HOW DOES MIGRATION AFFECT AGRICULTURAL LABOR PRODUCTIVITY?
THE CASE OF MEXICAN RURAL HOUSEHOLDS

By

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To all those who follow their dreams

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Using micro-level agricultural data from the ENHRUM survey, I examine the impact of international labor-out migration on the agricultural production of Mexican rural households. The study evaluates how households reallocate labor and capital resources as consequence of labor out-migration and incorporates a productivity variable to measure the efficiency of this reallocation. Estimating a Heckman Two-Stage model we capture the labor productivity of the household accounting for the selectivity of landholding. The results suggest that international labor-out migration and the formation of social networks have a negative impact on the household labor productivity. Migrant households are less labor productive than households with no migratory experience by 28,655.31 Mexican pesos. It seems that migrant households are not investing enough in capital-intensive resources to compensate for the reduction in labor supply. Changes in the intra-household allocation of labor are not observed. The education level of the household head and spouse, the tenancy status of the land and the location of the household are other factors affecting the labor productivity of the household.

CHAPTER 1
INTRODUCTION

Migration is increasingly being considered in the literature on agricultural productivity in developing countries, it has become a common practice for rural households worldwide. Migration has been found to affect a household's decisions in three important ways. First, migration reduces the labor availability of the household; second, it generates an increase in the household's income through remittances sent by the migrant; and third, it strengthens the formation of social networks, which can be used to promote the migration of other household members.

In the case of Mexico, migration is one of the off-farm activities that rural households rely upon heavily. According to the *Consejo Nacional de Población* (CONAPO), the number of Mexicans engaging in a migratory experience to U.S. reached 3.3 million between 1990 and 2000. Furthermore the composition of the annual net flow to this country has increased by a factor of three in the last three decades, leading to the formation of a Mexican migrant community in the U.S. that reached 26.7 million in 2003.[1]

Thus far the studies on migration have not reached a consensus on the way migration influences the farming practices and decisions of the household. However, it has been noticed that the household's initial endowments as well as the type of migration lead to different effects of labor out-migration on the sending community. Furthermore, it has been found that, in general, remittances are used to relax credit constraints and improve the farm management practices of the household.

Analysis of the way in which Mexican international migration affects the labor productivity in rural households is scarce. Existing studies suggest farming differences between

[1] Approximately 9.9 million people represent the migrants that were born in Mexico and the remaining 16.8 millions represent the population already born in the United States but with Mexican heritage.

migrant and non migrant households depend not only on the household's initial endowments but also on how labor-intensive the farming practices of the households are, and the household's ability to substitute the family labor with reciprocal or wage labor i.e.; it depends upon how rural labor markets work.

This study central research question is the impact of international migration on the household labor productivity. The study aims to evaluate the reallocation of labor and capital resources as a consequence of labor out-migration and measure the efficiency of this reallocation. My primary hypothesis is that, as a household strategy to manage uncertainty and market imperfections, migrant households maintain their agricultural production levels by investing more in capital-intensive inputs to compensate for the reduced labor force availability due to the migration of at least one of the household members. My corollary hypothesis is that labor productivity, measured as the agricultural output generated per day of work, will be greater in migrant households compared to non migrant households. To test these hypotheses, my study employs econometric techniques using the Mexican National Rural Household Survey (ENHRUM), a nationally representative sample of 1765 household co-directed by the *Colegio de México* (COLMEX) and the University of California at Davis in 2002/2003.

The contribution our study to the existing literature focuses on three main points. First, we rely on the New Economics of Labor Migration (NELM) approach, using the household as the unit of analysis to study the way labor out-migration influences the labor productivity of rural households. Second, we estimate labor productivity accounting for the selectivity of whether or not a household has access to land. The idea behind this is that agricultural productivity can only be measured for those households holding land, and until now no study recognized this selectivity when studying labor productivity. Finally, we introduce into the labor productivity analysis the study of social networks.

CHAPTER 2
OVERVIEW OF THE AGRICULTURAL SECTOR IN MEXICO

Introduction

The purpose of this chapter is to review the status of the agricultural sector on the past three decades. A review of past and current agricultural policies in Mexico is crucial in understanding the way these changes have currently influenced the agricultural sector. These agricultural policies have directly or indirectly changed farmers' agricultural practices affecting how the agricultural sector operates as well as its productivity. This chapter is structured as follows. The first section summarizes the domestic and international agricultural policies institutionalized in Mexico during the twentieth century. The second section reviews the implications of the policies for the agricultural sector. Finally, some conclusions are presented in the third and last section.

Review of Agricultural Policies in Mexico

At the beginning of the twentieth century agriculture employed an important share of the labor force but most of the agricultural workers were landless (Fernandez-Cornejo and Shumway, 1997; Villa-Issa, 1990). The concentration of land in the hands of a few and the inequalities among social classes were two factors leading to the Mexican Revolution (1910-17). After the Revolution and during the 1920's the agricultural sector received little or no investment. It was not until the 1930's that there was a substantial increase in public investment in the agricultural sector, such as the construction of roads, irrigation systems and the intensification of the land reform. From the 1930's until the 1980's the government played a key role in the development of the sector, for instance, with the creation of the *ejido* and the institutionalization of CONASUPO (Yunez-Naude, 2003; Yunez-Naude and Barceinas, 2000). The next sub-sections describe these in detail.

Land Reforms in Mexico

Following the Mexican Revolution, the first land reform[2] was particularly important because it not only reallocated the possession of the land, but also set the foundation for the contemporary agrarian system. In essence, this reform encompassed a new system of tenancy called the *ejido* system, which consisted in communal land possession but generally individual farming. The *ejido* was made up of the *ejidatarios,* who are the farmers who have rights to the *ejido* land (called agrarian reform rights). This type of ownership has remained effective until the present.

During the government of Lázaro Cárdenas (1934-1940) there was a large-scale redistribution of land. By 1940, the *ejido* sector possessed 22.5 per cent of the agricultural land and 47.4 per cent of the arable land of the country (Assies, 2008). Two additional presidential periods characterized by important redistribution of land were those of Gustavo Diaz Ordaz (1964-1970) and Luis Echeverria (1970-1976). During these two periods, however, no significant amount of irrigated land was redistributed.

There were three major restrictions imposed on the way the *ejido* operated. First, there was a labor restriction, where the *ejidatarios* were not allowed to hire labor. Second, if the *ejidatarios* resided away from their allocated land for more than two years, they ran the risk of losing their *ejidal* rights. Moreover, within this system, long-term production contracts with farmers outside the *ejido* were not allowed (Johnson, 2001). In practice, however these restrictions were not always followed. For instance, illegal renting of *ejido* land to commercial farms was a common practice among farmers as was migration (Assies, 2008).

With the creation of *ejidos* the government aimed to promote productivity and satisfy the internal market for agricultural products. In its early stage, the land agrarian reform was backed

[2] The first land reform consisted in the 1917 amendment of Article 27 of the Constitution.

up by technical assistance, credit and supply of seeds. However, with the instauration of an import-substitution industrialization model in the early 1930s, the policy gradually shifted away from the agrarian sector toward the industrial sector favoring the provision of cheap food for an increasingly industrializing country (Assies, 2008).

The “social sector” consisting of *ejidos* and agrarian communities was thus confined to the production of staples under price regulation and subsidies. At the same time, however, policies promoting the investment in irrigation systems and capital-intensive production favored the development of the private sector and the production of high value exports, giving rise to the formation of a dual agrarian structure and a deepening in the existing regional differences that persists until nowadays (Assies, 2008).

By the early 1990s the *ejido* system accounted for approximately 100 million hectares entailing half of the national farmland (Fernandez-Cornejo and Shumway, 1997). Furthermore, the land was distributed to nearly 3 million peasants that represented about three quarters of total producers, grouped in 26,796 *ejidos* and 2,366 agrarian communities (Quintana, Borquez and Aviles, 1998).A typical *ejido* would consist of approximately 74 *ejidatarios* and possess some 2,000 hectares The average *ejidatario* would hold 9.2 hectares in two parcels and have access to 28 hectares of common land (Assies, 2008).

One of the most radical policies institutionalized in Mexico during the 1990s was the second land reform or counter reform. The 1992 amendment of Article 27 of the Constitution put an end to the land redistribution process existent in the country since the 1930s. This reform aimed to transform the collective possession of land into an individual possession, setting the conditions necessary to start the privatization process of land. It also laid the foundations for trade liberalization of the agricultural sector (Fernandez Cornejo and Shumway, 1997). It was believed the reform was going to help to overcome the crisis in the sector through the expansion consolidation of rental markets, increased productivity and the promotion of foreign investment (Assies, 2008). It has been noticed however, that "in a context of globalization and asymmetric free-trade relations" (Assies, 2008, pg 33) the agrarian crisis has only intensified.

Under the 1992 reform, the *ejidatarios* were granted the opportunity to certify their land rights if the *ejido* consented to participate in *Procede*.[3] They were also allowed to hire labor and grow any crop and market it wherever they wanted. Long-term production contracts with outsiders were made also feasible. In a general way, this reform reintroduced a market oriented scheme into the agricultural sector, allowing farmers to respond directly to market incentives and disincentives.

One important feature of *Procede* is that the decision to participate in this certification program not necessarily resulted in the privatization of the *ejido*. A governmental report capturing information for 1992-2005, for example, showed that in total only 1% of the social property entering the certification process achieved full private property status in this time period. Moreover, 60% of this privatization was done for urbanization purposes (Assies, 2008). This number clearly suggests that one of the main goals of the reform, to start the privatization process of the land, in order to capitalize the *ejidos* has not been achieved.

Domestic Market Intervention

The Mexican government has always played an active role in regulating the agricultural domestic market. For instance, in 1965 the government creased a state trading enterprise (STE) called The National Company of Popular Subsistence (CONASUPO). The organization's main

[3] *Ejidatarios* participating in PROCEDE had the right to legally sell, rent, sharecrop or mortgage their land. The decision to sell *ejido* land to outsiders, however, required the approval of two-thirds of the *ejido* general assembly, witnessed by a government representative.

objective consisted in promoting the domestic market by subsidizing both producers and consumers and regulating international trade through direct imports (Yunez-Naude 2003).

