (the friends and relatives effect).

NELM, finding in the imperfection of insurance and credit markets the main causes of migration, provides a partial explanation to these problems. Identifying the household as the decisional unit, NELM allows potential migrants to exploit a larger set of optimization strategies; in particular, migration is the result of a process of income risk minimization. Households, composed of a certain number of members, permit strategic allocation of workers in different sectors of the economy or in different countries. If risk minimization is the only objective function, we should observe widespread migration, with migrants from the same household working in different countries or economic sectors, whereas migrants usually tend to concentrate in specific groups and economic sectors.

Although NELM explicitly identifies in household internal links one of the key aspects in migration decisions, households do act independently of each other, and equilibrating mechanisms are determined by aggregate behaviors.[8] This is not likely to be the case in the real world, where interactions outside the households have been shown to be crucial in many economic decisions,[9] specifically on the decision to migrate.

Network Theory based on social interactions explains the high ethnic concentration of migrants and the presence of migrant flows with preferential receiving counties. Each migrant, creating new links in the receiving country and retaining[10] some in the sending country, modifies the social environment in both, allowing the accumulation of migration-specific knowledge (migration social capital) able to reduce the costs and risks of migration and generating a self-perpetuating mechanism. In particular, networks affect the relation between migration and

[8] Each migrant reducing the supply of labor in the sending country and increasing it in the receiving country, increases wages in the sending country and decreases them in the receiving country, respectively. Similar aggregate behaviors happen in markets different from that of labor. Only Stark's (1989) deprivation effect explicitly models social interactions among different households.
[9] Goyal (2007).
[10] Hanson and Spilimbergo (1999) find that the purchasing power of both the U.S. and Mexico matters in border apprehension, suggesting that potential illegal migrants expect to retain connections in both countries.

wealth, mitigating the effect of budget constraints not only by reducing costs and risks, but also acting as substitutes for financial and insurance markets.[11]

The endogenous process identified by network theory is not limited to potential migrants, since migration alters the whole sending country's socio-economic environment. The accumulation of migration-specific social capital, remittances, changes in the distribution of wealth[12] and land, all concur in generating a new set-up which has the potential to produce favorable new conditions for migration. Cumulative causation, as developed by Massey and followers, goes in this direction, providing a general framework for tracing potential migration paths.

Analysis of the main empirical contributions dealing with the problems arising in the migration context follows a review of the theory. Applied economists have been studying the economic causes of migration at least since the 1980s. Only recently, however study of the effects of networks and accumulation of migration capital, testing network and cumulative causation theory prediction, has been made possible by the availability of new databases and empirical tools. Most empirical research focuses on Mexican migration to the U.S., because databases are more detailed and go beyond the mere stock of compatriot effect. This dissertation uses data from the Mexican Migration Project (MMP) and Latin American Migration Project (LAMP). The choice of these databases is due to their ethno-survey structure, that can reconstruct migrants' history and produce some useful measures of family and community networks.

1.2 The Wealth-Migration Relation

As noted by Roy (1951) and later investigated in depth by economists, migration of labor is the result of strategic behavior undertaken as a response to income differences, credit and insurance market imperfections, shocks and, more in general, economic opportunities. International migration is expensive, and thus requires investments which must be paid before

[11] Yang (2008).

[12] Docquier and Rapoport (2003) develop a model to analyse the link between migration, remittances and inequality. The main pro of their model is to take into account the effect of migration in local labor markets, making migration an endogenous process even in the absence of networks able to reduce the cost of migration.

migration actually takes place (or in the initial phase), whereas returns will be enjoyed only after a certain period of time.

This section specifically focuses on how literature analyses the migration decision. The theories presented all focus on the strategic decision of potential migrants as single agents. Independently of the minimum decisional unit and its set of strategies, all these theories have one feature in common: potential migrants are not directly influenced by other migrants. This reduces the migration decision to a "simple" evaluation of economic pros and cons.

At microeconomic level, two main fundamentals which must be discussed when analysing the wealth-migration relation have been driving most of the academic debate: determining who the decision-makers are and what their objective function is. The neoclassical approach and NELM both investigate the role of wealth (intended as expected returns and budget constraints)[13] in the migration decision - the former focusing mainly on single agents migrating to maximize their expected return (or utility), and the latter on households having income risk minimization as their objective function.

In this context the typical economic definition of wealth intended as a stock of capital is too strict and misleading. I define wealth in a broader sense, as the sum of all productive capital decision-makers own. This is not only financial capital, but also land, education and, more in general, all those characteristics which make a worker out of a migrant. When referring to the *compound wealth effect,* I mean the contrasting effect between the economic attraction (as an income and investment possibility) of the receiving country's economy, and the budget constraint binding potential migrants.

1.2.1 The Neoclassical Approach: Single Agents Maximizing Income

The neoclassical approach, from the pioneer work of Lewis (1954) to its best-known formal representation in Harris and Todaro (1970), identifies wage gaps among countries as the origin of migration flows. The direction and dimension of migration flows are driven by those gaps. In condition of full employment, labor owners move from their original countries and regions to places where returns to labor are higher. The elimination of these differentials eventually causes migration to cease. In particular, following Harris and Todaro (1970: 126), "migration proceeds in

[13] Henceforth: *compound wealth effect.*

response to urban-rural differences in expected *earnings* […] with the urban employment rate acting as an equilibrating force on such migration".

This partial equilibrium model of urban/rural labor migration, extended to international mobility, is the cornerstone for a larger set of microeconomic models based on the original work of Sjaastad (1962) on the mobility of workers. In these models rational, risk-neutral and perfectly informed individual agents decide whether and where to migrate computing the net present value of migration. In its simplest formulation, the neoclassical microeconomic approach to migration (Roy, 1951; Todaro, 1969; Borjas, 1985, 1987, 1990, 1991; Chiswick, 1986, 1999; Chiswick, and Miller, 2002, 2006) may be expressed as:

$$d_i = w_{f,i} - w_{h,i} - z_i - c > 0 \qquad (1)$$

where d is the decision to migrate of individual i ($i = 1 \dots n$), $w_{f,i}$ and $w_{h,i}$ are the expected earnings in the foreign and mother countries respectively, z_i is the psychological cost of migration, and c is the direct cost of migration. Clearly the higher the expected earnings in the receiving country, the more prone individual i will be to migrate, and the higher those in the native country and migration costs,[14] the less prone individual i will be. In this framework, migration may be viewed as a form of investment in human capital. Labor owners move to where productivity is higher, i.e. where they can earn higher wages but, before they earn them, they have to invest in the process of migration. Since people discount future earnings, young people are more likely to migrate, as the advantage of migration declines as the remaining working life becomes shorter.[15]

This approach highlights labor migration as an individual strategy to improve living conditions based on economic determinants. Specifically, labor migration is a wealth improvement

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[14] Because expected earnings depend on the number of years a potential migrant expects to work, the equation may be reformulated as: $ER(0) = \int_0^n [P_1(t)P_2(t)Y_f(t) - P_3(t)Y_h(t)]e^{-rt}dt - C(0) \qquad (2)$
where $ER(0)$ is the expected return to migration at time 0, t is time, $P_1(t)$ is the probability of successful migration, $P_2(t)$ is the probability of employment at the destination, $Y_f(t)$ is earnings in the receiving country, $P_3(t)$ is the probability of employment at home, $Y_h(t)$ is home country earnings; r is the discount factor, and $C(0)$ is the cost of migration including physical and psychological costs. Clearly, each subject has different expectations in terms of probability of success, earnings (which are function of the skill level of the potential migrant), discount factor, and costs. If $ER(0)$ is greater than zero the potential migrant will migrate, and at least in theory potential migrants will migrate where their expected earnings are greater.

[15] Hatton (1995) proposed a model explicitly to take into account expectations both in sending and receiving countries. Starting from the basic formulation: $d_i = Eu(y_f) - Eu(y_h) + z_i$
where d_i is the probability of migration, $Eu(y)$ is the expected stream of income in the two countries, and z_i is the individual's non-peculiar utility difference between location (including costs). The author stresses the importance of unemployment rates, which have greater weight than in usual risk-neutral models, and the auto-recursive nature of migration flows.

opportunity which attracts migrant flows to receiving countries, not the effect of exogenous factors pushing people out of their original countries.

The microeconomic neoclassical approach raises a set of questions concerning the relation between development and migration: of particular interest is the responsiveness to differences in expected earnings from the poorer or poorest regions and social strata. In the fundamental hypothesis of the neoclassical approach, LDCs are more likely to be labor sending countries and have poorer social strata with higher incentives to migrate. De Hann (2006: 5) noted that, while "many development specialists have argued for rural development to reduce migration pressure", this does not seem to be the case according to empirical research. Some studies have come to the conclusion that development increases migration. For example, in the Punjab, the Green Revolution occurred during period of high rates of both emigration and immigration. While Japan was urbanizing, emigration increased, and, in China, as shown by Liang and White (1997), the development of rural areas coincided with massive outmigration, with important negative effects in terms of selection.

The fundamental cause underlying these phenomena is the costly nature of migration. Lack of resources to invest in migration drastically limits the opportunity of the poorer sections of the population, i.e., those having the higher incentive to migrate. This poverty trap[16] is influenced by the amount initially needed to undertake migration: as the necessary initial cost increases, the number of migrants decreases, eliminating the poorer social strata from migration. According to Skeldon (1997), as reported by de Hann (2006:5): "it is impossible to envisage development without migration, and migration *is* development".

In a world of perfect competition with complete present and future markets, single agents may overcome budget constraints by using loans from credit markets to finance migration. Even in the most highly financially developed countries, it is extremely difficult to find legal institutions financing migration, as the default risk is extremely high. In any case, credit institutions require guarantees which many potential migrants, particularly those in the poverty trap, cannot offer.[17] This partially explains why we observe relatively low levels of migration: for example, Clemens et

[16] This effect is due to the presence of imperfect financial and insurance institutions, and inadequate welfare programs in origin countries – caused by their extreme poverty.
[17] This suggests that the neoclassical approach (at least in its simpler form) may be a valid way of modeling North-North migration, so that it is a valid instrument to analyse migration flows involving developed areas, where credit institutions are well developed, or migration flows facing low initial investment. It fails to describe correctly South-North migration and, more in general, migration requiring high initial investment.

al. (2008) showed that the yearly net return to migration from Mexico to the U.S. in 1994 was of the order of 15,000 US$, while the cost of a *coyote*[18] was 619 US$ (Orrenius, 1999).[19] Hanson (2006) estimates that, in 2000, a 23-27-year-old Mexican migrant with 5-8 years of schooling would have covered the cost of crossing the border in 313 hours of work in the U.S.. With such a high differential, we should observe a considerably larger migration flow.

The core of the neoclassical models based on individual rational agents, finds its main limitation in that a single agent maximizing income (or utility) cannot overcome budget constraints in underdeveloped financial markets. Migration, particularly South-North, is characterized by a series of informal institutions providing support to potential migrants. The first and foremost informal institution is the household. Households or enlarged families can finance the migration of one or more members, by pooling members' resources to overcome individual budget constraints and to escape from the poverty trap. In addition, households, who can spread their endowment of resources, can pursue objective functions different from those of a single agent. The change of the decisional unit allowed scholars to develop a completely different set of models, now grouped in the so called NELM.

1.2.2 The New Economics of Labor Migration: Households as the Core of Migration

> ***"Just as it is clear that neither a brick nor a bottle of wine can decide to move between markets, so should it be equally clear that a migrant is not necessarily the decision-making entity accountable for his or her migration."***

Oded Stark, The Migration of Labor, 1991 Page 25

In the 1980s and 1990s, considerable developments in migration research improved the level of analysis, identifying a broader number of variables involved in the location decision of the supply of labor (migrants). In particular, analysis focused on two main interlinked elements:

1. A "new" decision-maker agent: the household (Stark and Bloom, 1985);

[18] A smuggler; Hanson and Spilimbergo (1999) find a strong negative correlation between attempted illegal migration and Mexican wages.

[19] Using MMP data, Orrenius (2001) showed that, during the period 1978-1996, around 69 percent of Mexican migrants to the U.S. passed the border by hiring a coyote for average prices of US$385 – 715; Cornelius (2005) found that, after the change in U.S. immigration policy after 9/11, the cost of hiring a coyote increased by around 37%

2. The importance in the migration decision of markets different from that of labor (Stark and Levhari, 1982).

In cases of market failures, such as occur in underdeveloped credit and insurance markets, single-income (utility) maximizer agents cannot diversify their source of income and are extremely vulnerable to shocks (Levhari and Weiss, 1974). Spreading risks is the great way of diminishing them (Hicks, 1967): households, through the strategic allocation of members and sharing of earnings, can diversify earning sources to minimize income risk. In this optic, migration is viewed as a way to reallocate household resources - in the specific case labor. Some members are kept at home to work in local activities, while others can be sent abroad to work in places (or specific activities) which are negatively correlated with home activities.[20]

Migration decisions are often taken together with other non-migrating relatives: costs and returns are shared among household members following rules defined in a "shadow" (implicit) contract between those who leave and those who remain. This kind of agreement explains why remittances exist, not only in terms of altruistic behavior (from which the incentive to deviate can be strong), but as part of an intertemporal contractual arrangement. Scholars have identified the conditions in which this kind of contract is voluntarily "signed" with family members rather than with third parties[21], and in which conditions such contracts are self-enforceable (Stark, 1984).

Remittances play a key role in this approach, reflecting the relative bargaining power of components within a family and depending on various household structures (Sana and Massey, 2005); they are also the vehicle through which minimization of risk is attained. Non-migrant members are ensured against shocks to home activities because they usually receive remittances;[22] in turn, they ensure that migrants are protected against problems (such as housing costs and periods of unemployment) which they might encounter during the whole period they stay in the receiving country. It is, in fact, not uncommon to observe counter-remittance flows.

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[20] Following Ghatak et al. (1996), if the utility of a representative household is $u(Y)$ where Y is the income and u is the typical concave utility function, the household can allocate a proportion M of the total labor force $\overline{N}$ to migration. The cost of migration is assumed to be rC (each period); the probability of getting a job is p, attached to the receiving country wage w_b; unemployment $(1-p)$ is attached to a wage w_{b^*}. Sending and receiving countries are called a and b respectively. Those members not involved in migration receive a salary w_a. Defining $\widetilde{w}_b = w_b - rC$ and $\widetilde{w}_{b^*} = w_{b^*} - rC$, since households maximize their expected income (and therefore minimize the risk), the condition in which to observe migration is: $p(\widetilde{w}_b - w_a) \geq (1-p)(w_a - \widetilde{w}_{b^*})$.

[21] For example, either because third parties are not available (underdeveloped financial markets) or because the cost of a contract with a third party is too high, and therefore not affordable or profitable.

[22] See Yang (2008), on the effect of the monetary shock on Korean remittances.

NELM emphasizes the importance of link between migration, as a phenomenon due to labor market conditions, and migration conditioned by a variety of other markets determinant in household survival strategy (Stark and Levhari, 1982; Stark, 1984, 1991; Taylor, 1986): *crop insurance markets*, *futures markets*, *unemployment insurance* and c*apital markets*. As reported by Massey et al. (1993), these four main sources of risk cannot be overcome in LDCs, because of the lack of developed insurance and credit markets. Notably, NELM highlights the importance of the distribution of income and the risk associated with expectations and market imperfections, as well as differentials in expected returns. These are key players in increasing the propensity, as well in reducing the possibility of migrating.

Although NELM, by identifying the main actor in the migration decision as the household, appears to be more in line with the fundamentals behind South-North migration than the neoclassical approach, one critical element must be noted. While differentiating the production of farming activity, or reallocating family members to various other labor sectors is certainly feasible and may be labeled as “good father behavior”, computing migration risk and its correlation with a household’s main business is too complex for most LDC households. Migration mainly appears to be a maximizing income strategy. If migration were an income-risk minimization strategy, we should expect migrants from the same household to migrate to very different places and to economic sectors negatively correlated with those of the rest of the household. This is not likely to happen, for example, in Mexican migration. Although U.S. and Mexican economies are highly correlated[23] we observe that the vast majority of Mexicans migrate to the U.S.. Moreover, members of the same household have, probably, not only been migrating in the same country, city and neighborhood, but they often work in the same economic activity. This goes in the opposite direction of the diversification proposed to minimize income risk.

1.2.3 Conclusions on the Wealth-Migration Relation

In this section, two of the main theories investigating the determinants of initiation of migration (Massey et al., 1993) were presented: the neoclassical approach, and NELM. Dual Labor Market Theory and World System Theory were not discussed, since their approaches do not focus

[23] Rather, the Mexican economy depend on that of the U.S..

explicitly on the free strategic choice of migrants and on the key relation between wealth and migration at microeconomic level.

The two approaches jointly identify as the crucial node in the migration decision the relation between wealth, intended as budget constraints, migration costs and underdeveloped financial markets. In each labor migration decision, the poorer are those who have both higher incentives to migrate and fewer opportunities to do so. Migration and development are closely associated and this must be taken into consideration when formulating a model or a theory.

The neoclassical approach and NELM have similar features but different focal points. Both focus on rational decision-makers optimizing their objective functions in isolation; the former on a single utility maximizer, and the latter on a household risk minimizer. Both theories find the explanation of migration in differences in the economic structure of two or more countries: wage gaps, income risks and differences in the development of insurance and financial markets are just some of the identified causes which may influence decisions about if, when and where to migrate. Neither approach examines the causes of these discrepancies across nations, but, at least in some developments, they propose migration as a long-run solution to these gaps.

I argue that households better represent the typical decisional unit in South-North migration. Pooling their members' resources, households can, at least partially, overcome budget constraints, even in the absence of working and/or reliable credit institutions. This approach also justifies the presence of remittances, not simply in terms of altruism but in terms of informal contracts. At the same time, migration appears to be a strategy to maximize family income[24] more than one to minimize income risk. This does not mean that sending some members abroad is not a diversification strategy, but that the first purpose of migration is to increase income.

Nonetheless, the high ethnic concentration of migrants, the occurrence of relatively small migration flows compared with wage gaps, the unclear results of self-selection analyses and other empirical evidence and qualitative[25] research, all suggest that internal household link are not sufficient to explain migration patterns. As economic agents behave differently in isolation or

[24] For example, Görlich and Trebesch (2008) find that, for poorer households in Moldavia migration is an important strategy to improve standard living conditions.

[25] Using data collected in 2002 in northwestern Oklahoma, Garcia (2005) traces three different yet interconnected kinds of networks: a traditional subnetwork, a church subnetwork, and a contract subnetwork.

when they are embedded in social relations,[26] so potential migrants are affected both by their own networks of relations and by the migration social capital of the community.

1.3 Social Interaction Based Approaches to Labor Mobility: Endogenising Migration Flows

The previous section reviewed approaches to the migration decision based on one common element: decision-makers are embedded in a social structure in which social interactions play no role in the decision-making process. On the contrary, it is well established in economic literature that social interactions affect economic behavior. Manski (2000) identifies in constraints, expectations and preferences the three channels through which social interactions enter the decision-making process of potential migrants.

To mention only a few important contributions using constraints, Tullock (1971), Krugman (1991) and Braun (1993) all share the core idea that, other things being equal, migrants' decisions on where to relocate take into account public good externalities. The use of public good is generally modeled to define an equilibrium condition for the migration flow. In Krugman (1991) migration flows decline as income differentials decrease, Braun (1993) introduces congestion to slow down the migration flow. After Greenwood (1970), establishing the conditions by means of which migrant stocks can increase the appeal of migration, many scholars (see, e.g., Borjas, 1995; Bauer and Zimmermann, 1997) applied analysis of the stock of compatriots. In the late 1990s, this approach was formalized among others by Carrington et al. (1996) and Chau (1997). The former developed a dynamic model in which migration costs declines as the number of compatriots already present in the receiving country grows. The latter developed a two-region set-up in which networks produce positive externalities, allowing positive regional migration propensities even when domestic wages are equal.[27]

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[26] For example see Borjas (1995) on the importance of ethnicity and neighborhoods; in development studies Chantarat and Barret (2007) stress the importance of social network capital in allowing poorer households to escape the poverty trap.

[27] Two regions home and foreign. Home is endowed with an inelastic supply of labor normalized to one. Let m_t be the share of the home country labor force working in the foreign country at time t. Home wages: $w_t = w(1 - m_t)$. In full employment $(1 - m_t)$ is the employment ration in the home country. Wages in Foreign are $w_t^* = w^*(m_t)$. Individuals have preferences over income sequences $\{y_{t+r}\}_{\tau=0}^{\infty}$, expressed as: $Y_t = \sum_{\tau=0}^{\infty} \beta^\tau y_{t+\tau} \quad with \quad 0 < \beta < 1$ At the beginning of each period workers can migrate. Individuals are different only in terms of the propensity to migrate $a \in [0,1]$. $F(\bar{a}) = \Pr[a \leq \bar{a}]$, where $F(.)$ is a CDF (continuous and with a strictly positive density function).

The largest group of existing economic models of migration involving social interactions is based on allowing changes in expectation formation. Since the 1970s, a series of dynamic models focused on the structure of information have been developed. Graves and Linneman (1979) and McCall and McCall (1987), concentrated their analysis on the process by means of which migrants obtain information on migration opportunities and costs. These search theoretic models deal either with "speculative migration", in which migrants move looking for a possible job, or "contracted migration" in which migrants move knowing there is a job available.[28] O'Connell (1997) developed a model encompassing uncertainty in conditions in both sending and receiving countries. In a partial equilibrium model, potential migrants are incentivized to apply try and look behavior. To explain the effect of information on potential migrants' decisions, network theorists introduced the so-called friends and relatives effect. For example, DaVanzo (1981) explained the distribution of information and migrants' preferred locations by the concept of location-specific human capital, showing that "ties built up over time limit the migration propensity" (Radu, 2008:536).

Preferences may be influenced by the characteristics of other members in the reference group (contextual effect) and/or by the decisions of the reference group (endogenous effect; Postlewaite, 1998). An example of the contextual effect is that of Stark and Taylor (1991),[29] in which potential migrants use an income reference point to evaluate their own sense of relative

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The cost of migration is $C(a, m_{t-1}) \geq 0$, where m_{t-1} is the stock of compatriots present in the previous period. The cost is strictly more than 0, cost function is continuous, twice differentiable, increasing in a and decreasing in m_{t-1}. In Chau's (1997) approach migrants with high a are considered Schumpeterian followers in adopting migration as an innovation which allows them to increment their wealth; those with a close to 0 are considered initiators.
Denote: $Y_t(a, m_{t-1}) = E_t\{\max \ [w(m_t) + \beta Y_{t+1}(a, m_t), w^*(m_t) + \beta Y_{t+1}(a, m_t) - C(a, m_{t-1})] \,|m_{t-1}\}$. Migration depends not only on the income sequences of the two regions, but also on the stock of migrants in the foreign region, and on how the expectation of future income flows is formed. With static expectations, i.e., $E_t(m_t|m_{t-1}) = m_{t-1}$.:

$$Y_t(a, m_{t-1}) = \max\left\{\frac{1}{1-\beta} w(m_{t-1}), \frac{1}{1-\beta}[w^*(m_{t-1}) - C(a, m_{t-1})] \right\}$$

There are three possible scenarios. First, the network effect dominates;. for all values of $m_{t-1} < \overline{m}$, emigration is not feasible, and $\overline{m}$ is the only value for which a subject is indifferent between migrating and non-migrating. Second, income differential reduction dominates. This is the opposite of the first scenario. Third, an intermediate scenario, in which the network effect prevails over the reduction effect only for small values of the stock of compatriots.
Mathematically migration takes place if and only if: $\frac{1}{1-\beta} w(m_{t-1}) - \frac{1}{1-\beta}[w^*(m_{t-1}) - C(a, m_{t-1})] \leq 0$
The degree of migration may be written as: $m_t = F[A(m_{t-1})] \quad with \quad A(m_{t-1}) = \min[a(m_{t-1}), 1]$ This is the cornerstone equation which allows the model to depict a "cumulative process of migration in such a way that each act of migration on the part of the home-country workers induces a chain of subsequent out-migration, which would be otherwise impossible had the pioneers remained in the village" (Chau, 1997:7).

[28] Polachek and Horwath (1977) defined the migrant as a "peregrinator", an individual who moves across various locations gathering new information over the migration period. Characteristics across nations are exogenous and do not affect the decision making process. To overcome this limitation, Polachek and Siebert (1993), Diamatides (1994) and Burda (1995) developed models to take into account actual and future characteristics of locations.

[29] Relative Deprivation Approach.

deprivation. The endogenous effect is studied through two different approaches, both compatible with Akerlof's (1997) definition of social distance. Austen-Smith and Fryer (2005) offer a potential explanation to the puzzling under-achievement of members of black minorities in the U.S., based on the idea that peers impose a cost on those individuals not behaving according to community rules. Stark and Taylor (1991) and Fan and Stark (2007) identify the origin of changes in the utility function of potential migrants in interpersonal comparisons.

Although theoretical research on social interactions in migration choices has produced interesting findings it is still underdeveloped and lacks a common theoretical framework. Networks in migration studies are generally not as well formalized as in other branches of economy, such as international trade (Rauch and Casella, 2001) and industrial organization (Goyal, 2007).

This is partly due to the absence of well-defined theoretical equivalents for interactions in empirical analysis, and partly to the difficulty of observing social interactions in non-experimental settings. Nonetheless, all above mentioned studies start from a common element: networks and migration social capital matter in the economic behavior of potential migrants. Even in the absence of a single comprehensive theoretical formalized approach to migrant networks, qualitative as well as quantitative research concurs in defining the general framework of migration network theory stressing the importance of social interactions in the migration decision.

1.3.1 Network Theory

Massey et al. (1993: 448) define migrant networks as a "sets of interpersonal ties that connect migrants, former migrants, and nonmigrants in origin and destination areas through ties of kinship, friendship, and shared community origin". Networks are self-increasing systems which reduce the cost and risk[30] of migration by increasing the appeal of the receiving country, giving physical and psychological support to migrants and facilitating matching between newcomers and employers.[31] This increased appeal raises the probability that new migrants decide to go to a

[30] Espinosa and Massey (1998) show that migrant networks play a key role in reducing the border crossing hazard.
[31] Migrant networks alleviate capital constraints in high capital sectors in Mexico (Woodruff and Zentero, 2007), facilitate intra-regional trade in France (Combes et al, 2005), non-Commonwealth immigrants drive U.K. exports to origin countries (Girma and Yu, 2002) and the international trade of ethnic goods (Rauch and Trindade, 2002). Gould (1994) shows that, in the U.S., immigrant ties with the home country have historically been determinant in the

particular country. In turn, they increase the size of the network, and therefore further reduce costs and/or risks, and so on. After reaching a certain threshold, the network can perpetuate migration, eventually without the need for initial economic reasons (Fawcett, 1989).

How can networks reduce the costs and risks of migration? The first group of migrants to a new destination has no ties in the receiving country, which means that it has no factual information on how to cross the border (if they are illegal migrants), how to deal with the receiving countries' labor market, bureaucratic institutions and habits[32]. The economic meaning of all this is that migration is costly and risky. When migrants have successfully migrated, they maintain some connections with the mother country. Particularly ties with relatives and friends; this implies that the second wave of migrants has some advantages in terms of information, and of how to reduce direct and psychological costs.[33] When the networks are large enough, migration becomes self-perpetuating and influences some specific labor markets, which become migrant "enclaves" (Munshi, 2003; Mahuteau and Junankar, 2008). This further reduces the risk[34] of migration by ensuring that newcomers can find jobs and thus Pareto-improving social welfare.

Network theory is compatible with both the neoclassical approach and NELM, as it adds a dynamic perspective to them, stressing once migration has begun, it alters the structure of the world in a way that further encourages future migrants. This implies a series of effects which cannot be explained by other theories, above all the persistency of migration in the absence of its original conditions.[35]

The key concept behind the network theory of migration is the property which interpersonal links have of conveying information and services. Potential migrants are connected to networks both through direct links (family relatives and friends) and indirect ones (community networks). A priori, both types could provide access to the same kind of information and services. Their relative specific functions and relation in empirical research was studied by Winters et al. (2001). Who observe that family and community networks are partially complements and partially

development of U.S. bilateral trade flows, since immigrants convey knowledge spillover able to reduce the informative cost of trade. Similar results were obtained on Canadian data by Head and Ries (1998).

[32] Devillanova (2005) found that migrant networks in Milan facilitate access to social welfare and also female employment. Women are usually employed in sectors requiring high levels of trust, like domestic occupations, and so rely more on strong ties.

[33] Mahuteau and Junankar (2008) show that second-cohort migrants are more likely to get "good jobs", so that networks act as supports in providing preferential channels to labor markets.

[34] This allows migration to become a "risk-free" diversification strategy.

[35] The reduction of costs and risks, besides opening the doors of the receiving countries to larger groups of compatriots (Massey, 1990), has important effects on the composition of migrant flows (McKenzie et al., 2007).

substitutes, whereas connectivity[36] is not relevant. Despite this insight, the results of the above authors are biased by both endogeneity and the absence of an identification variable. Applying a procedure to correct for endogeneity (and also self-selection), and having a database providing an identification variable, the results of Winters et al. (2001) are substantially confirmed.

Quantitative analysis emphasizes the partial differentiation between family and community networks, the origins of which are unclear. There are several possible explanations, none of which excludes others or can alone explain this finding. Different networks may provide different kinds of information and services - for example, family networks can reduce housing costs whereas community networks reduce the cost of transmitting remittances through transnational migrants. Community networks may act as substitutes for family networks which are not large enough. The measure generally used to define community-level networks, *migration prevalence*,[37] may capture some community features endogenous to the process of migration which are not directly related to migrant networks. Migration is in fact a social phenomenon which endogenously modifies sending and receiving countries through the accumulation of migration capital, not only through networks. Changes in distribution of wealth and land, socio-demographic structure, *and* migrant networks all concur in this accumulation process, which some scholars have used in the cumulative causation approach.

1.3.2 Cumulative Causation

Developed initially by Myrdal, this theory was later applied to migration by Massey and followers (Massey, 1990; Massey et al., 1993; Massey and Zenteno, 1999, Fussell and Massey, 2004). The cause of the perpetuation of migration (Mexico-US in particular) was found in a cumulative process based on “the accumulation of social capital, by which members of a community gain migration-related knowledge and resources through family members and friends who have already traveled to the United States” (Fussell and Massey, 2004: 152).

The cumulative causation approach rests on two different forms of social capital. Social capital, intended as a social network, reduces the risks and costs of migration by providing potential migrants with information and assistance in finding jobs and ways of crossing borders.

[36] The cross-effect between family and community networks.
[37] The number of persons aged 15 or more with a migration experience in a certain year and community over the total population aged 15 or more in the community, as defined by Massey et al. (1994).

Once the receiving countries, migrants convert their migration network social capital into financial social capital (Bourdieu, 1986; Coleman, 1988). In this way, each migrant alters the socioeconomic structure of the receiving country, making migration more appealing and allowing the migration of new groups. This transformation partly explains some effects identified in NELM (and also in Dual Labor Market Theory and World System, theories not discussed here), such as the distribution of income (deprivation approach), distribution of land (WST), organization of agriculture (WST), culture (WST), regional distribution of human capital (DLMT and WST), and the social meaning of work (DLMT and WST).

Social capital based on migration networks is a set of resources embodied in the social network which acquire value whenever a subject decides to migrate. Owing to the people already living in the receiving country, who can help newcomers in various ways, subjects who are connected with them are more likely to migrate (Massey and Espinoza, 1997). Since each single migration increases this form of social capital, at each round a new group of people is in a position to migrate, this in turn produces new migration, and so on. This is an easily testable hypothesis: if this mechanism works, than people belonging to communities with longer or more extensive histories of migration should be more likely to migrate than people belonging to communities with shorter or less extensive histories of migration (Massey and Espinoza, 1997).

While network theory identifies at the origin of the endogeneity in migration only the direct effect of networks in the migration decision, the cumulative causation approach extends analysis to changes in the economic and cultural environment which are not the direct effect of networks. Migration is not only a matter of costs, information or tastes; it is the result of the interaction of all these dimensions and their relation with the environment of the current and historical community. This implies that all elements concur in determining migration, as they are the cause and effect of migration at the same time.

For example, remittances alter the income distribution of sending communities, increasing the sense of relative deprivation of those who are left behind, and this in turn increases the incentive to migrate (as already evidenced in the relative deprivation approach; Stark and Taylor, 1989).[38] This process stops when almost all households are involved in migration (Stark, 1991).

[38] The relative deprivation approach differs from the standard utility approach for two main reasons: it identifies a reference point in society and links the wellbeing of potential migrants to that of others in the society. Following Stark and Taylor (1989), let us assume a continuous income distribution - see original paper for technical details. Let $F(y)$ be the cdf of income and $1 - F(y)$ the percentage of population with an income higher than y. The feeling of deprivation is an increasing function of this percentage - that is $h[1 - F(y)]$ is the deprivation from having $[y, y +$

Remittances can also be used to purchase land as a long-term investment rather than an immediate productive asset, thus decreasing the demand for farm workers and creating further incentive for migration (Reichert, 1981; Mines, 1984). The reduction in rural labor demand can occur even when land is used as a productive asset, as remittances can be used to introduce more capital-intensive methods of production, in turn reducing the demand for labor (Massey et al., 1987).

Once migration starts, it changes the value of migration, as hypothesized by Piore (1979) and shown in Martinez (1994), Chavez (1998) and Kandel and Massey (2002): migrants and migration are glorified and romanticized and back home this has the effect of changing preferences and motivations in local societies. At community level, migration becomes part of the common imagination. For many young man (and increasing numbers of women), migration becomes a rite of passage and, as reported by Reichert (1982), those who do not migrate are considered at best as lazy. At individual level, the first migration is probably driven only by economic motivations, with the idea of migrating for a given period of time and then coming back after saving/remitting a certain amount of money. But after migrating, migrants might undergo a change in tastes, in particular because of the acquisition of a stronger concept of social mobility.

This cumulative process determines who migrates today, but also who remains and who will have the possibility of migrating in the future. According to the idea that migration is a selective phenomenon[39] (Chiswick, 1999), first migrants are more educated, skilled and productive people. However, as shown among others by McKenzie and Rapoport (2007), over time migrants tend to be less well educated as migration goes on. This empirical evidence finds its explanation in the cost and risk reduction function of networks. As costs decrease new, poorer social strata can join migration (McKenzie and Rapoport, 2007). Since the poorer social strata are those more likely to have lower levels of education, the expansion of migrant networks is linked with lower "quality of migrants".

The main feature of cumulative causation is to study migration as an endogenous process, and central to it is the accumulation of migration-specific capital, which is only partially the effect of migrant networks. Household and community characteristics, and the sending and receiving

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$\Delta y]$. Thus, we can write $RD(y) = \int_y^\infty h[1 - F(z)]dz$ where z is the income of a "richer person". Using a survey on rural Mexican households, Stark and Taylor (1989) show that the probability of households migrating is directly proportional to their initial sense of relative deprivation.

[39] I will come back to this issue in Section 5

country economies and networks all dynamically interact in a process in which each element directly or indirectly affects all the others in a "natural" mechanism. Although such a complex environment has not yet been described in a single model, several scholars have engaged in formalizing specific aspects of endogeneity in migration.

1.3.4 Conclusions on Social Interaction Based Approaches to Labor Mobility

Summarizing, social interactions modify migration strategy in three main ways. They affect budget constraints by relaxing them, as in Chau (1997); they modify expectation formation through the information channel, as in O'Connell (1997); they directly affect the utility function through preferences - for example, on the distribution of income, as in Stark and Taylor (1989).

Introducing interactions among agents explains some of the peculiarities which are typical of migration and which standard theories cannot explain, like the perpetuation of migration and the high concentration of migrants in some specific areas and economic sectors. A key role in explaining these effects is played by networks, since they are self-increasing systems that reduce the cost and risk of migration by increasing the appeal of the receiving country (Massey et al., 1993).

Networks intended as links within a household are the basis of NELM, but Network and Cumulative Causation theories go further, explicitly taking into consideration the cost reduction and social capital accumulation effects (or functions) of networks. These are two sides of the same coin. The first is observable to a certain extent and regards out-of-pocket costs, like border crossing and housing. The other side is difficult to capture, particularly in quantitative analysis, and regards psychological costs and information. The former is reduced by the mere presence of family members and compatriots, by the presence of a network able to provide ethnic goods and services, and by changes in tastes for migration in sending communities through the accumulation of migration social capital. The latter, providing information on available jobs as well as on how to cross borders and how to behave in the receiving country, generates a migration social capital based on knowledge.