In its first stages, CONASUPO was designed as an economic development tool to protect small staple-farmers as well as low-income consumers. To protect producers, CONASUPO absorbed the transaction costs farmers faced by reducing the number of intermediaries involved in purchase-sale transactions; it also guaranteed crop support prices[4]. It also promoted production subsidies, including input subsidies for water, electricity and fertilizers (Fernandez-Cornejo and Shumway, 1997). CONASUPO also managed subsidiary programs for processing, storing, distributing and selling the crops. At some point, CONASUPO exerted control over 30% of the total gross domestic agricultural production (Yunez-Naude, 2003). The most important crop, however, was corn, representing 56% of the total value of crops managed by CONASUPO (Yunez-Naude and Barceinas, 2000). [5]

By the end of the 1980's some of the tasks performed by CONASUPO began to decline; and by mid 1990's most of CONASUPO's programs were already dismantled[6], privatized or transferred to farmers. For instance, the processing of corn was privatized and the processing of wheat to make bread was ended. In addition, the warehouses for basic crop storage belonging to CONASUPO were transferred to farmers and local authorities.[7] Finally, price intervention was reduced to just corn and beans.

Corn and beans were the last two staple crops administered by CONASUPO since these two crops, representing Mexico's two major staple crops produced by the larger number of

[4] The agricultural crops involved in the CONASUPO's programs were barley, beans, copra, corn, cotton, rice, sesame, sorghum, soybeans, sunflower and wheat.
[5] To help low income consumers, CONASUPO sold basic foods to rural and urban costumers at very low prices. Some of these goods included: corn, flour, wheat pasta, edible oils and fluid milk (Yunez-Naude, 2003).
[6] The only two entities that survived this dismantling process were the LICONSA entity in charge of processing milk powder to produce fluid milk for access to the poor at subsidized prices; and the retail store DICONSA responsible for distributing basic food to low-income consumers at low prices.
[7] Also, one of the extension programs called CECONCA, used for technical supports to farmers was also abolished.

peasant households, required a longer transformation period. By the end of 1995, CONASUPO was still a “last resort” buyer of corn and beans at minimum prices. It was also in charge of regulating the external trade of both crops. In 1998 however, CONASUPO’s involvement in social programs to assist the poor was ending, undermining the main reason for the existence of the company. CONASUPO was subsequently liquidated during the Zedillo administration (1995-2000) (Yunez-Naude, 2003).

In 1991 a new agency was created by the Agricultural Ministry called Support Services for Agricultural Marketing (ASERCA) [8]. This agency emerged as a substitute for CONASUPO although ASERCA has no mandate with respect to price fixing commodity imports. Some of the tasks this agency carries out include marketing and the coordination of direct income transfer programs.

Between 1992 and 1996 and under the supervision of ASERCA, two programs were developed, the Program of Direct Payments to the Countryside (*Procampo*) [9] and Alliance for the Countryside. The goal of these two programs was to support agricultural producers without interfering with the new rural market economy. Although the goal of these two programs is the same, they differ in the way they are managed and funded. Alliance for the Countryside is state-managed while *Procampo* is managed by the federal government. Moreover, a portion of the Alliance for the Countryside program is funded using farmers’ resources.

The Program of direct Payment to the Countryside *(Procampo)* replaced the traditional price support system by an income direct payment for farmers based on the number of acres devoted to the production of maize, beans, wheat, rice, cotton, soybeans, safflower, barley, and sorghum. The Alliance for the Countryside provided farmers with financial aid, technical and

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[8] ASERCA stands in Spanish for *Apoyo y Servicio a la Comercialización Agropecuaria*.
[9] This program was expected to last 15 years ending in 2008.

marketing assistance and training. In essence, its objectives were to: (1) increase the investment in capital intensity technology; (2) support the transformation of agriculture toward areas with comparative advantage; (3) promote the creation of distribution channels for the products commercialization (Cord and Wodon, 2001).

With the elimination of CONASUPO along with the creation of *Procampo* and Alliance for the Countryside, Mexico was laying the foundations for the trade liberalization of the agricultural sector. With these changes as well as other market oriented policies, Mexico was preparing itself to enter into the General Agreement on Tariffs and Trade (GATT) as well as the North American Trade Agreement (NAFTA)[10].

International Trade Regulation

International trade for agricultural products was also regulated heavily by the Mexican government. For instance, CONASUPO also had an active role regulating international trade through direct imports in the early-mid 1980s[11]; but just as with the domestic market, CONASUPO's participation in trade regulation through the direct import of basic crops began to decrease considerably in the following years.[12] The government also controlled trade volumes, imposing tariffs, quotes and licensing requirements.

Other policies (outside the agricultural sector) that influenced the sector's performance were exchange rates policies, investment policy in the rural sector, as well as state investment in infrastructure, transportation and communication (Villa-Issa, 1998).[13]

[10] Fernandez-Cornejo, 1997
[11] CONASUPO accounted for 95% of total rice imports, 83% of corn imports and 68% of wheat import in 1983-88 period; for 99% of beans import from 1989 until 1993; and more than 95% of total sorghum and soybean imports at the beginning of the 1970s (Yunez-Naude and Barceinas, 2000).
[12] For example, the rice imported by CONASUPO reduced from 25% in 1989-1993 to zero in 1994-1996. Also, its corn imports declined from 38% in 1989-93 to 16% 1994-96. And CONASUPO direct imports of beans and wheat reached cero by the period 1994-96 (Yunez-Naude, 2003)
[13] For instance, from 1955 to 1972 the scarce amount of private investments in the rural sector, due to a lag of 19% in the farm prices, was offset by public investment. During that time, the exchange rate was also overvalued

In the mid 1980s Mexico started a series of adjustments to the existing economic model. In 1986 Mexico became a member of the General Agreement on Tariffs and Trade (GATT) and in 1994 Mexico was admitted into NAFTA. The admittance of Mexico represented an important step toward a market-oriented strategy and consolidated many of the structural changes that began in the early 1980s. The most important structural changes included the substitution of the import substitution model by a market oriented model with a diminished participation of the government. An important trade policy change was the shift from import licenses to tariff rate quotas (TRQs).[14]

The North American Free Trade Agreement (NAFTA) included two separate agreements, one between Mexico and the United States and the other one between Mexico and Canada. It was agreed that import levels below the consented quota would not be subject to tariffs. A 15 year period (1994-2008) was set to eliminate the over quota tariffs for corn, dry beans and milk powder (milk powder was not negotiated between Mexico and Canada).

Mexico has also signed other FTAs with Latin American and European countries. After its incorporation as a full member of the WTO in 1995, Mexico agreed during the Uruguay Round to set a tariff base of 25% for almost all agricultural products, with the promise of reducing it an additional 1% by 2000. The basic crops subject to TRQs in the NAFTA negotiation were also kept valid in this negotiation adding wheat to this type of trade regulation. Canada and United States however have larger quota access and lower above quota tariffs.

In summary, this overview of the Mexican policy reforms is a starting point to understand the agricultural sector. The next section focuses in explaining the implications for the agricultural sector.

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[14] The crops that were changed from import licenses to TRQs during the NAFTA negotiation were: barley, beans, corn and milk powder.

Implications for the Agricultural Sector

All the changes taking place in the agricultural sector –trade liberalization, reform of the *ejido* and retreat of State- have led to a new incentive structure affecting farmers' behavior and consequently the way they operate. This section analyzes the adjustment strategies farmers have adopted as a consequence of these changes in the agricultural sector.

In general terms, the reforms were expected to have a positive impact on agricultural sector productivity. Some of the expected results were: a decline of small, less productive farmers, who under this new scenario would be willing to sell their land and move out of agriculture; an increase in crop diversification toward more marketable crops; and finally, an increase of capital intensification in the agricultural sector. For a number of reasons, however, the reforms have not produced the expected results (Johnson, 2001; Cord and Wodon, 2001; Davis, 2000; Assies, 2008).

There are different and inconclusive answers to this puzzling situation. According to Davis (2000) for instance, farmers are assuming a risk-averse strategy, in which they abstain themselves from incurring big changes and they diversify their sources of income in order to reduce uncertainty. From this point of view, farmers can assure their subsistence by remaining in the same crop production; not investing in technological inputs such as fertilizers, machinery and improved seeds; and keeping a secure source of money through off-farm activities or migrant remittances.

Assies (2008), on the other hand, suggests the changes taking place in the agricultural sector –trade liberalization, reform of the *ejido* and retreat of State- have only deepened the crisis in the rural sector because of the inaccessibility to credit[15], insurance, market, modern inputs and

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[15] The total amount of credit the rural sector had access to decrease from 30 percent to 20 percent in 1997 (Assies, 2008).

technical assistance in the rural sector. For a better understanding of farmers' behavior and its impact on productivity, I turn to how ownership of major agricultural assets has changed since the policies reforms were implemented.

Landholdings experienced some changes after the *ejido* reforms. In an analysis done by Davis (2000) for example, based on panel data for 1,287 *ejido* households, it was found that from 1994 to 1997, the amount of land owned by an individual increased on average by 25%, from 8 NRE[16] hectares to 10 NRE hectares. The increase of owned land can be attributed to the fact that common land owned by *ejidos* was divided after the reform was implemented, as well as to an increase in land converted into agriculture.

In spite of the expansion in average land ownership, the changes in land tenure appear to have had no impact on productivity. Johnson (2001) tested the hypothesis that farmers faced asset-based credit rationing, meaning the amount of credit offered to individuals was constrained by the lack of assets. This hypothesis suggested that farmers did not invest in productive assets because of their inability to access the credit market. She found however no evidence to support this hypothesis, implying that the lack of collateral and credit is not the cause of low-capital use and low productivity observed in the agriculture. This finding is very important in the sense that it shows that the reform of tenancy in Mexico by itself will not have a positive impact in agricultural productivity.

Crop prices have been changing through the years. There is strong evidence suggesting that after the trade reform, the Mexican domestic agricultural prices are indeed converging toward international prices. OECD estimates reflect how the reduction in the nominal protection of basic staples has proceeded over time. For example, maize protection decreased from 109% to 51% from 1993 to 1994, to 24.13% in 1995. In the case of yellow maize, the protection

[16] National Rain fed Equivalents

decreased from 77%, to 28% and then 5%. Some other crops following the same declining pattern are sorghum, soybean, wheat and barley. In the specific case of rice, the protection estimate decreased and became negative around 1991 (Yunez-Naude and Barceinas, 2000).

There is also evidence suggesting a decrease in the production of rain-fed agriculture, which is the realm of small and medium size producers. Between 1985 and 1990, for example, the principal products of rain-fed agriculture decreased by 0.60 per cent per year and between 1990 and 1994, they fell by 4.35 percent per year. Maize production fell by 4.64 per cent annually and beans by 2.63 per cent (Assies, 2008).

Little research has been done on the crop diversification topic. However, in general terms it appears farmers are not undergoing crop diversification after guaranteed prices were eliminated. Although the amount of land has increased, maize, bean and fodder crops remain the staples of most producers in most regions of the country. Between 1994 and 1997 for instance, Davis (2000) found that 75% of the surveyed *ejido* households planted only maize, while 19% intercropped maize with other crops, leaving the growing of fruit and vegetables as well as fodder unchanged. These results support the hypothesis that farmers are behaving as risk-averse agents investing in low price, riskless production instead of undertaking the risk of producing high value crops. On the other hand, it has also been argued that crop diversification has not materialized because a considerable number of small farmers produce for own consumption purposes, remaining indifferent to reductions in the relative price gap.

As mentioned above, the government has played an important role in providing technical support to farmers through two of its programs, CONASUPO in the past and now ASERCA. The government has focused on the diffusion of improved crop varieties, which has proven to be an important source of agricultural productivity (Wood, You and Zhang, 2004). Through

Procampo, with a coverage rate equal to 80% of all *ejidatarios*, the government encourages the use of high yield variety (HYV) seeds among basic grains producers.[17] And with less success, Alliance, which has reached only 12% of the *ejidatarios*, the government promotes investment in capital intensity technology and the transformation of agriculture toward areas with comparative advantage (Cord and Wodon, 2001).

Usage of technology, however, does not depend on governmental support alone. Evidence suggests that the characteristics of the household as well as of the community, such as farm size, community infrastructure and household member's education and income also play an important role in determining the use of technology in agriculture. For instance, Davis (2000) found that after the reforms, larger farmers made more use of HYV seeds, chemicals, technical assistance and credit, while small and poor households were the less likely to invest in technology use.

Wood, You and Zhang, (2004) found that over time, most of the agricultural R&D has favored irrigated production systems, where the potential for technology spillovers is greater than for heterogeneous rain fed areas. Many agricultural technologies are often location specific. This means that a large part of the agricultural research is directed to overcome site specific constraints in crop production such as, increasing plants tolerance to frost or drought, or increasing plant resistance against a specific pest or disease. Homogeneous areas have more potential for agricultural R&D spillovers, thus research is more abundant on irrigated production systems.

[17] Studies measuring the impact of *Procampo* on agricultural productivity have found that the program has increased the agricultural income of the households keeping farmers growing their crops. However, the program has had little impact on the productivity itself. Assies (2008) for instance, suggests the program has been insufficient to help the rural sector make the transition to other commercial crops.

In general, the increased use of technology in the agricultural sector remains a long run goal. The *ejido* reforms have not had a substantial effect on increasing capital intensification as expected. Government continues supporting the diffusion of technology among farmers, but because of its potential spillovers, the farmers taking advantage of this technology have mostly been large, modernized farms. New programs oriented toward small farmers are still needed in order to bring technology to less productive farmers and have a major impact in the rural sector.

Returning to farmers' risk-averse strategies, livestock accumulation seems to be an important strategy for farmers because it keeps their savings relatively liquid but also protects the household from macroeconomic shocks such as inflation or devaluation. In addition, livestock and livestock derivatives consumed at home represent a fundamental part of the household diet. Finally, animal by-products such as the sheep's wool also represent an important source of income.

Evidence suggests a clear increase in livestock accumulation after the *ejido* reforms were implemented. Davis (2000) found that on average the number of heads of cattle owned per household increased by almost 20% from 1994 to 1997. About half of the households surveyed had poultry, followed by pigs. Milk was produced by 25% of the households and eggs by 38%.

Off-farm activities have always represented an important source of income for many rural households. Evidence from El Salvador, Mexico and Ecuador suggest that nonagricultural employment generates 40 to 50% of a rural household's income (Araujo, 2004), representing from 38% on the largest farms to 77% on the smallest (Araujo, de Janvry and Sadoulet, 2002). Furthermore, about 60% of rural Mexican households have some family member working off-farm (Davis, 2000).

Studies reveal that demographic characteristics of the household members such as gender, age, ethnicity (de Janvry and Sadoulet, 2001) and secondary education (Araujo, de Janvry and Sadoulet,.2002) play an important role stimulating off-farm activities. The location of the community including the proximity of the community to an economic center, and the availability of roads connecting the community also affect the propensity to be involved in off-farm activities (Araujo, de Janvry and Sadoulet, 2002).

In Mexico, the main sources of off-farm income come from nonagricultural employment, followed by other income, which includes governmental direct income transfers and welfare programs, and remittances. The *ejido* reforms have had an important effect on this specific asset. Evidence suggests that, after the reform, the diversification toward off-farm activities has considerably increased. Davis (2000) found that the proportion of families participating in off-farm activities rose by 33% between 1994 and 1997, encompassing up to 60% of the *ejido* households. The success of *Procampo* has also increased the dependency of many farmers on this source of off-farm income (direct income transfers).

The impact of off-farm activities on agricultural productivity has not been widely studied. However, it seems agricultural production and off-farm activities are negative correlated. This means the share of total household income derived from off-farm activities is inversely correlated to a farm's size. The exception to this pattern is remittance, which is frequently found among medium size farms (de Janvry and Sadoulet, 2001).

Furthermore, evidence suggests road availability as well as proximity to an economic center influence the effect agricultural output has on off-farm activities. For instance, if there is road nearby and the distance between the rural community and the economic center is not so large, high value agricultural output would promote off-farm activities through service and manufacturing employment growth. On the other hand, if the community is isolated, high value agricultural output would shrink off-farm employment (Arajuo, de Janvry and Sadoulet, 2002).

One of the major strategies of rural households is international migration. Through the years this phenomenon has been expanding in the rural sector. In his survey of *ejido* households, Davis (2000) found that around 45% of the households had either a family member with migratory experience to the U.S. or children or siblings living there. Moreover, around 50% of the households with more than 5 NRE hectares reported some connection with the U.S. Researchers have noticed that the formation of social networks over the years has promoted migration through the reduction of the risk and transaction costs embedded in the migratory experience.

Researchers studying the impact of the reforms anticipated an increase in out-migration in the agricultural sector. Studies measuring the impact of NAFTA, for example, predicted a decrease in rural employment and wages, generating an emigration of as high as 800,000 people from the rural sector, migrating mostly to the United States (Cornelius and Martin, 1993). However, to date this prediction has not materialized. As a matter of fact, the agricultural sector continues employing around 20% of the population (Taylor, Yunez-Naude and Dyer,.1999; Davis, 2000).

Lastly, an important consequence of international migration in the sending communities is remittances, which represents an important source of income in rural areas. In 2003, for instance, Mexican immigrants living in the US sent $14 billion in remittances to their relatives in Mexico (Orozco and Lapointe, 2004). Different studies have been carried out in the impact of remittances on rural Mexico, reaching no consensus on its impact. Chapter 3 discusses in detail the findings of these studies.

Conclusion

This chapter presented an overview of the main changes in the Mexican agricultural sector until the present time. As opposed to past policies, current policies attempt to set the necessary conditions for a market oriented strategy. However, it seems trade liberalization and the retreat of the State, have not made producers more responsive to market signals as expected. In addition, the *ejido* reforms alone have not created enough incentives to increase the productivity in the agricultural sector.

The way the agricultural sector will achieve competitiveness within the international markets remains an enigma. Some believe that big private entrepreneurs will bring competitiveness to the sector; others believe small farmers who are now land owners and with government assistance will be able to gain competitiveness in the international market, bringing new forms of self-employment and poverty alleviation (Quintana, Borquez and Aviles, 1998). Research in this area is still limited.

As mentioned before, the impact off-farm activities on agricultural productivity has not been widely studied. The next chapter will be devoted to migration, one of the off-farm activities rural households rely upon heavily, and its linkage to the agricultural sector in rural Mexico.

CHAPTER 3
MIGRATION AND AGRICULTURAL PRODUCTIVITY

Introduction

Migration is being increasingly considered in the literature on agricultural productivity in developing countries. This is because migration has become a common practice for many rural households world-wide. Migration has been found to affect a household's decisions in three important ways. First, migration reduces the labor availability of the household; second, it generates an increase in the household's income through remittances sent by the migrant; and third, it strengthens the formation of social networks, which can be used to promote the migration of other household members. The aim of this chapter is to review the existing literature on this topic.

In order to understand the impact of migration on the agricultural sector of the home country, specifically the way in which the household's structure changes due to the migration of one of its members and its impact on productivity, it is fundamental to study not only the demographic characteristics of the migrant and the household, but also to understand the composition of the migratory flows, the macroeconomic factors inducing the migration (Orrenius and Zavodny, 2005;Cornelius, 2001;Jones, 1995;Donato, 1999;1994), and the inherent dynamics of migration (Davis, Stecklov and Winters, 2001; Massey and Espinosa, 1997;Massey, Goldring and Durand, 1994).

In the specific case of Mexico, migration has become a common practice in rural Mexico. According to the CONAPO the number of Mexicans engaging in a migratory experience to the U.S. reached 3.3 million between 1990 and 2000. Furthermore, remittances have become an important part of the Mexican economy reaching the second place in source of foreign currency after oil exports. The structure of this chapter is the following. The literature on Mexican migration is reviewed first, followed by the literature on labor out-migration and agricultural productivity.