While theoretical analysis has been dealing with both sides of the coin, empirical analysis is limited by the availability of databases and the difficulty of capturing, in non-experimental settings, information on tastes and of empirical modeling of social capital. The analysis of each network function is not feasible, whereas it is possible to capture the channels through which functions are transmitted. Analysing the specific importance of family and community ties in the receiving country enables us to identify the cost reduction effect intended as out-of-pocket costs and as psychological costs. Interpreting McKenzie and Rapoport (2007), we can argue:

- whereas the effect of networks is larger for poorer social strata the main constraint to migration is out-of-pocket costs (that is, budget constraint);
- networks mitigate psychological costs when differences among social strata are not significant.

The present analysis is devoted not only to the relation between wealth and migration, to disentangle the cost reduction effect of networks, but goes a step further in estimating the relative importance of family and community networks. This allows us partially to capture the effect of both out-of-pocket and psychological cost reduction, and the importance of migration social capital accumulation, due to community migration history. Thus, the strong link between out-of-pocket costs and networks is stressed, and endogeneity and the accumulation of migration capital are brought to the fore.

1.4 Main Empirical Approaches to Labor Migration

Before explaining the empirical analysis of migration, it is necessary to note that the relevant literature mainly focuses on Mexican migration to the U.S.. Mexican migration has been and is to this day a priority concern, both in Mexico and in the U.S.. Geographically, the U.S. and Mexico share the longest border between a developed and a developing country. Demographically, considering only legal migrants, Mexico-U.S. migration flows involve more than one million people each year. In addition, more than 11 million illegal migrants live in the U.S., which corresponds to around 5% of the U.S. workforce (Swain, 2007) and more than 15% of the Mexican one (Mishra, 2007). The effect of such massive migration, which has a fundamental influence on transforming social structures in both sending and receiving countries, is reflected in the concern of policy-makers and scholars. The concern of both public opinion and policy-makers enable scholars to obtain needed resources to carry out large projects, with the aim of collecting exhaustive and appropriate databases. The availability of the detailed database on Mexican migration enabled us to test the hypothesis of our model empirically.

As emerges in theoretical literature, in order to investigate migration in detail one should have access to a panel database which includes complete information across time on both migrants and non-migrants, their wealth, human and social capital, and their family and community networks in both sending and receiving countries.[40] Labor migration is a phenomenon closely related to economic conditions in sending and receiving countries, requiring both micro and macro information. To understand the dynamics of migration flows - the accumulation of migration social capital, as well as the presence of migrant networks, and the continuous changes due to migration flows in sending and receiving societies – requires information collected over time. Since such a complete database does not exist, scholars have developed several empirical approaches conditional on the origin of available data:

1. Cross-country analysis, generally by application of the gravity theory approach, as carried out among others by Karemera et al (2000) and Ortega and Peri (2009);
2. Receiving-country analysis, with data collected in the receiving country through censuses or NGOs (e.g. Aydemir and Borjas, 2007);
3. Sending-country analysis, with data collected in sending countries (see Massey et al., 1994).

Based on the neoclassical approach and largely borrowing from international economics, cross-country flow analysis considers labor as a traded “good”, moving to where its return is higher, like financial capital and other production factors. This approach, stemming from Tinbergen’s 1962 revision of Newton’s *Law of Universal Gravitation,* has been used to study internal (Basile and Causi, 2005) and international (Karemera et al., 2000) migration, the relative “quality of migrants” (Borjas, 1987; Pedersen et al., 2008), migration policy effects (Ortega and Peri, 2009) and migrant networks (Karemera et al., 2000), as well as non-economic determinants (Mayda, 2005). One of its major advantages is the relatively small amount of information needed to produce reliable results. In particular, it links migration flows with macro information like GDP, unemployment levels, Gini index, barriers to free mobility, historic variables such as colonial relations and conflicts, and cultural and physical distances, all easy to verify and extensively recorded.

In almost all these analyses, independently of their specific topic, some common elements emerge. Larger countries have relatively larger migration flows; richer countries attract more

[40] Very few attempts have been made to develop a comprehensive panel on migration flows. One of the main limitations to the creation of such a database is represented by the differences in national census structures and in the definition of migrants across countries. For a complete analysis of the problem, see Parsons et al. (2007)

migrants; and the presence of compatriots, a common language and colonial history facilitate migration, while distance acts in the opposite direction. Although the gravity approach has been shown to produce reliable forecasts of international migration flows, the reduced data used to study migration gives limited information on migrant characteristics. Networks are implemented in the analysis merely as the stock of compatriots in receiving countries, and specific local contingent events cannot be captured. Cross-country analysis is not appropriate, since our aim is to study how potential migrants behave and the relation linking wealth, networks and migration at micro level.

Receiving country data have extensively been used to provide a picture of immigration at country level. Borjas (1985, 1995) analysed the quality of migrants, Chiswick (1990) language fluency and labor market performance, Chiswick and Houseworth (2008) intermarriage levels, Aydemir and Borjas (2007) the effect of different immigration policies among countries and within the same country, and Borjas (1998) within-country welfare state magnetism. Friedberg (2001) examined the influence of immigration on labour markets, whereas Massey and Akresh (2006) and Massey and Redstone (2006) looked at immigrants' intentions, Oyelere and Belton (2009) focused on the economic status of sending countries as a determinant for self-employment in the U.S., and Haisken-DeNew and Sinning (2007) concentrated on social inclusion. This approach is conditional on the ability of receiving-country institutions to "capture" unregistered migrants.[41] The U.S. census is very efficient in collecting information, not only on legal migrants but also on overstay and illegal ones. Despite this, the incentive to lie is strong, particularly as regards information concerning actual occupation, original conditions, and networks of relations. In addition, data collected in the receiving country completely miss information on those who fail in migration, short-term migrants (as censuses are carried out every 5-10 years) and those who are left behind. Since in determining potential migrants' migration strategy, it is essential to know not only who leaves but also to compare migrants with those who remain, data collected in receiving countries do not appear to be adequate for the purposes of this thesis.

Sending-country data have largely been used to study the determinants of migration, their effect on the quality of migrants and on the subsequent development of the sending communities. Kaluzny (1975) proposed one of the first empirical analyses on the determinants of household migration, noting the importance of wealth and ethnicity in intrastate (U.S.) migration propensity.

41 Jasso et al. (2008) estimate that about 32 percent of recent adult immigrants to the U.S. who received a permanent residence permit had had a previous illegal migration experience.

Vijverberg (1993) proposed a human capital model of migration in order to study the productivity level of migrants with respect to non-migrants, showing that more productive workers "migrate only if there exists a strong *positive* correlation between person-specific productivity component at the origin and the destination" (Vijverberg (1993: 154). Analysis of data from the 1987 and 1988 Ivory Coast Living Standard Survey notes the positive selection of migrants, confirming the positive correlation mentioned above. Mishra (2007), combining Mexican and U.S. census data, studied the effect of migrants on the U.S. In particular, emigration appears to have little negative influence on Mexican welfare, but does have a significant effect on the distribution of labor and other factors. Analysing Mexican Migration Project[42] data, Massey and Capofferro (2004) measure undocumented migration, proposing detailed analysis of the problems of censuses and other data collection methods. They point out how ethno-survey seem to be the best way of collecting data in sending countries. Using data from a Mexican national survey, Winter et al. (2001) analyse the importance of family and community networks in determining both the probability of migration and the number of migrants sent by a family, and discover that family and community networks are complements rather than substitutes in the propensity to migrate. Using MMP data, McKenzie and Rapoport (2007) analyse the importance of migrant networks in the household migration decision and the effect of migration on inequality. They show that network support has a significantly positive effect on migration of poorer people, but no effect on that of richer ones. This is in line with the debate on the importance of migrant networks in determining migration flows. As pointed out, the main cause of relatively small migration flows compared with expected earnings is budget constraints. By reducing the costs and risks of migration, as well as allowing resource pooling, networks enable the migration of people belonging to poorer social strata.

Data collected in sending countries appear to be the best option when the aim of analysis is the strategic behavior of potential migrants. In particular, ethno-surveys such as MMP and LAMP convey complete life history retrospectives of each migrant and non-migrant household, with complete information on the first and last migrations to the U.S.. This information, in conjunction with that collected at community level in both sending and receiving countries allows us to construct a series of variables able to capture the economic status of households (by Principal Component Analysis - PCA), and their migration experience and social capital. Having complete information on the migration history of all household members enables us reconstruct

[42] MMP and LAMP are discussed in detail in chapter 3 and 4.

their network of relations as well as their specific experience of migration. Aggregating household level data allows *migration prevalence* to be computed to capture community-level migration capital.

Before concluding this section, we note that, in order to study the determinants of migration, two main empirical problems must be taken into account: sample selection and endogeneity. In the literature, these two sources of bias are usually not solved simultaneously. By way of example, Winters et al. (2001) solve for sample selection, whereas McKenzie and Rapoport (2007), applying the Instrumental Variable (IV) approach, solve for endogeneity. In this dissertation, in analysing the determinants of Mexican migration to the U.S., two possible approaches are proposed for a simultaneous solution.

According to Baum (2006: 267) sample selection arises when "the sample is representative of the entire population, but the observations on the dependent variable are truncated to a rule whose errors are correlated with the errors from the equation of interest".[43] In migration studies, for example, sample selection arises in the migration strategy of households when deciding the optimal number of members to send in migration. Specifically, as pointed out by Winters et al. (2001), the household migration strategy is determined in two steps. First, the household evaluates if it is profitable to be engaged in migration; then it determines the optimal number of migrants. Since the latter is conditional on the decision to undertake migration, sample selection is clear and, as the authors suggest, can be corrected by a Heckman Two-Step (HTS) procedure, including the Inverse Mills ratio.[44] Unfortunately, the HTS procedure cannot solve for endogeneity, the other main problem when analysing migration.

To avoid the problem of selection and to concentrate on the endogeneity issue, many scholars, instead of studying the optimal number of migrants, have focused only on the first-time migrant households, explicitly cutting from the sample households with more than one member in migration and estimating only the probability that the household is "in migration" (McKenzie and Rapoport, 2007).

Endogeneity may be solved though the use of the IV approach. In migration studies, endogeneity is intrinsic to the phenomenon and is particularly relevant in analysis focusing on the effect of migrant networks. By definition, migrant networks are endogenous (at least at

[43] For a theoretical analysis of sample selection bias and correction methods, see Baum (2006) and Cameron and Trivedi (2008).
[44] Details are provided in Chapter 3.

community level). People are affected by the network when they decide to migrate and, at the same time, they thus becomes part of the network. This effect, which may seem to be of marginal importance at individual level, is extremely important at community level, when the migration of a group of co-villagers is directly affected by other migrants' behavior and may modify the whole structure of the network.

A good instrument must be correlated with the variable suspected of being endogenous (in this dissertation, *migration prevalence*) and uncorrelated with the error term. Following Woodruff and Zentero (2007) and McKenzie and Rapoport (2007), for Mexico the average migration rate by state over the period 1956-1959, at the peak of the Bracero Program (1942 -1964),[45]and the 1924 migration rate by state are used. The two set of instruments are explained in detail in McKenzie and Rapoport (2007). Because of the lack of similar data, 1980s outmigration rates are used in the analysis of Central American countries.

The lack of good instruments, combined with small sample are the main limitation of analysis of Central American countries.

1.5 Conclusions

International migration of labor is a voluntary and rational strategy. Moving from this assumption to analyse the literature, I identify in the household the fundamental decisional unit in South-North migration. In the underdeveloped credit and insurance markets of LDCs, particularly low incomes and the risks associated with the relatively high cost of migration make migration a unfeasible strategy for most of the people who have the highest incentive to migrate. For altruistic as well as strategic motivations, households can pool their members' resources, partially overcoming individual subjects' budget constraints.

Being composed of several members, households can choose among a larger set of strategies than those available to a single person. Specifically, NELM scholars identify as the main objective function the minimization of income risk. Households allocating their production factors to various areas and economic sectors can differentiate their source of income. Migration in areas and economic sectors characterized by a business cycle negatively correlated with households

[45] Original data from Gonzàlez Navarro (1974).

main business allows income fluctuations to be reduced. From this perspective, remittances are the channel through which this risk minimization strategy is transmitted. Nonetheless, migration still appears to be mainly an income maximization strategy. As pointed out in section 1.2, migration as an income risk minimization is too complex a strategy to be properly adopted by households and the high ethnic concentration of migrants confirms this. If households minimize income risk, we should observe their members spread out in different countries and/or different working sectors, whereas we often observe the opposite. To reject income risk minimization as an objective function in migration choices does not mean that some "rule of thumb" to reduce risk is not applied, or that income risk minimization is not part of "good father" behavior. It simply means that, in migration decisions, the main aim is to improve family wealth.

While household can partly overcome individual agents' budget constraints, migration is too costly an investment, particularly for poorer social strata. Both theoretical and empirical studies highlight the importance of migrant networks in facilitating migration, by reducing migration costs and risk and by accumulating social and financial community migration capital. This field of research is still theoretically and empirically underdeveloped. On one hand, mathematical complexity has limited the development of models of migration dealing with social interactions. On the other the scarcity of theoretical hypotheses and the complexity of translating them into empirical terms have been a limitation for empirical analysis.

The next chapter provides a simple model derived from McKenzie and Rapoport (2007), to stress how social interactions can improve migration propensity and possibility, by reducing costs and risks and allowing resource pooling. Specifically, households maximizing their income in a dual economy with underdeveloped financial and insurance markets present an inverted U-shaped relation between migration and wealth. This relation is compatible with empirical findings, emphasizing that migration goes hand in hand with development. Networks of migrants act in mitigating this relation, particularly in poorer households, modifying the "composition of migrants".

The last part of the literature reveals the complexity of empirical investigations. Two main issues have been raised by scholars: migrants are not random samples and networks of migrants are endogenous in the migration decision. Although both problems have specific solutions in the econometric literature, they lack a common approach. In addition, households may have more than one member in migration, so that count analysis is needed. Chapter 3, analysing Mexican migration to the U.S., provides two solutions dealing simultaneously with at least two of the three problems.

Another limitation of empirical research on migration is the limited number of exhaustive databases available. Much of the quantitative literature analysing the determinants of migration with data collected in the sending country focuses on Mexico. To test whether results can be extended to other settings, chapter 4 compares Mexican migration with migration from five other Central American countries: the Dominican Republic, Nicaragua, Costa Rica, Guatemala, Haiti and Peru.

Chapter 2 A Dual Economy Model of Migration: the Role of Wealth and Networks

2.1 Introduction

Starting from the idea that wage gaps[46] are the fundamental elements driving migration in a household income maximization decision, this study, largely borrowing from McKenzie and Rapoport (2007), derives a model of the link between budget constraints, costs and risks of migration and migrant networks. While all these elements are usually investigated separately, they all influence migration flows, sometimes substitutes and sometimes complements in the decision to migrate. The model provides a simple, possible interpretation, which does not contradict the orthodox approach, but rather complements it. The aim is to contribute to the study of economic migration building a bridge between neoclassical, NELM and network theory approaches.[47]

Conditional upon the existence of wage[48] gaps between countries, the relationships among wealth, budget constraints, migration costs and risks, and networks is *a priori* unclear. On one hand, if initial migration costs are large, we may presume that migrants belong to the upper or middle-upper class in the sending country. Only those who are relatively better off are in fact in a position to migrate. Once migration happens, migrants increase the wealth of relatives left behind through remittances, eventually financing further migration. On the other hand, if migration costs are relatively small, even people belonging to the left tail of the income distribution will have the opportunity of migrating and, through remittances, improve the condition of those left behind. This selection effect based on wealth has important consequences on inequality in the sending community (McKenzie and Rapoport, 2007), in the sense of relative deprivation (Stark, 1989) as well as on the quality of migrants (Borjas, 1994). For example, without spillovers across social groups and with high migration costs, only relatively richer subjects are in a position to migrate. This, in turn, increases the inequality level in the sending communities, thus the sense of relative

[46] It is not one of the purposes of this dissertation to examine the causes behind these wage gaps.
[47] This excludes from analysis not only refugees and asylum seekers, but also migrants driven by specific psychological and cultural conditions.
[48] As well as income and business opportunity differentials.

deprivation and, given the correlation between education and wealth, a brain drain effect (at least in terms of education).

However, as McKenzie and Rapoport (2007:44) observe, from a dynamic perspective: "there are a number of channels through which past migration impacts on current migration incentives". Although budget constraints can reduce the outmigration rate, binding the optimal choices of potential migrants, scholars have shown how social networks, particularly migrants' networks, can increase the propensity to migrate, acting as a counterforce to budget constraints. The literature on the effect of networks may be organized in two main groups. According to Espinosa and Massey (1997), networks can reduce the costs and risks of migration increasing the propensity to migrate of potential migrants. Barret and Chantarat (2007), among others, stress how networks can facilitate escape from the poverty trap by relaxing budget constraints, through resource pooling.

The model of McKenzie and Rapoport (2007), despite its simple structure, conveys all these features in a unique framework. The household is the decisional unit which acts to maximize its own wellbeing. The household is endowed with a certain number of resources[49] and migration can only be financed through it. Borrowing is not allowed. In these conditions, migration and wealth have an inverted U-shaped relation. The model of McKenzie and Rapoport (2007) examines the probability of a household being involved in migration as well as the optimal number of migrants, but their empirical analysis, the main objective of which is the relation inequality-migration, evaluates only first-time migrant households with only one member in migration.

The above authors, focusing on the relation between migration and inequality, do not derive the effect of migrants' networks on the migration decision, but only provide a graphic representation, whereas this work analytically derives the importance of migrants' networks in facilitating migration.

In Section 2.2, the model of McKenzie and Rapoport (2007) is developed and modified to take into account the risk of migration. In Section 2.3, the effect of networks on household migration strategy is derived by analysing their effect as cost and risks reducers and resource poolers. In Section 2.4, discusses and concludes.

[49] According to McKenzie and Rapoport, it is land, but this definition can be extended to all productive household assets: financial capital, education, labor, and so on.

2.2 Basic model

McKenzie and Rapoport (2007) developed a dual economy model with $i = 1,2,\ldots,I$ households of size $l_i = 1,2,\ldots,L$.[50] Households are endowed with an illiquid asset A_i which is the basis of the family business. Let us assume, for the sake of simplicity, that income is equally shared among household members, that each household member lives for two periods $t = 1,2$, and that each member provides one unit of work to the family business. The marginal product of family business is also linearly increasing in the initial endowment and marginally decreasing in the number of workers, so that one simple possible representation is:

$$y_i = A_i l_i - \frac{b l_i^2}{2} \qquad (1)$$

A household member can migrate at a cost c_i, which is, at the moment, assumed to be fixed and exogenous. If a household member migrates he or she will receive a salary $w_f \sim U\left[\mu_{w_f}, \sigma_{w_f}\right]$, where f stands for foreign country. We assume that risk[51] is fixed and exogenous, and that μ_{w_f} is equal for each household member and for each potential migrant across the society.[52]

In order to take into account the incompleteness of insurance and financial markets we assume that borrowing is not allowed,[53] so that migration must be financed through savings. This implies that migration is impossible in the first period, and that the decision to migrate is the effect of household income maximization in the second period, when the household can use savings to finance migration. The household cannot save all its first period income, but it needs to consume at least S (Subsistence need) for each member at that time.

We also assume that $\mu_{w_f} > S$ and that $A_i - \frac{b l_i}{2} > S$. The first assumption implies that migration is appealing, and the second that the share of wealth each household member has is large enough to ensure survival.

[50] At the moment, household size is treated as a continuum number. One effect of discrete number is discussed in section 2.3.3.
[51] Risk is here intended as the risk of failure in migration and as uncertainty about future income, due to lack of information of the receiving country's labor market.
[52] This to simplify the analysis; in principle it may be extended by introducing various expected incomes and costs based on household social strata. This would imply the introduction of different networks which might have different properties, complicating the theoretical analysis and making an empirical investigation difficult or even unfeasible.
[53] Thus the focus is on migration between countries with different levels of development (i.e., South-North migration).

In this simplified framework, a household[54] chooses the share of members who migrate m_i, to maximize the second-period income. Because income maximization does not take into account risk and uncertainty aversion,[55] in order to implement them this model assumes Constant Absolute Risk Aversion (CARA) utility functions. ρ is the Arrow-Pratt measure of absolute risk aversion and expected salaries are distributed as a normal. Making use of CARA properties, and assuming no discounting, the household second-period maximization is:

$$\max_{0\leq m\leq 1} A_i l_i(1-m_i) - \frac{bl_i^2(1-m_i)^2}{2} + m_i l_i \mu_{w_f} - m_i l_i c_i - \frac{\rho}{2} m_i^2 l_i^2 \sigma^2 \quad (2a)$$

$S.t.$:

$$A_i - \frac{bl_i}{2} - m_i c_i \geq S \quad (2b)$$

To simplify notation, we suppress subscript i. Solving first-order conditions, m^*, the optimal rate of outmigration is:

$$m^* = \frac{-A + bl + \mu - c}{l(b+\rho\sigma^2)} - \frac{\lambda c}{l^2(b+\rho\sigma^2)} \quad (3)$$

m^* is increasing in expected salary μ, and decreasing in its variance σ^2 $\forall \sigma > 0$ and in migration costs c. λ is equal to 0, unless the vinculum binds. If it binds, as in McKenzie and Rapoport (2007), the constrained migration rate is:

$$\widetilde{m} = \frac{1}{c}\left(A - \frac{bl}{2} - S\right) \quad (4)$$

We can compute the highest level of fixed assets at which a household has no possibility of migrating, $\underline{A} = \frac{bl}{2} + S$. Define A_1 the level of illiquid assets, above which a household is no longer trapped by subsistence needs:

$$m^* = \widetilde{m} \Rightarrow A_1 = \frac{2\rho\sigma^2 l(S+l) + 2c\mu + 2c(2bl-c) + bl(2S+bl)}{(2l\rho\sigma^2 + 2bl + 2c)} \quad (6)$$

If either $\sigma = 0$ or household is risk neutral, the analysis comes back to McKenzie and Rapoport (2007). Differentiating A_1 in its arguments μ ,σ and c:

$$\frac{\partial A_1}{\partial \mu} = \frac{2c}{(2l\rho\sigma^2 + 2bl + 2c)} \quad (7a)$$

$$\frac{\partial A_1}{\partial \sigma} = \frac{2cl\rho\sigma S + (2c^2 l - 2cl\mu - bcl^2)\rho\sigma}{(2l\rho\sigma^2 + 2bl + 2c)^2} \quad (7b)$$

[54] How the decision is taken inside the household is not examined here.

[55] This is the first difference with respect to McKenzie and Rapoport (2007), who do not take into account risk/uncertainty.

$$\frac{\partial A_1}{\partial c} = -\frac{(2l\rho\sigma^2 + 2bl)S + (-2l\mu - bl^2 + 4cl)\rho\sigma^2 - 2bl\mu - b^2l^2 + 2bcl + 2c^2}{(2l\rho\sigma^2 + 2bl + 2c)} \quad (7c)$$

A_1 linearly increases in μ and decreases in σ. When c varies, A_1 decreases if $\mu < \frac{2S(l\rho\sigma^2+bl)+(4cl-bl^2)\rho\sigma^2-b^2l^2+4bcl+2c^2}{2l\rho\sigma^2+2bl}$, and increases otherwise. In real terms, if the expected return to migration is larger than new costs, risk aversion and opportunity costs, an increase in migration costs will move A_1 to the right, thus increasing the number of households bound by their budget constraints; otherwise, if the expected return is not large enough, we observe a movement to the left.

We can also identify the minimal value of A at which households will not choose migration as the optimal behavioral strategy. This value is equal to that computed by McKenzie and Rapoport (2007):

$$\overline{A} = bl + (\mu - c) \quad (8)$$

The migration rate changes depending on the initial endowment:

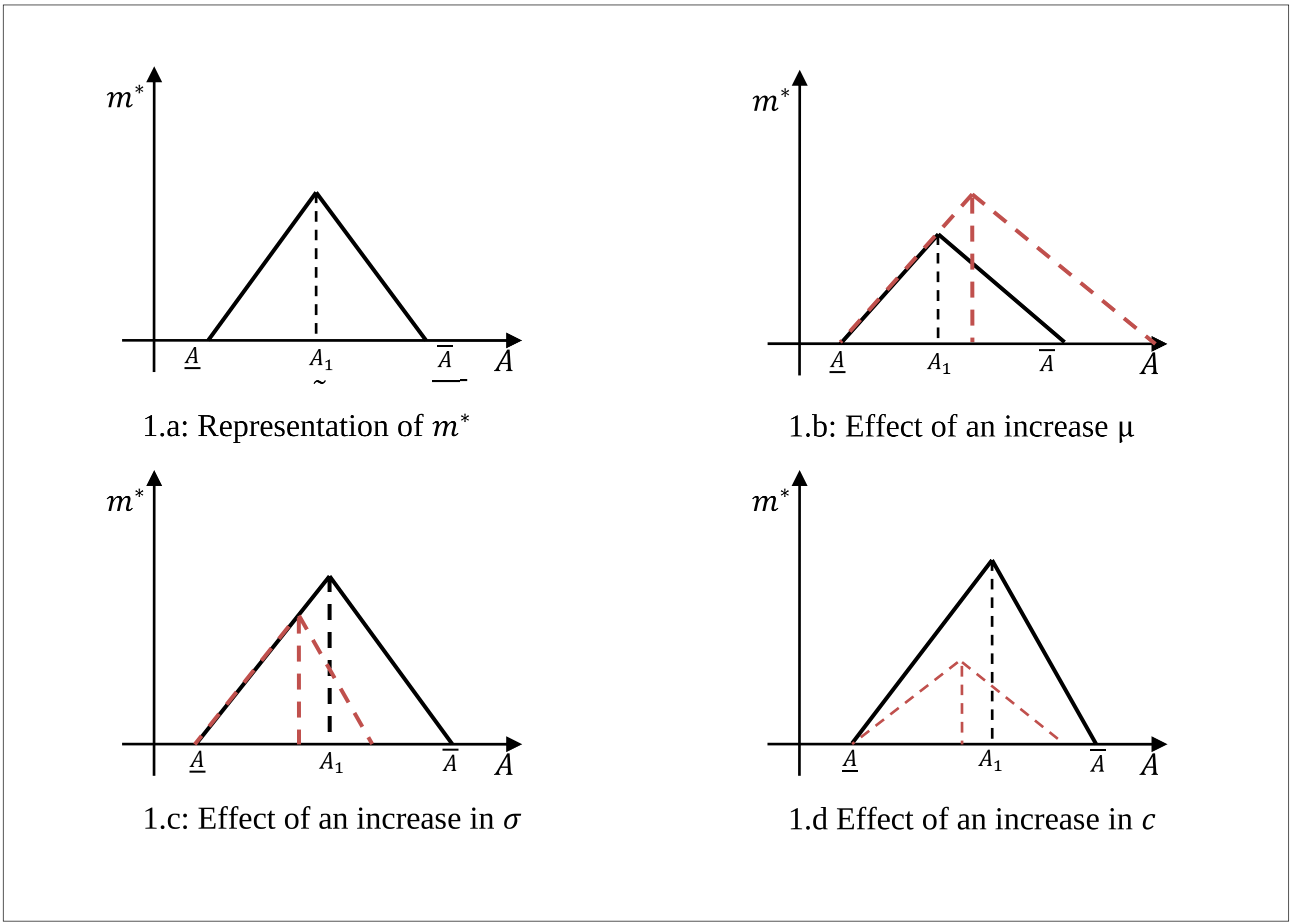
$$\frac{\partial m^*}{\partial A} = \begin{cases} -\frac{1}{l(\rho\sigma^2 + b)}, & \lambda = 0 \\ \frac{1}{c}, & \lambda > 0 \end{cases} \quad (9)$$

Thus, the migration rate path in relation to wealth levels is:

$$m^* = \begin{cases} 0, & A \le \underline{A} \\ \frac{1}{c}\left(A - \frac{bl}{2} - S\right), & \underline{A} < A \le A_1 \\ \frac{bl - A + \mu - c}{l(b + \rho\sigma^2)}, & A_1 < A \le \overline{A} \\ 0, & \overline{A} < A \end{cases} \quad (10)$$

This system can be graphically represented as in McKenzie and Rapoport (2007) though a "triangular" representation of the relation between the share of migration and the initial endowment of immobile capital. Introducing the risk/uncertainty of migration generalizes the model, so that McKenzie and Rapoport (2007) is a specific case of this model.

As shown in Picture 1, the household migration rate is a triangular function of immobile assets, migration is 0 under subsistence needs when the initial endowment of assets is below $\underline{A}$. First it increases with wealth up to A_1, and then it decreases until it returns to 0 when the initial endowment is above $\overline{A}$.



Picture 1: 1.a Relation between migration rate and initial asset; 1.b: in dotted the effect of a positive variation in expected salary; 1.c: in dotted the effect of an increase in uncertainty; 1.d: in dotted the effect of an increase in costs

2.3 The Effect of Migrant Networks

Besides providing a formal analysis of both cost and risk reducing effects in a framework in line with McKenzie and Rapoport (2007), it is necessary to point out that social networks are the cornerstones of social capital and that they do not have only a stock effect. In particular, when trying to reconciliate the views of Bourdieu (1980) and Onchan (1992) regarding social capital, I define three different forms of community social capital that are inter-correlated with migrant network:

1. *Financial Social Capital*: the share of economic resources that allows some "public investment" (Chantarat and Barrett, 2007) to be financed: specifically, in our case, to finance migration of those subjects not having enough private resources to self-sustain departure costs.

2. *Informational Social Capital*: the share of information about locations, how to cross borders, and lifestyles in receiving countries. This kind of social capital should not be confused with private information which an individual can obtain because of a particular position in the network (or because of particularly informative ties). Informational social capital is based on informative spillover and everyone belonging to the network has access to the same amount of information, which may be considered common knowledge.
3. *Cultural Social Capital*: the amount of education and cultural identity a community owns, characteristic of the community itself, which migrants carry with them to the receiving country. It is likely to affect both the psychological cost and the success of migration (Borjas, 1995).

Having defined how community social capital can be incorporated in migration studies, and summing up the relevant theoretical and empirical literature, we may argue that social networks can provide migrants with four forms of support:

I. Reduction in out-of-pocket costs;
II. Reduction in psychological costs;
III. Mitigation of risks;
IV. Financial support.

In this theoretical analysis, the out-of-pocket and psychological costs of migration are part of c_i. It is beyond the scope of this work to investigate how costs are composed and structured. This does not influence the theoretical analysis and allows us to reach a higher level of tractability.

2.3.1 Migrant Networks and Costs

Let us consider our two-period economy, but assume that c is a decreasing function of the stock of compatriots[56] in the receiving country. We also assume that there is always a minimum cost $\underline{c}$, which must be faced in order to migrate:

$$c = f(N) + \underline{c} \qquad (11)$$

with $f'(N) < 0$ and $f''(N) > 0$. Derivation follows section 2.2. The optimum is:[57]

$$m^* = \frac{-A + bl + \mu - f(N) - \underline{c}}{l(b + \rho\sigma^2)} - \frac{\lambda(f(N) + \underline{c})}{l^2(b + \rho\sigma^2)} \qquad (12)$$

The migration rate variation with respect to initial endowment is:

[56] Or even better, co-villagers.
[57] For a complete derivation see Appendix A

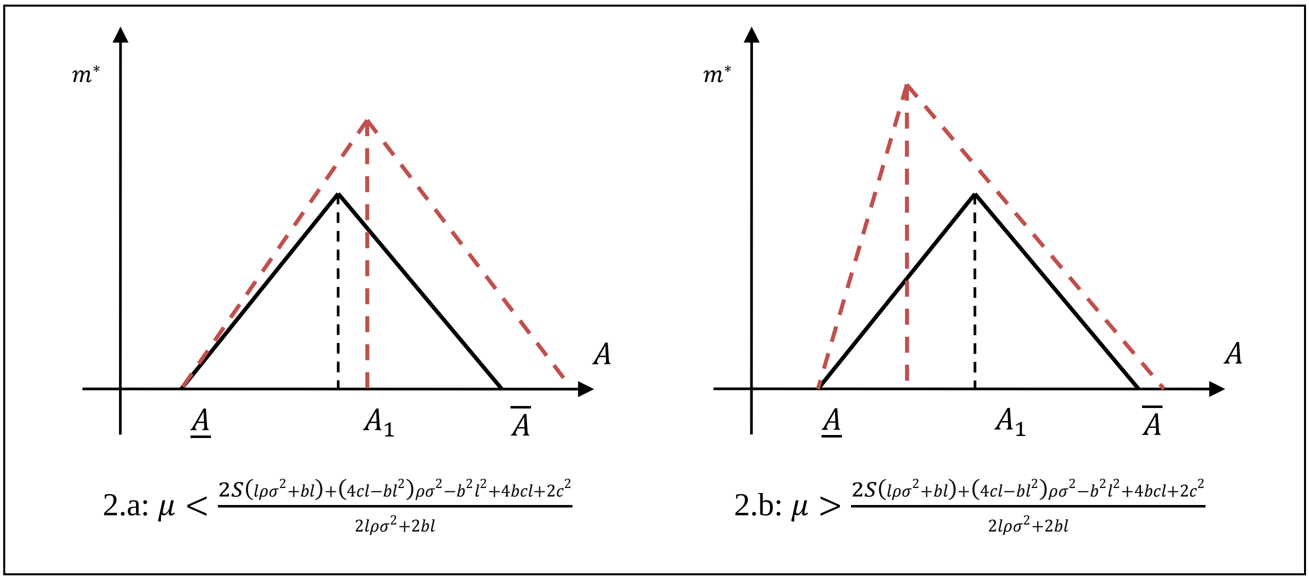
$$\frac{\partial m^*}{\partial A} = \begin{cases} -\frac{1}{l(\rho\sigma^2 + b)} & , \quad \lambda = 0 \\ \frac{1}{f(N) + \underline{c}} & , \quad \lambda > 0 \end{cases} \quad (13)$$

The migration rate path in relation to wealth levels is:

$$m^* = \begin{cases} 0 & , \quad A \le \underline{A} \\ \frac{1}{f(N) + \underline{c}}\left(A - \frac{bl}{2} - S\right) & , \quad \underline{A} < A \le A_1 \\ \frac{bl - A + \mu - \left(f(N) + \underline{c}\right)}{l(b + \rho\sigma^2)} & , \quad A_1 < A \le \overline{A} \\ 0 & , \quad \overline{A} < A \end{cases} \quad (14)$$

Picture 2 shows the effect of the network as a cost reducer. In empirical analysis households having some relatives abroad should be comparatively better off, even in the absence of remittances. Picture 2 reveals clearly that the magnitude of initial costs and expected returns is determinant in the evolution of migration. As pointed out by McKenzie and Rapoport (2007), a reduction in costs always increases migration, but it alters the distribution of migrants though two different channels. On one hand, households are less likely to be bound by subsistence needs, so that the triangle vertex should move upper-left (i.e. A_1 decreases). On the other hand, there is an increase in the incentive to migrate for all households, so that the vertex should move upper-right (i.e., A_1 increases). What determines the position of the vertex is the relation between expected returns, costs and risks. Specifically, if $\mu < \frac{2S(l\rho\sigma^2+bl)+(4cl-bl^2)\rho\sigma^2-b^2l^2+4bcl+2c^2}{2l\rho\sigma^2+2bl}$, a reduction in cost moves the vertex upper-right, while the unbinding effect prevails in the opposite case.

Proposition 1: if there is only one network (stock effect) and it has a monotonic effect as a cost reducer (only one asymptotic saturation point), it always increases the appeal of migration; the relative magnitude of expected returns and costs determines the distribution of migrants.



Picture 2: Cost Reduction Effect; 2.a increasing incentives; 2.b unbinding effect

2.3.2 Migrant Networks and Risks

Let us, again consider our simplified economy. We assume that costs are fixed and independent of the stock of compatriots in the receiving country. We also assume that σ (the risk on the expected salary) is a function of the number of links a household has in the receiving country. Because study of the number of connections and the strength of ties which constitutes the migrant network is beyond the scope of this work,[58] it is enough to assume that risk, and therefore standard deviation, is an inverse function of the number of compatriots present in the receiving country, which is:

$$\sigma = g(N) \quad (15)$$

and $g(N)$ decreases in N. Solving first-order conditions m^*, the optimal rate of outmigration in household i is:

$$m^* = \frac{-A + bl + \mu - c}{l(b + \rho g(N)^2)} - \frac{\lambda c}{l^2(b + \rho g(N)^2)} \quad (16)$$

The migration rate changes, depending on initial endowment:

$$\frac{\partial m^*}{\partial A} = \begin{cases} -\frac{1}{l(\rho g(N)^2 + b)}, & \lambda = 0 \\ \frac{1}{c}, & \lambda > 0 \end{cases} \quad (17)$$

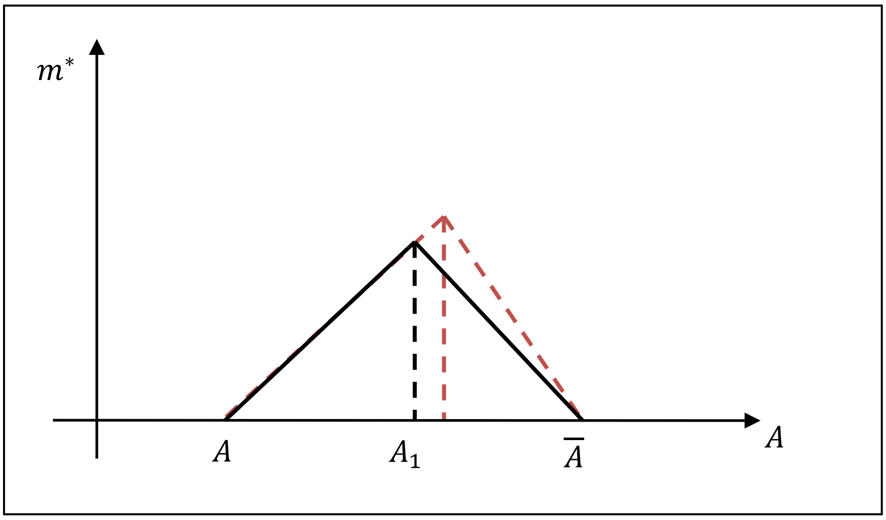
We can now identify the migration rate path in relation to wealth:

[58] Many open issues do not allow migrants' networks to be formalised

$$m^* = \begin{cases} 0 & , \quad A \leq \underline{A} \\ \frac{1}{c}\left(A - \frac{bl}{2} - S\right) & , \quad \underline{A} < A \leq A_1 \\ \frac{bl - A + \mu - c}{l(b + \rho g(N)^2)} & , \quad A_1 < A \leq \overline{A} \\ 0 & , \quad \overline{A} < A \end{cases} \tag{18}$$

Picture 3 shows the effect of the migrant network as a risk reducer. An increase in the network dimension modifies the migration rate only for the subjects who were not bound by the absence of a network. Notably, $\overline{A}$, the value at which migration is no longer profitable, does not vary with risk.

Proposition 2: *the uncertainty reduction effect of networks affects the migration rate only of households not bound in the absence of networks.*



Picture 2: The effect of Network as uncertainty reducer: in dotted the effect of a reduction of uncertainty

2.3.3 Migrant Networks and Resources Pooling

Up to this point, analysis has focused on the stock effect of migrant networks in increasing households' propensity and/or possibility of sending members abroad. The model is developed in the continuum: in particular, the optimal rate of migration is a continuous variable in the space $[0,1]$.

Nonetheless a household, once its optimal ratio of migration has been determined, must transform this value into a natural number: it must map $l_i m_i^*: (0, l_i) \rightarrow \{0,1,2, \dots, l_i\}$. By way of example, let us presume that a household has an optimal migration rate of $m_i^* = 0.3$, and is composed of $l_i = 5$ members. The optimal number of migrants is $m_i^* l_i = 0.3 \times 5 = 1.5$. In this case, the household would like to send abroad 1.5 components, but clearly this is impossible. The household must choose between sending 1 or 2. This can happen only happen in the ranges $\underline{A}_i \leq A_i \leq A_{1i}$ or $A_{1i} \leq A_i \leq \overline{A}_i$, because outside them households either have no incentive to send members abroad (if $A_i > \overline{A}_i$) or they cannot finance their migration (if $A_i < \underline{A}_i$).

It is possible to show that, if there is a social network in the country of origin, with a sufficient level of cohesion and trust among households, the aggregate number of migrants will be higher than in its absence, even without the stock effect of migrant networks reducing costs and risks.

Resources pooling can provide potential migrants with loans (not available in formal markets) financing the migration (at aggregate level) of a larger number of household members then that which would have been feasible with households acting as singletons. The objective is to prove that there exist some conditions under which resources pooling is Pareto-improving for households. For simplicity, formal proof is provided for two (called 1 and 2) households belonging to the range[59] $\underline{A}_i \leq A_i \leq A_{1i}$. To simplify notation, we rename A_{1i} and make it A_{mi}.

We assume that household 1 has an optimal outmigration rate which is positive and equal to $m_1^* = \frac{1}{c}\left(A_1 - \frac{bl_1}{2} - S\right)$.[60] Household 1 would let $l_1 m_1^*$ members migrate. We also assume that this number is not an integer. We can compute the income of the household in the second period, $Y_{1,con}$, where subscript con stands for the continuum case, which is:

$$Y_{1,con} = A_1 l_1 (1 - m_1^*) - \frac{b l_1^2 (1 - m_1^*)^2}{2} + m_1^* l_1 \mu_{w_f} - m_1^* l_1 c - \frac{\rho}{2} m_1^{*2} l_1^2 \sigma^2 \quad (19)$$

Similarly for household 2:

$$Y_{2,con} = A_2 l_2 (1 - m_2^*) - \frac{b l_2^2 (1 - m_2^*)^2}{2} + m_2^* l_2 \mu_{w_f} - m_2^* l_2 c - \frac{\rho}{2} m_2^{*2} l_2^2 \sigma^2 \quad (20)$$

Because households in the range $\underline{A}_i \leq A_i \leq A_{1i}$ are bound by their vinculum, and because $l_i m_i^*$ is not an integer (by assumption), households approximate to the closest smaller integer number (by way of example, if $l_i m_i^* = 3.3$, they send abroad 3 components). This implies that the income households obtain from the maximization in the discrete is lower than the income they would obtain in the continuum.

[59] The range choice is driven by the fact that, in this space, all households would like to send more members abroad, but they are bound by budget constraints.

[60] Note that we focus only on households which are bound.

Defining as $l_i(1-m_i^*) = x_{i,con}$ the number of household members who are not going to migrate, and recalling that each household is composed of L_i members, we can rewrite equations (19) and (20):

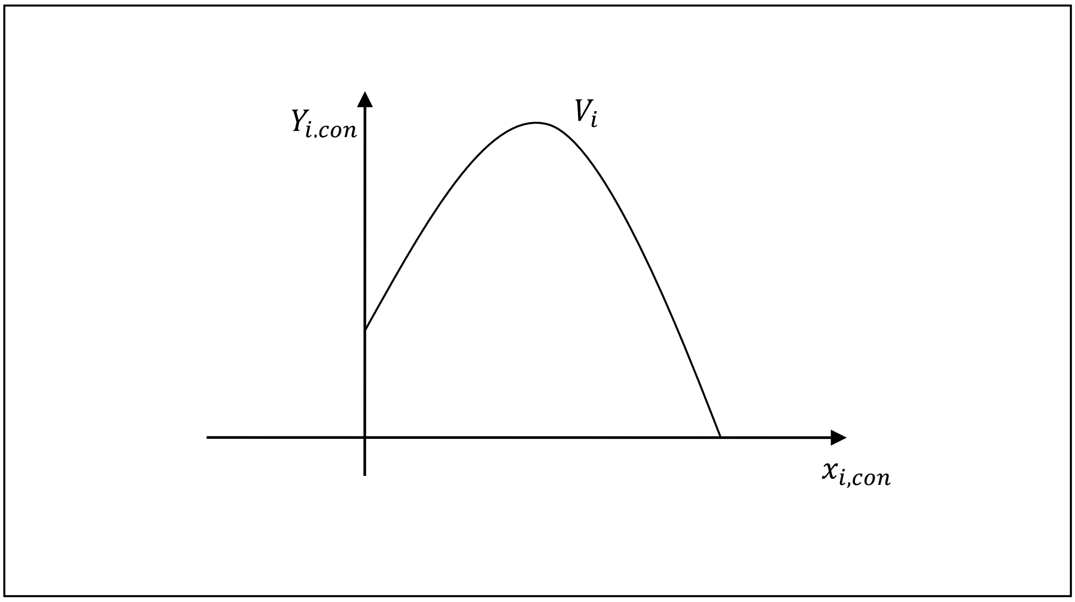
$$Y_{1,con} = A_1 x_{1,con} - \frac{b x_{1,con}^2}{2} + (L_1 - x_{1,con})\mu_{w_f} - (L_1 - x_{1,con})c - \frac{\rho}{2}(L_1 - x_{1,con})^2 \sigma^2 \quad (21)$$

$$Y_{2,con} = A_2 x_{2,con} - \frac{b x_{2,con}^2}{2} + (L_2 - x_{2,con})\mu_{w_f} - (L_2 - x_{2,con})c - \frac{\rho}{2}(L_2 - x_{2,con})^2 \sigma^2 \quad (22)$$

These are two parabolic curves, vertically negatively oriented, with vertexes in:

$$V_i = \left(\frac{\rho\sigma^2 L_i + A_i - \mu_{w_f} + c}{\rho\sigma^2 + b}, \frac{A_i\left(A_i - 2\mu_{w_f} + 2c + \rho\sigma^2 L_i\right) + \left(\mu_{w_f} - c\right)^2 + 2bL_i\left(\mu_{w_f} - c\right) - b\rho\sigma^2 L_i^2}{2(\rho\sigma^2 + b)} \right) (23)$$

Recalling that $0 \leq x_{i,con} \leq L_i$ (i.e., at the limit at which all households will migrate), and also that households cannot have more people employed in the household business than the number of their components, we can represent the relation between income and number of household members employed in the household business as in Picture 3.



Picture 3: Relation between Household income and number of household members employed in family business

Specifically, calling the income of households 1 and 2 in the discrete $Y_{1,int}$ and $Y_{2,int}$:

$$Y_{1,con} > Y_{1,int} \quad (24a)$$

$$Y_{2,con} > Y_{2,int} \quad (24b)$$

This implies:

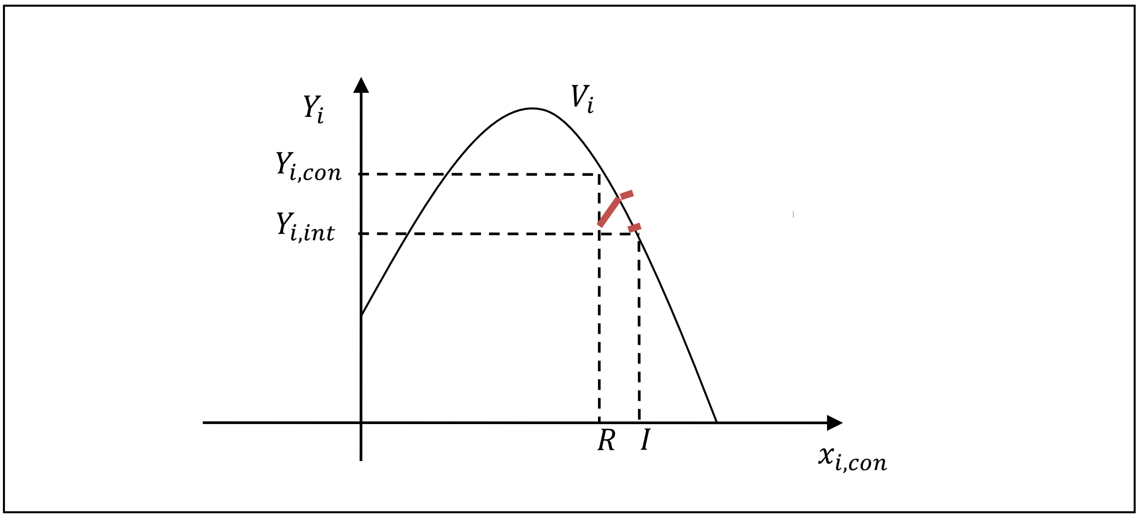
$$Y_{1,con} - Y_{1,int} = W_1 \quad (25a)$$

$$Y_{2,con} - Y_{2,int} = W_2 \quad (25b)$$

where W_i is the loss in income when moving from the continuum to the discrete case, and where W_i is:

$$W_i = \int_R^I Y_{1,con} dx_{i,con} \quad (26)$$

where I_i and R_i are the numbers of migrants in integer and in natural number terms respectively (Picture 4).



Picture 4: Differences in real income, moving from R to I; shadowed area is the loss of wellbeing W_i

We thus assume that $W_1 + W_2 \geq c$ (27), i.e., the loss in real income of the two households together, is large enough to cover the expenditure of sending abroad an additional member (i.e., sending abroad another member is profitable).[61]

Moreover, because we assumed that $x_{i,con} > x_{i,int}$, a fraction of the expenditure for migration is no longer invested in migration, and this amount is equal to $(x_{i,con} - x_{i,int})c$. We assume $\sum_{i=1}^{2}(x_{i,con} - x_{i,int})c \geq c$ (28), that is, migration is feasible.[62]

[61] A similar assumption can be made when j households want to pool their resources, i.e.: $\sum_{i=1}^{j} W_i \geq c$.

[62] A similar assumption can be made with j households, i.e.: $\sum_{i=1}^{j}(x_{i,con} - x_{i,int})c \geq c$.

Now all the elements that allow us to prove that the pooling of resources is an improving strategy are given, in fact, the two households[63] have the incentive to send one member abroad (condition (27)) and sending a member abroad is feasible (condition (28)).

At this point, it is necessary to prove that the two households, pooling their resources, will both end up in a better condition. To complete the proof, we need to define how households can pool their resources and how they can share the pooled income. There are two solutions to this problem. On one hand, households can pool all their resources as if they were only one family, and then share the total income of home businesses and foreign wages. On the other hand, one of the two households can partially finance the migration of one additional member of the other household, obtaining, in exchange, part of the remittances sent home.

Both these approaches implicitly assume either a high level of trust among households (which may be the effect of kinship,[64] or of cultural social capital)[65] or the possibility of "signing" an enforceable contract. As it is beyond the scope of this analysis to study the conditions underlying the social trust or punishment structure, we assume that such a potential punishment does exist.

The simpler solution is adopted. Two households decide to pool all their resources, becoming a new larger family. We assume that there exists two households (called 1 and 2) satisfying (27) and (28). To simplify, we assume no migration risks. If households pool their resources, the maximization problem becomes:

$$\max_{0 \le m \le 1} AL(1-m) - \frac{bL^2(1-m)^2}{2} + mL\left(\mu_{w_f} - c\right) \quad (29a)$$

$S.t.$:

$$A - \frac{bL}{2} - mc \ge S \quad (29b)$$

where $A = (A_1 + A_2)$ and $L = (l_1 + l_2)$.

[63] The same proof may be extended to a larger number of households.
[64] This implies that we should identify higher levels of outmigration among larger extended families.
[65] This implies that we should observe different levels of outmigration among economically similar and culturally different ethnic groups (Sana et al., 2008).

The maximization is structurally equal to that for a single household. The migration rate path in relation to wealth levels is:

$$m^*_{pooled} = \begin{cases} 0 & , \quad A < \underline{A} \\ \frac{1}{c}\left(A - \frac{bL}{2} - S\right) & , \quad \underline{A} \le A \le A_m \\ 1 - \frac{A - \left(\mu_{w_f} - c\right)}{bL} & , \quad A_m \le A \le \overline{A} \\ 0 & , \quad \overline{A} \le A \end{cases} \quad (30)$$

where $\underline{A} = \frac{bL}{2} + S$ is a value larger than that of a single household, but is smaller than the sum of $\underline{A}_1 + \underline{A}_2 = \frac{bl_1}{2} + S + \frac{bl_2}{2} + S = \frac{bL}{2} + 2S$.

$\overline{A} = bL + \left(\mu_{w_f} - c\right)$ is a value larger than the level for a single household, but smaller than the sum of $\overline{A}_1 + \overline{A}_2 = bL + 2\left(\mu_{w_f} - c\right)$.

More complex is analysis of the value at which households are no longer bound:

$$A_m = \frac{1}{2}\frac{b^2L^2 + 2bLS + 2bLc + 2c\mu_{w_f} - 2c^2}{(c + bL)} \quad (31)$$

Recalling that:

$A_{1m} = \frac{1}{2}\frac{b^2l_1^2 + 2bl_1S + 2bl_1c + 2c\mu_{w_f} - 2c^2}{(c+bl_1)}$ and $A_{2m} = \frac{1}{2}\frac{b^2l_2^2 + 2bl_2S + 2bl_2c + 2c\mu_{w_f} - 2c^2}{(c+bl_2)}$,

we compute $A_m \le A_{1m} + A_{2m}$.

Since the space of parameters of interest is only $\underline{A} \le A \le A_m$, the number of migrants under the pooled household union is $\frac{1}{c}\left(A - \frac{bL}{2} - S\right)L$, whereas the number of migrants in the case of two separate households is $\frac{1}{c}\left(A_1 - \frac{bl_1}{2} - S\right)l_1 + \frac{1}{c}\left(A_2 - \frac{bl_2}{2} - S\right)l_2$. Rewriting and rearranging:

$$\left(A - \frac{bL}{2} - S\right)l_1 + \left(A - \frac{bL}{2} - S\right)l_2 > \left(A_1 - \frac{bl_1}{2} - S\right)l_1 + \left(A_2 - \frac{bl_2}{2} - S\right)l_2 \quad (32)$$

This is true if $\left(A - \frac{bL}{2} - S\right)l_1 > \left(A_1 - \frac{bl_1}{2} - S\right)l_1$ and $\left(A - \frac{bL}{2} - S\right)l_2 > \left(A_2 - \frac{bl_2}{2} - S\right)l_2$ hold simultaneously.[66] Rewriting the first inequality:

$$A_1 + A_2 - \frac{bl_1}{2} - \frac{bl_2}{2} - S > A_1 - \frac{bl_1}{2} - S \quad (33)$$

This is always true if $A_2 - \frac{bl_2}{2} > 0$. Recalling that $A_i - \frac{bl_i}{2} > S$, the first inequality always holds in the model. Similarly for the second inequality. This concludes the proof, since under

[66] This is a sufficient condition, not the minimal condition.

condition (*27*) and (*28*), the combined total number of household members sent abroad is larger than the sum of household members when the households are disunited.

2.4 Discussion and Conclusions

The main purpose of the model is to study the effect of budget constraints, social capital, and networks on migration choices. Building on McKenzie and Rapoport (2007), the model generalizes those authors' framework by explicitly introducing the risk of migration and by deriving the effect of networks analytically. Even in such a simple framework, we have different effects according to the stock of immobile assets (and more in general wealth) which a household owns.

The model shows why we observe relatively low levels of migration even with large wage gaps, and why we observe persistent or increasing migration flows when wage gaps decrease. Budget constraints bind migration dramatically, reducing the outmigration rate of households having higher incentives to migrate (those belonging to the left tail of the income distribution). This, at aggregate level, confirms that migration flows go hand in hand with development. Economic development, increasing the average wealth in a country,[67] reduces the binding effect of budget constraints allowing increasing numbers of people to migrate.

This effect alone cannot explain why we observe increasing migration flows in the absence of such development processes. Along the analysis, I model three main channels through which social networks and social capital, intended respectively as stock of compatriots in the receiving country[68] and as cohesion among households in the sending country,[69] can affect household behavior and, at aggregate level, the dimension of migration flows.

Social networks and social capital reducing costs and risks and pooling resources all modify the economic framework households face, allowing them, at least partially, to overcome budget constraints under underdeveloped financial and insurance markets. Specifically, these effects can

[67] This is true, keeping constant the inequality level in the country or reducing it. However, it is not true if development only enriches social strata which were already better off. When economic "development" affects only richer social strata, we should expect even lower migration flows.
[68] This is in line with Zimmermann's approach to ethnic networks.
[69] This is in line with Sana and Massey (2007) and Chantarat and Barret (2007).

be summarized in two interrelated groups of empirically testable hypotheses concerning the relation between wealth, social networks and migration.

1. With underdeveloped credit and financial markets, wealth has an inverted U-shaped relation with migration. That is, as household wealth grows, both the probability of migration and the number of migrants a household sends in migration first increases and then decreases.
2. Migrant networks and social capital facilitate migration by reducing the costs and risks of migration and allowing migration to be finance though resources pooling. In particular, we should expect that communities with longer/larger histories of migration and households with larger networks to have present higher outmigration rates.

In order to examine these hypotheses, an ideal dataset should include individual and community panel information on household wealth, income, community capital and social capital accumulation, household and community histories of migration. Since such a complete dataset does not exist, I focused on MMP118 database, a collaborative research project based at Princeton University and the University of Guadalajara,[70]organizing information on 118 communities surveyed in the period 1987-2007, which is, in my opinion and to the best of my knowledge, the closest to the ideal one.

Notwithstanding its quality, the database does not convey information on migration risk. Thus, determining whether networks facilitate migration through cost-reducing or risk-mitigating effects, is not feasible for the time being. The focus of the analysis is on the relation wealth-migration and on the effect of networks in household migration decisions. Following Winters et al (2001) next chapter examines the difference between household and community level networks, emphasizing that they are sometimes complements and sometimes substitutes in household migration strategies.

[70] More information about the MMP database can be found in the MMP website: http://mmp.opr.princeton.edu/

Chapter 3 The Dynamics of Migration: Household and Community Networks in Mexico-U.S. Migration

3.1 Introduction

This chapter empirically examines the relations between wealth, migration costs and networks in determining migration decisions, with the aim of providing a structured analysis of the elements driving Mexican households' decisions to migrate to the U.S.. While all these elements are usually investigated separately, they all influence migration flows, sometimes being substitutes and sometimes complements in migration decisions. As derived in chapter 2, although budget constraints can reduce the outmigration rate by binding the optimal choice, scholars have shown how social networks can increase migration propensity, acting as a counterforce to budget constraints.

This empirical analysis is mainly inspired by and influenced by the works of McKenzie and Rapoport (2007) and Winters et al. (2001). The model derived in chapter 2 is a generalization from McKenzie and Rapoport (2007), and thus the MMP data[71] are used to test hypotheses and to make comparisons. Several prominent scholars contributed to the creation of/and/or used the MMP, which is probably the largest and most complete database on Mexican migration. Comparisons and the robustness of results are not the only rationale behind the choice to use MMP data. Using the same database as McKenzie and Rapoport (2007) allows the application of a similar set of instruments, in order to overcome the problem of endogeneity.

Winters et al. (2001) conducted an empirical inquiry on Mexican migration, based on a 2001 dataset from *ejido*[72] and household-level surveys, covering all the Mexican states except Chiapas. The main contributions of this work are two: the application of the HTS procedure to solve the problem of sample selectivity, and identification of a series of variables to measure and disentangle household and community-level networks. Network benefits depend on how the network may be used. As pointed out by the authors, if household and community networks

[71] In their work, McKenzie and Rapoport (2007) also used data from the Encuesta Nacional de Dinamica Demografica (ENADID), obtaining similar results using the two datasets. I focus here only on the MMP dataset, since it is more complete.

[72] The Mexican name for communities for which the government has promoted a shared use of communal lands.

accomplish the same functions, they are substitutes and household networks, when large enough, may take the place of community networks in migration decisions. If, however, households and community networks accomplish different functions (because, for example, they convey different kinds of information) they are complements.

The aim in the following pages is to disentangle the effects of budget constraints, household and community networks (as in Winters et al., 2001) on households' migration decisions, solving simultaneously two of the main problems in migration studies: sample selection (as in Winters et al., 2001) and endogeneity of network size (as in McKenzie and Rapoport, 2007). To tackle selection, the Heckman correction method is applied. Since the HTS procedure is not reliable in the presence of endogenous phenomena, two empirical approaches are applied. On one hand, following Mroz (1987) and Piacentini (2008), a three step procedure based on Instrumental Variable and Inverse Mills Ratio (IMR) is applied to identify the effect of selection (Probit and IV-Probit) and to examine the number of migrants a household sends abroad (IMR and IV Regression). On the other hand, following Cameron and Trivedi (1998), an IV-Poisson is used to examine the determinants of the number of members a household sends in migration.

In addition, using data from the MMP and a database on U.S. immigration policy,[73] I analyse the effect of changes in U.S. immigration policy on the decisions made by potential migrants.

The chapter is organized as follows: Section 3.2 describes data; Section 3.3 provides the empirical specification and results are discussed; Section 3.4 concludes and assesses future development.

3.2 Data

In order to investigate the effect of household wealth and networks and historic migrant networks on current households' migration decisions, the ideal dataset should include individual and community information on household income, community capital and social capital

[73]Thanks are due to Professor Giovanni Peri (University California, Davis) who kindly made his database available to me.

accumulation, household histories of migration, and community histories of migration. Since such a complete dataset does not exist, I focused on the MMP118 database, a collaborative research project based at Princeton University and the University of Guadalajara[74]organizing information on 118 communities surveyed in the period 1987-2007. In my opinion and to the best of my knowledge, this is the database closest to the ideal one.

This analysis is based on the dataset labeled HOUSE118, including information on 19,726 Mexican households. It is a household-level database containing information on household composition, economic and migratory activities of household members, land ownership and usage, home/real estate ownership and amenities, vehicle and livestock ownership and financing, and business ownership and operations.

In the dataset, a variety of communities were sampled in order to provide a basis for comparative study and generalization. These communities were chosen to provide a range of different sizes, regions, ethnic compositions, and economic bases. The sample therefore includes isolated rural towns, large farming communities, small cities, and very large metropolitan areas.[75] The dataset contains data from both indigenous and *mestizo*[76] towns and embraces communities specialized in mining, fishing, farming and manufacturing, as well as communities with very diversified economies.

Between two to five Mexican communities are surveyed each year during the months of December and January of successive years[77]. These representative community surveys yield information on where migrants go in the United States, and during the months of July and August interviewers travel to those U.S. destinations to gather (non-random) samples of 10 to 20 out-migrant households from each community.

Although each household has been surveyed once, all household heads are asked for their entire life retrospective migration histories. The survey also asks all member of the household whether they have been to the U.S. and, if so, the year of their first trip to the U.S.. However, since

[74] More information about the MMP database can be found in MMP website: http://mmp.opr.princeton.edu/

[75] The dataset covers communities in the states of Aguascalientes, Baja California Norte, Chihuahua, Colima, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, México, Michoacán, Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Tlaxcala, Veracruz and Zacatecas.

[76] *Mestizo* refers to people of mixed origin (particularly of Indian and white parentage)

[77] The sample size is generally 200 households, unless the community is under 500 residents, in which case a smaller number of households is interviewed. If initial fieldwork indicates that U.S. migrants return home in large numbers during months other than December or January, interviewers return to the community during those months to gather a portion of the 200 interviews.

each community is observed only once, the database is a large cross-section, even though data were collected in different years.

Although the MMP probably represents the most comprehensive database on Mexican migration, it does not contain complete information on household income or consumption levels. Data on communities 1-52 provide information on the income of household heads, but other members' income is missing. In addition, the information is about current income, and it is therefore difficult to infer economic conditions at the moment of the last migration. Data on communities 53-118 provide information on household heads and spouses' income for the last formal job in Mexico.

Although this type of information is close to that needed for analysis, it is not a complete and sufficient statistic for household income. First, when the last formal job in Mexico was undertaken is not reported. The job may have been obtained after coming back from the U.S.. Second, information on other household members' income is missing, so that household income may be underestimated. Third, since the survey collects income data across 20 years, to normalize them at Purchasing Power Parity (PPP) is problematic, especially if living standards are different among states and regions. Lastly, income data are collected on different time bases: yearly, monthly, biweekly, weekly, daily, or even hourly. In the absence of information on the total number of hours, days, weeks and months worked in a year by members, comparisons among households are impossible.

Since the MMP includes no reliable information on household income, an alternative measure had to be found. The MMP includes information on household access to infrastructures, such as access to electricity and running water, dirt or tile floors, and household ownership of some durable assets such as cars, radios and television sets, allowing the application of PCA to derive a household wealth indicator. Filmer and Pritchett (2001) used PCA to derive household wealth in India and several other countries, and showed that an asset-derived index is as accurate as information on expenditures in predicting school enrollment of children. McKenzie (2005) showed how information from the MMP can be used in conjunction with national income and expenditure surveys (ENIGH) to predict non-durable consumption (NDC) and derive a reliable inequality index for Mexico.

Since the investigation of inequality is beyond the scope of this chapter, I focus on Principal Components. Using assets as instruments for household wealth overcomes two main problems typical of income or expenditure data, since these are more subject to measurement errors. Secondly, consumption expenditures and income need to be normalized, to take into account the number of members in the family, whereas the utility of assets is usually the same for all household members, independently of their number.

Lastly before moving to the descriptive statistic, it is necessary to define what a migrant household is. A household is defined as migrant when one or more of its members have migrated to the U.S. in the three years prior to the survey. According to this definition, in the sample studied here there are 2,024 migrant households, i.e., 15.81 percent of the sample.

3.2.a Household Composition

Human Capital Assets identify a series of structural household elements which are likely to affect migration, as shown among others by Winters et al. (2001).

The size of migrant households (that is, the number of household members) is larger than the size of non-migrant households by around 0.8, and the difference is statistically significant (0.01 confidence level) when a t-test is performed.[78] The average age of migrant household heads is below that of non-migrant household heads. This is consistent with previous empirical findings[79] and with the neoclassical theory of migration. It is more likely, in fact, that subjects migrate for the first time when they are relatively young (usually between the ages of 15 and 45), to maximize expected returns. In the present analysis, household heads who already had migration experience are not dropped from the sample,[80] since the aim of the chapter is to disentangle the effect of community and household-level networks. Previous migration experiences play a key role in developing a network.

[78] Winter et al. (2001) report a difference of 3 members in favor of migrant households, but their measure only refers to the number of adults.
[79] Only Winters et al. (2001) find migrant household heads to be older than non-migrants.
[80] McKenzie and Rapoport (2007) only study first time migrant households.

	Table 1: Descriptive Statistics						
	Migrants		Non-Migrants		Total		
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	T-Test
Sample Size	2024	-	10781	-	12805	-	
Number of recent US Trips	1.374	0.787	0.000	0.000	0.217	0.591	*
Human Capital Assets							
N° of Members	5.399	2.527	4.629	2.285	4.751	2.342	*
N° of Workers	2.216	1.516	1.758	1.200	1.830	1.266	*
Percentage of Males	0.493	0.190	0.452	0.212	0.458	0.209	*
Household age	43.482	13.881	48.388	15.587	47.612	15.434	*
Eucation Level	5.073	3.438	5.669	4.230	5.575	4.121	*
Cross effect Wealth and Education							
educ*wealth	26.350	19.599	30.013	25.016	29.434	24.276	*
Physical Assets PCA							
Wealth	5.028	0.848	4.968	1.039	4.978	1.011	*
Household Network							
Historic Migration Experience	4.200	6.504	0.723	2.259	1.273	3.548	*
Current Network	16.417	21.445	7.702	14.028	9.080	15.762	*
U.S. resident	1.063	1.646	0.463	1.092	0.557	1.217	*
Community Network							
Migration Prevalence	0.268	0.139	0.189	0.148	0.201	0.149	*
Migration Prevalence*Wealth	1.346	0.752	0.928	0.747	0.994	0.763	*
Physical Costs							
Average Distance from the U.S.	1901.343	198.474	1889.724	279.267	1891.560	268.148	
Border (dummy)	0.041	0.197	0.125	0.331	0.112	0.315	
Economic Indicators							
Mexican Unemployment Level	0.034	0.008	0.034	0.008	0.034	0.008	
Average U.S. wage (log)	2.372	0.162	2.416	0.196	2.409	0.192	
US Unemployment Level	0.057	0.008	0.055	0.008	0.056	0.008	
Exchange Rate	5.339	3.092	6.573	3.233	6.378	3.242	
Inflation Rate	21.032	14.980	17.970	15.176	18.454	15.185	

Table 1: Descriptive statistics. Source: authors from MMP118, NATLHIST, NATLYEAR, Google Maps Tools for distances

In line with previous findings, the *education level* of non-migrant households is higher than that of migrants. This may be the effect of four possible non-competing selection processes. First, if migration is costly, those who have the opportunity of obtain higher levels of education may be less or not at all interested in migrating, because they are too "rich" to find the idea appealing. Second, if there is a gap among countries in education systems (which is probably the case between Mexico and the U.S.), obtaining a higher education certificate may be of little value if a person has already planned to migrate. Third, above a certain wealth threshold migration and education may be complementary investments, whereas below this threshold they are substitute investments. Fourth, lower levels of education may be the effect of brain drain. Without education requalification policies, a cumulative migration process may reduce the *education level* of those who remain, further reducing the quality level of those who migrate (see chapter 5).

3.2.b. Household Capital Assets

Since income information is not reliable, it is necessary to identify an alternative way of measuring household wealth. Following Filmer and Pritchett (2001) and McKenzie (2005), I proxy wealth by using PCA to derive a index for wealth from information on household facilities and asset indicators such as land holdings, house building materials and amenities.

Originally proposed by Pearson and independently by Hotelling, PCA is largely used in all forms of analysis because it is a simple, non-parametric method for reducing complex datasets to a lower dimension, able to capture hidden structures. The basic idea behind PCA is to describe a multivariate dataset in the most "simple" way possible through a set of derived uncorrelated variables, each of which is a linear combination of the variables in the original dataset.

PCA makes one stringent assumption: *linearity*, identifying the combination of original basis which best represent the dataset. The First Principal Component is the linear combination of all the variables which capture the largest variability and thus the largest amount of information. This instrument is used here assuming that asset ownership differences are explained by long-run wealth.[81]

Assuming that what mainly determines variations in housing construction materials, amenities, vehicle ownership and business holdings is wealth,[82] the first factor (Principal Component) identifies the wealth level of a household. MMP118 includes 27 asset indicators

[81] See Filmer and Pritchett (2001) for the validity of this assumption. See appendix A.
[82] It is implicitly assumed that everyone prefers higher (in quality or numbers) asset ownership than lower ones. Differences are not the effect of tastes but of different economic opportunities.

grouped in four main categories: farming and breeding, property holding, household amenities, and business holdings. Table 2 lists the scoring factors of each group and all components.

As expected, the factors derived using information about housing and amenity ownership are highly correlated with the *Total Index 25* (*TI25*). *TI25* is similar to the wealth index derived by McKenzie (2005) and used in McKenzie and Rapoport (2007) to compute Non-Durable Consumption (NDC). Only three elements differ between the index used by the authors and the one presented here. *TI25* includes the number of hectares owned and the number of businesses held by the household not taken into consideration in McKenzie and Rapoport (2007), whereas information about education is excluded from the PCA index. The introduction of the first two elements aims at increasing the number of variables which may, in principle, reflect the long-run wealth level of the household. Although educational attainment is highly correlated with the wellbeing of a household, the information is not used to derive *TI25,* since education is used as a regressor for migration analysis.

The farming factor has a low and negative correlation with *TI25.* One explanation is that, on average, rural households are poorer. The very low coefficient may be explained by the large amount of 0's in farming and breeding activities: only around 2000 households own land and even fewer own animals. Similarly, the low correlation coefficient between the *Business* factor and *TI25* may be explained by the large amount of 0's in the sample.

Table 2: PCA; Scoring Factors					
	Farming PCA	Housing PCA	Amenities PCA	Business PCA	Total Index 25
Farming and Breeding					
Land Ownership	0.8533				-0.0998
N° of hectares per household	0.2968				0.0138
Machinery	0.7934				
Fertilizers	0.8627				
Insecticides	0.8399				
Cows	0.322				
Pigs	0.1129				
Horses	0.3927				
Burros	0.3312				
Oxen	0.1827				
Chicken	0.3025				
Housing					
N° of Property Holding		0.1825			0.2088
Construction1: adobe and tile roof		-0.4428			-0.437
Construction2: brick and tile roof		-0.5786			-0.3448
Construction3: brick and cement roof		0.7952			0.6005
Construction4: wood		-0.1013			-0.0902
Floor1: dirt		-0.4046			-0.5386
Floor2: cement		-0.6122			-0.3832
Floor3: finished		0.8302			0.6752
N° of rooms		0.5546			
N° of rooms/member					0.3445
Amenities and vehicles					
Running water			0.4162		0.3807
Electricity			0.4084		0.3493
Sewer			0.5326		0.5473
Stove			0.5699		0.5224
Refrigerator			0.7419		0.7142
Washing machine			0.6849		0.6397
Sewing machine			0.461		0.4194
Radio			0.39		0.3197
TV			0.5749		0.4948
Stereo			0.6241		0.5879
Phone			0.5877		0.5938
Car			0.422		0.4116
Van			0.3239		0.2925
Bus			0.069		
Tractor			0.0744		
Taxi			0.0449		
Motorcycle			0.0493		
Other vehicle			0.0055		
Business Holdings					
N° of business holdings				0.9956	0.1931
Business type: store				0.4652	
Business type: street vendor				0.395	
Business type: restaurant/bar				0.2258	
Business type: workshop				0.3541	
Business type: factory				0.1068	
Business type: middleman				0.1971	
Business type: personal service				0.1636	
Business type: professional service				0.1112	
Business type: other service				0.0971	
Business type: agriculture				0.2814	
Business type: cattle raising				0.242	
Business type: other				0.3769	
Eigenvalues associated with first component	3.40048	2.742	3.69581	1.91871	5.01601
Share of variance associated with first component	0.3091	0.3047	0.2053	0.1476	0.2006
Number of variables used	11	9	18	13	25
Correlation with TI25	-0.0492	0.7881	0.935	0.1931	

Table 2. Author from database

3.2.c. Network Variables

Household network is identified by three main variables: the number of *historic migration experiences*, *current network*, and household relationships with *U.S. residents*. The *historic migration experience* is defined as the sum of the number of migration experiences of household heads and/or their spouses, sons and daughters prior to the last 3 years. As shown in Table 1, migrant households have, on average, *historic migration experience* six time larger than non-migrant households. This value is compatible with the idea that migration experience increases the probability of further migration.