Mexican Migration Literature

Immigration Reforms in the United States

The Mexican agricultural sector has always been very close linked to the agricultural sector of the United States. Some factors explaining this relationship include the geographical closeness between the countries, the similarities in climate, the bonds among relatives and economic factors. In the specific case of the labor market, the immigration laws have also played an important role in connecting the agricultural labor markets of the two countries. The major U.S. immigration reforms during the twentieth century are described below:

The *Bracero* program

Migration of Mexican farmers to work in US fields has been a common practice since the 1940's. The first major Mexican migratory flow took place during the *Bracero* Accord, which was implemented between 1942 and 1964 to face the shortages of agricultural labor in the United States as consequence of World War II. The *Bracero* program allowed Mexicans to migrate temporarily for agricultural employment in the United States encouraging seasonality in migration flows, with cyclical movements across countries (Donato, 1994). This program comprised approximately 4.5 million Mexican agricultural workers in total (Massey and Espinosa, 1997).

During the same period, the U.S. Congress also passed the Immigration and Nationality Act (INA) of 1952 promoting the allocation of visas to relatives of US citizens and *bracero* workers believed not to have an adverse impact on the US labor market. Consequently, many relatives of Mexican farmers enrolled in the *Bracero* program were able to apply and get visas.

After the *Bracero* program ended, there was a decline in the number of visas issued to Mexicans. For instance, prior to 1965, there were no numerical limits to the legal entry of Mexicans; in 1965 Mexico was placed under a hemispheric quota of 120,000, meaning Mexico had to compete with other Latin American and Caribbean countries for visas. In 1976, it was placed under a country quota of 20,000; in 1978 it was included under a global ceiling of 290,000; and in 1980 the global ceiling was reduced to 270,000 (Massey and Espinosa, 1997).

Immigration Reform and Control Act (IRCA)

Decrease in opportunities to enter the country legally, led to an increase in illegal migration to the United Sates. Indeed, the percentage of migrants leaving Mexico illegally increased from 37 percent during the *Bracero* program to 53 percent in 1965-68. Taking into account this situation and in an attempt to reduce undocumented migration to the United States, in 1986 the U.S. Congress passed the Immigration Reform and Control Act (IRCA).

This Act generated several measures to stop the illegal migratory flow. These included increased border enforcement, employer sanctions against those who knowingly hired undocumented migrants, a supplemental guest worker program, a modification of the H-2 program, and amnesty to migrants already resident in the United States (Donato, 1994; Iwai, Emerson and Walters, 2006).

There were two groups of immigrants that were eligible for legalization under IRCA: the first group was formed by those who had resided in the United States since before January 1, 1982; the second group were seasonal agricultural workers enrolled in the Special Agricultural Worker (SAW) Program and employed for a minimum of 90 days in the year prior to May, 1986. Three million Mexicans applied for legalization, and nearly 2.7 million were granted permanent residence (Rytina, 2002; Orrenius and Zavodny, 2005). Of this total, approximately, 1.3 million belonged to the second group (Iwai, Emerson and Walters, 2006).

Border enforcement

In spite of the endless efforts to stop illegal immigration, the number of illegal migrants entering the United States continues to increase. In 1992, Donato (1994) found that 73 percent of the migrants undergoing a first trip entered the United States without documents. Moreover, studies suggest that the Mexican illegal population in the United States has grown from 1.1 million in 1980 to 2 million in 1990 and 4.8 million in 2000, with an average annual growth of 90,000 in the 1980s and 280,000 in the 1990s. From the total population of unauthorized residents in the United States, Mexicans account for 69 percent of the undocumented residents (Angelucci, 2005).

In the search to stop illegal entry, the government has turned to border enforcement to decrease illegal immigration, especially since the 1986 IRCA. In the last two decades, the U.S. government has raised the enforcement budget of the U.S. Border Patrol from $290 million in 1980 to $1.7 billion in 1998 and more than $2 billion in 2006. Two additional pieces of immigration legislation passed after IRCA related to border enforcement were the Immigration Act (IA) of 1990 and the Illegal Immigration and Responsibility Act (IIRA) of 1996 (Carrion-Flores, 2007). The current debate regarding building a wall on the southern border and the huge expenses inherent in this project, questions the effectiveness of this measure to stop people from entering the country illegally.

The Evolution of Mexican Migration

Migratory patterns

Researchers working on Mexican migration have observed three migratory patterns: permanent migration, characterized by a long interval migration (more than five years), where migrants normally achieve legal status; temporary migration, characterized by shorter trips done mostly illegally; and return migration, characterized by the return of the migrant to the home country for either a period of time or forever. Temporary migration if done continuously is known as cyclical or repeating migration and is also associated with illegal migration.

In the literature, permanent migrants are commonly more skilled, with better jobs and opportunities than temporary migrants. When an individual first migrates to the foreign country, he usually has little or no skills valuable in the foreign labor market; only after some years when the migrant has learned certain skills such as the foreign language and has acquired some experience, can he aspire to a better job and look for a legal status (Borjas, 1984).

When the phenomenon of migration occurs both the receiving and the sending country undergo a change. Most of the research studying the impact of migration on the United States has focused on analyzing legal migrants, based on permanent migration. This is due to data constraints: data availability still plays an important role in defining the unit of study and most data on illegal immigration is limited. In the case of Mexico, data availability is a constraint because most of the databases on migration are not nationally representative. Also they only keep track of temporary migrants who return to the country of origin at the time of the survey. So much of the analysis on migration in Mexico focuses on temporary migration.

Cyclical migration has been the migratory pattern dominating the Mexican migration literature. Since the implementation of the *Bracero* program and until the 1990's, studies have found that Mexican migrants migrate to the United States repeatedly. This cyclical pattern becomes evident in a study carried out by Angelucci (2005), where Mexican migratory inflows and out flows were calculated. In the study it was found that the migratory inflow of Mexicans between 1972 and 1993 rose to 1,265,000 people, while the outflow was around 95% of the annual inflows (Angelucci, 2005).

Many researchers view Mexican migration to the United States as a self-perpetuating process. As the amount of prior U.S. experience grows, and the number of trips to the U.S. increases, so does the likelihood of repeat migration. Apparently, the nature of cyclical migration is associated with the changes in the family life cycle: increasing for young, unmarried men, falling with marriage, and then increasing again as children grow and the household's consumption needs rise (Massey and Espinosa, 1997).

Kinship ties also play an important role in the migratory decision. Once the migrant has achieved the reunification of the family in the host country, the probability of returning to Mexico is reduced significantly. Better-educated migrants are more likely to shorten their trips compared with less-educated migrants. The migrant's geographic location of origin also affects the duration of the trip. It seems distance is positively correlated with the duration of the trip. Furthermore, migrants coming from rural areas also spend more time in the United States compared to those coming from urban areas (Carrion-Flores, 2007).

Finally, the cyclical migratory pattern of Mexican migrants has begun to change in the past two decades, as border control has become more rigorous. Apparently, Mexican migrants are very sensitive to changes in border enforcement because they perceive it as an increase in the cost of migration, reducing migratory inflows to the United States (Hanson and Spilimbergo, 1999; Orrenius, 1999**)**. At the same time, it discourages recurrent returns to Mexico, and consequently lengthens the time spent in the United States. For instance, a one unit increase in border controls has proved to decrease the individual likelihood of returning to Mexico by 31.8 percent. This means that if normally 46% of the illegal residents in the United States return to Mexico each year, an increase in one unit of border control reduce the number of returns by 31% percent (Angelucci, 2005).

Migratory flows

In conjunction with the migratory pattern, the composition of the migratory flows has also experienced significant changes during the twentieth century. As mentioned above, economic conditions, social ties, and political issues such as border enforcement play a determining role in inducing or deterring the migration of Mexicans, primarily undocumented, into the United States.

Economic conditions in both Mexico and the United States have proven to influence the individual decision to migrate to the United States. For instance, an increase in the U.S. expected wage is commonly associated with an increase in the length of the trip (Carrion-Flores, 2007). Furthermore, a 10% decrease in the real Mexican manufacturing wages is associated with at least a 6% increase in attempted illegal border crossings (Hanson and Spilimbergo, 1999). And, older migrants are more responsive to increases in U.S. farm wages, while nonagricultural wages and the minimum wage in the United States have greater influence on sons' migration decision (Orrenius and Zavodny, 2005).

When measuring self-selectivity among undocumented immigrants from Mexico, research suggests that higher average U.S. wages and higher minimum wages are associated with more and less-skilled immigration that lead to a negative selection process. Improved conditions in the Mexican economy lead to less migration but also to relatively lower education levels among those who do migrate. In general, skilled workers seem to be more responsive to changes in the Mexican economy and the unskilled, more responsive to changes in the economy of the U.S. It seems skilled workers in Mexico are more tied to the Mexican economy through physical or human capital, making it more difficult to react to temporary changes. In addition, skilled workers, unlike unskilled workers, are able to use their savings as a measure to smooth consumption for a longer period of time (Orrenius and Zavodny, 2005).

Demographics of the migratory flows have also experienced some changes throughout the years. In a study carried out on first-time migrants' occupational decision, a shift toward non-agricultural jobs was found in the recent years. During the *Bracero* program around 76% of the migrants worked in agriculture on their first U.S. trip. After 1964 however, this percentage dropped by 30% percent. Since then, many migrants have shifted toward unskilled jobs such as manufacturing, service and construction. Furthermore the number of migrants employed in skilled jobs increased from 3 percent to 14 percent of total migrants between 1942 and 1992 (Donato, 1994).

Immigration reforms in the United States have been an important factor defining the demographics of the migratory flows. During the 1942-1964 period migration was comprised primarily of men over 15 years of age, with almost half of them being *bracero* workers. After 1964, when many *bracero* workers achieved legal status and were able to sponsor their families, the composition of cohorts changed. Women and children were increasingly likely to leave on a first trip.

As more restrictions were implemented and the likelihood of entering the United States legally reduced, the flow of women continued to increase while the flow of children was reduced dramatically. For example, the percentage of migrants less than 15 years old dropped from 20 percent in 1977-1981 to 14 percent in 1987-92. On the contrary, women migrating to the United States increased from 28 to 32 percent between 1969-76 and 1977-81 respectively.

In addition, studies suggest border enforcement is not only affecting the age and gender of the composition of the migratory flows, but also their level of education. The idea behind is that border enforcement represents an increase in the cost of migration, making it more difficult for unskilled workers to raise that money and consequently limiting the migration to only those who can. Higher-skilled workers are more likely to migrate, increasing positive selection among illegal immigrants (Orrenius and Zavodny, 2005).

On the other hand, it has been found social ties affect migratory flows by reducing of migration costs. Using social network as a proxy for migration cost and dividing the sample into communities with low and high-migration costs, a study found that about 38% of households head living in low-cost communities have ever migrated to the United States; while 30% have done so in average-cost communities; and only 17% in high cost communities (Orrenius and Zavodny, 2005).

Causes of Migration

There is no consensus in the literature on migration about what causes individuals to migrate. Different approaches have been developed and employed in different contexts. The most widely used until recently, however, is an economic decision-making framework in which the individual migration decision is based on comparing the expected net present value of income in the destination country and in the place of origin. Todaro (1980) formalizes this framework and predicts that migration occurs only when the expected net present value of the earnings (net of transportation cost), weighted by the probability of employment at the destination country is positive (Chiswick and Hatton, 2003; Moretti, 1999).

Other approaches have been developed as alternatives to understand the causes of migration. Most of these models re-introduce the importance of the social context as an explanatory tool of migration. For instance, a sociological approach of migration relies on components such as cultural[18] and social capital to understand migration decisions (Castles,

[18] Cultural capital is defined as the knowledge acquired about other societies and the work opportunities they offer, including information about the labor market and the living conditions. Social capital is more commonly used specially in terms of social networks and refers to the connections established among relatives, friends or people in a community to reduce the transaction costs and risks of migrating (Castles,2002).

2002). Complementary reasons inducing migration include a demographic approach (Massey, Goldring and Durand, 1994). However, the model that has gained acceptance and become an important conceptual framework for migration in the recent years is the New Economics of Labor Migration approach (NELM) (Stark and Bloom, 1985).

This approach studies the prospective migrant as a social agent involved in a family's and community decision-making. The migration decision is linked to the family's strategy to manage uncertainty, diversify the income portfolio and alleviate liquidity constraints through remittances (Castles, 2002; Stark, 1991). In consequence, the model suggests migrants, although separated physically, maintain relationships with their families during the migratory process.

In the specific case of Mexico, Mexican migration to the United States has proven to be determined by factors other than just the economic condition of the two countries. Furthermore, as noted previously, a common practice of rural households is the diversification of their sources of income, which suggests households entail a risk-averse complementary income generation strategy to confront incomplete or non-existent markets (Davis, Stecklov and Winters, 2001). For this reason, this research will use the NELM approach as a framework to model Mexican migration.

Impact of Migration in the Sending Communities

Sociologists have extensively studied the relationship between migration and community development, paying special attention to the links migrant establish with people and communities located in nations other than those to which they migrate (Vertovec, 2004). From this point of view, physical barriers as well as the physical location of the migrant lack of importance and instead efforts are made to quantify the participation of immigrants in the economic, political and cultural life of their country of origin through the constant flow of ideas, money, and information. (Portes, Escobar and Radford, 2007). This stateless way of studying migration is known as transnationalism in the sociological literature.

In his work, Castles reinforces the idea of transnationalism by reformulating the role of the immigrant under the new conditions of globalization. He argues that a global world would also affect the way migrants are conceived. Migrants will be each time more diverse in social and cultural attributes, and the types of migration will not be limited to the three types mentioned in the last section. New types of migration will include the repeated, circulatory and retirement migration. Also the worldwide use of internet and the improvements in transportation are expected to strengthen informal networks improving communication and organization among its members. According to the transnationalism literature remittances and hometown associations represent two important aspects of migrant transnationalism.

Remittances

Studies on the effects of migration in the sending country began receiving special attention, as the amount of remittances sent by the migrants to their families and home communities increased and became significant in volume. For instance, in 2003, Mexican immigrants living in the US sent $14 billion dollars in remittances to their relatives in Mexico. Also, the estimated amount of annual remittances in the world-wide is over $100 billion dollars (Orozco and Lapointe, 2004).

Given this inflow, that promises to increase in the coming years, researchers are motivated to study the use and impact the remittances have on the household’s economic activities, taking into account that in most cases, migrants came from rural areas. Until now, however, the research on remittances has led to contradictory results and no consensus has been reached on the impact of remittances in the sending country.

Positive evidence on development suggests remittances are directly invested in the development of small businesses such as manufacturing and craft companies, as well as in the purchase of productive inputs such as land, seeds, fertilizers and livestock. On the other hand, the negative findings indicate that remittances are not invested in productive activities but on the contrary, are spent on consumption goods such as food, cars, radio and television. Also, these are found to create big inequalities among community members and create a "culture of economic dependency" (Vertovec, 2004). Furthermore, there is the concern that remittances reduce the supply of labor by recipients in the labor market, affecting the economic activity adversely (Chami, Fullenkamp and Jahjah, 2005).

In another study, it has been found that the productive use of remittances is positively associated with education. In general terms, better educated migrants are more likely to have their recipient families invest their remittances in housing or productive capital instead of spending it on consumption or nondurable goods (Durant et. al., 1996). When introducing remittances into a family context model, where the relationship between migrant and family is characterized by altruism, it has been found remittances serve as compensatory transfers to help families overcome financial constraints created by poor economic performances (Chami, Fullenkamp and Jahjah, 2005).

Finally, in research using a disaggregated, rural economy wide modeling (DREM) approach, an increase in migrant's remittances by 10% was simulated. This increase in direct transfers translated into a rise in international migration, which in turn drove up the cost of agricultural labor by 1% negatively affecting cash crop and commercial maize production by between 0.5% and 2%. However, the income of household groups accessing remittances increased between 2% and 5%. An interesting fact is that remittances stimulate subsistence household’s consumption demand for maize, driving up the shadow price of maize and stimulating subsistence production (Taylor, Dyer and Yunez-Naude, 2005).

Hometown associations

There is a long history of migrants collecting money and sending it to home communities for collective benefits. However, it was not until the 1990s that the study of these associations increased. A hometown association can be defined as an organization of immigrants from the same town in a host country who meet for social and multi-aid purposes (Caglar, 2006).

Activities performed by these associations vary greatly. Some are involved in charitable work, such as enhancement of the church or the graveyard, while others focus on infrastructure improvement, such as building sewage treatment plants, providing electricity, paving roads, and improving health care and school facilities. They can also serve as means of fundraising when natural disasters occur, or for the celebration of the town patron.

The characteristics of members are as diverse as the activities performed by these associations. In a study of associations from three Latin American-origin immigrant groups in the East Cost of the United States, Portes, Escobar and Radford, (2007) found that the personal characteristics of the immigrants play a determining role influencing the activities undertaken by an organization. Some of these characteristics include the education, age and legal status of the immigrants, as well as their duration in the host country and their origins (rural or urban) For instance, migrants coming from rural areas tend to create associations not linked to politics while immigrants from urban origins tend to become more involved in the politics of their countries. Yet, it is difficult to generalize from these results.

In combination with the immigrant’s background, the policies developed by the sending government can also determine the investment decisions of the associations. Some of the schemes and financial incentives that have been used to channel the hometown associations

(HTAs) investments consist of reduction in tariffs on the importation of machinery and equipment, preferential access to capital goods as well as joint-investments between local government and migrant organizations (Caglar, 2006).

The Mexican Government has played a leading role directing the course of the HTAs activities in the country. Its major effort culminated in the creation of the Institute of Mexican Abroad (IME) to promote the participation of these associations (Portes, Escobar and Radford, 2007). Another initiative of the government was The Citizen Initiative Program 2x1 created in the 1990s, in which for each dollar raised by the hometown associations, the federal and state government each contributed a dollar to a community project. In 2002, the program was changed into 3x1 to incorporate the municipal governments into this program (Orozco and Lapointe, 2004; Vertovec, 2004).

In summary, the Mexican migration literature suggests that the demographics of the individual, the creation of social networks, and the economic and political condition of both countries affect the way in which the migratory process evolves. The literature also highlights the enormous heterogeneity that exists among the migrants working in the United States. These factors need to be taken into account when modeling. Now we turn our attention to the agricultural productivity literature to study the way in which the decision of migration affects the farming practices of the migrant households compared to non-migrant households.

Labor Out-Migration and the Agricultural Productivity Literature

There is an extensive body of literature that relies on agricultural productivity to measure the efficiency of the allocation of resources. Agricultural productivity is commonly defined as the ratio between total output and total input measured in a given time period (Christensen, 1975). There is no consensus on the way agricultural productivity should be measured.

Researchers use partial or total productivity, gross or net productivity depending on the aim of the research and the availability of data (Dovring, 1979).

Land productivity is a topic that has focused the attention of many researchers. The impact of tenure security on agricultural productivity and the findings on farm size-productivity relationship are summarized by (Kimhi, 2003; Johnson, 2001; Hayes, Roth and Zepeda,1997). Land management decisions such as crop choice, planting dates, fertilizer use rates and capital use have also proven to impact crop yields.[19]

In the specific case of labor productivity, there is an extensive body of literature studying the impact of migration in the host country (Napasintuwong and Emerson, (2005); Iwai, Napasintuwong, and Emerson, (2005); Hashida and Perloff, (1996)) but the study of labor out-migration and its impact on the agricultural productivity in the sending community is a small but increasing research area that has attracted the interest of researchers in the last decade. The idea of introducing migration into the agricultural productivity analysis of the local of origin is that national as well as international migration reduces the labor supply in the community, affecting the farming practices decisions of the household, which in turn can lead to a change in productivity.