Current network is the number of friends and relatives, not belonging to the household but to the extended family, who were abroad in the year of the survey. Migrant households have, on average, more than the double the number of links in the receiving country than non-migrant households.

U.S. resident is the number of relatives actually residing in the U.S.. Both variables are likely to affect migration decisions. Each household member can, in fact, receive financial support, assistance and information from the network. Specifically, three aspects of current household migration networks may have a great influence on migration decisions: financial support, housing, and information.

Financial support may be fundamental in overcoming budget constraints, particularly when crossing the border is expensive. Those who have already migrated can finance migration of co-villagers and relatives for various reasons: altruism, inequality aversion, social norms, loan repayments, household income maximization strategies, household income risk minimization, or speculation. Independently of the reason, financial support allows potential migrants to overcome budget constraints.

Housing has been shown to represent the main cost, at least in the first phase of residence in the receiving country. The larger the number of connections in the receiving country (or, even better, some residents in the receiving country), the greater the reduction of this cost. Housing support is usually “rent-free”.

Last but not least, information plays a key role in migration decisions. Migration is a risky form of investment. There are two main sources of risk: border crossing and unemployment. To be in contact with someone who has recently migrated or who is currently residing in the U.S. can greatly improve the information available to potential migrants and their households. Specifically, recent migrants can provide information on how to cross borders, can introduce potential migrants to *coyote,* or help newcomers with bureaucracy. Contacts in the receiving country can provide information on potentially available jobs. For example, in Texas and California resident migrants have been shown to act as recruiters in seasonal farming work. This may explain the high ethnic concentration of Mexicans in certain economic sectors. Moreover, some migrants resident in the U.S. become entrepreneurs, hiring compatriots as employees.

Community-level networks also provide information and a series of services which can probably reduce both psychological and physical costs, and the risks of migration. For instance, networks have been shown to be able to provide ethnic goods to migrants, reducing the psychological cost of migration; to organize money transfers and transportation services, lowering the costs of migration and of sending back remittances; to increase local knowledge of the receiving country, and even to organize development programs in the sending community. However, identification of community-level network effects on migration is less straightforward.

The main difficulty is finding an appropriate measure able to capture all support and information spillover effects. Following Durand et al. (2001), I used *migration prevalence* ratios to incorporate the community-level migration network in the analysis. As the above authors argue, migration prevalence does not describe "the migration flow per se, but rather, a phase in its development". *Migration prevalence* is a useful measure which can capture the level of development of migration flows in a certain community. *Migration prevalence* ratios are usually calculated with information on the date of birth of household members and the year of their first trip to the U.S..[83]

Nevertheless, *migration prevalence* has some important disadvantages. First, as already highlighted by Durand et al. (2001), "it tends to dehistoricize migration". This means that specific local or global events affecting migration rates (e.g., the 1925 railway construction, the 1940s Bracero Program, the 1980s economic crisis, 9/11) may occur at any moment in the history of migration of different communities, thus implying different effects. The use of IV, as in McKenzie and Rapoport (2007), not only solves endogeneity but also avoids the *dehistoricization* of migration.

Migration prevalence may be biased upwards or downwards, depending on internal and permanent migration dynamics. It may be overestimated if internal and international migrations

[83] For a complete explanation on how to compute migration prevalence ratios, see Massey et al. (1994).

are substitutes, or if migration becomes permanent (migrant households disappear from surveys). Like the internal migration situation, *migration prevalence* may be biased upwards in multiple migration destinations or subsequent migration steps. If migrants can choose among different receiving countries, the *migration prevalence* to country A may be overestimated if there is a large migration flow to country B. Or migration to A may just be a first step to reach B. Migrants may be recorded as migrating to A (thus increasing A migration prevalence), while the real network is in B (so that migration prevalence for B is underestimated).

This last observation leads to a discussion on the usefulness and applicability of the *migration prevalence* ratio as a proxy for community-level networks. *Migration prevalence* is a very powerful tool when applied to migration contexts presenting a prevalent destination country, such as the U.S. for Mexico. At the same time, *migration prevalence* captures some innate propensities of certain communities to migrate. This propensity cannot be captured with variables such as the stock of compatriots in the receiving country, so that migration prevalence improves understanding of the migration flow, allowing better generalization network effects derived from individual data. If migration prevalence must be applied to migration flows with multiple destination countries, it should be weighted and corrected to take into account overestimation.

3.2.d. Physical Costs and Economic Indicators

Two other categories of variables are identified in Table 1: Physical Costs and Economic Indicators. Among other characteristics migrant households should be more prone to migrate if the cost is lower and expected returns are higher.

Distance[84] is likely to be an approximate measure of the cost of migration. In cross-country migration flow analysis, distance is always used as a rough measure of physical cost of migration and of cultural distance (when country fixed effects are not applied). In unidirectional analysis, distance should still have a negative significant influence on the decision to migrate, if the sending country is large enough and if the cost of moving between countries is high enough to become a barrier for most of the population.

Economic Indicators are all likely to affect household migration strategies. All average levels are computed as the means in the last three years before the survey was undertaken. This is

[84] Distance is measured as the average distance of the Mexico state capital of the community in question and the U.S. state capitals of California and Texas.

to make those values compatible with the definition of migrant households used in this chapter. The *U.S. average wage* measures the return of migration, while *unemployment* levels are a partial measure of risk. To avoid possible fluctuations due to the business cycle I used the difference in unemployment levels between U.S. and Mexico and the exchange rate. Lastly, *exchange rate* and *inflation rate* are used to measure the monetary advantages of migration. Both affect not only the expected return of migration, but the family income risk minimization strategy. Migrating when exchange rates are high increases household wellbeing in Mexico. Remittances have higher value, since they are in U.S. dollars. Nonetheless, having remittances in U.S. dollars ensures households against hyperinflation and monetary devaluation.

3.2.e. U.S. Immigration Policy

One of the aims of this research is to improve the methodological approach in the study of the determinants of migration, to provide policy-makers with better forecasting instruments to avoid the unpredictable and undesirable consequences of immigration reforms.

This is the rationale behind implementing U.S. immigration legislation in the analysis using the index proposed by Ortega and Peri (2009).[85] Their database contains information the immigration legislation of 15 OECD countries over the period 1980-2005. Each change in legislation is associated with a (+1) or a (-1), whenever a reform increases or decreases the tightness of immigration laws. Since Mexican emigration is mainly unidirectional to the U.S., this work focuses on that part of database on U.S. legislation over the period 1987-2005 (see Table 3).

The database provides three variables on the tightness of entry, stay and refugee regulations. The focus here is not on refugees, so the refugees variable is not taken into consideration; moreover, since it is not within the scope of this paper to examine U.S. immigration policy in detail, I produced a single index, which is the yearly mean of entry and stay. Using only one index for the tightness of U.S. immigration policy also saves degrees of freedom in "temporal" analysis. The resulting variable (*avglaw*) is expected to have a significant negative influence on migration.

[85] For more details see the Giovanni Peri website http://www.econ.ucdavis.edu/faculty/gperi/ and Ortega and Peri (2009).

	Table 3: US immigration Policy					
	Migrans		Non Migrants		Total	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
US Immigration Policy (Peri)						
Entry	-3.2488	1.6587	-3.5589	1.2205	-3.5099	1.3045
NAFTA (dummy)	0.5440	0.4982	0.6888	0.4630	0.6659	0.4717
Stay	-1.1525	0.6517	-1.1574	0.7139	-1.1567	0.7044

Table 3: Authors from Ortega and Peri (2009)

Lastly NAFTA is a dummy variable for the NAFTA agreement. A priori, we may presume that the NAFTA agreement, facilitating relations among members (particularly after 1993), also increased migration flows.

3.3: Empirical Specification

In order to analyse the causality relation between network size and migration, an empirical approach is necessary, able to control simultaneously for both migrant selection and endogeneity of network size. Two methods of analysis are applied. On one hand, a three-step procedure along the lines of Mroz (1987), like that already used on migration in Piacentini (2008).[86] On the other hand, a count analysis approach, IV Poisson, is used to deal with count data analysis.

Following Mroz (1987), the three-step procedure is the following: the first step solves the self-selection problem by examining the dichotomous choice of migration; the second step tackles potential endogeneity in network size by using instrumental variables; the third step identifies the network effect by including both sample selection and instrumental variable approach in a structural equation for the number of migrants.

To show the efficiency of this approach, estimations for the HTS procedure and the IV approach are provided. The HTS procedure was used, among others, by Winters et al. (2001), and the IV-Probit approach was successfully applied by McKenzie and Rapoport (2007). Although McKenzie and Rapoport's empirical specification is the one used on this dataset to examine the model presented in chapter 2, I argue that the specification of Winters et al. (2001) is closer to

[86] Piacentini (2008) studied the relation between migrant networks and school enrollment in the context of internal migration in Thailand.

reality. The IV-Probit approach only determines the probability of a household being involved in migration, whereas the HTS makes it possible to determine both the probability and the optimal number of migrants. Lastly, IV-Poisson estimation method is explained and results reported.

Before moving to empirical methodology, some preliminary analyses, in particular Ordinary Least Squares (OLS), were carried out (see appendix B), showing that there is significant heteroskedasticity in the data (Breusch-Pagan test p=0.000). This result was expected, as the dependent variable is a binary variable,[87] and it was solved by using robust standard errors (option robust in STATA where available or the bootstrapping method). Cluster robust SE were discarded since heteroskedasticity in the model has two main sources: community level and national level. Since the difference between robust SE and cluster robust SE is below 0.10 for all variables, excluding *migration prevalence*, normal robust standard errors are used.

3.3.a. Solving Sample Selection, HTSP

Starting from the idea that migration is a two-step decision, in which at the first step the household decides whether to send migrants, and at the second step it decides the optimal number of migrants to send abroad, Winters et al. (2001) analysed the effect of community and family networks in determining migration decisions. As largely established in the literature, migrants are not a random sample, so that a mechanism correcting for the difference between migrants and non-migrants is needed.

Following Winters at al. (2001), the reduced form of the econometric model for the decision to migrate (*d*) and the level of migration (*l*) can be formulated in the following two steps:

Step 1: Choice of migration

$$d^* = W\gamma + u_1 \quad (1)$$

$d = 1$ if $d^* > 0$, 0 otherwise.

Step 2: Level of migration

$$l = W\beta + u_2 \quad (2)$$

observed if $d = 1$, with

$$(u_1, u_2) \sim N(0,0,1,\sigma_2,\rho)$$

and

$$W = \{L, Z_n, Z_c, n, N, nN\}$$

[87] Similar results were obtained when the number of migrants was analysed

The estimation is made with the HTS procedure: the first stage is estimated by maximum likelihood probit, and the second stage by a truncated least squares regression. This procedure computes unbiased estimators in the second stage (by including the IMR), but it cannot solve the endogeneity problem. Moreover, using the same variables to estimate the probability of migrating and the number of migrants a household sends abroad leads to a weak identification problem. As pointed by Winter et al. (2001), and according to the framework proposed here, if there were no entry costs, the household income maximization decision would be the same as the decision of the level of migration. However since migration is costly, the decisions are different. The optimal number of migrants is in fact independent of the fixed cost, while undertaking migration a household requires positive returns, including the fixed cost of that migration. While Winter et al. (2001) had no measure for costs, so that the selection equation lacked an identification variable, two rough measures for the migration cost are available here: *distance* and *border*.

If the hypothesis examined here is true, we should expect positive values for wealth and network variables. Squared income should be negative and interaction between wealth and migration prevalence may have different signs depending on social stratum selectivity.

Table 3 reports estimation results. Robust standard errors were obtained by the bootstrapping method. Appendix C report HTSP with non robust, robust and cluster robust standard errors.[88] Differences in SE are low (below 10-15%) between robust and non-robust estimates for all significant variables. Cluster robust SE show greater differences, particularly as regards *migration prevalence*. Clustering was made at community level and this seems to be imprecise: the sample probably contained heteroskedasticity at community, state and national level.

Although estimations cannot be directly compared with those by Winters et al (2001), being based on different databases, the two analyses produced similar results, highlighting the importance of network and income variables.

The main variables of interest, those concerning wealth and networks, are all significant and have the expected direction. *Wealth* has a positive effect on migration decisions, whereas the negative sign of squared wealth suggests that migration propensity decreases after a certain threshold is reached. Thus, as hypothesized, there is an inverted U-shape relation between wealth and migration (*compound wealth effect*). While wealth affects the migration propensity, it is non-

[88] Robust standard errors were applied.

significant at 0.001 and 0.01 confidence levels on the number of migrants, and wealth squared is non-significant even at the 0.05 confidence level. This is in line with the initial investment problem and confirms the fact that there are many households bound by budget constraints in their migration decisions.

As expected, *migration prevalence* has a statistically significant and positive effect on migration. Similarly, *household migration experience, current network,* and *U.S. Resident* all positively affect migration. While *migration prevalence* and *U.S. resident* affect only the probability of migration, past migration experience and *current network* also positively affect the number of migrants. The positive and significant effect of this group of variables confirms the positive influence of migrant networks, on both the decision to migrate and the number of migrants sent abroad. Nonetheless, the positive significance of all the estimated coefficients highlights the fact that community and household-level networks are both important in the migration decision. Thus, they are, at least partly, complements. In addition, community-level networks affecting only the probability of migration and not its optimal level, convey forms of information and support that are different from household ones.

In contrast with the findings of Winters et al. (2001), there is no evidence of education effect on either propensity to migrate[89] or number of migrants. The weak negative link (0.05 significance level) between the cross-effect of education and wealth and the number of migrants confirms the idea that education, particularly in developing countries, should be considered in the wealth indicator as a measure of household asset levels.

In line with previous findings,[90] both the size of the household (measured as number of *workers*[91]) and the proportion of males, positively affect the propensity to migrate and the number of migrants. In line with the neoclassical approach, the age of the household head negatively affects migration.

Distance, as expected, has a negative influence on the migration decision, since it roughly identifies the cost of migration, but it is not significant at the 0.05 confidence level. *Border*, unexpectedly, has a negative influence on the migration decision. This could be because communities belonging to *Baja California Norte*, *Nuevo Leon* and *Chihuahua* have historically lower levels of emigration to the U.S., migration being less necessary because of the greater

[89] There is a significant, but very small, negative effect of squared education.
[90] See Massey et al. (1994), Winter et al. (2001), Fussel and Massey (2004) and Konseiga (2006).
[91] The same effect is also found when the size of the household is expressed as the *number of members*.

number of U.S. firms across the border. Nonetheless, an F-test of the simultaneous significance of *Distance* and *Borders* strongly rejects the null hypothesis.

Contingent factors all affect both the migration decision and the number of migrants, and all present the expected sign. Lastly, the significantly positive value of the *IMR* is in line with expectations: households with higher values of the variables facilitating migration, are those that would like to send more members abroad.

Table 4: HTSP		**Selection**		**Numb.**	
		Rob. SE	**F-Test**	**Rob. SE**	**Joint F-Test**
Human Capital	N° of Workers	0.186 ***	0.000	0.245 ***	0.000
		0.013		0.030	
	Age	-0.033 ***		-0.013	
		0.007		0.007	
	Age Squared	0.000		0.000	
		0.000		0.000	
	Sexration	0.363 ***		0.351 ***	
		0.082		0.097	
	Educ.	0.042		0.056	
		0.030		0.031	
	Educ. Squared	-0.002		0.001	
		0.001		0.001	
	Educ*Wealth	-0.011		-0.015 *	
		0.007		0.006	
Fisical Capital	Wealth	1.112 ***	0.000	0.461 *	0.000
		0.180		0.211	
	Wealth Squared	-0.101 ***		-0.031	
		0.019		0.020	
Household Network	Hist. Migration	0.103 ***	0.000	0.049 ***	0.000
		0.007		0.012	
	Current Net	0.005 ***		0.005 ***	
		0.001		0.002	
	US Res.	0.081 ***		0.033 *	
		0.010		0.016	
Community Network	Migration Prev.	1.986 ***	0.000	0.331	0.000
		0.521		0.816	
	Mig. Prev.*Wealth	-0.278 *		0.033	
		0.112		0.155	
Contingent Factors	Unem. Diff.	-3.853 *	0.000	-5.262 *	0.000
		1.765		2.532	
	Exchage Rate	-0.022 **		-0.034 ***	
		0.007		0.009	
	Avg. Law index	-0.045 *		-0.093 ***	
		0.019		0.023	
Selection	Distance	0.000	0.000		
		0.000			
	Border	-0.393 ***			
		0.078			
Constant		-3.082		-1.247	
		0.462		0.772	
Inverse Mills ratio				0.510 **	
				0.172	
Censored obs	10781				
Uncensored obs	2024				

Table 4 Source: author computation from MMP118.
Robust standard errors are obtained by bootstrapping method; F-test shows that all the coefficient of the subgroup are 0 simultaneously

3-3.b. Ruling Out Endogeneity: the Instrumental Variable Approach

Solving the problem of sample selection does not guarantee that estimates are consistent. There are three circumstances in which the zero-conditional mean assumption may be violated, so that estimators are inconsistent: omitted variables, measurement errors, and endogeneity. As pointed out by Baum (2006), although these three problems arise for different reasons, they can all be solved through the same econometric approach: Instrumental Variable.

This is the approach used by McKenzie and Rapoport (2007) to deal with the endogeneity of network size. The probability of migration is given by:

$$p = \beta_0 + \beta_1 A + \beta_2 A^2 + \beta_3 n + \beta_4 (A * n) + \varepsilon \quad (3)$$

where A is the household wealth, n is the network, and $(A * n)$ the cross-effect. The model predicts that $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$ and $\beta_4 < 0$[92].

McKenzie and Rapoport (2007) focus on first-time migrants and estimate the probability that the household head (aged 15-49) migrates for the first time in the two years prior to the survey, conditional on the absence of previous migration experience. This work focuses on the total number of potential migrant households, whatever their prior experience of migration. Nonetheless, when focusing only on first-time migrants compatible estimations were obtained.

In the present analysis three sets of instruments were used, listed in Table 4. Following Woodruff and Zentero (2007) and McKenzie and Rapoport (2007), the first instrument is the average migration rate by state over the period 1956-59, at the peak of the Bracero Program (1942-1964).[93] The second instrument is the 1924 migration rate by state. The two sets of instruments are explained in detail in McKenzie and Rapoport (2007). The third set combines the first two and adds information on visa accessibility and average U.S. wages in the three years prior to the survey.

[92] In presence of relatively low migration costs.
[93] Original data from Gonzàlez Navarro (1974).

Table 5: Instrument Sets

Instrumental Variables	Mean	S.D.
1924 State Mig. Rate	0.097	0.065
1924 St. Mig. Rate*Wealth	0.494	0.353
1956-59 St. Mig. Rate	0.036	0.037
1956-59 St. Mig. Rate*Wealth	0.179	0.179
VISA accessability	0.064	0.042
Log US wage last 3.	2.409	0.192

Correlation	MP	MPW	M24	M24W	M50	M50W	VISA	LUSW
Migration Prevalence	1.000							
Mig. Prev.*Wealth	0.951	1.000						
1924 State Mig. Rate	0.322	0.350	1.000					
1924 St. Mig. Rate*Wealth	0.270	0.372	0.950	1.000				
1956-59 St. Mig. Rate	0.272	0.251	0.535	0.450	1.000			
1956-59 St. Mig. Rate*Wealth	0.266	0.308	0.555	0.544	0.954	1.000		
VISA accessability	0.098	0.106	0.269	0.238	0.321	0.315	1.000	
Log US wage last 3.	-0.251	-0.221	-0.215	-0.166	-0.226	-0.219	-0.123	1.000

Table 5: IV Set

Correlations between instruments and instrumented variables are low, but not too low to flag a problem of weak instruments. As reported in Appendix D under an IV Two-Stage Least Squares (2SLS) procedure, instruments appear to be exogenous, necessary and not weak. TLS is computed both for migration probability and number of migrants. Since the dependent variable is binary or discrete, robust standard errors were used. 2SLS estimations are not discussed here, since estimates are not unlike IV-Probit ones. Nonetheless, although 2SLS requires less structural hypothesis than IV-Probit, the binary nature of the dependent variable may lead to inconsistent estimates. IV-Probit estimates are reported in Table 5, estimation was undertaken with Newey's Two-Step[94] Estimator (Newey, 1987), since the maximum likelihood estimation could not be computed. As shown in Newey (1987), the two-step method estimates consistent values for parameters, but is less efficient in estimating SE in comparison with MLE. It is possible that, if the instruments are weak or too strong (in conjunction with large sample size), the standard errors may be inconsistent. The over-identification test and post-estimation analyses are made with STATA10 *overid plugin*.

[94] The name "Two-Step" oversimplifies the approach.

Table 6: IV-Probit	Set A		Set B		Set C	
N° of Workers	0.188	***	0.187	***	0.186	***
	0.012		0.012		0.012	
Age	-0.028	***	-0.031	***	-0.033	***
	0.007		0.007		0.007	
Age Squared	0.000		0.000		0.000	
	0.000		0.000		0.000	
Sexratio	0.348	***	0.352	***	0.360	***
	0.079		0.078		0.076	
Educ.	0.103	**	0.094	*	0.070	*
	0.037		0.036		0.031	
Educ. Squared	-0.002	*	-0.002		-0.002	
	0.001		0.001		0.001	
Educ*Wealth	-0.019	**	-0.019	**	-0.017	**
	0.007		0.007		0.006	
Wealth	0.982	***	1.108	***	1.185	***
	0.197		0.217		0.159	
Wealth Squared	-0.056	*	-0.069	**	-0.087	***
	0.025		0.026		0.018	
Hist. Migration	0.087	***	0.097	***	0.104	***
	0.010		0.012		0.006	
Current Net	0.001		0.003		0.005	***
	0.002		0.003		0.001	
US Res.	0.076	***	0.079	***	0.081	***
	0.013		0.013		0.012	
Migration Prev.	11.446	**	9.938	**	6.433	**
	3.610		3.440		2.045	
Mig. Prev.*Wealth	-1.466	**	-1.509	***	-1.118	**
	0.514		0.423		0.372	
Unem. Diff.	-0.876		-3.672		-5.221	*
	3.288		3.801		2.309	
Exchage Rate	0.018		-0.004		-0.022	
	0.023		0.028		0.012	
Avg. Law index	-0.126	**	-0.091		-0.059	*
	0.042		0.047		0.025	
Distance	0.001		0.000		0.000	
	0.000		0.001		0.000	
Border	0.209		-0.097		-0.365	*
	0.329		0.395		0.151	
Constant	-6.553		-5.420		-4.030	
	1.510		1.666		0.747	
Wald test of exogeneity:						
Prob > chi2 =	0.022		0.0089		0.0582	
Amemiya-Lee-Newey min. chi-sq statistic					7.902	
P-value =					0.0952	

Table 6 IV Probit.*,**,***, stand for significance at 10%, 5% and 1% respectively

A Wald test of exogeneity confirms the endogeneity problem and the need for an IV approach at 0.05 confidence interval when using set A, and at 0.01 confidence interval when using set B; it is refused at 0.05 confidence level with set C. The over-identification test (Amemiya-Lee-Newey test minimum chi squared statistic) fails to reject the over-identification restriction, corroborating the validity of the instruments used. Correlation matrix, 2SLS and IV-Probit suggest that the instruments are not weak but also not too strong, corroborating the idea that IV-Probit is the correct approach to used.

All the coefficients analysed have the expected sign and are robust to changes in the instrument set. Wealth and migration probability have an inverted U-shaped relation, and all network variables positively affect migration. Only *current network* appears to be non-significantly different from 0 with set A and set B. The instrumented variable, *migration prevalence* and its cross-effect with *wealth* positively affects poorer households' decision to migrate. This is in line with the idea that networks affect more social strata with lower access to information and economic opportunities. This, as predicted by both network and cumulative causation theory, partially explains how migration networks can also influence the "quality of migrants". The effect of migration networks is similar to what happens to *education*. *Education* has a small positive effect on the probability of migration, while the cross-effect of *wealth* and *education* has a significant negative effect. *Education*, as discussed in the previous section, may be considered a form of investment which only relatively better-off household can undertake. Since these households have less incentives to migrate, we should expect (and we observe) that high levels of education, being expensive, are associated with lower levels of migration.

Lastly, the control variables, *unemployment difference*, *exchange rate* and the *law tightness,* are all non-significant or slightly-significant. When a test of joint significance is performed, they are significant (chi1 (3)= 13.64 – p=0.0034). The *exchange rate* is the only variable which was never significant in all three estimations and it even changes sign across treatments. A partial explanation for these results can be found in the small amount of information available at the time. Although twenty years is quite a long period, it is not likely to be informative since we have the same information the all the database in each year. Thus, a priori, it is possible that the variables analysed are only giving evidence of yearly effects. Nonetheless, the results are plausible and robust to changes in instruments, and to the exclusion of one or both of the other variables.

3.3.c Tackling Simultaneously Self-Selection and Endogeneity: Three-Stage Estimation

Following Mroz (1987) and Piacentini (2008), a model able to tackle sample selection and endogeneity simultaneously has this reduced form:

$$l_i = \alpha'^{X_i} + \beta'^{N_i} + \varepsilon_{i1} \quad (4)$$

$$N_i = \theta Z_i + u_i \quad (5)$$

$$M_i = (\gamma'^{R_i} + \varepsilon_{i2} > 0) \quad (6)$$

where equation (4) is level of migration, equation (5) identifies the instrument set, and equation (6) is selection. Errors are allowed to be arbitrarily correlated among the three. The system can be estimated through a TSLS, if at least two valid instruments are available.

Implementation consists of deriving the IMR from the first step of the Heckman correction method, and then using it as a regressor in the TSLS.

Since in this case *migration prevalence* is likely to be endogenous, both in migration decision and in level of migration a three-step procedure is applied. The first step consists of estimating the probability of migration with an IV-Probit procedure. The second step consists of computing the IMR from the first step. The third step consists of using the IMR in the IV regression for level of migration.

Table 7 reports results for the level of migration equation, using all three sets of instruments. *Distance* and *border* are used as identification variables, and are therefore not included in the level of migration equation. This procedure was developed to study situations with one endogenous variable, and it needs at least two valid instruments. Thus, we rely on Set C for the discussion, since Set C has at least two valid instruments for each endogenous variable. However set A and set B tell us that, even two instruments and two endogenous variables can produce consistent estimations.

As expected, and already observed, with a conventional HTS procedure, only a few variables have a significant influence on migration decisions. In particular, human capital and household-level network variables all affect the number of migrants, as well as the probability of migration.

In the opposite direction, *unemployment differences* and *exchange rate* significantly affect the number of migrants, but not the migration decision. Households constrained in their optimal strategy by their budget constraints are less likely to be affected by non-dramatic changes in the economic situation, since they cannot modify their migration strategy. In fact, they are likely to be non-migrants, or only one member migrates. Instead, richer households, able to send more members, are those more affected by changes in the economic situation.

The non-significance of community-level networks in level of migration analysis confirms that community-level and household networks partially act as substitutes. Since they both affect the probability of migration, it is possible to argue that they have different functions, and/or that they convey different kinds of information. Thus, they are partially complements and partially substitutes.

Focusing on set A and set B we also observe a slightly significant inverted U-shaped relation between number of migrants and wealth.

Once the problem of endogeneity is solved, IMR appears to be non-significant under sets A and B, and has a small negative effect under set C. This suggests, an absence of selectivity or, in the case of set C, negative bias selectivity, so that households with more "migration-prone" characteristics are those less likely to send more members.

Although estimations seem to corroborate the proposed underlying process and to validate the empirical approach, there are two main flaws in the applied procedure. On one hand, it lacks formal and theoretical validation. The three-stage procedure of Mroz (1997) was in fact developed to deal with endogenous covariates only in the level equation and not also in the selection equation. Moreover, in this situation, endogenous variables and instruments are the same in both estimations. On the other hand, the level of migration is not a continuous variable, and TSL-IV regression may be inappropriate if count variables occur. These are the motivations behind the decision to use an alternative econometric specification: the IV-Poisson was explicitly developed for count data analysis. Results are presented in the next sub-section.

Table 7: 2SLS Pr.	Set A		Set B		Set C	
N° of Workers	0.268	**	0.082	***	0.065	***
	0.103		0.014		0.012	
Age	-0.034	*	-0.010	***	-0.008	***
	0.014		0.002		0.002	
Age Squared	0.000	***	0.000	***	0.000	***
	0.000		0.000		0.000	
Sexratio	0.440	*	0.073	*	0.039	
	0.206		0.035		0.030	
Educ.	0.138		0.008		-0.007	
	0.074		0.010		0.009	
Educ. Squared	-0.002		0.000		0.000	
	0.001		0.000		0.000	
Educ*Wealth	-0.029	*	-0.004		-0.001	
	0.015		0.002		0.002	
Wealth	1.173	*	0.181	*	0.073	
	0.566		0.077		0.063	
Wealth Squared	-0.066	*	-0.011	*	-0.007	
	0.031		0.006		0.005	
Hist. Migration	0.114	***	0.056	***	0.050	***
	0.033		0.005		0.005	
Current Net	0.004	***	0.003	***	0.003	***
	0.001		0.001		0.001	
US Res.	0.097	*	0.022	**	0.015	*
	0.043		0.008		0.007	
Migration Prev.	12.132		1.004		-0.523	
	6.529		0.816		0.667	
Mig. Prev.*Wealth	-1.653		-0.204		0.041	
	0.887		0.124		0.108	
Unem. Diff.	-2.762	***	-2.421	***	-2.085	***
	0.824		0.628		0.609	
Exchage Rate	0.003		-0.014	***	-0.015	***
	0.009		0.002		0.002	
Avg. Law index	-0.172	*	-0.021		-0.007	
	0.086		0.014		0.012	
Inverse Mills' Ration	1.208		-0.035		-0.150	*
	0.692		0.089		0.071	
_cons	-6.532		-0.140		0.528	
	3.614		0.463		0.371	
Number of Obs.	12800		12800		12800	
R2	0.123		0.228		0.230	
Migration Prev.						
R-sq	0.848		0.857		0.8617	
Adj R-sq	0.848		0.8567		0.8614	
Shea's Partial R-sq	0.003		0.104		0.1738	
Shea's Adj. P. R-sq	0.002		0.0977		0.1725	
Robust F(2,12785)	152.830	***	739.672	***	324.644	***
Mig. Prev*Wealth						
R-sq	0.759		0.7684		0.7731	
Adj R-sq	0.759		0.7681		0.7727	
Shea's Partial R-sq	0.004		0.0977		0.1508	
Shea's Adj. P. R-sq	0.002		0.0965		0.1494	
Robust F(2,12785)	183.048	***	535.676	***	211.048	***
Overid. Test					8.261	0.08

Table 7 Second Stage of TSL IV.*,**,***, stand for significance at 0.10, 0.05 and 0.01, respectively

3.3.d. Alternative Econometric Specification: IV-Poisson

Since this is not the place to discuss the theoretical background behind IV-Poisson, the focus is on empirical results. A detailed explanation of the theoretical background is provided in Cameron and Trivedi (1998). In any case an important observation is necessary: IV-Poisson assumes that the probability of each subsequent event is the same - that is that they have the same variance.

This is in contrast with the underlying mechanism presumed at the beginning of this section. IV-Poisson assumes that there is no structural difference in sending one migrant or two. In economic terms, if there is a fixed cost of migration, it must be paid for each member undertaking migration, and not only for the first migrant. In any case this is not implausible, and the truth probably lays somewhere in between.

Recalling that an household is defined as migrant if one or more members have been in the U.S. in the three years prior to the undertaking of the survey, and that first-time migrants and experienced migrants are analysed together, migration costs are plausibly different. In particular, the first migration requires an investment in contacts and human capital, while subsequent migrations do not.

Although with the limitation described, the count approach is technically more correct, as the dependent variable in question is a discrete number between 0 and 7. Table 8 reports results for Poisson, IV-Poisson and Negative Binomial regression.[95] The results do not contradict previous findings. *wealth* affects migration with an inverted U-shaped relation, all household-level network variables positively affect the number of migrants. *Education* is non-significant, and no selection in terms of education is observed. Moreover, if a form of selection in *education* is present (set A), it is positive and associated with a significant negative coefficient of the cross-effect of education and wealth.

Migration prevalence and its cross-effect with wealth have the expected signs, but they are significant at the 0.05 confidence level only under set A. This reflects results already found in previous analyses. Migration has a certain fixed initial investment which affects the probability of migration (as found in IV-Probit analysis), but it does not affect the optimal number of migrants. Since IV-Poisson estimates the number of migrants without a selection process, *migration prevalence* loses part of its significance. Networks of migrants are more important for poorer than

[95] IV-Poisson regression is made with ivpois command in STATA10.

for richer social strata, as highlighted by the negative coefficient of the cross-effect of community networks and wealth. Coefficients for economic and political variables have the expected signs, but they are non-significant.

Table 8: IV-Poisson	Poisson		Neg. Binomial		Set A		Set B		Set C	
N° of Workers	0.306	***	0.326	***	0.416	***	0.375	***	0.386	***
	0.015		0.016		0.040		0.035		0.031	
Age	-0.032	***	-0.039	***	-0.022		-0.033		-0.042	**
	0.009		0.010		0.020		0.020		0.016	
Age Squared	0.000		0.000		0.000		0.000		0.000	
	0.000		0.000		0.000		0.000		0.000	
Sexratio	0.639	***	0.666	***	0.752	**	0.557	**	0.558	**
	0.115		0.114		0.251		0.186		0.185	
Educ.	0.089	*	0.081		0.301	*	0.104		0.122	
	0.044		0.044		0.125		0.092		0.095	
Educ. Squared	-0.004	*	-0.003	*	-0.003		-0.001		-0.002	
	0.002		0.002		0.003		0.003		0.003	
Educ*Wealth	-0.019	*	-0.019	*	-0.061	*	-0.032		-0.033	
	0.009		0.009		0.025		0.020		0.019	
Wealth	1.653	***	1.781	***	2.779	***	2.329	***	2.242	***
	0.229		0.230		0.507		0.420		0.435	
Wealth Squared	-0.140	***	-0.155	***	-0.136		-0.184	***	-0.168	***
	0.025		0.025		0.072		0.039		0.039	
Hist. Migration	0.066	***	0.083	***	0.150	***	0.182	***	0.169	***
	0.003		0.004		0.029		0.015		0.014	
Current Net	0.006	***	0.008	***	0.012	**	0.014	***	0.013	***
	0.001		0.001		0.004		0.003		0.003	
US Res.	0.084	***	0.094	***	0.121	***	0.141	***	0.137	***
	0.015		0.015		0.032		0.026		0.026	
Migration Prev.	2.277	**	2.514	***	32.743	*	4.590		8.199	
	0.729		0.750		13.910		4.989		5.559	
Mig. Prev.*Wealth	-0.309	*	-0.329	*	-5.611	*	-1.322		-1.651	
	0.147		0.151		2.341		0.804		0.926	
Unem. Diff.	-10.368	***	-9.162	**	-9.097		-17.859		-11.561	
	2.940		2.895		7.735		11.044		6.219	
Exchage Rate	-0.064	***	-0.058	***	-0.027		-0.095		-0.063	*
	0.010		0.011		0.043		0.052		0.029	
Avg. Law index	-0.131	***	-0.121	***	-0.078		-0.069		-0.078	
	0.032		0.031		0.068		0.058		0.046	
_cons	-4.547		-5.217		-13.734		-5.043		-6.533	
	0.691		0.683		3.417		2.639		2.332	
Log-Likelihood	-6203.355		-6112.007							
Test of Exogeneity										
Migration Prev.					***		***		***	
Mig. Prev.*Wealth					***		***		***	

Table 8. IV-Poisson .*,**,***, stand for significance at 0.10, 0.05 and 0.01, respectively

3.4: Discussion and Conclusions

The main contribution of this chapter is in the empirical approach used to evidence the relation between migration choices, wealth, and migrant networks.

In line with previous findings, Mexican migrants belong to the middle of the income distribution in Mexico. Migration and wealth are non-linearly related (*compound wealth effect*). Household and community networks increase the migration propensity. Specifically, when large enough, networks further increase the migration propensity of the households belonging to the middle-left of the income distribution. This relation is the main candidate in potentially explaining the unclear results of the analysis of selection of migrants.

Community and household-level networks are partially substitutes and partially complements. In particular, while household-level networks always positively affect migration (in both terms of propensity and numbers), community-level networks convey information which makes migration a feasible strategy.

The Three-Stage Procedure and the IV-Poisson can simultaneously solve several empirical problems typical of migration studies: sample selection, endogeneity of migration networks, and the presence of count dependent variables. These approaches confirm previous findings, ensuring that they are not the result of endogeneity or sample-selection. Nonetheless, both methods, and more in general empirical migration studies, need to be improved in at least four aspects.

First, data collection. Although the MMP is probably the most complete database on migration, it is “only” a large cross-section: it cannot reconstruct the migration flow and its evolution over time. In addition, information on income in the dataset is incomplete. Although PCA is a reliable solution to this problem (McKenzie, 2005), it remains a second-best solution.

Second, legislation. The effect of U.S. legislation on Mexican migration should be investigated in more detail, focusing not on the aggregate level of analysis, but on checking whether changes in legislation have generated changes in the composition of migration flows. Since MMP contains information on the first and last destinations of household heads in the U.S. and Canada, local changes in legislation could be collected and analysed to see if they affect the destinations of migrants.

Third, although the Three-Stage Procedure and the IV-Poisson improve the quality of the analysis, they do not solve all the empirical problems. Specifically, the TSP lacks an analytical background when endogenous covariates affect both equations. In addition, it is a procedure developed to deal with continuous variables. IV-Poisson was developed for count data, but it assumes a fixed probability, leading to a possible selection problem.

Last but not least, migration prevalence is a very powerful instrument for predicting Mexican migration to the US, but it needs to be refined and reviewed when dealing with multidirectional migrations. What is needed is deeper analysis of the structural differences between rural and urban migrations. Migration prevalence has been shown to be useful in predicting specifically rural migration to the U.S., but not urban migration. This limitation raised a series of questions on the differences in migration strategy between rural and urban households, and thus on cumulative causation as a valid theory of migration. To try to answer these and similar questions, the next chapter analyses the determinants of migration in Mexico and in five other Central American countries. Comparing different frameworks allows us to test simultaneously both the validity of migration prevalence as a measure of community-level networks and whether cumulative causation can be applied to frameworks which different from rural Mexican areas.

Appendix A PCA

Following Filmer and Pritchett's notation, let us presume that we have N variables and j households: $a^*_{1,j}$ represents the ownership of asset 1 by household j, $a^*_{2,j}$ represents the ownership of asset 2 by household j, and so on. We normalize each variable by its mean a^*_N and standard deviation s^*_N: thus, for asset 1:

$$a_{1,j} = \frac{(a^*_{1,j} - a^*_1)}{s^*_1} \quad (1a)$$

PCA expresses variables derived in this way as linear combinations of a set of underlying components for each household. We use A to name the components and coefficients on each component for each variable v:

$$\begin{aligned} a_{1,j} &= v_{1,1} \times A_{1,j} + v_{1,2} \times A_{2,j} + \cdots + v_{1,N} \times A_{N,j} \\ &\ldots \qquad\qquad \forall j = 1, \ldots, J \qquad (2a) \\ a_{N,j} &= v_{N,1} \times A_{1,j} + v_{N,2} \times A_{2,j} + \cdots + v_{N,N} \times A_{N,j} \end{aligned}$$

The solution of this system of equations is indeterminate, since only the left-hand side is observed. Thus, the problem of determining a unique basis cannot be solved in general.

As already mentioned, PCA assumes linearity, vastly simplifying the problem by re-expressing the data as a *linear combination* of its basis vectors. Specifically, PCA determines the First Principal Component, $A_{1,j}$, by finding the linear combination of the variables which has maximum variance. The Second Principal Component, $A_{2,j}$, is a linear combination of the variables, orthogonal to the first, with maximal residual variance, and so on. Since variance may, in principle, be increased to infinity merely by rearranging the scale of coefficients, the importance of the normalization becomes clear.[96] It can be shown that the required coefficients vs are given by the eigenvectors of the sample covariance matrix of $A_{1,j}, \ldots, A_{N,j}$, and their variances are given by the corresponding eigenvalues. Inverting the system presented in equation (2):

$$\begin{aligned} A_{1,j} &= f_{1,1} \times a_{1,j} + f_{1,2} \times a_{2,j} + \cdots + f_{1,N} \times a_{N,j} \\ &\ldots \qquad\qquad \forall j = 1, \ldots, J \qquad (3a) \\ A_{N,j} &= f_{N,1} \times a_{1,j} + f_{N,2} \times a_{2,j} + \cdots + f_{N,N} \times a_{N,j} \end{aligned}$$

where fs are scoring factors. Combining equations (2) and (3), the Principal Component may be written as:

$$A_{1,j} = f_{1,1} \times \frac{(a^*_{1,j} - a^*_1)}{s^*_1} + f_{1,2} \times \frac{(a^*_{2,j} - a^*_2)}{s^*_2} + \cdots + f_{1,N} \times \frac{(a^*_{N,j} - a^*_N)}{s^*_N} \quad (4a)$$

[96] An alternative restriction is to impose the sum of squares equal to one.

Appendix B OLS

Probability of Migration	OLS		OLS Rob. SE		OLS Cluster Rob. SE	
N° of Workers	0.038	***	0.038	***	0.038	***
	0.002		0.003		0.004	
Age	-0.009	***	-0.009	***	-0.009	***
	0.001		0.001		0.001	
Age Squared	0.000	***	0.000	***	0.000	***
	0.000		0.000		0.000	
Sexration	0.053	***	0.053	***	0.053	***
	0.014		0.013		0.015	
Educ.	0.002		0.002		0.002	
	0.005		0.004		0.004	
Educ. Squared	0.000		0.000		0.000	
	0.000		0.000		0.000	
Educ*Wealth	-0.001		-0.001		-0.001	
	0.001		0.001		0.001	
Wealth	0.156	***	0.156	***	0.156	***
	0.022		0.018		0.025	
Wealth Squared	-0.014	***	-0.014	***	-0.014	***
	0.003		0.002		0.003	
Hist. Migration	0.030	***	0.030	***	0.030	***
	0.001		0.002		0.004	
Current Net	0.001	***	0.001	***	0.001	**
	0.000		0.000		0.000	
US Res.	0.020	***	0.020	***	0.020	***
	0.003		0.003		0.004	
Migration Prev.	0.367	***	0.367	***	0.367	
	0.107		0.104		0.248	
Mig. Prev.*Wealth	-0.049	*	-0.049	*	-0.049	
	0.021		0.021		0.039	
Unem. Diff.	-0.856	*	-0.856	*	-0.856	
	0.357		0.357		0.813	
Exchage Rate	-0.005	***	-0.005	***	-0.005	
	0.001		0.001		0.003	
Avg. Law index	-0.008		-0.008		-0.008	
	0.004		0.005		0.012	
Distance	0.000		0.000		0.000	
	0.000		0.000		0.000	
Border	-0.061	***	-0.061	***	-0.061	
	0.015		0.013		0.036	
Constant	-0.021		-0.021		-0.021	
	0.071		0.060		0.125	
N° of observations	12805		12805		12805	
R2	0.1933		0.1933		0.1933	

Table 9: OLS.*,,***, stand for significance at 0.10, 0.05 and 0.01, respectively**

Number of Migrants	OLS		OLS Rob. SE		OLS Cluster Rob. SE	
N° of Workers	0.087	***	0.087	***	0.087	***
	0.004		0.006		0.013	
Age	-0.011	***	-0.011	***	-0.011	***
	0.002		0.002		0.002	
Age Squared	0.000	***	0.000	***	0.000	**
	0.000		0.000		0.000	
Sexration	0.084	***	0.084	***	0.084	**
	0.022		0.021		0.025	
Educ.	0.005		0.005		0.005	
	0.008		0.006		0.006	
Educ. Squared	0.000		0.000		0.000	
	0.000		0.000		0.000	
Educ*Wealth	-0.003		-0.003		-0.003	
	0.002		0.001		0.001	
Wealth	0.177	***	0.177	***	0.177	***
	0.034		0.027		0.039	
Wealth Squared	-0.015	***	-0.015	***	-0.015	***
	0.004		0.003		0.004	
Hist. Migration	0.056	***	0.056	***	0.056	***
	0.001		0.004		0.004	
Current Net	0.003	***	0.003	***	0.003	**
	0.000		0.001		0.001	
US Res.	0.024	***	0.024	***	0.024	**
	0.004		0.006		0.009	
Migration Prev.	0.212		0.212		0.212	
	0.169		0.160		0.309	
Mig. Prev.*Wealth	-0.005		-0.005		-0.005	
	0.034		0.034		0.059	
Unem. Diff.	-1.978	***	-1.978	***	-1.978	
	0.564		0.576		1.325	
Exchage Rate	-0.010	***	-0.010	***	-0.010	*
	0.002		0.002		0.004	
Avg. Law index	-0.023	***	-0.023	**	-0.023	
	0.007		0.008		0.018	
Distance	0.000		0.000		0.000	
	0.000		0.000		0.000	
Border	-0.062	**	-0.062	**	-0.062	
	0.024		0.019		0.051	
Constant	-0.125		-0.125		-0.125	
	0.111		0.089		0.187	
N° of observations	12805		12805		12805	
R2	0.2325		0.2325		0.2325	

Table 10: OLS (Number of Migrants) *,**,***, stand for significance at 0.10, 0.05 and 0.01, respectively

Appendix C

HTSP	Selection	Selection Rob. SE	Selection Cluster Rob. SE	Numb.	Numb. Rob. SE	Numb. Cl. Rob. SE
N° of Workers	0.186 ***	0.186 ***	0.186 ***	0.245 ***	0.245 ***	0.245 ***
	0.012	0.013	0.013	0.020	0.030	0.034
Age	-0.033 ***	-0.033 ***	-0.033 ***	-0.013	-0.013	-0.013
	0.007	0.007	0.007	0.008	0.007	0.007
Age Squared	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
Sexratio	0.363 ***	0.363 ***	0.363 ***	0.351 ***	0.351 ***	0.351 **
	0.076	0.082	0.084	0.092	0.097	0.117
Educ.	0.042	0.042	0.042	0.056	0.056	0.056
	0.028	0.030	0.031	0.036	0.031	0.033
Educ. Squared	-0.002 *	-0.002	-0.002 *	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001
Educ*Wealth	-0.011	-0.011	-0.011	-0.015 *	-0.015 *	-0.015 *
	0.006	0.007	0.006	0.007	0.006	0.007
Wealth	1.112 ***	1.112 ***	1.112 ***	0.461 *	0.461 *	0.461 **
	0.144	0.180	0.174	0.209	0.211	0.177
Wealth Squared	-0.101 ***	-0.101 ***	-0.101 ***	-0.031	-0.031	-0.031
	0.016	0.019	0.018	0.021	0.020	0.018
Hist. Migration	0.103 ***	0.103 ***	0.103 ***	0.049 ***	0.049 ***	0.049 ***
	0.004	0.007	0.015	0.007	0.012	0.007
Current Net	0.005 ***	0.005 ***	0.005 **	0.005 ***	0.005 ***	0.005 ***
	0.001	0.001	0.002	0.001	0.002	0.001
US Res.	0.081 ***	0.081 ***	0.081 ***	0.033 *	0.033 *	0.033 *
	0.012	0.010	0.013	0.013	0.016	0.014
Migration Prev.	1.986 ***	1.986 ***	1.986	0.331	0.331	0.331
	0.568	0.521	1.445	0.790	0.816	0.872
Mig. Prev.*Wealth	-0.278 *	-0.278 *	-0.278	0.033	0.033	0.033
	0.114	0.112	0.228	0.150	0.155	0.164
Unem. Diff.	-3.853 *	-3.853 *	-3.853	-5.262 *	-5.262 *	-5.262
	1.834	1.765	4.026	2.116	2.532	3.617
Exchage Rate	-0.022 **	-0.022 **	-0.022	-0.034 ***	-0.034 ***	-0.034 **
	0.007	0.007	0.015	0.009	0.009	0.012
Avg. Law index	-0.045 *	-0.045 *	-0.045	-0.093 ***	-0.093 ***	-0.093 **
	0.020	0.019	0.048	0.021	0.023	0.030
Distance	0.000	0.000	0.000			
	0.000	0.000	0.000			
Border	-0.393 ***	-0.393 ***	-0.393 ***			
	0.086	0.078	0.239			
Constant	-3.082	-3.082	-3.082	-1.247	-1.247	-1.247
	0.437	0.462	0.837	0.670	0.772	0.656
Inverse Mills ratio				0.510 ***	0.510 **	0.510 ***
				0.127	0.172	0.148
Censored obs				10781	10781	10781
Uncensored obs				2024	2024	2024

Table 11 HTSp. *,,***, stand for significance at 0.10, 0.05 and 0.01, respectively. Robust standard errors using bootstrapping method**

Chapter 4 Cumulative Causation: a Mexican Peculiarity or a Common Element Across Central America?

4.1 Introduction

Cumulative causation theory on how migration can become a self-perpetuating mechanism through networks and migration capital accumulation, has been shown to be powerful in explaining Mexican migration from rural areas to the U.S.. The same does not seem to be the case when dealing with urban migration. The main line of argument of Fussel and Massey (2004) to explain why the principal mechanism underlying cumulative causation is not functioning in large urban areas is the inefficiency of these areas in accumulating migration social capital which together with social stratification, make networks less effective. Therefore, the above authors argue, the cumulative causation approach should only be applied to rural areas.

This chapter examines whether cumulative causation can be extended to other settings (in particular, five other Central American countries: the Dominican Republic, Nicaragua, Costa Rica, Guatemala and Haiti). The aim is to test whether the results of determinants of migration are a Mexican peculiarity, the effect of differences between urban and rural areas, and/or the consequence of network size determining networks effectiveness on migration decision. In addition, examining the determinants of migration in an enlarged setting allows us to test jointly the theory and methodology used for empirical investigation. The key variable in cumulative causation theory is *migration prevalence*. *Migration prevalence* is suitable for capturing the accumulation of migration capital at community level in rural Mexican areas. If similar results could be obtained for the other five Central American countries, we could argue that *migration prevalence* is a good proxy for networks. Instead, if it appears to be non-significant for those five countries, this would raise questions on what is really captured by *migration prevalence*.

4.2 Data and Methods

Testing whether cumulative causation can be extended to settings other than rural Mexican areas, a database obtained by merging data from the MMP and the LAMP was used. This section provides a description of the two databases and a brief explanation of problems encountered in the merging process. MMP and LAMP are the largest ongoing surveys on migration behavior with information collected from sending countries. MMP is more articulated and detailed, whereas LAMP covering various countries, is less well articulated and includes less detailed information.

4.2.a Mexican Migration Project

MMP124 is a more recent release of the MMP118 described in chapter 3, and therefore only a short summary is provided here. MMP124 contains data gathered since 1982 in surveys administered every year in Mexico and the U.S.. Between two to five Mexican communities are surveyed each year during the months of December and January of successive years[97]. These representative community surveys yield information on where migrants go in the U.S., and during the months of July and August interviewers travel to those U.S. destinations to gather (non-random) samples of 10 to 20 out-migrant households from each community.[98]

Although each household has been surveyed once, household heads are asked for their entire life migration history in retrospect. The survey also asks all members of the household whether they have been to the U.S. and, if so, the year of their first trip there. However, since each community is observed only once, even though data were collected in different years, the database represents a large cross-section of the communities in question.

The MMP124 database is composed of a series of files conveying differing pieces of information. First a file with general demographic and migratory information for each member of a surveyed household (PERS). Second a file with detailed information on each migratory experience of all household heads (MIG). Third a file with the general characteristics of the household, its members, and other holdings (HOUSE). Fourth is a detailed file on the labor histories for each head of the household and each spouse (LIFE and SPOUSE, respectively). In addition, supplementary files are available, containing information at community and *municipio* levels (COMMUN) and environment (ENVIRONS).

[97] The sample size is generally 200 households, unless the community is under 500 residents, in which case a smaller number of households is interviewed. If initial fieldwork indicates that U.S. migrants return home in large numbers during months other than December or January, interviewers return to the community during those months to gather a portion of the 200 interviews.

[98] Description from MMP website as requested by MMP organization: http://mmp.opr.princeton.edu/

The main file used in this work is HOUSE, although other files were used to obtain specific pieces of information. The database under analysis reports information on 20,828 households surveyed in the period 1982-2008. After cleaning the database and reducing the sample to a coherent period of time with respect to the LAMP database (i.e., 1999-2004), the number of households in the sample was reduced to 5,593, that is, more than 24,000 subjects and 35 communities. Database reduction involved the number of communities sampled and the "number of years".

The reduced sample has two major disadvantages: there is no point in studying more than one time-variant variable at the same time, and the representativeness of the analysis is reduced. We can argue that the first problem should not affect the analysis, as the period of time involved is short, while the work focuses on a social phenomenon (network and migration social capital formation) which requires long periods of time. As regards the reduced representativeness of the database, we may argue that it does not substantially affect the results. The difference between estimates obtained using the full (chapter 3) and the reduced Mexican sample are low and generally below 10%. Since the aim of this chapter is not to determine the precise magnitude of variables affecting Mexican migration, but to compare Mexican and Central American fundamentals, to test whether they are the same, representativeness is not a key issue.

4.2.b Latin American Migration Project

The LAMP was born as an extension of the MMP and they share the same methodology. An ethno-survey focusing on the migration process lies at its core. LAMP began operations in 1998 with a set of surveys conducted in Puerto Rico. It later expanded with fieldwork carried out in the Dominican Republic, Nicaragua, Costa Rica, Guatemala, Haiti and Peru. The surveys in Nicaragua and Costa Rica were made possible through an association between LAMP and the Central American Population Center of the University of Costa Rica.[99]

In this chapter, data on Costa Rica, the Dominican Republic, Nicaragua, Haiti[100] and Guatemala are analysed. The five countries all belong to Central America and have the U.S. as their main (if not unique) outmigration market. Costa Rica, Guatemala and Nicaragua are continental

[99] LAMP also covers other countries not included in this analysis.
[100] Data on Haiti all refer to a period prior to the 2008 hurricanes and the 2010 earthquake. In particular, after January 2010 we presume that major changes will take place. Also, information on communities 1 and 2, located between 45 and 80 miles from the capital, Port-au-Prince, respectively, are not yet available.

countries, whereas the Dominican Republic and Haiti share the same island. Guatemala shares its border with Mexico, and Haiti is the closest to the U.S. (in air miles). All five countries are poorer than Mexico, and Haiti is one of the poorest countries in the world.

To test whether similar mechanisms apply in differing settings it was necessary to choose countries not too dissimilar from each other socially and politically, in order to avoid differentials in initial conditions, originating different paths. In addition, to avoid fluctuation generated by different shocks in destination countries, we required a common main receiving country and a database conveying the same kind of information.

LAMP, being based on MMP, satisfies this requirement even when there are several discrepancies in the country database, which entailed a long process of data managing. First of all, LAMP is not as detailed as MMP, so that some interesting features (like many community-level variables) could not be studied. Second, some information, e.g., land ownership, construction materials and some amenities, were collected with a different unit of measurement (land) in quantitative variables and different orders/types (construction materials, vehicles) in qualitative variables. Third, some variables were labeled differently (particularly those concerning parents-in-law and migration experience). Fourth, migration experience is not always reported in the same file. lastly, in the case of Dominica, information on land ownership was not collected, so that the country had to be removed from the sample although it was socio-economically relevant for the analysis.

As for MMP, the database does not include reliable information on household income and/or consumption levels. To overcome this problem, following Filmer and Pritchett (2001), McKenzie (2005) and McKenzie and Rapoport (2007) and also the contents of chapter 3, an index of wealth was derived by PCA.

4.2.c Data description

Table 1 reports summary statistics for the database. In this chapter, a household is defined a migrant household if one or more of its members have been in migration for the last three years before the survey was undertaken. According to this definition, migrant households number 811, a very low fraction (0.08) of the sample. However, since the database is vast, we have enough information to make statistical inferences.

	Table 1: Descriptive statistics						
	Total		Non Migrant		Migrant		
N° of Observations	10279		9468		811		
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**t-Test**
Human Capital							
N° of Workers	1.771	1.196	1.758	1.184	1.915	1.315	*** (+)
Household age	46.334	14.700	46.843	14.770	40.394	12.397	*** (-)
Household educ.	7.076	4.316	7.092	4.365	6.887	3.686	
Male Rate	0.432	0.229	0.426	0.228	0.505	0.223	*** (+)
Social Capital							
Historic Mig. Experience	0.460	1.618	0.334	1.201	1.931	3.745	*** (+)
US Resident	0.631	1.355	0.584	1.306	1.189	1.736	*** (+)
Current Network	7.525	15.530	7.047	14.899	13.111	20.782	*** (+)
Migration Prevalence	0.103	0.055	0.101	0.055	0.126	0.050	*** (+)
Physical Capital							
Wealth	5.000	0.958	4.980	0.972	5.232	0.734	*** (+)
Contingent Factors							
Distance	2359.763	787.824	2367.008	795.000	2275.181	693.472	*** (-)
City	0.456	0.498	0.463	0.499	0.376	0.485	*** (-)
Caribbean	0.456	0.498	0.474	0.499	0.244	0.430	*** (-)
Law	-5.284	0.640	-5.291	0.637	-5.196	0.665	*** (+)

Table 5: *** stand for significance at the 0.001 confidence level; + if the difference is positive - if the difference is negative.

The first four variables represent the households' human capital. Following previous literature, all these characteristics are expected to contribute positively to household migration strategy. Households with a larger *number of workers* are expected to be more able to differentiate their sources of income. In particular, following NELM, we should expect that larger households, planning their allocation of resources to minimize income risks (in this case, workers as income generators), should send members in migration with a higher probability to prevent themselves from national economic shocks.

On average migrant households are expected to be younger, since migration is a costly investment generating returns in the future (neoclassical approach). Households with longer-lasting life expectancies should be more willing to invest in migration (*household age*). The *male rate,* computed as the number of males in a household over the total number of members, is usually found to affect migration positively. In particular, studies on Mexican migration reveal a strong positive gender effect. This is not surprising, since migration is often a phenomenon involving more men than women and is even more evident in countries with marked patriarchal structures (Sana and Massey, 2005).

Of the four variables, e*ducation level* is the most controversial. Since the seminal contribution of Roy (1951), literature on the quality of migrants has produced conflicting results.

From a theoretical point of view, a priori, both positive and negative selections are possible, depending on the differential in skills remuneration between countries and on how that differential is computed. A key role in theoretical approaches is played by the difference between absolute and relative gains. It has been shown that education/skills groups with the largest potential absolute gain may also be those with the lowest potential relative gain, and vice versa. In this case, according to the differential examined, we may observe different kinds of selection. For example Chiquiar and Hanson (2005) and Mishra (2007) find evidence to support a positive selection effect, whereas Ibarran and Lubotsky (2005) and Fernandez-Huertas (2008) report the opposite. As emphasized in chapter 3, education in Mexico is highly correlated with wealth, and this correlation, in conjunction with the effect of networks (McKenzie and Rapoport, 2007), may lie at the origin of these results (chapter 5).

The second group of four variables in Table 1 represents the household migration social capital: *historic migration experience* (number of previous migration experiences of all household members)*, U.S. resident* (number of close relatives with a U.S. resident permit)*, current network* (number of relatives and friends in the U.S. in the three years prior to the survey) and *migration prevalence*, which all define the links between the household and the U.S.. All these variables are expected to affect migration positively. The first three are specific per household, whereas *migration prevalence* is a community-level variable. It is defined as the number of persons older than 15 in a community at a particular year with a migration experience, over the total number of persons older than 15 in the community. *Migration prevalence* captures not only the community-level network, but diffused migration capital at community level.[101] Dehistoricization is solved through the use of the IV approach (necessary, in view of the endogeneity of networks in the migration decision). Under/over estimation is partially avoided by selecting a group of countries having a predominant receiving market for migrants.

As already anticipated, an index for *wealth* was derived by PCA. The original information is composed of 25 variables, conveying information on construction materials, land ownership, amenities, vehicles, and business ownership. Variables in use are the same as in McKenzie (2005) and in chapter 3: the high correlation (0.954) between the index derived with only Mexican households and all the households in the sample validate the procedure. *Education* was intentionally excluded from this set, so that it could be studied as a separate element. To take into

[101] For an exhaustive discussion of the pros and cons, see Fussel and Massey (2004) and chapter 3.

account possible interactions between *education* and *wealth,* the cross-effect was implemented in the regression.

Wealth, in relation to migration, is expected to have an inverted U-shaped form. In particular, poorer households are those with the highest incentive but the least possibility of migrating. Instead relatively better-off households have the opportunity, but often not the incentive, to migrate. To stress this effect, *wealth squared* is implemented in the regression and is expected to be negatively correlated with migration. Since, by construction, the first component of PCA has 0 mean, in order to avoid any reverse effect due to squaring negative values, the variable was shifted by one scalar (5), bringing *wealth* into the range of positive numbers.

Another interaction effect involves *wealth.* Since we expect an inverted U-shaped relation between wealth and migration, and we know from previous literature that migration networks reduce the costs and risks of migration, then networks should be more important for poorer than for richer households. If this is the case, the cross-effect between *wealth* and *migration prevalence* should have a significant negative sign.

Lastly, four variables are labeled as contingent factors. The first three are, broadly speaking, geographical factors. *Distance* is a rough measure for the cost of migration, and may be not only a measure of physical cost, but also of psychological and adaptation costs. *City* and *Caribbean* are dummy variables. Both are central to the analysis, as the focus is on the importance of migrant networks in determining household migration strategies in various settings. If the relative dimension of migration flows in Mexico and other Central American countries is the same, we should observe the non-significant effect of the specific dummy. Since we know that Mexican migration flows are older, more highly developed and mainly from rural areas, we expect a significant negative effect of both dummies.

This chapter departs from the hypothesis that the important fact in migration decisions is the dimension of networks. Community-level networks in urban areas are less highly developed than in rural areas. The large gap between the insignificant correlation between *city* and *current network* (corr=0.0088) and the large negative correlation between *city* and *migration prevalence* (corr=-0.2196) both corroborate this idea. The difference suggests that living in an urban context does not affect the household network, but rather the community network. Is it the urban context, offering more opportunities, that reduces the number of migrants and thus the dimension of the network, or is it the other way around? Can it be that migration from urban areas, being more recent, generates smaller community-level networks, less able to push migration, than older rural networks?

Before passing to the next section, a remark is necessary on the last contingent factor: *law*. This variable is derived from the work of Ortega and Peri (2009). As noted in chapter 3, authors' database contains information on the immigration legislation of 15 OECD countries over the period 1980-2005. To each change in legislation, a (+1) or a (-1) is associated whenever a reform increases or decreases the tightness of immigration laws. Since in the countries analysed here migration is mainly unidirectional to the U.S., the focus is on U.S. legislation (period 2000-2005). Although the period is relatively short, historical events have had a major influence on immigration legislation, and it thus appears useful to analyse the effect of U.S. legislation on household migration strategies.

4.3 Empirical Results

To verify whether the determinants behind Mexican migration are also in motion in the other countries, we make use of probit and IV-probit estimation. First, using the full information, we examine whether previous results on Mexican migration are confirmed at aggregate level. Second, separating Mexico and the other Central American countries, estimation results are compared. Third, rural vs. urban analysis is proposed. Lastly, the small network – large network analysis concludes the study. Although chapter 3 focuses both on the probability that a household is migrant and on the optimal number of migrants, the small sample of migrant households available for the five Central American countries only allows us to analyse the probability of migration.

Since networks are potentially endogenous in the migration decision, Instrumental Variable probit was estimated to avoid endogeneity. However, results for OLS, Probit without correcting for endogeneity, and conventional IV-2SLS were produced. The main problem with the IV approach is to identify instruments which must be correlated with the variable suspected of being endogenous (in our case, *migration prevalence*) and uncorrelated with the error term.

Following McKenzie and Rapoport (2007), it was possible to instrument Mexican *migration prevalence* according to state-level outmigration rates. In particular, 1956-59 state outmigration rates have been shown to be exogenous, necessary, and non-weak. Similar information is not available for other Central American countries. The most recent reliable information satisfying the characteristic of exogeneity and un-correlation with the dependent variable is that giving the 1986-90 national migration flows to the U.S., normalized on the national population. This information can be taken from the Migration Policy Institute (MPI) Data Hub (yearly flows to the U.S.) and the International Labor Organization (ILO) website, which provides free statistics on migration flows (the former) and social economic indicators (the latter).

There are two main differences with respect to the instrument available for Mexico: country/state dimension, and period of time. Mexican information at state level is available, but this is not the case for the other five countries. Since Mexico constitutes around one half of the sample and Mexican states are often larger (in population and/or in size) than any of the other five countries, we can use the five countries' outmigration rates as if they were Mexican states' outmigration rates.

More controversial is the time period. The Mexican instrument was collected in the 1950s, whereas instruments for Central American countries were collected in the late 1980s. A priori, we can argue that the 1950s migration does not directly affect the migration strategy in the period 1999-2005, but this rationale cannot be applied straightforwardly to the 1980s migration flows. On one hand, shorter gap in time may underestimate the Mexican *migration prevalence* in favor of the Central American one (if more recent migration flows are larger). On the other hand, the instrument may be correlated with the dependent variable. The problem of correlation is rejected when testing for the endogeneity of the instruments in a 2SLS procedure, but not in probit procedure. Table 2 lists descriptive statistics for the two instruments, when different from 0.

	Table 2 Instruments				
	N° of Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**
migrate5659	5593	0.0253	0.0179	0.0004	0.0549
migrate8690	4686	0.0016	0.0014	0.0006	0.0042

Table 6 Descriptive statistics for Instrumental Variables

The reduced form of the model may be expressed in the following way:

$$M_i = (\gamma X_i + \beta N_i + \varepsilon_i > 0) \quad (1a)$$

$$N_i = \theta Z_i + u_i \quad (1b)$$

where M_i is the probability of migration (dependent variable), X_i is the set of exogenous explanatory variables, N_i are the endogenous variables, Z_i the set of instruments, and ε_i and u_i are the uncorrelated error terms. In this particular case, Z_i is a set of two instruments. Instrument 1 (instrument for Mexico) takes 1956-59 Mexican states' outmigration rates for Mexican communities and value 0 for Central American communities. Instrument 2 takes value 0 for Mexico and is the own-country outmigration rate for Central American communities.

4.3.a: Aggregate Level Analysis

Table 3 list the results of aggregate analysis: column 1 OLS, column 2 IV-2SLS, column 3 Probit and column 4 IV-Probit, with the Newey Two-Step procedure. Robust standard errors are implemented where feasible.

Estimated coefficients have the expected direction. The *number of workers* and *male ratio* both have a significant positive influence on the probability of migration, whereas *age* has a negative effect. The quadratic term for *age* is significant and positive in OLS estimation (although its estimated influence is close to 0) and not different from 0 in probit and IV-probit estimates. *Education* is not significant, as expected from previous analyses. Similarly, the interaction effect between *education* and *wealth* is not significantly different from 0.

In line with McKenzie and Rapoport (2007) and the findings of chapter 3, *wealth* has an inverted U-shaped relation with probability of migration.

All household-level social capital indicators have positive estimated coefficients. Both *historic migration experience* and *U.S. residence* have significant positive effects, whereas *current network* is not significantly different from 0.

Of the contextual variables, both *city* and *Caribbean* have a negative effect on migration. The next two sections discuss in detail these results and how they relate to the dimension of migration networks. *Law* seems to play no role, but this may be the effect of too few observations and low variance.

Lastly *migration prevalence* and its cross-effect with *wealth* have the expected sign. As migration prevalence increases, so does the probability of migration. The cross-effect with *wealth* is instrumented by the cross-effect between migration rates in 1956-59 and wealth, and that between migration rates in 1986-1990 and wealth. Instruments are significant at the first stage, jointly significant, non-weak (strong rejection by the over-identification test) but, under the null of exogeneity, the Wald test fails to reject H_0.

When we focus on Probit and IV-Probit estimates, we obtain similar estimated coefficients for all variables. Only *migration prevalence* diverges considerably, but its direction does not change. Focusing on the Wald test, we may argue that IV-analysis is hindered by the quality of instruments. At this point, it is enough to stress that, independently of the use of instruments, community-level networks appear to be important in facilitating the migration process. In addition, since both household and community networks have positive effects on migration, we may argue that they are complements in the migration decision. The negative sign of the cross-effect between network and wealth corroborates the idea that networks, by reducing migration costs, are more important for the relatively poorer social strata, since they help to overcome budget constraints.

A Hausman test between IV-Probit and Probit cannot reject the null hypothesis that the two models are the same (Prob>χ^2=0.9634). This may be explained in two different ways. On one hand, endogeneity may not be such a big problem in the dataset. On the other hand, given the low quality of the instruments used for Central America, IV-probit may not be able to correct properly for endogeneity. Comparison between IV-probit and IV-2SLS has no econometric meaning. The Hausman test between IV-2SLS and OLS rejects OLS estimates. From this point onwards, only Probit and IV-Probit results will be presented. Once the aggregate context has been clarified, we can move on to analysing the differences and similarities in migration between Mexican and the other Central American countries.

Table 3: Aggregate Analysis				
	OLS	IV-2SLS	Probit	IV-Probit
Mig. Prev.	0.323	1.334	7.581 ***	12.129 *
	0.228	0.828	2.133	5.133
Mig. Prev. x W.	-0.032	-0.224	-1.150 **	-2.016 *
	0.046	0.158	0.412	0.956
N° of Workers	0.012 ***	0.012 ***	0.114 ***	0.114 ***
	0.002	0.002	0.018	0.017
Male Ratio	0.054 ***	0.054 ***	0.543 ***	0.538 ***
	0.011	0.011	0.099	0.094
Age	-0.006 ***	-0.006 ***	-0.023 *	-0.023 *
	0.001	0.001	0.009	0.009
Age x Age	0.000 ***	0.000 ***	0.000	0.000
	0.000	0.000	0.000	0.000
Educ.	0.002	0.003	0.066	0.072
	0.003	0.003	0.044	0.039
Educ. X Educ.	0.000	0.000	-0.001	-0.001
	0.000	0.000	0.001	0.001
Wealth x Educ.	0.000	-0.001	-0.012	-0.013
	0.001	0.001	0.008	0.007
Wealth	0.081 ***	0.081 ***	1.253 ***	1.213 ***
	0.015	0.016	0.268	0.246
Wealth x Wealth	-0.007 ***	-0.005	-0.096 ***	-0.081 ***
	0.002	0.003	0.029	0.028
His. Mig. Exp.	0.038 ***	0.039 ***	0.135 ***	0.137 ***
	0.005	0.005	0.020	0.010
US Res.	0.008 **	0.008 **	0.045 ***	0.045 ***
	0.003	0.003	0.013	0.014
Current Net.	0.000	0.000	0.002	0.002
	0.000	0.000	0.001	0.001
Distance	0.000 ***	0.000 ***	0.000 ***	0.000 **
	0.000	0.000	0.000	0.000
City	-0.028 ***	-0.029 ***	-0.256 ***	-0.256 ***
	0.006	0.006	0.046	0.049
Caribbean	-0.052 ***	-0.049 ***	-0.414 ***	-0.388 ***
	0.007	0.009	0.057	0.072
Law	-0.008	-0.012	-0.076	-0.089
	0.005	0.009	0.040	0.060
Constant	-0.092	-0.174	-5.484	-5.732
	0.051	0.090	0.746	0.841
N° of Observations	10279			
R-squared	0.111	0.109		
Pseudo R-Squared			0.160	
Log-Likelihood			-2384.013	
First-stage Adj. R-sq.				
Mig. Prev		0.495		
Mig. Prev. x Wealth		0.554		
First-stage par. R-sq.				
Mig. Prev		0.136		
Mig. Prev. x Wealth		0.145		
First-stage Rob. F				
Mig. Prev		489.67 ***		
Mig. Prev. x Wealth		480.32 ***		
Shea's partial R-sq.				
Mig. Prev		0.177		
Mig. Prev. x Wealth		0.188		
Test of overid.		0.876		0.029
Wald Test of Exog.				0.605

Table 7 Aggregate level estimates. First line estimated coefficient, second line robust SE. *** stand for significant at 0.001 confidence level, ** => 0.01, * => 0.05; p-values for overidentification test and Wald test of exogeneity;

4.3.b: Central America vs. Mexico

At aggregate level, the results are in line with previous findings on Mexican migration to the U.S.. To disentangle the differences between Central American and Mexican migration flows, the two are analysed separately. Table 4 lists the results for a reduced number of variables and for the full set of explanatory variables, respectively. The reduced set was necessary, since we have only 198 Central American households which could be labeled as migrant, and the full set of explanatory variables is 18 (plus the constant). The reduced set can determine at least whether some of the differences between Mexican and Central American migration are structural, avoiding the risk that they are the result of imprecise estimation. Table 4 reveals two elements: the IV-strategy is hindered by the quality of instruments, and the determinants of Mexican and Central American migration differ.