This topic has recently gained the attention of agricultural economists due to several reasons: first, the growth in volume of migration; second, most migrants come from rural areas where agriculture remains one of the primary economic activities; and third, migration, through the flow of remittances, is expected to alleviate liquidity constraints, caused by credit and other markets imperfections in the rural economy, enabling farmers to invest more heavily in enhancing productive assets.

[19] For a list of papers exploring the relationship between crop management and productivity see Pender et.al. (2003), Jansen et.al. (2006) and Tittonell et.al. (2007).

The literature on migration and agricultural productivity in the home country can be divided into two main areas. The first basically focuses on the study of migration and the way it affects the farming practices of the household through changes in input use, the second is relatively new and introduces the concept of gender into the labor out-migration analysis. We summarize this literature in below.

Changes in Farming Practices and Decisions

No consensus has been reached on the way migration influences the farming practices and decisions of the household. Migration is used in different circumstances either as a strategy to enhance the productive use of inputs or as a mechanism for moving out of agriculture. Most of the empirical work; however, coincides in finding differences in the farming practices of migrants compared with non-migrants households.

How migration is incorporated into the model also varies greatly from one study to another. Some studies use a Total Factor Productivity approach (TFP) in their analysis to estimate a production function and evaluate the effects of migration on the crop output (Nonthakot and Villano, (2008); Ortega-Sanchez and Findeis, (2001)). Other studies adopt a partial productivity methodology and focus their analysis on the effect of migration on a specific farming practice (Mendola, 2008; Miluka, et.al. 2007).

Using a cross-sectional household survey, Mendola (2008) tests whether migration stimulates the use of high-yielding seed technology in rural Bangladesh where labor migration has been an enduring phenomenon. The empirical analysis of this paper, based on the NELM insights, addresses the fact that farm households typically face income uncertainty, and measures the effect of migration on risk-taking behavior in agricultural production. An important contribution of the paper is the differentiation the author makes between temporary-domestic, permanent-domestic, and international migration to account for heterogeneous household migration strategies. .

The author finds that households engaging in international migration, which normally have higher initial asset holdings to support migration expenses, are more likely to employ modern farming technology, such as HYVs of rice, thereby achieving higher productivity after migration of a household member. Asset-poor farm households are more likely to engage on domestic migration, and rely more on conservative strategies, which do not drive production increases.

Mendola (2008) argues that the success of migratory practices, as an income diversification strategy and as promoter in risk-taking behavior among farmers, depends heavily on the initial asset holdings of the household. This means that if rural policies are not implemented to help farmers overcome the uncertainties linked to agriculture, asset-poor farm households, unable to pay the costs of international migration, will be kept marginalized and in a persistent poverty trap.

Miluka, et.al, (2007) study the case of Albania, where 54 percent of the population resides in rural areas and agriculture still employs around 50% of the workforce. Following the New Economics of Labor Migration (NELM) approach, the authors analyze the allocation of labor and capital resources in the household as a consequence of migration. Their objective is to measure the effect on agriculture of changes in labor supply availability and the gain in access to working capital or credit, due to the inflow of remittances.

They first study the impact of migration on the family labor hours spent in agriculture, finding that members of households with migrants abroad work significantly fewer hours in agricultural production. However, women in migrant households work proportionately more than men, when compared with their counterparts in non-migrant households.

Then they measure the impact of migration on non-labor input expenses in agriculture to measure the effect of migration on the investment in productivity-enhancing assets. They conclude that migrant households do not seem to invest in more productive techniques such as chemicals, fertilizers and machinery. Instead, migrant households are shifting toward livestock production. This result is intuitive since the shift toward less labor-intensive activities such as livestock production can be explained by the fact that male activities are being replaced by female activities within the migrant household.

In the case of Mexico, Ortega-Sanchez and Findeis (2001) estimate the labor out-migration impact on corn farmers of the central and southern regions of the country. However, as opposed to the studies of Albania and Bangladesh, they study labor out-migration without differentiating between internal and international migration. Instead they partition their sample according to migration status (migrant households *vs.* non-migrant households), agricultural environment (traditional, semi-modern and modern farming practices) and household typology (classification of households by asset endowment or access to it) using discriminant analysis. The idea is that differentiated access of land, agricultural machinery and family labor affects the way labor out-migration impacts the production system.

In opposition to the previous studies that focus on the NELM approach, Ortega-Sanchez and Findeis (2001) rely less on borrowing and liquidity constraints and focuses their research on analyzing rural labor markets imperfections. Specifically, they note family labor faces two major imperfections: the potential moral hazard problem linked to in-hired labor doing tasks that require intensive effort; and the difficulty of replacing farmers with knowledge and organizational leadership for traditional farming practices. Overcoming these market imperfection problems requires costly supervision or adjustments to farm production. The question that remains unanswered is the ability of migrant households to overcome these imperfections.

They hypothesize that outmigration reduces the productivity of farm resources and causes a malfunctioning of the agrarian production system. Estimating a sequential production function Ortega-Sanchez and Findeis find that labor outmigration does have an impact on the household's productivity. For instance, they find higher output and productivity levels in non-migrant households that use traditional or semi-modern techniques compared to migrant households using the same techniques. The same relationship is found for households with low-asset endowments. This relationship, however, does not hold for migrant households using modern techniques or with high-asset endowment. These findings support the idea that the impact labor out-migration has on agricultural productivity depends not only on the household's initial endowments but also on how labor-intensive the farming practices of the households and the household's ability to substitute family labor with reciprocal or in-hire labor.

To analyze the substitution capacity of the households, Ortega-Sanchez and Findeis (2001) calculate the partial elasticity of substitution, differentiating by household migration status. They find similar elasticity ratios across inputs and tasks for households in both groups. This finding suggests that the difference in output and productivity might be due to some sort of inefficiencies in the migrant households. Such inefficiencies, however, are not observed in migrant households using modern techniques or with high-asset endowment.

Another recent study carried out in Mexico by Taylor and Lopez-Feldman (2007), focuses on the ways in which labor out-migration influences incomes and productivity of land

and human capital. Using the ENHRUM[20] survey, they estimate a switching regression model with cross-section income for 2002 and retrospective data on international migration dating for 1990. Their findings suggest that migration to the United States increases the per capita income of households.

They find that households with a migrant in 1990 had higher marginal returns to land in 2002 than households that did not participate in migration. This finding suggests that a lapse of time is required before the effects of migration on productivity can be observed. In the case of human capital, they find that an additional year of farmer schooling has a significant and positive effect on total income in households without a U.S. migrant and no effect in households with migrants. This findings suggest that local wages is important in the migration decision of the household.

Nonthakot and Villano (2008) pick up on the unresolved question regarding whether remittance incomes enhance production enough to compensate for the reduced availability of labor (Mochebelele and Winter-Nelson, 2000; Rozelle, Taylor and DeBrauw, 1999). They study rural-urban migration in the northern part of Thailand, where seasonal migration has been a common practice especially during the dry seasons.

They estimate a stochastic production function to evaluate the effects of migration on the mean maize output. Their findings suggest that indeed labor shortages, caused by migration, negatively affect maize production. Nevertheless, they also find that remittances as well as the period of migration have a positive effect on decreasing technical inefficiencies. This means that the longer the duration of migration, the greater the chances are that the migrant will send an important amount of remittances to the household, allowing it to invest more income to improve production efficiency.

[20] The acronym stands for Mexican National Rural Household Survey .

They also find that age and education have a negative association with technical inefficiency, inferring importance of experience and knowledge in improving farm management practices. Finally, the migrant farms computed an average technical efficiency of 86 percent, which is ten percent more than the coefficient registered for non-migrant farms. These findings support the idea that migration can help relax liquidity and credit constraints, allowing households to buy productivity-enhancing inputs such as chemicals and fertilizers and to hire pre- and post-harvest labor for their farming operations in a timely manner.

Gender Productivity

Another important consequence of outmigration, in addition to shortages in labor and remittances, has been the shift from male to female labor in agriculture. This shift in roles within the migrant household has introduced the study of gender productivity into the labor out-migration literature. In the gender productivity literature, studies have been done to analyze the impact of gender discrimination on the allocation of agricultural inputs (Deere and Leon, 2003; Doss and Morris, 2001); the effect on production of the intra-household allocation of resources among the household's members (Udry, 1996); and the gender differences in production between male- and female- headed households (Masterson, 2005; Holden, Shiferaw and Pender, 2001; Jacoby, 1992; Lastarria-Cornhiel, 1988).

In the labor out-migration and agricultural productivity literature, the way in which the gender effect is modeled depends on the availability of data on the ownership of land as discussed in Quisumbing (1996). In the database used in our study 14% are female-headed households; however, only 5.4% percent of these households work the land and less than 1% has undergone a migratory experience, making it difficult to carry out inter-household comparisons. In this case, gender effects can only be measured in terms of the intra-household allocation of resources.

Most of the empirical work done on the intra-household gender effect of labor out-migration has been carried out in Africa. According to Mabogunje (1989), for example, the outmigration of farmers in the Sub-Saharan African agrarian economies has led to the reorganization of the traditional labor supply institutions and the changing role and status of women. It has been observed that agricultural production has had to adjust toward tasks that are less labor intensive, and women have started assuming an active role in the decision-making of the household.

Additional studies from South Africa coincide in the belief that farms without male labor are at disadvantage compared to other households. Farm households in South Africa with the male migrating to another place, for example, experience lower productivity per acre and per worker due to the shortages in labor the migrant household face (Masterson, 2005). Mochebelele and Winter-Nelson (2000) analyze the effects of gender on farms estimating the technical efficiency coefficients for each group, taking into account migratory status. With an average technical inefficiency of 0.24 for female and male managers in the migrant sample and of 0.37 and 0.35 for female and male managers in the non-migrant sample respectively, the author concludes that within each migratory group, the gender-based estimates are not significantly different from the sample estimates, suggesting no gender bias in technical inefficiency. The findings that both male and female farm managers benefit from having a household member away shows that the benefits of migration, through remittances, is not gender biased.

In the case of Latin America, and specifically Mexico, female labor is more oriented toward household domestic activities making it much harder to analyze the efficiency of the allocation of resources. Furthermore, the division of labor in agriculture tends to be complementary, female and male. In addition, as mentioned before, the availability of data on female-headed households undergoing a migratory experience is scarce. For these reasons, the literature in this topic is still very limited.

Conclusion

This chapter presents an overview of the evolution of the Mexican migration during the twentieth century and summarizes the exiting literature on labor out-migration and its impact on agricultural productivity. In general, no consensus has been reached on the way migration influences the farming practices and decisions of the household. However, it has been noticed that the household's initial endowments as well as the type of migration entail different effects of labor out-migration in the sending community. Furthermore, it has been found that, in general, remittances are being used to relax credit constraints and improve the farm management practices of the household. On the other hand, the study of labor out-migration on gender is still limited.

In the case of Mexico, the analysis of the way in which migration affects productivity in rural households is still limited. Existing studies suggest important differences between migrant and non migrant households. Furthermore it has been found that the effect of labor out-migration on agricultural productivity depends not only on the household's initial endowments but also on how labor-intensive the farming practices of the households are, and the household's ability to substitute the family labor with reciprocal or in-hire labor (i.e. the way the rural labor market works).

Chapter 4 describes the database and explains the methodology that will be used in this study to analyze labor out-migration in Mexico and its potential impact on agricultural labor productivity.

CHAPTER 4
DATA ANALYSIS AND METHODOLOGY

Introduction

Building on the theoretical foundations and substantial empirical research highlighted in the previous chapters, my hypothesis is that labor productivity in migrant households is greater compared to the labor productivity of non migrant households. Adopting a NELM theoretical framework and reasoning (Castles, 2002; Stark, 1991), my primary hypothesis is that, as a household strategy to manage uncertainty and market imperfections, migrant households maintain their agricultural production level by investing more in capital-intensive inputs to compensate for the reduced labor force availability due to the migration of at least one of the household members.

That is to say, among migrant families, the availability of labor measured as the total number of days worked in agriculture is expected to fall as members in the household migrate. My corollary hypothesis is that labor productivity, measured as the agricultural output generated per day of work will be greater in migrant households compared to non migrant households. To test these hypotheses, my study employs econometric techniques using the Mexican National Rural Household Survey (ENHRUM).

The contribution of this study to the existing literature focuses on three main points. First, we rely on the New Economics of Labor Migration (NELM) approach, using the household as the unit of analysis to study the way labor out-migration influences the labor productivity of rural households. Second, we estimate labor productivity accounting for the selectivity of landholding. The idea behind this is that agricultural productivity can only be measured for those households holding land, and until now no study recognized this selectivity when studying labor productivity. Finally, we introduce into the labor productivity analysis the study of social networks.

This chapter has the following structure. The first section describes in detail the survey and the descriptive statistics of the sample. The second section describes the Heckman two-stage procedure. The third section summarizes the variables introduced in the model. The fourth section tackles the possibility of having endogenous variables in the model. The fifth section presents conclusions.

Data and Descriptive Statistics

The Mexican National Rural Household Survey (ENHRUM)

The Mexican National Rural Household Survey (ENHRUM)[21] is a survey conducted among rural communities in Mexico,[22] that is part of a project co-directed by the Colegio de Mexico (Colmex) and the University of California at Davis.[23] The goal of this project was to obtain a representative survey of Mexican rural society and economy; this sample would enable researchers to study the way in which the agricultural and trade reforms have impacted the production, income and migration of rural households in Mexico.

It is a cross sectional survey which includes 8,520 individuals from 1,765 households in 14 states. According to Mexico's National Information and Census Office (INEGI), who designed the sample the survey represents more than 80 percent of the rural population in Mexico. It was conducted between January and March 2003 and collected detailed socio-demographic and economic characteristics of the households as well as their labor and migratory

[21] EHNRUM stands for *Encuesta Nacional a Hogares Rurales de Méxcio*.
[22] The communities included in the sample contain a population between 500 and 2499 people.
[23] For more information visit http://precesam.colmex.mx/ENHRUM/PAG%20PRIN_ENHRUM_.htm

experience[24]. It also captures the farming practices of the household, sources of income and credit history, among other variables. In addition, it provides information on use of family labor and consumption. The information captured in the household survey has been classified into 12 chapters: housing, household members, plot, crop, livestock, natural resources, other expenditures and incomes, assets, credit and inheritance, household corner store (*tienda)* and fishing.

In addition to the household survey, ENHRUM collected information on the surveyed communities, such as major economic activities, possession land, land characteristics, overall farming practices, use and access to natural resources, migratory patterns and governmental programs, among others characteristics during the months of August and October of 2002. The goal was to provide a generalized picture of the economic, social and political situation of the surveyed communities. The communities were also grouped into five different regions defined by the National Development Plan: Northeast, Northwest, Midwest, Central and South-Southeast[25].

Some drawbacks of the survey are the fact that it is cross sectional data, it does not provide information on return migration or duration of trips, and some of the farming practices were aggregated at the household level instead of the desired parcel/plot level. The first one will not allow us to make inferences across time, such as inferences about whether or not migration has made Mexican Agriculture more or less productive. The migratory history provided by ENHRUM is not as rich when compared to the MMP. Finally, the lack of data at the parcel level does not permit us to make any analysis at the parcel/plot or crop level.

[24] A similar survey is The Mexican Migration Project (MMP), which has tracked information of migratory experience of the head of the households since 1982. However, the MMP does not provide information about agricultural practices.
[25] For a list of the community codes refer to Table 4-1.

Sample Description

Households represent the unit of analysis in this study. According to the NELM literature, migration becomes an intra-household strategy to overcome liquidity and other market imperfection constraints (Castles, 2002; Stark, 1991). Hence, in order to analyze the impact of labor out-migration on agricultural productivity the study needs to rely upon the household to determine how households reallocates the remaining labor and capital resources once the member of the household migrates.

The number of observations in the survey consists of 1765 households (n=1,765). An important feature of this database, however, is that the number of observations in each chapter varies greatly across households. In order to calculate the labor productivity of the household, for example, information on production and labor employed are required. From those households reporting information on plot characteristics (n=871), only 762 (n=762) reported their annual production in the survey and 707 reported the family's labor during the crop cycle (n=707).

For the purpose of this study, those households that reported information on both production and labor (n=707) were the only households taken into account.[26] This group of households is labeled sub-sample B and is the one used to measure the labor productivity at the household level. The labor productivity of the head is also measured separately because the household head constitutes an important asset in the family's labor force. The number of households reporting information on the household's head labor productivity equals 667 and represent the sub-sample A (n=667).

In order to avoid the non randomness nature of sub-sample A and B, we first estimate the probability of households' having access to land and from those that have land, we then estimate

[26] The remaining 164 households reporting information on plot characteristics but not specifically on output and labor force are excluded.

the labor productivity of the household. We defined a household as a land holder if during the survey the household reported information on plot characteristics otherwise it is considered a non landholder. This is a strong assumption, but unfortunately no direct question about possession of land was formulated in the survey. Something to keep in mind is that land tenure is not taken into account under this definition. This means that the plot could be owned, rented or leased and the household would still be considered a landholder.

Sample A consists of 1561 households, of which 894 are non landholders and 667 are landholders. Sample B consists of 1601 households, of which 894 households are non landholders and the remaining 707 are landholders. In sample A we are measuring the labor productivity of the household head assuming the family's labor is a function of the labor force of the head alone. In sample B we are measuring the labor productivity of the household. We are assuming the family's labor is a function of the head, the son/daughter, the wife, the grandchildren and the son/daughter-in-law. Once we described the two samples, we devote what is left of this section to describe the demographic characteristics of our samples. Because sample A forms part of sample B, and in an attempt to avoid duplications, we will focus on the descriptive statistics of sample B in this chapter.

Of the 1601 households conforming sample B, 86.7% are male-headed and the remaining 13.3% are female-headed households. The average age of the household head is approximately 48 years[27]; while the average age of the household spouse is 41 years. 84% of the households are married or live together. The level of education varies greatly across households overall, the level of education can be considered as low. As shown in Figure 4-2., in approximately 17% of the households, the head of the household has no education; in 21%, he/she finished elementary school; in 40% he/she has some elementary school; only 9% finished middle school; and 2%

[27] Figure 4-1 presents a breakdown of the household head age.

finished high school. In the case of the household spouse, in 14% of the households the spouse has no education; in 61% he/she has elementary school; in 14.9%, middle school education; only 3.2% finished or not high school.

Despite the low education rate, the average experience of the household head (in any sector, not exclusively agriculture) is approximately thirty three years. Furthermore, 24.2% of the household heads were employed outside the agricultural sector during their first job. The average number of household members is approximately five,[28] with 29.1% of the households having at least one child between zero and six years old. Finally, 17% of the households in the sample speak an indigenous language at home. The following sections compare sub-samples according to land holders and migratory experience.

Landholder and non landholder mean differences

For the 1601 households in sample B, we have plot level attributes for only 707 of the households, what we have defined as landholders (n=707), the remaining households are considered non landholders (n=894). Now we analyze the potential differences between these two groups. To check for differences in the means, we run a ttest assuming equal variance.

When comparing household demographics, we observe that landholders are relatively older and more numerous than those without land. As shown in Table 4-2, the average age of the landholder head is 51 compared to 46 in a non landholder house. It seems that households speaking an indigenous language are more likely to be landholders. For example, only 6.4% of non landholders speak an indigenous language compared with 30.6% of landholders. In terms of marital status, landholders are more likely to have a partner than non landholders.

Non landholders have on average higher education than landholders, as shown in Figure 4-4. Despite the fact that differences between no schooling and elementary school are not

[28] Figure 4-3 shows the number of members in the households.

observed across heads, differences are observed across partners. The partners of landholders are more likely to have no schooling (18.81%) and elementary school (64.64%) compared to non landholders. Furthermore, the non landholder head is on average more likely to have completed middle education (12.2%) than non landholder heads (5.7%). The same relationship holds for the head partner.

On the other hand, children between zero and six years old are more likely to be present in non landholders households (32.6%) compared to landholders households (24.8%). We also find that the first employment sector of the head affects the likelihood of holding land. For instance, only 9.8% of those that started working outside the agricultural sector hold land in the sample.