Focusing on IV-Probit, in both restricted and extended form, we see that the Wald test – .under a null hypothesis of exogeneity - fails to reject H_0 . This suggests that, in the best case, *migration prevalence* is exogenous and in the worst case, either that the instruments are endogenous or that they are insufficient to avoid endogeneity. Hausman tests on extended and reduced forms for Caribbean and Mexico all reject systematic differences in estimated coefficients between IV-probit and probit.[102]

The analysis of Mexican households' migration strategy produces estimates in line with the previous chapter and literature findings. Specifically focusing on the extended form, differences in estimated coefficients with the full Mexican database are below 10%. Almost all the variables in the restricted and extended models have the expected sign and are significant at the 0.001 confidence level. However, *migration prevalence* and its cross-effect with *wealth* is non-significantly different from 0, although both have the expected direction and magnitude.

On Mexican migration, there is only one value which differs significantly between the reduced and extended forms: *education*. It appears to have a negative influence on migration in the reduced form at the 0.001 confidence level, but it is non-different from 0 in the extended form. The explanation may be found in the absence, in the reduced form, of the quadratic form of *wealth*. *Education* is highly correlated with *wealth* (corr=0.209), so that once the quadratic form of wealth is cut, *education* partially captures the inverted U-shaped form.

[102] Extended Caribbean Prob>χ^2=0.9745; reduced Caribbean Prob>χ^2=0.4926; extended Mexican Prob>χ^2=0.9995; reduced Mexican Prob>χ^2=0.7909.

While almost all variables (with few exceptions) have the expected direction and magnitude, only a few of them are significant at the 0.05 confidence level: *male ratio*, *wealth*, *historic migration experience* and *city*. In contrast with Mexico, *migration prevalence* has a significant positive influence on migration probability. Thus, Central American migration appears to be very different from Mexican migration.

Nonetheless, a joint test of significance, grouping variables by type, tells a slightly different story. Human capital variables are jointly significant in both extended and reduced forms at the 0.01 confidence level (p-value= 0.006). Similarly, physical capital variables (p-value=0.003), household-level network (p-value=0.000) and community-level network (p-value=0.000) are all jointly significant.[103] From this perspective, Mexican and Central American migration appear similar. Estimated coefficients generally have the same direction and do not differ greatly magnitude.

Analysis of probit estimate results for Mexico and the five Central American countries reveals differences large enough to indicate a structural difference between Mexico and the others.

A Chow test on the extended and reduced probit confirms a structural difference between Mexico and Central American countries at the 0.005 confidence level.[104]

Despite this structural difference, *city* still has a significant negative influence in all treatments. This result is common across borders, and thus tells us that Mexican and Central American migration share at least one common element: the negative effect on migration of living in urban areas. This corroborates the idea that the question we are trying to answer is not marginal. Cumulative causation or, rather, one of its limitations, extends outside the Mexican border. The next two subsections examines what generates this result and, in particular, if it is the only, correct and robust interpretation of the phenomenon.

[103] Only p-values for the extended form are reported. For the reduced form, please contact the author.
[104] Chow statistic for extended probit p-value=4.996e-15; reduced probit p-value=0.000.

	Table 4: Mexico vs. Central America							
	Probit CA	**Probit Mx**	**IV-Pr CA**	**IV-Pr Mx**	**Probit CA**	**Probit Mx**	**IV-Pr CA**	**IV-Pr Mx**
Mig. Prev.	6.403 *	2.282	-1.791	8.850	6.912 *	4.721	-55.054	8.629
	2.910	2.671	8.909	7.134	3.416	3.022	344.527	7.218
Mig. Prev. x Wealth	-0.863	-0.358	0.112	-1.989	-0.574	-0.789	3.773	-1.603
	0.599	0.506	1.715	1.397	0.681	0.570	16.663	1.380
N° of Workers	0.051	0.140 ***	0.051	0.140 ***	0.055	0.143 ***	0.096	0.143 ***
	0.032	0.021	0.030 i	0.020	0.034	0.022	0.251	0.021
Male Ratio	0.361 *	0.636 ***	0.368 *	0.624 ***	0.328 *	0.647 ***	0.586	0.645 ***
	0.157	0.126	0.152	0.121	0.161	0.125	1.676	0.121
Age	-0.006 i	-0.030 ***	-0.006 *	-0.031 ***	0.013	-0.040 ***	-0.012	-0.041 ***
	0.003	0.002	0.003	0.002	0.017	0.011	0.156	0.012
Age x Age					0.000	0.000	0.000	0.000
					0.000	0.000	0.001	0.000
Educ.	0.004	-0.047 ***	0.000	-0.050 ***	0.194 **	-0.030	0.181	-0.023
	0.010	0.008	0.010	0.008	0.074	0.056	0.099	0.056
Educ. X Educ.					-0.002	-0.001	0.000	-0.001
					0.002	0.002	0.016	0.002
Wealth x Educ.					-0.030 *	0.001	-0.046	0.000
					0.014	0.011	0.107	0.011
Wealth	0.243 ***	0.159 *	0.186	0.361 *	0.616	1.243 ***	1.706	1.391 ***
	0.076	0.072	0.149	0.177	0.434	0.343	6.320	0.401
Wealth x Wealth					-0.021	-0.106 **	-0.155	-0.110 **
					0.050	0.035	0.673	0.034
Historic Mig. Exp.	0.290 ***	0.117 ***	0.297 ***	0.127 ***	0.284 ***	0.115 ***	0.474	0.117 ***
	0.039	0.018	1.253	0.011	0.040	0.018	1.253	0.011
US Res.	-0.016	0.055 ***	0.004	0.063 ***	-0.012	0.057 ***	0.115	0.058 ***
	0.028	0.016	0.027	0.017	0.028	0.016	0.838	0.017
Current Net.	0.001	0.002	0.004 *	0.003 *	0.002	0.002	0.015	0.002
	0.002	0.002	0.002	0.002	0.002	0.002	0.080	0.002
Distance					0.000 **	0.000 **	-0.001	0.000 **
					0.000	0.000	0.009	0.000
City	-0.191 *	-0.331 ***	-0.194 *	-0.431 ***	-0.015	-0.319 ***	-0.394	-0.341 ***
	0.079	0.058	0.080	0.073	0.094	0.058	2.520	0.073
Law					-0.027	-0.050	1.423	-0.043
					0.080	0.049	9.217	0.064
Constant	-3.233	-4.246	-2.646	-1.837	-6.791	-4.246	7.471	-4.823
	0.400	1.011	0.760	0.888	1.209	1.011	91.507	1.456
N° of Observations	4686	5593	4686	5593	4686	5593	4686	5593
Pseudo R-Squared	0.150	0.143			0.165	0.150		
Wald Test of Exog.			0.024	0.098			0.542	0.793

Table 8: Central America vs. Mexico. First line estimated coefficient, second line robust SE. * stand for significant at 0.001 confidence level, ** => 0.01, * => 0.05; i stand for significant at 0.10 confidence level. p-values are reported for overidentification test and Wald test of exogeneity;**

4.3.c Urban vs. Rural

We have already found two indications suggesting that urban households are less likely to migrate. We still cannot say why this happens. In the literature, the main candidate is the smaller diffusion of migrant networks in urban settings. We also know that *migration prevalence* is smaller in large cities than in rural contexts.

Table 5 reports estimation results on the probability of migration from rural and urban areas. Despite the clear difference between urban and rural migration highlighted in the previous regression, its origin seems to be due only to a difference in community-level network. All the other estimated coefficients not only have the expected direction and significance, but they are also not dissimilar in rural and urban areas. Differences are around 10% and not far from those obtained with the full set.

Instead, *migration prevalence* has no significant influence on the propensity for urban household migration, but positively affects rural households. A joint test of significance shows that *migration prevalence* and *migration prevalence x wealth* are also jointly significant in determining migration probability (p-val=0.015) in urban areas.

A Chow test on the structural difference between urban and rural rejects the null hypothesis that the two models are the same at the 0.001 confidence level. However, when the same test is performed on the probit analysis, excluding *migration prevalence* and *migration prevalence x wealth* from the group of explanatory variables, the two models are the same at the 0.001 confidence level (p-value=0.002).

This result raises a new question: why do community-level networks appear to have no effect (or a very limited one) in urban areas? It is often argued that urban areas have smaller networks. If this were the case, we should observe a large negative correlation between *city* and *migration prevalence*. This seems to be confirmed in our sample: correlation is -0.2196, suggesting that it is not the urban context but the dimension of networks which affect their efficiency. Even when we divide our sample into two groups using the network dimension mean as discriminator (nothing changes if we use the median), we note that small and large networks are "equally distributed" between rural and urban areas (see Table 6), the correlation between *city* and *Low Network* is being 0.0993. It is the average dimension of rural community networks that explains this difference. The mean of *migration prevalence* in rural areas is 0.114 ($\sigma = 0.0607$) but 0.089 ($\sigma = 0.428$) in urban ones, and the difference is statistically significant (p-value=0.000).

Before passing to the next subsection, to verify whether the dimension of networks affects not only the probability of migration but also the full process of decision, it is necessary to note again that, although endogeneity appears to be present and problematic, our analysis is thwarted by the quality of instruments. If we exclude the source of endogeneity (i.e., *migration prevalence*), all other estimates do not differ significantly between the probit and IV-probit approaches.

	Table5:Urban vs.Rural							
	Probit U		Probit R		IV-Pr U		IV-Pr R	
Mig. Prev.	4.478		11.022	***	-5.567		14.153	**
	5.186		2.515		9.045		5.489	
Mig. Prev. x Wealth	-0.356		-1.924	***	1.604		-2.446	**
	0.963		0.494		1.774		0.911	
N° of Workers	0.116	***	0.108	***	0.116	***	0.107	***
	0.026		0.025		0.026		0.024	
Male Ratio	0.594	***	0.494	***	0.596	***	0.490	***
	0.158		0.127		0.147		0.123	
Age	-0.033	*	-0.015		-0.031	*	-0.014	
	0.014		0.013		0.014		0.013	
Age x Age	0.000		0.000		0.000		0.000	
	0.000		0.000		0.000		0.000	
Educ.	0.003		0.094		0.015		0.101	*
	0.075		0.055		0.064		0.051	
Educ. X Educ.	-0.001		-0.002		-0.001		-0.002	
	0.002		0.002		0.002		0.002	
Wealth x Educ.	-0.001		-0.016		-0.003		-0.018	
	0.013		0.011		0.011		0.010	
Wealth	1.147		1.160	***	1.123	*	1.105	***
	0.594		0.302		0.486		0.296	
Wealth x Wealth	-0.104		-0.071	*	-0.117	*	-0.058	
	0.060		0.033		0.050		0.035	
Historic Mig. Exp.	0.105	***	0.186	***	0.103	***	0.184	***
	0.021		0.025		0.012		0.019	
US Res.	0.063	**	0.030		0.062	**	0.029	
	0.020		0.018		0.021		0.019	
Current Net.	0.003	*	0.000		0.003		0.000	
	0.001		0.002		0.002		0.002	
Distance	0.000	*	0.000		0.000		0.000	
	0.000		0.000		0.000		0.000	
Law	-0.007		-0.113		-0.008		-0.147	
	0.059		0.055		0.066		0.106	
Caribbean	-0.327	**	-0.459	***	-0.327	**	-0.419	***
	0.101		0.071		0.101		0.112	
Constant	-4.492		-5.891		-4.006		-6.178	
	1.629		0.878		1.452		1.142	
N° of Observations	4684		5595.0		4684		5595	
Pseudo R-Squared	0.188		0.146					
Wald Test of Exog.					0.3499		0.7725	

Table 9 Urban vs. rural migration. First line estimated coefficient, second line robust SE. * stand for significant at 0.001 confidence level, ** => 0.01, * => 0.05; p-values are reported for Overidentification test and Wald test of exogeneity;**

	Table 6 City/Small Networks		
	Small N.	Big N.	Total
Rural	2,790	2,805	5,595
Urban	1,871	2,813	4,684
Total	4,661	5,618	10,279

Table 10 Household number divided by rural/urban and network dimension

4.3.d:Small vs. Large Networks

To complete our analysis, we provide the results of probit and IV-probit regressions for two groups, divided according to network dimension. Communities belonging to the first half of the *migration prevalence* distribution are labeled Small Network (SN) communities, and the others are labeled Large Network (LG) communities. Table 7 lists estimated coefficients.

The *number of workers* and *male ratio* affect the migration probability positively, with values close to those identified in all previous regressions. This confirms the robustness of the results.[105] *Age* has a small negative effect on migration (columns 2 and 4), whereas *education* appears to have no effect or only a small positive effect on migration probability. If *education* has a positive effect, it is counterbalanced by the negative effect of its interaction term with *wealth*.

Wealth has an inverted U-shaped relation with migration probability corroborating the idea that economic improvements underlie migration decisions. Moreover, as expected, poorer social strata have more incentive to migrate, but they are usually bound by budget constraints.

Distance, city and *Caribbean* all play a role. The positive non-significant effect of *distance* tells us either that *distance* is a poor measure of the cost of migration, or that physical costs are everywhere low enough not to generate discrimination. *City* and *Caribbean* both negatively affect migration, so that the lower propensity to migrate in urban and non Mexican areas is not only due to lower diffusion of networks, but also to other forces. Second, while the effect of *city* is almost constant among different treatments and estimations, that of *Caribbean* undergoes major changes. In particular, analysing the change between SN and LN, we note a doubling of the negative effect. This result corroborates the idea that the more recent and smaller development of migration networks in Central American countries is partially at the origin of smaller migration flows to the U.S. in comparison with Mexico.

[105] They slightly differ in the Mexican vs. Central American analysis, confirming that Mexican migration is still strongly a male migration, due to its Catholic patriarchal family structure, as shown in Sana and Massey (2005).

	Table7:Small vs. Large Networks			
	Probit SN	**Probit BN**	**IV-Probit SN**	**IV-Probit BN**
Mig. Prev.	2.183	11.526	-1.615	20.189
	4.218	9.369	9.118	30.419
Mig. Prev. x Wealth	-0.684	-1.544	0.676	-6.329
	0.810	1.824	1.908	5.817
N° of Workers	0.126 ***	0.080 **	0.122 ***	0.085 **
	0.023	0.030	0.023	0.029
Male Ratio	0.517 ***	0.581 ***	0.530 ***	0.605 ***
	0.129	0.155	0.128	0.147
Age	-0.022	-0.026 *	-0.019	-0.030 *
	0.013	0.013	0.013	0.014
Age x Age	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000
Educ.	0.009	0.159 *	0.001	0.164 *
	0.059	0.062	0.053	0.066
Educ. X Educ.	-0.003	0.000	-0.003	0.000
	0.002	0.002	0.002	0.002
Wealth x Educ.	0.002	-0.032 **	0.005	-0.037 **
	0.011	0.011	0.011	0.012
Wealth	1.200 ***	1.272 **	1.008 *	1.439 ***
	0.332	0.452	0.392	0.419
Wealth x Wealth	-0.105 **	-0.082	-0.109 **	-0.065
	0.035	0.047	0.035	0.052
Historic Mig. Exp.	0.130 ***	0.202 ***	0.127 ***	0.231 ***
	0.020	0.048	0.011	0.029
US Res.	0.032 *	0.062 *	0.025	0.088 **
	0.016	0.024	0.017	0.027
Current Net.	0.002	0.004	0.001	0.008 **
	0.001	0.003	0.001	0.003
Distance	0.000	0.000 ***	0.000	0.000 ***
	0.000	0.000	0.000	0.000
Law	-0.121 **	0.125	-0.172 *	0.267
	0.045	0.081	0.067	0.174
City	-0.259 ***	-0.246 **	-0.150	-0.249 **
	0.061	0.078	0.113	0.077
Caribbean	-0.215 **	-0.682 ***	-0.210 **	-0.839 ***
	0.074	0.094	0.078	0.140
Constant	-4.289	-5.262	-4.154	-4.512
	1.088	1.322	1.615	2.469
N° of Observations	4661	5618	4661	5618
Pseudo R-Squared	0.148	0.153		
Wald Test of Exog.			0.532	0.000
Amemiya-Lee-Newey minimum chi-sq statistic			0.007	0.395

Table 11 SN vs. LN. First line estimated coefficient, second line robust SE. * stand for significant at 0.001 confidence level, ** => 0.01, * => 0.05; p-values are reported for Overidentification test and Wald test of exogeneity.**

As regards networks, household-level networks throughout the analysis positively affect migration: the migration experience has a positive coefficient which falls between 0.130 and 0.200, and *U.S. resident* is around 0.05. Only *current network* is often non-significant.

Migration prevalence does not affect migration probability, although two elements emerge, splitting the sample between Small and Large networks. First, focusing on normal probit, in the SN group community-level networks are non-significant, both analysed alone and jointly (p-val=0.167), while the LN group still has joint significance at the 0.05 confidence level (p-val=0.050). Second, focusing on IV-probit, not only does the joint test produce similar results (p-value=0.813 and p-value=0.012), but the problem of endogeneity is solved through the use of the instruments. This is one interpretation of the endogeneity problem.

Community-level networks must reach a certain dimension before they can play a role in household decision-making. In particular, before this threshold is reached, households only rely on personal ties to facilitate migration. After the threshold is reached, diffuse migration social capital increases the migration flow, partially substituting and partially complementing household-level ties. Before the threshold is reached, community-level networks are only an observable effect of migration; after the threshold, they become an active determinant of migration.

Lastly a Chow test of the probit and IV-probit cannot reject the possibility of structural differences between the two at the 0.001 and 0.005 confidence levels. Similar results were obtained by regressing the probability of migration against the same set of variables, but at community-level.

4.4 Conclusions

As Massey et al. (1998:107) argued, "far too much of the research is centered in Mexico, which because of its unique relationship to the USA may be unrepresentative of broader patterns and trends." Analysis of the importance of ties has been systematic only for Mexican migration, while other migration flows are understudied. Research over the past two decades has established the central role of networks in determining migration paths, but few attempts have been made to compare the importance of ties in multiple settings.

The present analysis, combining and comparing data from MMP and LAMP on the relative importance of family and community networks in migration choices in differing settings, highlights simultaneously the reference theory (cumulative causation) and the main empirical variables used to investigate the theory itself.

After a first comprehensive analysis, three different settings were studied: Mexico vs. Central America, rural vs. urban, and small vs. large networks. Some elements emerge, confirming previous findings. Independently of setting. We may argue:

1. Larger households are more likely to be involved in migration. This is in line with NELM, since larger households are more likely to be able to differentiate their source of income and thus minimize their associated risk.
2. Migration is still conditional on "males". Households with larger numbers/proportions of males are more likely to be involved in migration. Nonetheless, Mexican migration is largely male, whereas that of Central America has an estimated coefficient about half that of Mexican coefficients. This result is in line with the views of Sana and Massey (2005), stressing the effect of the Catholic patriarchal family in Mexico compared with the Caribbean matriarchal family.
3. Younger households are more likely to migrate. As the neoclassical approach argues, longer life expectancy increases the expected return to migration and thus the appeal of migration.
4. Household migration experience and family networks always positively affect migration. As network theory states, ties allow the costs and risks of migration to be reduced, facilitating outmigration. Previous experience of migration also allows the accumulation of migration social capital which reduces the psychological and adaptation costs of migration, eventually making migration psychologically attractive.
5. Migration has an inverted U-shaped relation with wealth. As proposed in chapter 2 and stressed in chapter 3, this is the compound effect of the propensity and possibility of migrating. On one hand, poorer households are those with a higher incentive to migrate. On the other hand, in underdeveloped credit and insurance markets, since migration is an expensive investment, only households relatively better off can afford to migrate.

Since these five results are confirmed independently of setting, we may state that the theoretical background proposed in chapter 2 is not flawed. Nonetheless, this is not enough to confirm or reject cumulative causation.

Focusing on the accumulation of community social capital - that is on *migration prevalence* - its influence on households' migration strategy vary with the setting in question. Although part of the fluctuation in the analysis Central America vs. Mexico may be due to the relatively small number of Central American migrant households in the sample and to the low quality of the instruments used to disentangle endogeneity, it should be noted that *migration prevalence* is not always significant. Even when it generally has the expected direction, it seems significant only for rural Mexican households. This confirms the idea of Fussel and Massey (2004) on the limitations of cumulative causation.

However community-network variables are always jointly significant, so that we cannot argue that Cumulative Causation cannot be extended to settings different from rural Mexican areas. The two dummies *City* and *Caribbean* tell us that, independently of the network dimension, living in urban areas and in Central America has negative effects on migration probability. Fussel and Massey (2004) argue that the accumulation of community level capital in urban areas is more complex, so that cumulative causation is less effective in explaining outmigration paths. We argue here that it is not the urban context itself, but rather the relative dimension of networks that influence migration strategy.

Cities, being richer and offering more income opportunities, reduce the household propensity to migrate by increasing the opportunity cost. Also, urban areas, being the destination of internal migration flows, are the arrival point for many migrants. Lastly, outmigration from urban areas is a more recent phenomenon, so that migration community capital has still not reached the threshold.

Similarly, Central American countries, being historically less involved in migration, have not yet reached the critical point (threshold) in the accumulation of migration capital to self-perpetuate the mechanism. These results are in line with the idea that *migration prevalence* does not capture the migration process *per se*, but rather a phase in its development. Analysis of endogeneity goes in this direction. Endogeneity is statistically non-present when networks are small, but present when they are large. This suggests that accumulation of migration community capital is the effect of migration until a certain threshold is reached, but becomes a cause of migration when that threshold is exceeded.

Unfortunately, at this point further analysis is impossible. LAMP is a recent project and the small number of observations (198 migrant households) does not allows us to confirm the hypothesis. The poor quality of the available data and of the instruments used to solve for endogeneity in Central American countries constrains analysis, leaving the question open. Since LAMP is an ongoing project, we expect that future continuing analysis of different settings will enable us to increase our knowledge of the determinants of migration.

We have left the discussion on education until last. The effect of education on migration (see chapter 3) changes with treatment and type of variables involved in the analysis. Education, partially capturing the level of selection of migrants, is a key variable for both scholars and policy-makers. The next chapter provides an analysis of the so-called “quality of migrants” issue, building a theoretical structure capable of explaining the unclear results obtained in the literature so far and those obtained in the previous chapters and this one.

Chapter 5: Cumulative Causation at Work: Intergenerational Transfers and Social Capital in a Spatially Varied Economy

Co-authored with Luca Ferretti[106]

5.1 Introduction

The central topic of this dissertation is the effect of migrant networks on South-North migration flows. Starting from a simple, static, dual-economy model with imperfect credit and insurance markets, we examine how, through cost and risk reduction and resource pooling, migrant networks can facilitate migration. Testing theoretical results of the model on Mexico and five other Central American countries, we highlight the importance of networks in facilitating migration particularly for the poorer social strata. Thus, networks do not simply increase the dimension of migration flows; they also concur in determining their composition.

Both in chapter 3 and 4 empirical analyses, although education has a slightly positive link with migration, it is highly sensitive to changes in the method of analysis and to the set of explanatory variables. As noted in chapter 4, education is usually highly correlated with wealth and, for example, if the quadratic term for wealth is excluded from the set of explanatory variables, education partially captures the inverted U-shaped form of wealth.

In the third part of his review, *The Economics of Immigration,* Borjas (1994:1671) asks: “How Do Immigrants Perform in the Host Country?”. This implicitly raises another question: who are the migrants, in terms of abilities and education? Although “the quality of migrants” is a recognized key issue, a clear answer to Borjas’ question is still far from being reached. Several prominent scholars have contributed to the debate between positive and negative selection, producing theoretical and empirical evidence to support one or the other side. It is not uncommon to read articles which, using the same or very “similar” databases, reach opposite empirical results. McKenzie and Rapoport (2007) give a partial explanation of this phenomenon stressing the effect of networks on the composition of migration flows.

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The aim of this chapter is to develop a theoretical framework, incorporating migrant networks, capable of explaining, under a few simple assumptions, why we observe decreasing levels of selection among migrant cohorts in receiving countries and brain drain in sending countries. This contribution falls into the cumulative causation line of thought and is one of the first extensive formalized models in this branch of literature.

The chapter is organized as follows: Section 1, theoretical and empirical background; Section 2, current debate; Section 3, basic model; Section 4, analysis of the dynamics of the basic model; Section 5, effect of migrant networks on the "natural level of migration"; Section 6, model with population growth; Conclusions, future developments.

5.1 Background

Literature on the so-called "quality of migrants" is extensive, going back to the 1978 pioneer work by Chiswick. Since that paper and Borjas' 1985 critique, we now broadly divide scholars into two groups, those supporting Chiswick's positive selection of migrants and those supporting Borjas' negative one. To provide a theoretical framework of reference, this section reports a more recent version of Chiswick's approach (1999). Let us presume an economy formed of two countries: home (0) and host (1). It is assumed, for the sake of simplicity, that there is no return for experience in both labor markets[107] and that life has an infinite time horizon. Costs of migration C occur in the first period, and include immediate costs C_i and opportunity costs C_o. Thus, costs incorporate reorganization of life-style in the new country. The rate of return to migration may be written as:

$$r = \frac{W_1 - W_0}{C_i + C_o} \quad (1)$$

where W_1 and W_0 are earnings in destination and original countries, respectively."Migration occurs if the rate of return to the investment in migration r is greater than or equal to the investment cost of funds for investment in human capital. The interest cost of funds is lower the greater the person's wealth and access to the capital market" (Chiswick, 1999:3).

[107] This also allows us to exclude the possibility of post-migration training, particularly post-migration investments.

It is assumed that there exists only two type of workers: skilled and unskilled. Skilled workers are more able, either because they have more innate abilities or simply because they have a higher degree of education. The rates of return of skilled r_s and of unskilled r_u workers are different. If both subjects face the same costs for migration, the one with higher returns for it will be more inclined to migrate.

It is also assumed that, both in the origin and in the host countries, the rate of return for skilled workers is $100k$ larger than the rate of return for unskilled ones and, that the ratio of returns in the two countries is constant and independent of ability.

$$W_{0,s} = (1+k)W_{0,u} \quad (2a)$$

$$W_{1,s} = (1+k)W_{1,u} \quad (2b)$$

Lastly, Chiswick assumes that out of pocket costs do not vary with ability (i.e.: $C_{i,s} = C_{i,u}$) and that skilled workers do not have any advantages in migration (i.e., they are not more efficient), but that they face larger opportunity costs.

$$C_{o,s} = (1+k)C_{o,u} \ (3)$$

Given these assumptions, the rate of return for skilled worker is:

$$r_s = \frac{(1+k)W_{1,u} - (1+k)W_{0,u}}{C_i + (1+k)C_{o,u}}$$

$$= \frac{W_{1,u} - W_{0,u}}{C_{0,u} + \frac{C_i}{(1+k)}} \quad (4)$$

Equation (4) shows that the rate of return of skilled workers is greater than that of unskilled ones, as long as earnings increase with ability (i.e. $k > 0$). This implies that migration is a selective phenomenon, positive selection being driven by the greater rate of returns for skilled workers.

5.2 Current Debate

The literature on the quality of migrants grew rapidly after the pioneer work of Chiswick (1978) who estimated the following equations:

$$lnY_{n,i} = lnY_0 + rS_i + b_1T_i + b_2T_i^2 + U_i \quad (5)$$

$$lnY_i = lnY_0 + rS_i + C_1T_i + C_2T_i^2 + C_3(YSM_i) + C_2(YSM_i^2) + U_i \quad (6)$$

These are the earning functions of host country workers and migrants, respectively. $Y_{n,I}$ is earnings, T_i is years of labor market experience measured as age minus years of schooling minus 5, and U_i is the residual. Chiswick obtained equation (6), in which YSM is the number of years since migration - after some computations and assumptions, as both schooling and labor experience may be broken down into number of years in both home and host countries. Based on the 1970 U.S. census, the analysis shows that, at the moment of their arrival, foreigners earn 17% less than host-country workers, but that after 15 years' work they "overtake" this situation. Similar results were found by Carliner (1980).

These results have been explained in two ways. The human capital accumulation approach assumes that the original wage gap is due to the lower level of specific human capital owned by immigrants compared with natives. Even the most skilled immigrants do in fact "pay a fee" to adapt to labor market of the host country. This "fee" may be viewed as an investment cost to obtain the same level of specific skills as a native worker. These skills can be acquired neither before migration nor in a short time, and their influence is reflected in the lower wage level of immigrants compared with host-country workers. This gap decreases over time as immigrants gain the skills required in the host country. This approach explains the presence of the gap and its disappearance in the long run, but not the "overtaking" effect.

To explain the overtaking point, Chiswick assumed the existence of a process of self-selection. Immigrants are not randomly drawn from the population, but are the more capable and motivated (Chiswick, 1978).

This view was challenged by Borjas in his 1985 paper, showing that within-cohort income growth is significantly smaller than that predicted using cross-section regressions. Borjas' main criticism to Chiswick was based on the dynamic of migration, which cannot be measured using a static tool like cross-section analysis. Newcomers may be different from those who had arrived ten or twenty years before. Borjas' approach is compatible with another empirical finding: the "decline" in quality of immigrants over time.

To explain his point, Borjas (1985) proposed the following example. Let us assume that there are three distinct immigrant cohorts, one arriving in 1950 and the other two 20 and 40 years later. The 1950s wave is assumed to have the highest level of productivity, and the 1990s wave the lowest, with the 1970s wave lying in between. If we use cross-section analysis with the 1990 Census data, we find a growth path of immigrant wages which intercepts the real growth path of the three waves at different moments in subjects' lives.[108] This gives an unrealistic high growth rate. In addition, the 1990s cohort may never reach the overtaking point.

Chiswick's and Borjas' pioneer works opened an extended debate in the American academic community, reflecting the U.S. public debate on migration policies. In the last 30 years, the two positions have been enriched by the work of these two scholars as well as by many other contributors.

After Borjas' work, the focus has shifted to what causes changes in cohort quality. Particularly as regards the differences between the earnings of immigrants having the same level of measured skills, but arriving from different countries (Borjas, 1987). Differences in earnings are explained by varying political and economic conditions in the home countries at the time of migration.

Within this framework Borjas identifies the conditions favoring positive or negative selection specifically in terms of wage distribution. Positive self-selection identifies the situation in which the "best" people or groups of people leave the origin country for the host one. This happens when returns are sufficiently high and the wage distribution in the host country is more dispersed than in the home country. Negative self-selection occurs when migrants come from the lower tail of the income distribution in their home country.[109] To observe negative selection, returns must be sufficiently high, but host country wage distribution is less dispersed compared with the home country. A third group is defined as "refugee sorting", migrants coming from the average of the distribution in their home country, but performing badly in their host country.

Borjas' findings have been the subjected to many criticisms.[110] The key issue in the debate generated by his work focused on the new econometric tools applied to the phenomenon of migration. Particularly significant are the contributions of Heckman and Honoré (1990) and, again, Borjas et al. (1992).

However, despite Borjas and followers, the positive self-selection vision of migration did not stop developing. In the last 20 years, it has produced a large body of evidence. Chiswick, just one year after Borjas' famous paper (Borjas, 1985), showed that immigrant educational levels in the U.S. did not decrease, when changes in the origin nations of immigrants occurred. At the same

[108] See Borjas (1985) for a more detailed explanation.
[109] Borjas assumes that wages reflect real skills.
[110] Particularly interesting are the critique of Jasso and Rosenzweig (1990) and Borjas' replay (Borjas, 1990).

time, he noted that a different policy with respect to VISA assignments may have produced a "better" mix of immigrants, as happened in Canada.

One of the best pieces of supporting evidence for Chiswick's approach was the reduction in the wage gap overtime between migrants and natives. The main explanation is based on the acquisition of specific human capital, such as knowledge of the English language and computer proficiency (see Chiswick et al., 1990, 1995, 1998, 2002, 2006).

Chiquiar and Hanson's 2005 paper provides the best evidence supporting positive self-selection position. They develop an econometric approach to estimate the distribution of skills between Mexican immigrants and non-immigrants in the U.S. Through a statistical method developed by Di Nardo et al. (1996), they showed that Mexican migrants are more skilled than non-migrants, even when illegal migration is included. They also analyse differences in the educational systems of the two countries and network effects.

Chiquiar and Hanson (2005), instead of concentrating on migrants' performance in the labor market of the receiving country, focused analysis on the sending country because, in order to determine the level of selection, non-migrants must also be considered. It is in fact possible (as will be argued later) that we can observe a negative cohort effect with positive selection.

However, how is it possible that, analysing migration data across the U.S.–Mexican border over the last decade, Chiquiar and Hanson (2005) and Mishra (2007) found evidence to support a positive selection effect, whereas Ibarran and Lubotsky (2005) and Fernandez-Huertas (2008) found the opposite? One explanation of these contrasting results can be found in the empirical analysis of McKenzie and Rapoport (2006, 2007) who, applying network analysis to ENADID data, argued that an increasing presence of migration networks reduces migrants' skill levels, causing negative selection. The question is: what drives this inverse path between the increasing size of migration networks and the decreasing quality of migrants?

According to Chiswick (1999), self-selection is driven by the rate of return to migration, more capable subjects being favorably selected in terms of education. If the cost of migration is too high and financial market is underdeveloped, migration is too costly for less qualified potential migrants (Zimmerman and Carter, 2003). Once migrant networks expand, lowering costs, they can allow newcomers with lower financial capabilities.

With this structure of costs, we can explain the results of McKenzie and Rapoport (2007) in term of self-selection. Networks reducing the cost of migration allow newcomers from the left tail of the income distribution. Newcomers, being "education expensive", are more likely to have lower levels of education. The expansion of networks, at least in the medium term, causes a decrease in the quality level of migrants in terms of observable characteristics.

As noted in previous chapters, in order to migrate people from the left tail of the income distribution need networks; otherwise, migration costs are too high and cannot be afforded. Instead, households belonging to the right tail of the income distribution do not need network support, because they can overcome these costs fairly easily.

The model presented in this chapter demonstrates that migration is a cumulative process in which each migrant alters the structure of the world. In this framework, the dimension of flows of migrants, their level of selection in terms of observable characteristics (cohort effect) and the quality levels of those who are left behind (brain drain) are characterized by the moment at which migration is observed.

Through the model, we show that even in cases of extreme positive selection at individual and aggregate levels, the negative cohort effect (i.e., lower level of observable qualities of successive migration cohorts) and brain drain represent the normal evolution of migration flows when there is no economic convergence between sending and receiving countries or requalification policies.

Although all these effects are independent of networks, once migrant networks are taken into account new effects arise. In particular networks can drastically modify what we call the *natural limit of migration* and the *timing of migration*.

5.3 Basic Model

Let us imagine an economy composed of a large number of households $j = 1, \dots, N$, with N large, and overlapping generations along the lines of Samuelson (1958), in a framework similar to that of Loury (1981).[111] Time is a discrete variable and each individual lives 2+1 periods. The growth of the population is assumed at the moment to be 0, so that in each period the same numbers of people enter and leave the economy.[112]

[111] The choice of Loury's (1981) framework is based on the idea that, even without a direct cost of education, if wealth distribution is skewed to the left, studying instead of working is a cost.

[112] Section 5.6 discusses what happens when the population grows.

A person living in the first period is called Child, in the second Adult. Each Child is "attached" to an Adult, and this is our definition of a "strict" household. At the +1 period (third period of life) a subject is called Old and is no longer a member of the household. This is the first difference between our model and Loury's (1981): our economy is composed of two principal decision-makers, the household and what we call the "Council of Elders". The Council of Elders brings together all the Old people, and has two main functions: to provide the Old with means of survival and to make important decisions about the use of financial social capital.[113] That is, the Old cannot work or produce and therefore their consumption must be financed through a "social tax" and remittances.

In our economy, the household is the basic socioeconomic unit, and the Adult makes all the economic decisions. Household income depends on the income function of the Adult, which is based on that person's level of innate abilities (α) and education (e). As in Loury (1981), household income must be divided in each period between consumption (c) and Child schooling (I_e). In this framework, we assume no child labor[114] and no savings,[115] so that investment in children's education is the only way of transferring wealth across time. The education level of the household head is a function of the investment made in the previous period. Production requires neither social interaction between families nor the use of factors of production other than Adult time, which is supplied inelastically. Here is the second main difference with respect to Loury (1981): a fraction of the family income is paid to the Council of Elders' budget. Since this fraction is a fixed percentage of income,[116] it does not affect either the income function form or household behavior. Households cannot decide to evade payment because the Council of Elders controls both formal and informal economies, and this means that those who evade it will suffer full punishment, which will set their productive capacity at 0.[117]

Consumption is the second family activity. We do not examine here how consumption is shared within the family. The only assumption is that the utility function in terms of consumption is steep enough to ensure that consumption cannot fall, by choice, under certain survival levels.

[113] This will be discussed later on in the chapter.
[114] Following Basu & Van. (1998).
[115] This is in line with the mainstream of development literature.
[116] It may also be interpreted as a "tax".
[117] See Mude et al. (2003:9).

The level of innate abilities, assigned at the beginning of life but only known when Adult age is reached, varies among individuals. Production technology is assumed to be equal for all households in each period of time. Calling income y:

$$y = f(\alpha, e) \ (7)$$

is the income function of each Adult, and follows the usual assumptions, so that it is continuous, differentiable in its arguments in space R^+, increasing in its arguments and marginally decreasing.

Education is a function of investment in education I_e, and follows the same assumptions. We also assume that extreme values of abilities (α) have such high returns that $E[f(\alpha, e)] \gg E[f(\alpha, 0)]$.

The Adult chooses how to divide income between consumption and Child education. The utility function is equal for all households and has two main arguments: actual consumption, and the discounted wellbeing of the Child when that Child becomes an Adult[118]. The earnings function of offspring is a random variable determined by the distribution of abilities and the education level financed by an Adult of the previous generation.

5.3.a The Child Decision

Before analyzing the Adult decision process, let us consider the Child decision when that Child becomes an Adult. At the beginning of their Adult life period, subjects have to decide where to settle for the rest of their lives. Here is the third main difference with respect to Loury (1981): new Adults may remain in the origin community or country or leave it for a wealthier community or country. If they stay at home, their income will be:

$$y = f(\alpha, e) \ \ (8)$$

and their maximization will exactly be like that of their ancestors, so that the model can be brought back to Loury (1981). If they decide to migrate, their income will be:

$$y_m = zf(\alpha, e) \ (9)$$

where z is the difference in real terms between the two economies.[119] Migration has a cost I_m, which must be paid before it takes place. The cost incorporates both the financing of migration

[118] See Becker and Tomes (1979): there are not many differences in assuming that parents care about their children's income or consumption in the future.

[119] Here we implicitly assume that returns for abilities and education are equal across countries. What makes the difference is only the level of the economy or, as defined by Mude et al. (2003), the relative host/home infrastructure ratio.

(housing, transport, information, etc.) as well as the psychological cost that results from leaving home and adapting to the host country:

$$I_m = I_{md} + I_{ma} \quad (10)$$

where I_{md} is the fixed cost of migration and I_{ma} is the psychological and adaptation component. It may also be expressed as a function of α, to take into account the fact that more able subjects should be faster in adapting to the receiving country's context:

$$I_m(\alpha) = h(\alpha) = I_{md} + I_{ma}(\alpha) \quad (11)$$

This is strictly decreasing in α as noted by Chiswick (1999).

Since there are no savings in our economy, new Adults ask the Council of Elders for the money they need. In exchange, the Council of Elders requires remittances (R). However the Council of Elders cannot finance all the people who want to migrate. The rationale underlying who will be financed is discussed below. Remittances must cover at least the initial cost of migration but, as show by Stark and Taylor (1989),[120] they usually exceed this value:

$$R \geq \rho(I_{md}) \ (12)$$

where $\rho(I_m)$ is decided by the Council of Elders. New Adults have an incentive to migrate if:

$$y_m - y \geq R + I_{ma}(\alpha) \quad (13)$$

We assume that free-riding is not allowed, i.e., all migrants pay remittances. This assumption is not very strict: if a person does not repay the "loan", the related Old person will be isolated and excluded from the Council: unable to work, he will die (maximum punishment). If the council decides to finance migration, the location decision of the new Adult is:

$$\max[f(\alpha,e), zf(\alpha,e) - R - I_{ma}(\alpha)] \quad (14a)$$
$$s.t.:$$
$$R \geq \rho(I_{md}) \quad (14b)$$

If the Council decides not to finance migration, the model comes back to Loury (1981). Before proceeding to examine the Adult decision-making process, it is useful to analyse new Adults' incentives to migrate in terms of variations of innate abilities. A subject migrates if:

$$y_m - y - R + I_{ma}(\alpha) \geq 0 \quad (15a)$$
$$zf(\alpha,e) - f(\alpha,e) - \rho(I_{md}) - I_{ma}(\alpha) \geq 0 \quad (15b)$$
$$(z-1)f(\alpha,e) - \rho(I_{md}) - I_{ma}(\alpha) \geq 0 \quad (15c)$$

The first term, $(z-1)f(\alpha,e)$, is strictly increasing in α and e, $\rho(I_{md})$ is independent of α, and $I_{ma}(\alpha)$ is decreasing in α, so that it enters the incentive with negative sign. Therefore, the

[120] Our economy may also be seen as an enlarged family decision.

overall equation is strictly increasing in α. The incentive to migrate decreases if costs of migration increase. The probability that a new Adult has an incentive to migrate is:

$$P[(z-1)f(\alpha,e)-\rho(I_{md})-I_{ma}(\alpha)\geq 0]= \qquad (16a)$$

$$=\iint_{(z-1)f(\alpha,e)-\rho(I_{md})-I_{ma}(\alpha)\geq 0} p_\alpha(\alpha)p_e(e)d\alpha p_e(e)= \qquad (16b)$$

$$=1-\int_0^1 p_\alpha(\alpha)d\alpha\int_0^{f_i\left(\alpha,\frac{\rho(I_{md})+I_{ma}(\alpha)}{(z-1)}\right)} p_e(e)\,de \qquad (16c)$$

where $p_\alpha(\alpha)$ and $p_e(e)$ are the distribution of innate abilities and education respectively.

5.3.b The Adult Decision

Coming back to period 1, Adult, caring altruistically about family consumption and Child wellbeing, maximizes household utility:

$$\max_{0\leq c\leq y} \mathrm{E}_{\alpha,\mathrm{p}}\mathrm{U}(c,V) \qquad (17)$$

where p is the probability the Council finances migration, and V is the indirect utility function, to take into account the wellbeing of the Child when the Child becomes an Adult. Following Loury (1981: 846) an indirect utility function is "consistent if it correctly characterizes the relationship between maximized expected utility and earnings for a parent whenever it is taken to characterize that same relationship for the offspring". In our case, V^* is the consistent indirect utility function if it solves:

$$V^*(y_1)=\max_{0\leq c\leq y_1}\Bigg[\int_0^{\bar{\alpha}(e(y_1-c))} d\alpha_2 p_\alpha(\alpha_2)U\Big(c,V^*\big(f(\alpha_2,e(y_1-c))\big)\Big)$$

$$+\int_{\bar{\alpha}(e(y_1-c))}^1 d\alpha_2 p_\alpha(\alpha_2)U\Big(c,V_m^*\big(zf(\alpha_2,e(y_1-c)-\rho(I_{md})-I_{ma}(\alpha_2)\big)\Big)\Bigg] \qquad (18)$$

S.t.: $\bar{\alpha}(e(y_1-c))$ is the level of ability, given a certain level of education, necessary for a Child to be chosen for migration by the Council, and it is identically estimated by Adult and Child, and so on for each generation. Implicitly, this means that Adult and Child will act in the same way when facing the same situation. In addition, Adults are not able to forecast correctly the distribution of ability and education for a period longer than a generation. 1 and 2 stands for the generation to which the number is related. After migration takes place, for second-generation migrants, the model comes back directly to Loury (1981).

Assumption 1: *(i) $U: R_+^2 \to R_+$ is a strictly increasing, strictly concave, twice continuously differentiable function on the interior of its domain, satisfying $U(0,0) = 0$. (ii) $\forall V \geq 0$,*

$$\lim_{c \downarrow 0} \frac{\partial U}{\partial c}(c, V) = +\infty \quad (19)$$

(iii) There exists $\gamma > 0$ such that $\forall (c, V) \in R_+^2$, $\left(\frac{\partial U}{\partial V}\right) \in [\gamma, 1-\gamma]$

Assumption 2: *(i) $f: R_+^2 \to R_+$ is continuously differentiable, strictly increasing, strictly concave in e, satisfying $h(0,0) = 0$, and $h(0, e) \leq e$, $\forall e \geq 0$.*

(ii) $$\frac{\partial f}{\partial \alpha}(\alpha, e) \geq \beta > 0, \quad \forall (\alpha, e) \in R_+^2 \quad (20)$$

(iii) There exists $\tau > 0$, $\hat{e} > 0$ such that:

$$e \geq \hat{e} \Rightarrow \max_{0 \leq \alpha \leq 1} \frac{\partial f}{\partial \alpha}(\alpha, e) \leq \tau < 1 \quad (21)$$

Assumption 3: *Innate economic ability is distributed on the unit interval independently and identically for all agents. Distribution has a continuous, strictly positive density function, $p_\alpha(\alpha): [0,1] \to R_+$*

Theorem 1[121]:*Under Assumption 1 to 3, there exists a unique, consistent, indirect, utility function V^*on $[0, y]$.*

Demonstration: Appendix A

5.3.c The Council of Elders.

The Council of elders is responsible for managing the community social capital through two main functions: ensuring taxes and remittance payments, and deciding whom to finance for migration.

The Council can finance only a fraction of those eligible. This fraction is function of the amount of remittances the Council received in the previous period. Assuming that all the wealth controlled by the Council must be redistributed in the economy, the budget constraint of the council is:

$$m_{t-1}R + \sum_{j=1}^{N_t - m_t} s\left(f_j(\alpha, e)\right) = C + m_t I_{md} + I \quad (22)$$

[121] Proof in Appendix **A**

where m_{t-1} are the number of migrants in the previous period, R are remittances[122], $\sum_{j=1}^{N-m} s\left(f_j(\alpha, e)\right)$ is the social contribution ("social tax"), C is the total consumption of the Old, $m_t I_{md}$ is the amount needed to finance the migration of m new Adults, and I is the residual part reinvested in local economy.

To simplify, we assume that the Council has an incentive to send those who have higher levels of expected returns in the receiving country. This is in line with Chiswick's (1979) selection theory, and is explained by the fact that people with higher levels of innate abilities and education have a lower probability of failure in migration. In addition, in our economy, sending people with higher incentives implies the possibility of receiving higher remittances. This is the strongest behavioral assumption in our model.

Behavioral Assumption 1: the Council of Elders finances the migration of individuals who are comparatively better in terms of the compound value of (α, e). That is, we assume highly positive selection of migrants in terms of a compound value of ability and education.

5.4 Dynamics Analysis

We start our analysis by considering the dimension of migration flows, and then move our focus to the quality of migrants. The strategy the Council adopts has important implications on the economic growth and convergence path among countries. Nevertheless, to determine a long-term strategy is probably beyond the Council's reach, so it will probably adopt some "rule of thumbs" or a trial-and-error process. In this context, the concept of long-term optimal strategy is unsuitable, because the optimal strategy is probably determined in the short or medium term. To be able to assess the dynamics of the model analytically, we need to assume that the Council adopts an "investment and development" strategy which that does not change in time.

Behavioral Assumption 2: the investment strategy does not change in time. The strategy is required to be constant, not optimal.

We start with a simple situation which helps to identify most of the forces involved in the dynamics. We assume that the budget of the Council of Elders is employed in constant proportions

[122] Here we implicitly assume that the value of the remittance does not vary across periods.

between Old people's consumption and sending New Adults abroad. This implies that nothing is reinvested in the local economy:

$$m_{t-1}R + \sum_{j=1}^{N_t - m_t} s\left(f_j(\alpha_j, e_j)\right) = \theta C + (1-\theta) m_t I_{md} \quad (23)$$

where θ is the share of the Council income used for consumption. Recalling that R is a function of I_{md}, the number of migrants at period t is given by:

$$m_t = \frac{m_{t-1}R + \sum_{j=1}^{N_t - m_t} s\left(f_j(\alpha_j, e_j)\right) - \theta C}{(1-\theta) I_{md}} = \quad (24a)$$

$$= \frac{m_{t-1}\rho(I_{md})}{(1-\theta) I_{md}} + \frac{\sum_{j=1}^{N-m_t} s\left(f_j(\alpha_j, e_j)\right) - \theta C}{(1-\theta) I_{md}} \quad (24b)$$

The number of migrants at time t depends on the total amount of remittances in the previous period, and decreases as the cost of migration increases. Since the cost of migration is decreasing in the number of compatriots in the receiving country (Massey & al., 1994), larger m_{t-1} not only increases the total amount of remittances (keeping R constant) but also reduces I_{md}, generating a self-perpetuating process (everything else remaining the same). At the beginning, the number of migrants which can be sent is relatively small, but increases over time through the possibility of financing more migrants each round.

It is important to note that, even when networks play no role in the migration decision, they do not influence costs or preferences, the self-perpetuating process can start. As already mentioned it is enough to keep constant the economic distance between countries (z) and the proportion between Old consumption and investment in migration (θ). Each round, as $R > I_{md}$, the Council has a return from investing in migration. With this simple framework, a growing investment in migration will be possible each round, up to the point at which everyone who has an incentive migrates.[123]

Two other effects must be taken into account. First, the decision on how to allocate remittances: they can only be used for consumption, and this does not generate the self-increasing process mentioned above; otherwise they can be used to speed up migration, keeping consumption constant and sending abroad as many co-villagers as possible. Second, without population growth, $\sum_{j=1}^{N-m} s\left(f_j(\alpha, e)\right)$ decreases constantly because of relative depopulation and brain drain. Differentiating with respect to time and simplifying:

[123] We will come back to this issue later, when describing the qualitative effect of migration.

$$\Delta m = \frac{(m_{t-1} - m_{t-2})R}{\Delta I_{md}} + \frac{\sum_{j=1}^{N_{t-1}-m_{t-1}-m_t} s\left(f_j(\alpha_j, e_j)\right) - \sum_{j=1}^{N_{t-1}-m_{t-1}} s\left(f_j(\alpha_j, e_j)\right)}{\Delta I_{md}} - \frac{\Delta C}{\Delta I_{md}} \quad (25)$$

Holding consumption and remittances constant, the growth in the migration rate is increasing in the number of compatriots abroad (if ΔI_{md} is decreasing in the stock of compatriots), while component $\sum_{j=1}^{N_{t-1}-m_{t-1}-m_t} s\left(f_j(\alpha, e)\right) - \sum_{j=1}^{N_{t-1}-m_{t-1}} s\left(f_j(\alpha, e)\right)$ enters the equation with a negative sign. While depopulation is not observed at aggregate level,[124] the decreasing quality of potential migrants must be taken into consideration. In the long term and in the absence of shocks reduced social contribution may have a negative influence on the council's budget. To avoid this risk, remittances must not be only higher than the cost of migration, but they must compensate for the loss of social contributions:

$$R_j > sf_j(\alpha_j, e_j) + I_{md} \quad (26)$$

This condition ensures that financing migration is always profitable. This assumption is plausible and does not substantially modify the result of the model, except for the fact that it avoids complex relations between migration and council strategy.

Since depopulation is not an observed phenomenon in sending countries, it is necessary to define a rule of substitution of the leaving population. Independently of demographic dynamics, we assume that all migrants are replaced by applying one of the following rules: perfect replacement, random replacement with fixed distribution, random replacement with modified distribution.

Perfect replacement: whenever a New Adult (i) migrates, that person is replaced in the origin country by another Adult (j), equally able $(\alpha_i = \alpha_j)$ and skilled $(e_i = e_j)$.

Random replacement with fixed distribution (RRFD): whenever a New Adult migrates at time t, that person is replaced in the origin country by another Adult randomly drawn from the original distribution of ability and education.

Random replacement with modified distribution (RRMD): whenever a New Adult migrates at time t, that person is replaced in the origin country by another Adult randomly drawn from the distribution of ability and education at time t.

We begin our analysis with the simple case of perfect replacement.

Proposition 1: *Under the hypotheses that:*

- *migrants are perfectly replaced;*

[124] Section 5.6 discusses what happens in the case of population growth.

- *there is growth in outmigration between subsequent periods* $(m_t > m_{t-1})$*;*
- *the economic distance between countries is not reduced* $(z_t \geq z_{t-1})$*;*
- *costs and remittances are constant.*

*There is a negative cohort effect***.**

With perfect replacement, $p_t(\alpha, e) = p_{t-1}(\alpha, e)$, $p_t(\alpha, e)$ being the distribution of (α, e) at time t. The number of migrants at time t is:

$$m_t = N \int_{\{f(\alpha,e)>\bar{f}\}} p_t(\alpha, e)\, \chi_{\{(z-1)f(\alpha,e)-\rho(I_{md})-I_{ma}(\alpha)>0\}}(\alpha, e) d\alpha de \quad (27)$$

where N is the total population, $\chi_{\{(z-1)f(\alpha,e)-\rho(I_{md})-I_{ma}(\alpha)>0\}}$ the characteristic function which is 1 if a subject has the incentive to migrate and 0 otherwise. $p_t(\alpha, e)$ is the distribution of (α, e), and is the maximum value of $f(\alpha, e)$, such that all the population with $f(\alpha, e) \leq \bar{f}$ is not financed to migrate.

The above equation determines implicitly that $\bar{f} = \bar{f}(m_t)$ is a strictly decreasing function of m_t. This follows from the positivity of $p_t(\alpha, e)$, implying that the integrand in the above expression is positive; therefore the difference $m_{t-1} - m_t > 0$ is positive if and only if condition $\bar{f}(m_t) \geq f(\alpha, e) \geq \bar{f}(m_{t+1})$ is verified for some values of (α, e) - that is, if $\bar{f}(m_t) > \bar{f}(m_{t+1})$.

As $f(\alpha, e)$ is an increasing function of (α, e), this implies that the flow of migrants at time $t + 1$ is increased with respect to the flow at time t, but the difference between the two flows is composed of people with lower values of (α, e) compared with their migrant ancestors. That is, there is negative cohort effect.

To obtain analytical results about the effects of migration, we develop our analysis in the continuum. This is a good approximation for large populations and over long periods of time. This approximation is also a correct approach if subjects migrate at random times in a time continuum, which seems to be the case for migration. Obviously, continuum analysis does not allow us to evaluate the time-scale of migration. As a further technical simplification, migration and substitution occur at the same time. This is implicit in the continuum approximation and affects the general results only marginally.

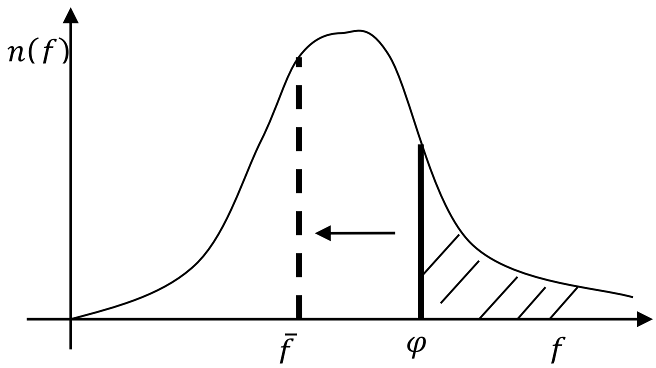
Proposition 2: *Under the hypotheses that:*

- *migrants are randomly replaced with fixed distribution or randomly replaced with modified distribution;*

- *economic distance between countries, costs and remittances are constant;*
- *the distribution of $f(\alpha, e)$ does not change during generational changes.*

Both a negative cohort effect and brain drain occur. In addition, the quality of present migration is a function of past migration.

To prove proposition 2 and analyse its qualitative implications, some graphic representations are useful. Picture 1 shows a generic distribution of compound (α, e).



Picture 5

First, let us define $\bar{f}$ as the minimum level of compound $f(\alpha, e)$ at time t for which there is an incentive to migrate. $\bar{f}$ is what we define to be the *natural limit of migration:* that is, the limit of the compound distribution at which there is no incentive to migrate at individual or community level:

$$\bar{f} \equiv max(\bar{f}_{individual}, \bar{f}_{community}) = \bar{f}(z, R(I_{md}), I_{ma}) \quad (28)$$

Define $n(f)$ as the number of people with $f(\alpha, e) = f$. The total population at the initial time is:

$$N = \int_0^\infty n(f')\, df' \quad (29)$$

$C(f)$ is the population with a level of ability $f(\alpha, e) < f$, and $H(f)$ is the population with $f(\alpha, e) > f$:

$$C(f) = \int_0^f n(f')df', \quad and \quad H(f) = N - C(f) \quad (30)$$

Proof of Proposition 2. Define $h(t)$ to be the number of subjects in the population with $f(\alpha, e) > \varphi$. In the case of RRFD, we can write the continuous differential equation for $h(t)$ as:

$$h(t+dt) = h(t) - m(t)dt + m(t)\frac{h(0)}{N}dt \quad (31)$$

where $m(t)$ is the number of migrants at time t and $m(t)\frac{h(0)}{N}dt$ the replacement term, when subjects are drawn from the original distribution of qualities. Thus:

$$\frac{dh(t)}{dt} = -m(t)\left(1 - \frac{h(0)}{N}\right) \quad (32a)$$

$$h(t) = h(0) - \int_0^t m(t')dt' \left(1 - \frac{h(0)}{N}\right) \quad (32b)$$

We can calculate the time at which condition $h(t) = 0$ is attained as:

$$h(t_\varphi) = 0 \Leftrightarrow \frac{h(0)}{1 - \frac{h(0)}{N}} = M(t_\varphi) \quad (33)$$

where $M(t) \equiv \int_0^t m(t')dt'$. At time t_φ the population with $f(\alpha, e) = \varphi$ or higher has disappeared. Similarly, in the case of RRMD, we can write the continuous differential equation for $h(t)$ as:

$$h(t+dt) = h(t) - m(t)dt + m(t)\frac{h(t)}{N}dt \quad (34)$$

where $m(t)$ is the number of migrants at time t and $m(t)\frac{h(t)}{N}dt$ the replacement term, when subjects are drawn from the compound distribution of qualities at the time migrants leave. Thus:

$$\frac{dh(t)}{dt} = -m(t)\left(1 - \frac{h(t)}{N}\right) \quad (35a)$$

$$\int_{h(0)}^{h(t)} \frac{dh}{1 - \frac{h}{N}} = -\int_0^t m(t')dt' \quad (35b)$$

$$-Nln\left(\frac{1 - \frac{h(t)}{N}}{1 - \frac{h(0)}{N}}\right) = -M(t) \quad (35c)$$

$$h(t_\varphi) = 0 \Leftrightarrow -ln\left(1 - \frac{h(0)}{N}\right) = M(t_\varphi) \quad (35d)$$

Now we can replace $h(0)$ with initial cumulative function $H(\varphi(t))$, where $\varphi(t)$ is the maximum value of quality at time t:

$$\varphi(t) = \sup_{p_t(\alpha,e)} f(\alpha, e) \quad (36)$$

The RRFD and RRMD migration equations are respectively:

$$\frac{H(\varphi(t))}{1 - \frac{H(\varphi(t))}{N}} = \int_0^t m(t')dt' \equiv M(t), \quad and \quad -Nln\left(1 - \frac{H(\varphi(t))}{N}\right) = M(t) \quad (37)$$

where $M(t)$ is the total number of migrants from 0 to t. This means that migration is a cumulative phenomenon. The result validates the use of the *migration propensity* as proposed in Massey et al. (1994), and constitutes a theoretical basis for cumulative causation theory. As the above authors argue, characteristics of migration flows do not describe "the migration flow per se, but rather, a phase in its development".

If we rewrite the two equation in terms of $H\big(\varphi(t)\big)$, we can compute migrants' quality level:

$$H\big(\varphi(t)\big) = \frac{M(t)}{1 + \frac{M(t)}{N}}, \qquad and \qquad H\big(\varphi(t)\big) = N\left(1 - e^{-\frac{M(t)}{N}}\right) \quad (38a\&b)$$

That is, the quality of today's migrants is a function of the "community history of migration". We assume for example that a fixed number of migrants is sent abroad each round, that is, in each round the population with $f > \varphi(t)$ migrates. $\varphi(t)$ is a function of the incentives and strategies adopted by the Council. Under both replacement rules, in each round we observe a deterioration in the population quality level. Therefore, we observe brain drain and a negative cohort effect. In fact, $\varphi(t)$ decreases over time or, better, as $M(t)$ grows (graphically, φ moves left each period). $H\big(\varphi(t)\big)$ may be interpreted as the distribution of qualities which is "no longer present"[125] with respect to the original distribution. $H\big(\varphi(t)\big) = N - C\big(\varphi(t)\big)$ is the upper part of the original distribution[126] and $C\big(\varphi(t)\big)$ decreases as $\varphi(t)$ decreases.

Let us suppose that the council finances the same number of migrants each year. To keep this number constant each round, the Council must move the minimum level of required abilities to the left. This reduces the quality of those not involved in migration and, given the structure of our economy, the quality of their offspring. The quality of offspring, i.e., their education, is a function of the parents' current investment in education, that is, a function of their income. As income increases in innate abilities (which are independent among generations) and in education (which is correlated among generations), and as those who leave are on average better educated, they are the richer ones. Those who remain have lower incomes, and thus less possibility of investing in the education of offspring, and so on.

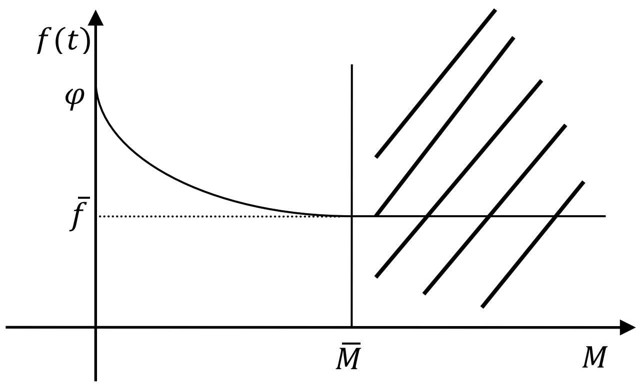
[125] All people belonging to that part of the distribution migrate.
[126] The shaded area in Picture 1.

With each "step" in the migration we observe a brain-drain in the sending country and a negative cohort effect: as the quality of those who remain decreases, so does the quality of migrants. In particular, what decreases is their average education.

These two consequences of migration flows can be observed without exception when applying RRFD and RRMD, or a mixed replacement rule. The main difference between the two forms of replacement is the speed of convergence to the *natural limit of migration*. In both cases, there exist a limit to the process just described. The limit is fixed at the level at which:

$$H\big(\varphi(t)\big) = H\big(\bar{f}\big) \quad (39)$$

In both cases, $\lim_{\frac{M(t)}{N} \gg 1} H(\varphi(t)) = H(\bar{f})$, where $\bar{f}$ is a function of: the level of physical and psychological costs, the expected returns, and the remittance level. Although a different rule of replacement implies a different speed in reaching this limit (slower under RRFD and faster under RRMD), we identify three main scenarios (see Pictures 2, 3 and 4) under the vinculum of constant migration flows.[127]



Picture 6: Natural limit of migration

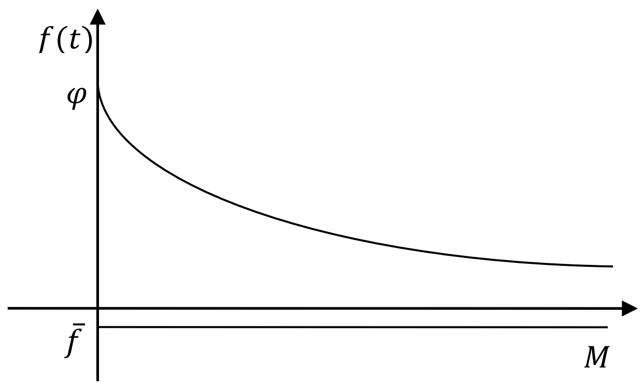
Picture 2 shows the normal case. The quality of migrants sent each period decreases as M grows. When level $\bar{M}$ is reached[128] no further decrease in migrants' quality is observed: we may say that migration ceases. This does not mean that no migration can be observed, but that, by chance, once someone appears in the sending country's economy with an ability level higher than

[127] Increasing migration flows will only speed up the process, thus further emphasizing our results. What happens under decreasing migration flows needs deeper investigation.

[128] In principle, this value may be identified if we knows details of the original population: original distribution of (α, e), and the cost of migration. Value $\bar{M}$ also identifies a unique period t of time (in the absence of shocks).

$\bar{f}$, that person is "instantaneously" financed to migrate. In the long term we may say that migration ceases, because almost nobody has the incentive to migrate.

Picture 3 shows a scenario in which the economic distance between the two countries is so large and/or costs are so low that migration never stops. That is, φ is always higher than $\bar{f}$. For example, the receiving country may be psychologically attractive (the psychological cost of migration is zero or less) and, for some reason, migration costs are especially low (common language, border sharing). In this situation, φ decreases step by step until each member of the sending country has migrated.[129]

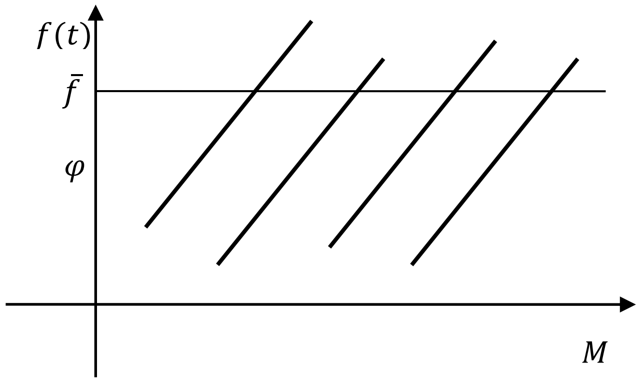


Picture 7: Migration "without Natural Limit"

Picture 3 shows the extreme case, in which $\bar{f}$ is negative. This is not necessarily the only representation for migration without *natural limit*. It may simply be that the lowest level of φ is always larger than $\bar{f}$. This is possible if there exists a minimum of the distribution of (α, e)that is larger than $\bar{f}$.

Picture 4 displays the case in which initial costs make migration non-profitable, and, so no migration is observed.

[129] This is the case of countries migrants are obliged to cross to reach their preferred destination. In some of these countries migrants may stay longer than just the time to cross them, for example, because they need to accumulate capital to finance the remaining migration. These countries observe a continuum of migrants leaving to reach their preferred destination psychologically attractive and entering (replacing those who leave). We do not observe depopulation because the transitory flow continues in the long term.



Picture 8: No Migration

These findings are robust even when a mix replacement rule is applied. Let us assume that both the total population and outmigration are constant, and define r_0 and r_1 as the percentage of migrants who are substituted by applying RRFD and RRMD, respectively, $(1 - r_0 - r_1)$ is the percentage of migrants replaced with identical subjects.

Proposition 3: *independently of the replacement rule adopted, in the condition of:*

- *no full perfect substitution (i.e.* $0 < r_0 + r_1 \leq 1$*);*
- *constant population;*
- *no changes in the fundamentals of both economies;*

brain drain and a negative cohort effect are the results of migration flows.

Defining $M(t)$ as the total number of migrants:

$$M(t) = \frac{N(t)}{r_1} ln \left[\frac{r_0 \left(\frac{H(\varphi(t))}{N(0)} - 1 \right) - r_1}{r_0 \left(\frac{H(\varphi(t))}{N(0)} - 1 \right) + r_1 \left(\frac{H(\varphi(t))}{N(0)} - 1 \right)} \right] \quad (40)$$

The equation is a weighted form of the migration equation in the case of RRMD, and therefore has the same dynamics concerning migration flows and the quality of migrants.

Before passing to migrant networks and their effect on migration paths, let us summarize the main results of this section. We show that, in a simple overlapping generation economy, in which only ability and education determine the wellbeing of households, several phenomena can be observed when introducing migration.

We prove that migration over time modifies the structure of the economy. Each migrant is affected and affects other people's migration choices. This self-perpetuating phenomenon has a limit in terms of numbers of migrants and their ability levels: *the natural limit of migration*.

We also prove that, in some specific conditions, particularly in positive self selection, a negative cohort effect and brain drain are the normal consequences of migration. This result has great importance for two main reasons. First of all, it explains the contrasting results obtained by scholars when analysing the level of selection of migrants, reconciling positive selectivity with a negative cohort without introducing new variables. In particular, the negative cohort effect is not the effect of decreasing selectivity or the result of reduced costs, allowing newcomers from lower levels of the income distribution (and thus of the education distribution), but is the result of the increased possibility that sending countries have of financing migration, and of the brain drain which decreases the quality of potential migrants.

5.5 Effect of Migrant Networks

Migrant networks are usually identified as the main cause of the negative cohort effect. In our framework it is not necessary to reduce migration costs and risks in order to observe the negative cohort effect. Therefore, the role of networks must be examined to understand their influence on the dynamics of the model.

Reduction in costs and risks due to networks may be implemented in our model through the incentive mechanism at individual and community levels. The individual incentive is:

$$(z-1)f(\alpha,e) - R - I_{ma}(\alpha) \geq 0 \qquad (41a)$$

$$or\ (z-1)f(\alpha,e) - \rho(I_{md}) - I_{ma}(\alpha) \geq 0 \qquad (41b)$$

where $\rho(.)$ is the remittance mark-up function determined by the Council of Elders. The community level incentive is:

$$R_j > sf_j(\alpha_j, e_j) + I_{md} \qquad (42)$$

That is, the return of the investment in migration must be larger than the cost and loss of social contributions. We also know that incentives enter the model through the *natural limit of migration*. We define *the natural limit of migration* as the value of compound (α, e) at which migration is no longer attractive. Recalling that:

$$\bar{f} \equiv max(\bar{f}_{individual}, \bar{f}_{community}) = \bar{f}(z, R(I_{md}), I_{ma}) \quad (43)$$

If networks are able to modify costs and risks and thus the expected return of migration, we can rewrite the migration incentive equations:

$$(z(M) - 1)f(\alpha, e) - \rho(I_{md}(M)) - I_{ma}(\alpha, M) \geq 0,$$

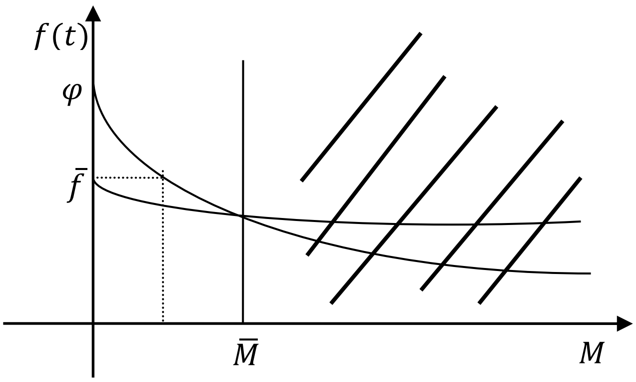
$$and \quad R_j > sf_j(\alpha_j, e_j) + I_{md}(R) \quad (44a\&b)$$

Hence for $\bar{f} = g(z(M), R(I_{md}(M)), I_{ma}(M))$. Thus $if\ M \uparrow \Rightarrow \bar{f}(M) \downarrow$.

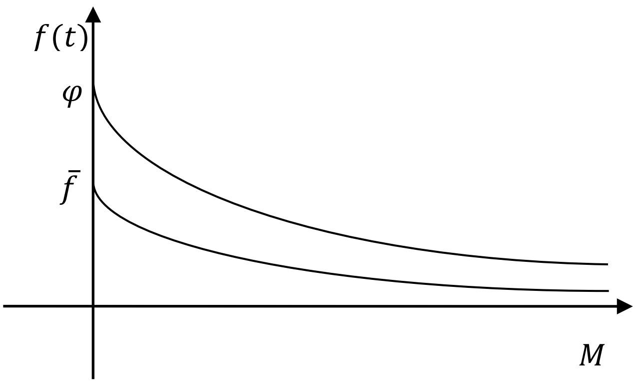
We identify some peculiar scenarios (see Picture 5 – 9). We must define $M_0\ and\ \bar{M}$ before describing each scenario.

M_0 is the minimum value of M such that $M:\ 0 \leq M < M_0 \Rightarrow \varphi(M) < \bar{f}(M)$

$\bar{M}$ is the maximum value of M such that $\forall M:\ M_0 < M < \bar{M} \Rightarrow \varphi(M) > \bar{f}(M)$



Picture 9: Natural level of migration decreasing as M grows.



Picture 10: Strong Network Effect

Pictures 5 and 6 respectively show the evolution of the scenarios of Pictures 2 and 3. In Picture 5, the scenario satisfies the following condition:

$$\varphi(0) > \bar{f}(0),\ \ and\ \ \varphi(+\infty) < \bar{f}(+\infty) \quad (45)$$

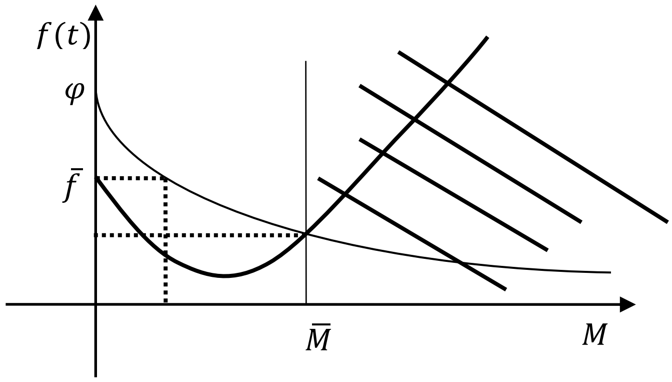
This is the typical effect of networks hypothesized in the literature. At the beginning ($t \; and \; M$ close to 0), costs of migration are high, so only those with higher levels of abilities and education have an incentive to migrate.[130] Once migration starts, the presence of compatriots reduces the cost and risk of less skilled compatriots. Networks speed up migration and reduce the natural level of migration ($\bar{f}$), increasing the total amount of potential migrants. The new endpoint has a higher value of $\bar{M}$ and a lower level of qualification of migrants with respect to a situation in which networks have no effect on costs and risks.

As Picture 6 shows the brain drain effect may be slower than the speed at which networks reduce costs and risks (i.e., $\varphi(M) > \bar{f}(M) \;\; \forall M \geq 0$). This means that migration will never cease (at the limit, we see everyone migrating, even those who have a compound of ability and education close to 0).

Picture 7 shows the opposite scenario. While at the beginning, as a rule, networks reduce the costs and risks of migration, increasing migration flows (or, rather, the number of subjects who have an incentive to migrate), they produce the opposite effect when a certain critical mass is reached. This may happen, for example, when networks become "ghettos".

There are economic explanations for the U-shaped form shown in Picture 7. As we have seen, $\bar{f}(M)$ is determined by migration costs and economic distance between countries. If both psychological and physical costs decrease as the network grows, the relationship between z and M is a priori unclear. On one hand z should increase in M. Networks increase the probability of getting a job in the receiving country, increasing the expected return of migration. Nonetheless, the informative advantage has an upper bound as M grows. On the other hand, being migrants usually concentrated in some regions and economic sectors, large migration flows produce an excess of labor supply, increasing unemployment and thus reducing the economic distance between countries.[131]

[130] Moreover, the more skilled are usually people belonging to wealthier social groups who can afford higher migration costs.
[131] We may also observe salary growth in sending countries, because of the relative scarcity of workers.



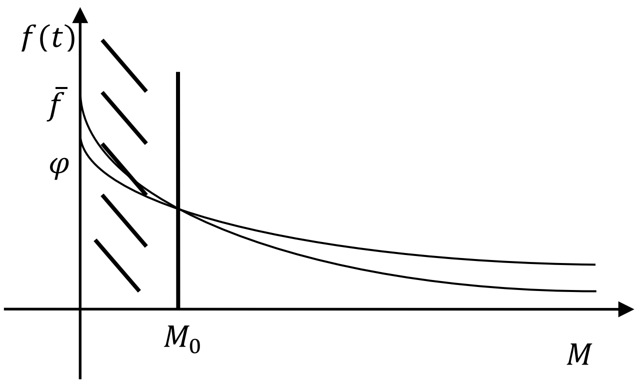
Picture 11: U-Shaped network effect

Pictures 8 and 9 shows two scenarios in which migration cannot start spontaneously. The costs of migration are too high, and so nobody has an incentive to migrate. If something breaks the equilibrium[132] and threshold M_0 is reached, the self-perpetuating process described previously can start. In Picture 9, $\bar{f}$ and φ cross twice, and there is nothing which excludes the possibility that there are many more different crossing-points.

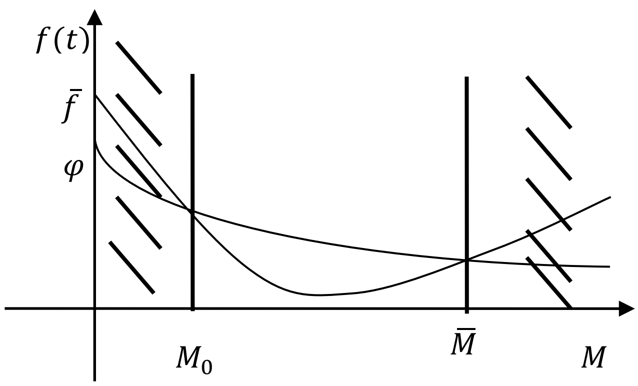
One scenario that may generate multiple crossing-points is when migrants move from one economic sector or region to another. Such intra-sector movements happen whenever the saturation point of one sector is reached. If migrants concentrate in a particular economic sector (in Europe, it may be the construction industry, in the US the agricultural sector) the result is an excess of supply. Because the network and its members are specialized in that particular work sector,[133] it will take time to get successful results in other economic areas. Once the door of a new sector is opened, the network comes back to its self-increasing function.

[132] We have several historical examples of this scenario: the colonization of Australia with convicts, deportation because of civil war, the creation of a state like Israel, and family reunification after the Second World War and the Vietnam war.

[133] They have specific skills, contacts and information on available job positions in the sector, and even monopolistic positions in the job market of the sector.



Picture 12: Threshold



Picture 13: Threshold and ghetto

All scenarios identified above may be synthesized in a single theorem.

Assumption A: *$\bar{f}(M)$ is a continuous function of the network size M. The effect of the network on $\bar{f}(M)$ (i.e. $\bar{f}(M) - \bar{f}(0)$) is always negative or zero for $M > 0$.*[134] *Define*

$$M_0 = inf\{M \in R_0^+ | \varphi(M) > \bar{f}(M)\} \quad (46)$$

and

$$M_\infty = sup\{M \in R_0^+ | \varphi(M) \geq \bar{f}(M) \; et \; \nexists M' \in R^+, M_0 < M' < M \; s.t. \varphi(M') \leq \bar{f}(M')\} \quad (47)$$

M_0 represents the lower threshold for migration and M_∞ the upper limit of migration. Both M_0 and M_∞ can be in either R_0^+ or $+\infty$.

[134] This assumption is explained by noting that for M=0 the network is absent and cannot affect $\bar{f}$. In addition, if the effect of the network on $\bar{f}$ becomes positive for M>0, then it is always possible to migrate outside the network (if it is far from the critical point of percolation in the social network of the receiving area) or to other areas. Thus, the actual effect of the network is null. This assumption implicitly does not account for racism and ghetto phenomena which affect migrants independently of their position with respect to the network.

Lemma 1: *if a value M exists such that $\varphi(M) > \bar{f}(M)$, then $M_0 \leq M_\infty$, otherwise $M_0 = +\infty$ and $M_\infty = 0$.*

Proof: if $\mathrm{M}_0 \in \mathrm{R}_0^+$, then $\phi(\mathrm{M}_0) = \bar{\mathrm{f}}(\mathrm{M}_0)$, and it therefore belongs to the set:

$$\mathrm{M}_\infty = \sup\{\mathrm{M} \in \mathrm{R}_0^+ | \phi(\mathrm{M}) \geq \bar{\mathrm{f}}(\mathrm{M}) \text{ et } \nexists \mathrm{M}' \in \mathrm{R}^+, \mathrm{M}_0 < \mathrm{M}' < M \; s.t. \, \varphi(\mathrm{M}') \leq \bar{\mathrm{f}}(\mathrm{M}')\} \quad (48)$$

Therefore, the supremum of this set is greater than or equal to M_0, i.e., $\mathrm{M}_0 \leq \mathrm{M}_\infty$.

Theorem 2: *in the absence of a network, M_0 may be either 0 or $+\infty$, and there exist only three possible scenarios:*

- *(a1) $M_0 = +\infty$ et $M_\infty = 0$: no migration;*
- *(b1) $M_0 = 0$ et $M_\infty \in R^+$: limited migration;*
- *(b2) $M_0 = 0$ et $M_\infty = +\infty$: unlimited migration.*

When a network is present, then $M_0^{(network)} \leq M_0^{(no\ network)}$ and $M_\infty^{(network)} \leq M_\infty^{(no\ network)}$ (that is, the existence of a network always increases the possibility of migrating) and five possible scenarios exist:

- *(a1') $M_0 = +\infty$ et $M_\infty = 0$: no migration (corresponding to (a1) in the absence of a network);*
- *(a2') $M_0 = M_\infty \in R^+$: a pathological case, with migration above multiple (infinite) thresholds (corresponding to (a1) in the absence of a network);*
- *(a3') $M_0 \in R^+$ et $M_\infty \in R^+$ et $M_0 < M_\infty$: limited migration above the threshold (corresponding to (a1) in the absence of a network);*
- *(a4') $M_0 \in R^+$ et $M_\infty = +\infty$: unlimited migration above the threshold (corresponding to (a1) in the absence of a network);*
- *(b1') $M_0 = 0$ et $M_\infty \in R^+$: limited migration (corresponding to (b1) in the absence of a network);*
- *(b2') $M_0 = 0$ et $M_\infty = +\infty$: unlimited migration (corresponding to (b1) or (b2) in the absence of a network).*

Proof: without a network, $\varphi(M) - \bar{f}$ is a continuous and strictly decreasing function of M, so that the set $\{M \in R_0^+ | \varphi(M) > \bar{f}(M)\}$ corresponds either to the interval $[0, M_\infty)$ or to the empty set, so that $M_0 = 0$ *or* $M_0 = +\infty$.

From the assumption on the effect of networks: $\bar{f}(M) \leq \bar{f}(0)$ therefore the set $\{M \in R_0^+ | \varphi(M) > \bar{f}(0)\}$ is a subset of $\{M \in R_0^+ | \varphi(M) > \bar{f}(M)\}$. From the properties of the infima we obtain:

$$M_0^{(network)} \leq M_0^{(no\ network)} \quad (49)$$

Similarly, $M_{\infty}^{(network)} \leq M_{\infty}^{(no\ network)}$ can be verified by studying the two cases $M_0^{(no\ network)} = 0$ and $M_0^{(no\ network)} = +\infty$ separately. If $M_0^{(no\ network)} = +\infty$ then $M_{\infty}^{(no\ network)} = 0 \leq M_{\infty}^{(network)}$, because it is the supremum of an empty set. If $M_0^{(no\ network)} = 0$, the set $\{M \in R_0^+ | \varphi(M) \geq \bar{f}(0)\}$ is a subset of $\{M \in R_0^+ | \varphi(M) \geq \bar{f}(M)\}$, and set $\{\mathrm{M} \in \mathrm{R}_0^+ | \nexists \mathrm{M}' \in \mathrm{R}^+, \mathrm{M}' < M\ s.t.\ \varphi(\mathrm{M}') \leq \bar{\mathrm{f}}(0)\}$ is a subset of $\{\mathrm{M} \in \mathrm{R}_0^+ |\ \nexists \mathrm{M}' \in \mathrm{R}^+, \mathrm{M}' < M\ s.t.\ \varphi(\mathrm{M}') \leq \bar{\mathrm{f}}(\mathrm{M}')\}$. Therefore, we can obtain $M_{\infty}^{(network)} \geq M_{\infty}^{(no\ network)}$ from the properties of the suprema of the joint set. From these results and the constraints on M_0 and M_{∞} classification of the scenarios proposed in the theorem is straightforward.

5.6 Population Growth

In this section we examine what happens when we introduce population growth. To implement population growth, we assume that migrants keep the rates of population growth at home and in the receiving country constant.[135] To simplify the analysis, we derive the model under the FFMD substitution method.

We rewrite the equations, such that $H(\varphi(t))$ is the number of Adults with value of compound (α, e) larger than $\varphi(t)$ in the initial distribution. $\varphi(t)$ is the upper limit of the compound distribution in t and is the minimum level of the compound to be financed at time t. Define $\frac{H(\varphi(t))}{N(0)}$ as the percentage of the initial population with compound value larger than $\varphi(t)$:

$$\frac{H(\varphi(t))}{N(0)} = \widehat{H}(\varphi(t)) \quad (50)$$

Because we assume that the fertility rate in sending and receiving countries does not vary, we define $M(t)$ as the number of migrants and all their offspring in the receiving country. That is:

$$M(t) = \int_0^{\tau} m(\tau) \frac{N(t)}{N(\tau)} d\tau \quad (51)$$

where $m(\tau)$ is the number of migrants at τ. If we assume that $\bar{f}$, as in the previous Section, is a function of the total network of migrants (including offspring), thus:

[135] This assumption is plausible for first-generation migrants, but becomes problematic when we consider second- and third-generation migrants, who usually standardize to the rate of reproduction of the receiving country.

$$\bar{f} = f\big(M(t)\big) \quad (52)$$

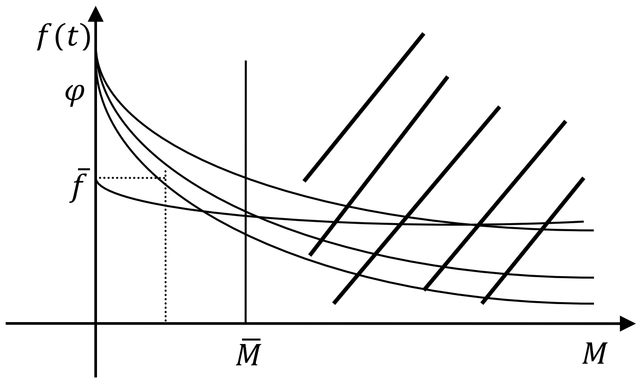
This implies that:

$$\frac{M(t)}{N(t)} = G\left(\widehat{H}\big(\varphi(t)\big)\right) \quad (53)$$

where $G(.) = -\ln(1-x)$ is an increasing function in $0 < x < 1$. To investigate the dynamics, we need to fix the population at a certain positive value. We can write:

$$\varphi(t) = \widehat{H}^{-1}\left(G^{-1}\left(\frac{M(t)}{N(t)}\right)\right) \quad (54)$$

where $\varphi(t)$ is decreases in $M(t)$ and increases in $N(t)$. Picture 10 shows this scenario. The main difference with respect to the previous scenario is that, here, $\varphi(t)$ is a family of curves which vary as $N(t)$ varies. The family of curves is also constituted by the same curve rescaled on the horizontal axis with a scale factor proportional to N.



Picture 14: Population Growth

5.7 Conclusions

The theoretical analysis presented here brings together several lines of thought in migration literature, and shows that the position of Chiswick and Borjas are not mutually exclusive. We started from an overlapping generation model along the lines of Loury (1981) because we needed a model in which innate abilities and education were taken into consideration as separate elements.

Secondly, Loury's framework assumes a "balkanized" market for education - that is, households must self-finance their offspring's education. We believe it is more correct to consider education investment in developing countries, excluding the existence of working education loan markets. Even when and where free public education is available, sending children to school instead of to work is a form of investment which affects the household consumption.

Last but not least, the model proposes intergeneration social mobility among households according to abilities and education levels. This implies that mobility closely depends on innate abilities and education variance, and on their payoff.

In this framework, we introduced the possibility of migration, showing that the properties identified by Loury are preserved. This allowed us to study the dynamics of migration flows with a strong focus on the quality of migrants. Starting from the assumption that a single subject cannot, alone finance migration (which seems to be the case for the largest groups of migrants), we introduced a “planner”, which decides how many people and who can be financed. The planner, called the Council of Elders in the model (following the structure of Senegalese fraternal orders - Riccio: 2004), does not need to be structured at village (or higher) level, but may simply be a group of household heads taking decisions in an enlarged family network.

We agree with Chiswick (1978) that migrants are favorably selected, and show that decreasing quality among subsequent cohorts is not incompatible with this assumption. Once migration starts, independently of the method of substitution used (which is not-quality improving), two main forces reduce the observable quality of migrants: (1) when migration flows increase in dimension, from time to time there will be enough resources to finance less and less skilled people until the *natural level of migration* is reached; (2) given the intergenerational transmission of education and the independence of innate abilities, there will be a draining effect.

What is observed in the receiving country (where data are usually collected) is a decreasing level in the observable quality, and thus a negative cohort effect in terms of education. This effect can not only occur in the case of extremely positive self-selection, but is its consequence when there are no investments to compensate for brain drain.

We also show, as already proposed among others by Massey, that migration is a cumulative process, in which each migrant is influenced by those who migrated previously and in turn influences those who migrate later. Migration time (expressed as numbers of migrants) and the quality of migrants are two sides of the same coin and, once one of the two is known, we can predict the other. The framework allows us to predict the path a migration flow will take in the future and when its natural end will occur, in terms not only of numbers but also of qualities.

To the best of our knowledge, this is the first time that this cumulative process has been formalized and investigated in terms of quality of migrants, without the need to introduce networks. The cumulative process takes place even when networks are not present.

Clearly, migrant networks are important when examining the economy of migration. As we showed in Section 5.5, even when networks are not at the origin of the self-perpetuating mechanism, they can strongly influence the convergence path, speed of convergence, and endpoint values. In addition, by reducing the costs and risks of migration, networks can increase the negative cohort effect and also produce opposite results. In fact, congestion and excess of labor supply may reduce the incentive to migrate.

In our model, the developmental strategy adopted by the Council of Elders plays a cardinal role in determining migration flows. To develop our analysis, we make only one assumption: a single strategy exists and even if it is not optimal, it is kept constant in time. Nonetheless, the ability to reinvest in the local economy instead of in consumption, to invest in education, and the adopt long term development strategies (if computable) all mitigate the negative effects of migration, and may also produce the reverse scenario. Promoting local economic growth, investing in children’s education, and developing the right mix between investing in migration and in future generations, all produce a “virtuous” mechanism which, in principle, will reduce the gap between countries, therefore reducing migration flows and increasing the skill levels of new cohorts of migrants.

To conclude, as the decision to invest in education and migration is the outcome of rational choices, our model can analyse the dynamics of migration in depth and provide policy-makers with normative schemes for public policies. Public education and incentives to prevent child labor improve the welfare of those belonging to the left tail of the income distribution. Sending and receiving countries should adopt these policies, not because of any particular social welfare function, but because it is optimal for their economies. In fact, from the point of view of sending countries good-quality migrants, public education could reduce or even eliminate the brain drain effect by cutting the interdependence of education among generations.

From the point of view of the receiving country, helping sending countries to develop good education institutions will in time ensure higher-quality immigrants, preventing negative cohort effects. Better and widespread education can ensure that those who are better also in terms of innate abilities will be able to migrate.

Appendix A

Following Loury (1981) we must show that mapping $T: C[0,\bar{y}] \to C[0,\bar{y}]$ is a contraction mapping thus has a unique fixed point. The map is defined by:

$$(T\Phi) = \max_{0\le c\le y} E_\alpha \widetilde{U}_\alpha \left(c, \Phi\big(f(\alpha, y-c)\big)\right) \ (a)$$

where $\widetilde{U}_\alpha = \begin{cases} \mathrm{U}\left(\mathrm{c}, \Phi\left(f\left(\alpha_2, \mathrm{e}(\mathrm{y}_1 - \mathrm{c})\right)\right)\right) & \text{if } 0 \le \alpha_2 < \bar{\alpha} \\ \mathrm{U}\left(\mathrm{c}, \mathrm{V}^*_{\mathrm{m}}\left(\mathrm{z}f(\alpha_2, \mathrm{e}(\mathrm{y}_1 - \mathrm{c}) - \rho(\mathrm{I}_{\mathrm{md}}) - \mathrm{I}_{\mathrm{ma}}(\alpha_2)\right)\right) & \text{if } \bar{\alpha} \le \alpha_2 < 1 \end{cases}$

for $\Phi \in C[0,\bar{y}]$ define $\|\Phi\| = sup_{x\epsilon[0,y]}|\Phi(x)|$. Under this norm T is a contraction on $C[0,\bar{y}]$, thus, let $\Phi, \Psi \in C[0,\bar{y}]$:

$$\|T\Phi - T\Psi\| \equiv \sup_{\bar{y}\ge y\ge 0}\left|\max_{0\le c\le y} E_\alpha \widetilde{U}_\alpha \left(c, \Phi\big(f(\alpha, y-c)\big)\right) - \max_{0\le c\le y} E_\alpha \widetilde{U}_\alpha \left(c, \Psi\big(f(\alpha, y-c)\big)\right)\right|$$

Let $\dot{c}(y)$ give the maximum for $E_\alpha \widetilde{U}_\alpha(c, \Phi)$ and $\ddot{c}(y)$ give the maximum for $E_\alpha \widetilde{U}_\alpha(c, \Psi)$, and defining $\tilde{E}_\alpha g(\alpha) = \int_0^{\bar{\alpha}} \mathrm{d}\alpha_2 \mathrm{p}_\alpha(\alpha_2)\mathrm{g}(\alpha)$, then:

$$\|T\Phi - T\Psi\| \equiv \sup_{\bar{y}\ge y\ge 0}\left|E_\alpha\left(\widetilde{U}_\alpha(\dot{c}, \Phi) - \widetilde{U}_\alpha(\ddot{c}, \Psi)\right)\right|$$

$$\le \sup_{\bar{y}\ge y\ge 0} max\left\{\left|E_\alpha\left(\widetilde{U}_\alpha(\dot{c}, \Phi) - \widetilde{U}_\alpha(\dot{c}, \Psi)\right)\right|; \left|E_\alpha\left(\widetilde{U}_\alpha(\ddot{c}, \Phi) - \widetilde{U}_\alpha(\ddot{c}, \Psi)\right)\right|\right\}$$

$$\le \sup_{\bar{y}\ge y\ge 0} max\left\{\left|\tilde{E}_\alpha\big(U(\dot{c}, \Phi) - U(\dot{c}, \Psi)\big)\right|; \left|\tilde{E}_\alpha\big(U(\ddot{c}, \Phi) - U(\ddot{c}, \Psi)\big)\right|\right\}$$

$$\le max\left\{\sup_{\bar{y}\ge y\ge 0}\left|\tilde{E}_\alpha(U_2(\dot{c}, \Psi)\cdot[\Phi - \Psi])\right|; \sup_{\bar{y}\ge y\ge 0}\left|\tilde{E}_\alpha(U_2(\ddot{c}, \Psi)\cdot[\Phi - \Psi])\right|\right\}$$

$$\le \gamma \max\left\{\sup_{\bar{y}\ge y\ge 0}\left|\Phi\Big(f\big(\alpha, y-\dot{c}(y)\big)\Big) - \Psi\Big(f\big(\alpha, y-\dot{c}(y)\big)\Big)\right|;\right.$$

$$\left.\sup_{\bar{y}\ge y\ge 0}\left|\Phi\Big(f\big(\alpha, y-\ddot{c}(y)\big)\Big) - \Psi\Big(f\big(\alpha, y-\ddot{c}(y)\big)\Big)\right|\right\} \ \alpha \in [0,1]$$

$$\le \gamma \sup_{\bar{y}\ge y\ge 0}|\Phi(y) - \Psi(y)| = \gamma\|\Phi - \Psi\|$$

for some $0 < \gamma < 1$, using assumption 3. Thus $T$is a contraction and according to the Banach Fixed Point Theorem, there exist an unique fixed point $V^* \in C[0,\bar{y}]$ that is the solution to (a).

Chapter 6: Conclusions and Future Developments

6.1 Summary

This dissertation examines how wealth, costs and networks affect South-North labor migration. Specifically, it focuses on four main issues. First, we examine the relation between wealth and household migration strategies in cases of underdeveloped credit and insurance markets stressing the importance of budget constraints in determining the number and selection of migrants. Second, we examine how household- and community-level networks of migrants can facilitate migration, particularly of poorer social strata. Third, we explore whether empirical results obtained for Mexico can be applied to other settings. Lastly, with Luca Ferretti, we model the effect of networks on the so-called "quality of migrants".

In order to test the theoretical hypothesis derived from the literature and chapter 2, the focus is on Mexico and five other Central American countries, making use of MMP and LAMP data. These ethno-surveys convey a large amount of information on household physical assets as well as household migration history. All household heads were asked to describe in retrospective their entire migration life histories. Both datasets also established the number of ties each household had in the receiving country and produced variables for community-level migration capital. Specifically, at household level, I use the *previous migration experience*, the number of relatives with a permanent U.S. resident permits and the number of friends in the U.S.; in order to trace community-level migration capital, I use *migration prevalence* ratios.

Chapter 1 reviews the theoretical and empirical literature on South-North migration, with particular focus on Mexican migration to the U.S.. Analysis of the literature moves from the neoclassical approach to migration, and passes through NELM to produce the theoretical framework: households maximizing income in a dual economy with underdeveloped credit and insurance markets. Thus, migration becomes an investment in human capital, producing returns in the future but requiring to be financed before migration can take place. Following literature costs (or rather the resources needed to pay them) are the main limitation to migration of poorer social strata. This explains why we observe relatively small migration flows compared with expected earnings.

Theoretical and empirical studies stress the importance of migrant networks in facilitating migration, by reducing migration costs and risks and allowing the accumulation of social and financial migration capital, at both household and community level. This field of research is still theoretically and empirically underdeveloped, due on one hand to the mathematical complexity limiting the theoretical approach and, on the other because of the difficulty of translating the theoretical hypothesis into empirical terms.

Chapter 2 provides a theoretical model, giving a general framework of reference for the empirical analysis. Starting from the idea that migration is a household income maximization strategy, the chapter is based on and generalizes the work of McKenzie and Rapoport (2007). It derives a model of the link between budget constraints, costs and risks of migration and migrant networks in the presence of underdeveloped credit and insurance markets. As we see from all these elements, which are usually investigated separately, they all influence migration flows, being sometimes substitutes and every so often complements.

By explicitly introducing the risk of migration and by deriving the effect of networks in the McKenzie and Rapoport framework analytically the model shows why we observe relatively low levels of migration even in cases of large wage gaps, and why we observe persistent or increasing migration flows when wage gaps decrease. Budget constraints on migration reduce the outmigration rate of households having higher incentives to migrate (poorer households). This is counterbalanced by economic development and migrant networks. Economic development, increasing the average wealth in a country, reduces the binding effect of budget constraints, allowing increasing numbers of people to migrate. Migrant networks, reducing the costs and risks of migration and allowing pooling of resources, facilitate migration, particularly of poorer social strata. I model three main channels through which social networks and social capital can affect household behavior and, at aggregate level, the dimension and composition of migration flows.

The derivation of the model yielded two main empirical hypotheses. First, in the case of underdeveloped credit and financial markets, wealth shows inverted U-shaped relation with migration. Second, migrant networks and social capital facilitate migration by reducing the costs and risks of migration and allowing migration to be financed though resource pooling. Communities with longer or larger histories of migration and households with larger networks have higher outmigration rates. These hypotheses are tested in the following chapter.

Chapter 3 empirically examines the relations between wealth, migration costs and networks in determining the decision to migrate, with the aim of providing a structured analysis of the elements driving Mexican households' decision to migrate to the U.S. The MMP data are used to achieve this aim. The main contribution of this chapter lies in the empirical approach used to deal simultaneously with sample selection, endogeneity of migration networks, and the presence of binary (or count) dependent variables. Making use of a Three-Stage procedure and an IV-Poisson, I substantially confirm previous findings, ensuring that they are not the result of endogeneity or sample selection. Mexican migrants belong to the middle of the income distribution in Mexico. Migration and wealth are in an inverse U-shaped relation. Household and community networks increase the propensity for migration, and networks further increase the migration propensity of households belonging to the middle-left of the income distribution.

Household- and community-level networks are partially substitutes and partially complements: the former positively affects migration in both terms of propensity and numbers; the latter conveys information which makes migration a feasible strategy, but it seems to have any effect on the optimal number of migrants. This is in line with the idea that migration is a two-stage decision, due to some initial sunk cost, corroborating the approach of Winter et al. (2001). First, Mexican households evaluate migration to the U.S. as a possible income-improving strategy; then they decide the optimal number of migrants, conditional on having already paid the investment cost. Once a member is already in the receiving country, migration of additional members require a smaller economic effort.

Chapter 4 examines whether cumulative causation can be extended to five other Central American countries: the Dominican Republic, Nicaragua, Costa Rica, Guatemala and Haiti. I examine whether the results of the determinants of migration are a peculiarity of Mexico, the effect of differences between urban and rural areas, and/or the consequence of network size, determining effectiveness on migration decisions. Examining the determinants of migration in an enlarged setting allows us to test jointly the theory and methodology used for the empirical investigation. The key variable in cumulative causation theory is *migration prevalence*. It is suitable for capturing the accumulation of migration capital at community level in rural Mexican areas, and provides information on the migration network as well as on services and ideology about migration. In order to test cumulative causation in settings other than rural Mexican areas, a database obtained merging MMP and LAMP is used.

The LAMP was born as an extension of the MMP and they share the same methodology. Its core is an ethno-survey focusing on the migration process. The countries in analysed in the chapter all belong to Central America and have the U.S. as their main (if not unique) outmigration market. All Central American countries are poorer than Mexico, although they are not too far from Mexico from many points of view. Specifically, there are three the rationales behind the decision on country. First, as it was necessary to avoid differentials in initial conditions which originated different paths, it was necessary to study countries with similar socio-economic histories. Second, in order to avoid fluctuations generated by different shocks in destination countries, a common main receiving country was required. Third, it was necessary to have uniform data collection.

After a first comprehensive analysis, three different settings were studied: Mexico vs. Central America, rural vs. urban, and small vs. large networks. The results are substantially in line with literature findings, although the quality of the database and of the instrument may represent a limitation to the analysis. Larger and younger households are more likely to be involved in migration. Migration is still a male affair. Household migration experience and family networks always positively affect migration. Migration has an inverted U-shaped relation with wealth. All these results are common across treatments and frameworks. Thus, we may argue that the theoretical background proposed in chapter 2 is not flawed.

Focusing on *migration prevalence,* estimates vary with the setting in question. Part of the fluctuation in the analysis Central America vs. Mexico may be due to the relatively small number of Central American migrant households in the sample and to the low quality of the instruments used to disentangle endogeneity. Although it generally has the expected direction, it seems significant only for rural Mexican households. This confirms the opinion of Fussel and Massey (2004) on the limitations of cumulative causation. Nonetheless, community network variables are always jointly significant.

Independently of the network dimension, living in urban areas and in Central America has a negative effect on the probability of migration. Fussel and Massey (2004) argue that the accumulation of community-level capital in urban areas is more complex, so that cumulative causation is less effective in explaining outmigration paths. I argue that it is not the urban context itself, but rather the relative dimension of networks, that influence migration strategy. Cities - being richer, offering more income opportunities and being the destination of internal migration flows - discourage migration: thus, migration community capital has still not reached the threshold. Similarly, Central American countries, being historically less involved in migration, have not yet reached the critical point in the accumulation of migration capital to self-perpetuate the mechanism.

Chapter 5 provides a theoretical analysis of the quality of migrants, with particular focus on education. In chapter 3, the effect of education on migration changes with the treatment and types of variables involved in the analysis. Education, capturing (partially) the level of selection of migrants, is a key variable for both scholars and policy-makers. Similar results are obtained in chapter 4. More in general, in the literature on Mexican migration to the U.S., we can distinguish between those supporting positive selection (Chiswick) and the opposite (Borjas). Chapter 5 proposes a theoretical framework incorporating migrant networks which, under a few simple assumptions, explains why we observe decreasing levels of selection among migrant cohorts in receiving countries and brain drain in sending countries. This contribution falls into the cumulative causation line of thought and is one of the first extensive formalized models in this branch of literature.

We started from an overlapping generation model along the lines of Loury (1981), in which innate abilities and education were examined as separate elements and in which there is a "balkanized" market for education - that is, households have to self-finance the education of their offspring. Thus, intergeneration social mobility among households depends on abilities and education levels. This implies that mobility closely depends on innate abilities and education variance, and on their payoff.

We agree with the view of Chiswick (1978): migrants are favorably selected. We show that decreasing quality among subsequent cohorts is not incompatible with this assumption. Once migration starts, it modifies the framework in both sending and receiving countries. If migration flows increase in their dimension, in time there will be enough resources to finance increasingly less skilled people until the *natural level of migration* is reached. Since education has strong intergenerational transmission, there will be a draining effect. In the receiving country, we observe decreasing levels of education, and thus a negative cohort. This effect not only can occur in case of extremely positive self-selection, but it is its consequence when there are no investments to compensate for brain drain.

Networks do not lie at the origin of the self-perpetuating mechanism, nor at that of the negative cohort effect, but they can strongly influence the convergence path, speed of convergence and endpoint values. In addition, by reducing the costs and risks of migration, networks can increase the negative cohort effect, and also produce opposite results. In fact, congestion and excess of labor supply may reduce the incentive to migrate.

6.2 Further research

This dissertation aims at contributing to the debate on the determinants of migration by improving our knowledge in three different directions, all requiring further investigation.

Chapter 3 provides a new empirical tool the Three-Step Procedure to avoid simultaneously endogeneity and sample selection; it also proposes a relatively new way of studying the determinants of migration. In massive migration, such as the Mexican migration to the U.S., in order to understand the determinants of migration, as well as to forecast migration flows, it is not only the probability of a household that matters, but rather the number of migrants the household sends in migration. This approach raises several interesting questions.

First of all, it is necessary to develop econometric tools able to disentangle endogeneity and sample selection in cases of count variables. The Three-Step procedure and IV-Poisson used in chapter 3 go in this direction but, as pointed out in the conclusion of the chapter, they are not sufficient. The procedure lacks a theoretical background, and IV-Poisson is not able to correct for the selection process.

Second, in line with Winter et al. (2001), analysis of the optimal number of migrants emphasizes how household- and community-level networks convey different kinds of information. As pointed out, the former positively affects both the household probability of being involved in migration and the optimal number of migrants, whereas the latter only affects the probability of migrating. This difference and the nexus between community- and household-level networks need deeper study. One possible explanation for it lies in the costly nature of the first migrants. If they are obliged to face higher costs than later ones, then community-level networks act as a surrogate for household networks for the first migrants, but play no role for subsequent ones. However, a key role is played by costs and risks. Measures of migration costs and risks are usually very poor in capturing costs (with distance as a proxy) or are not computed in the risk of migration. The composition of migration costs is determinant in understanding exactly how household- and community-level networks act in supporting migration. This measure should include both formal and informal migration channels, in terms of both monetary costs and time.

Third, the MMP is a huge database but is "only" a large cross-section. There are no extensive panel databases on migration. Only few attempts have been made to build extensive panels, but they are usually based on international flows with little or no information at micro-level. In order to trace network information at household level in other ways, the only measure we can use is the stock of compatriots already in the receiving country.

Fourth, *migration prevalence* is a very powerful instrument for predicting migration from rural Mexican areas. The analysis of cumulative causation and its applicability in settings different from rural Mexico was the core of Chapter 4. The key question at the beginning of the chapter is still not completely answered. While several similarities across Central America seem to validate the framework proposed in chapter 2, community-level network variables play no role. Unfortunately, the quality of the database is too low to give a clear answer to the question: however, I argue that it is not cumulative causation theory which fails outside rural Mexican areas, but rather our interpretation of empirical results, which must be modified. The non-significant estimation for *migration prevalence* is due to its nature. As pointed out by Massey et al. (1994), *migration prevalence* does not capture migration per se but rather a phase in its development. I argue, and leave it as an open issue, that community-level networks are only a consequence of migration until a threshold is reached. Once that threshold is reached, they become a cause of migration, being able to act as surrogates to household-level networks and open the doors to new groups of potential migrants. What is the threshold? How is it reached?

Last but not least, chapter 5 analyses the problem of the quality of migrants and stresses the need to find better measures to evaluate it. Simply understanding the determinants of migration is not sufficient - we need to understand exactly who migrates. In addition, the model itself, with its limitations, requires further development.

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