In the specific case of the households' liquidity constraints, it is not evident which group faces less of a liquidity constraint. Although landholders receive on average more loans from the bank (6.2%) than non landholders (2%), non landholders are more likely to have an account at a bank (12.6%) than landholders (8.91%).

According to our proxy of income accounting for the annual expenses of the household, we observe that non landholders have greater home expenses during the year $8.454 than landholders $7,350. Furthermore, the program of *Progresa*, which aims to alleviate poverty in rural Mexico, has on average a wider coverage in those households holding land (47.4%) than in those not holding land (25.4%). These two variables give some insight that households not holding land are indeed better off than those households holding land.

When we measure the spatial distribution of the households we notice that households living in the Midwest and Northern part of the country are less likely to be landholders than those households located in the central or Southern part of the country. As shown in Figure 4-5, 33.5% of the landholders live in the South, while another 31.40%, in the Central region of the country. Only 22.7% of non landholders live in the Northwest, another 26% in the Northeast and 22.8% in the Midwest. Despite this fact, the distance from the community to the closest town however does not seem to affect the likelihood of holding land.

In the case of international migration, 19.2% of landholders and 28.8% of non landholders live in communities where the migrant population represents a significant percentage of the total population, specifically more than 20%. This evidence suggests that in fact landholders are less likely to migrate to another country than non landholders; however, one must be careful with this evidence since this variable is being measured at the community level. At the household level there is no significant difference between the two groups in the share of households migrating to the United States, 19% of the migrant households are landholders and 19.4%, of the migrant households are non landholders.

However, when we analyze national migration differences across groups, we observe than indeed landholders are more likely to migrate to another part of the country (51.5%) in the search for a job than those not holding land (43.5%). An explanation for this finding is that households holding land are more likely to seek seasonal work in agriculture in other parts of the country and try to diversify their sources of income working partially in non-farm activities, which most of the time are located outside the home community.

The landholder sample

Landholder sample contains 707 households that were those households that reported information on plot as well as labor productivity during the 2002 survey. According to the sample, on average the size of land a household holds is 9.82 acres, while the average cultivated area is 5.12 acres. One needs to be careful when analyzing these statistics, since farmers in

Mexico are not homogenous. For instance, the annual value of output of these households ranges between zero and more than $69,212,744 pesos.

According to the information obtained in the survey, the majority of the farmers rely heavily on rainfalls for crop production. Only 24.1% of the households reported access to an irrigation system. In terms of tenancy rights, 82% of the households reported to own at least one plot and 55.3% to have *ejidal* rights over at least one plot. Of the households with *ejidal* rights, 55.30% were already registered in *Procede* at the time of the survey.

As explained above, an important limitation of the household survey is that it doesn't capture the input information specific for each crop. So no direct inference can be made on what agricultural inputs are being used to grow which crop. Since our analysis is based on the household's strategy, the relationship between input use and crop pattern was studied at the household-level.

This study analyzes three crops maize, beans and vegetables. As discussed in chapter 2, maize and bean represent Mexico's two major staple crops. Vegetable is a high value crop that after Mexico was admitted into NAFTA, was expected to gain in importance. In general, 77.9% of the households that registered a positive output in 2002 grew maize, 24.6%, beans, and 12.7%, vegetables.

Many farmers in Mexico grow their crops only for subsistence. Indeed, in the survey 55.5% of the households reported no commercialization of their 2002 production. However, for those that reported sales, the average share of crop traded represents 45.4% of their total production. The raising of livestock is also a common practice in rural Mexico (Davis, 2000). The average number of cattle per household equals 2.35.

Chemical use such as fertilizers and pesticides is a common farming practice. On average 62.8% of the households reported to have used fertilizers and 50.4% pesticides during 2002. However, only 23.5% of the households used high yield varieties (HYV). In terms of labor input, the average number of days a household spends in agriculture is approximately 88 days in a year, the head of the household spends the most time (54 days), followed by the wife (13 days), son/daughter (11 days), son/daughter-in-law (6 days), and finally the grandson (4 days).

As mentioned in Chapter 2, two governmental programs promote the adoption of HYV, technical assistance and training among farmers, *Procampo* and Alliance for the Countryside. In the case of *Procampo*, the survey reports that 54.3% of the landholding households received a direct income transfer from this program during 2002. Alliance for the Countryside on the other hand has only reached 36.2% of the communities in the sample.

Migrant and non migrant mean differences

This section analyzes the household's migratory pattern for the whole sample (n=1601). For the purpose of this research, a household is classified as a migrant household if at least one of its members reported having a migratory experience to the United States in 2002. The data reveals that 19.2% of the households had an international migrant in this year. During 2002, when the survey was carried out, 4.8% of these were living permanently in the host country.

There are two main reasons why we follow this classification of migration. First, we are measuring labor productivity at one point in time (2002), so information on labor availability is needed for that specific year. Second, although the survey presents information on the migratory history of the household (1980-2002) the survey does not capture the return date of the migrant, so we cannot differentiate between those who have returned from those who haven't at the time of the survey.

I summarized the mean differences in the demographic variables between the migrant and non migrant households in Table 4-3. We observe, for instance, significant differences in age. The migrant household heads are on average older (52) than non migrant households (47). The migrant household partner is also on average older (46) than the partner in non migrant households (40). No difference in marital status was found across groups.

Households where an indigenous language is the primary language spoken in the household are less likely to undergo an international migration (3.9%) compared to other households where the predominant language is Spanish (20.2%). In addition, migrant households have on average a larger family size but fewer children between the ages of 0 and 6 years old, compared to non migrant households. For instance 30.7% of the non migrant households have children compared to 22.5% of the migrant households. Education at the household head level is only significantly different across groups at the middle school level. Non migrant households are more likely to finish middle school (10.2%) compared to migrants households (5.5%). The education of the partner also varies across groups. In migrant households partners are more likely to have elementary school (67.1%) compared to non migrant households (59.6%) while in non migrant households partners are more likely to have middle school (16.38%) than in non migrant households (8.8%).

Spatial distribution of the households also varies across the two groups. As shown in Figure 4-6., migrant households come predominantly from the Midwest and Northeastern regions. These findings support previous findings on Mexican migration (Massey, 1997; 1994) that affirm that states such as Zacatecas and Guadalajara, which are located in the Midwest, experience a high migratory flow to the United States.

Access to credit is an important limitation faced by many households in rural Mexico. Contrasting the credit situation of both groups, it seems migrant households are more likely to overcome liquidity constraints. Migrant households, for instance, have on average more accounts at a bank. The sending of remittances increases the migrant households' likelihood of having an account at a bank. No significant difference, however, was found across groups when analyzing their ability to get a loan from a bank. When analyzing the household's annual expenses, migrant households spend on average $11,450 while non migrant households only spend $7,159.

Description of landholding households accounting for migratory status

This section focuses on the differences in farming practices between migrant and non migrant households. The analysis takes into consideration only the landholders (n=707) subsample. Table 4-4 summarizes the results of the comparison between migrant and non migrant landholders. At a 90% confidence level we find that migrants possess more land (on average 14. 90 acres), compared to non migrants (8.64 acres). Furthermore, migrant households have on average a larger cultivated area, 7.48 acres, compared to non migrant households, 4.56. Interesting enough, however, there are no differences in output among migrant and non migrant households.

Another surprising result is that on average the number of days the migrant household dedicates to agricultural production is not significantly different from those of non migrant households. This condition holds for all the members of the household (head, wife, son/daughter, son/daughter-in-law, grandchildren). This is an unexpected result, because with the migration to the United States of one of its members, we would expect a significant reduction in the number of days the migrant household spends working in agriculture. Although the differences are not significant, we observe that the head, son and son-in-law in the migrant household spend on average, less days in agriculture than non migrant households. However, the wife and grandson in migrant households spend a little more time in agriculture than non migrant households.

Usage of non labor inputs, however, presents differences across groups. Specifically, migrant households are more likely to adopt capital-intensive and productivity-enhancing inputs than non migrant households. The migrant households, for example, spend on average 81% more on fertilizers and more than the double on seed purchases than the non migrant households. Furthermore, the migrant group is more likely to use machinery (55.2%) during the crop cycle and HYV (32.1%) than the non migrant group (41.7%) and (22.7%) respectively. The usage of pesticide is also larger on migrant households but at a significant level of only $p<0.10$).

No difference in cropping patterns was found when we measured the total production of each crop. However, when considering the predominant crop grown by the household, we find that non migrant households are more likely to assign more than 50% of their production to growing maize, while migrant households, to grow bean. Crop commercialization is also different across groups but only at a significant level of $p<0.10$. Migrant households sell a greater percentage of their total harvest (25.1%) in comparison to non-migrant households (19.3%). The inverse relationship is observed in the volume left for subsistence. In the case of livestock assets, we observe as found in the literature (Miluka, et.al. 2007), that migrant households have a greater accumulation of livestock assets than non-migrant households. For instance, the average number of cattle in a non-migrant household is approximately two, while in migrant households that number increases to almost five.

Participation in governmental programs differs greatly between migrant and non migrant households. For instance, migrant households are more likely to be enrolled in the *Procampo* program (62.6%) compared to non migrants (52.4%), while non migrant households have greater chances of receiving an income transfer from *Progresa* (36.4%) than migrant households (29.6%). *Procede* was not significantly different across groups.

Heckman Two-Stage Procedure

In the previous section two important characteristics of the sample became evident. First, the information on farm management practices is only available for those households with a plot at the time of the survey (44.16% of the households). Second, we are making the assumption that only those households that reported plot information are the ones that hold land. Given these circumstances, using OLS to estimate a non-randomly selected sample would generate biased estimators. The Heckman two-stage estimation procedure deals with the sample selection bias and still analyzes the data by simple least squares methods (Heckman,1979).[29] For that reason the Heckman two-stage procedure will be used in this research. Using this method will allow us to draw conclusions based on the whole sample, taking into account not only the household's agricultural productivity but their likelihood to have land.

The Heckman two-stage procedure is specified by a selection equation defined as follows:

$$L_i = \beta' X_i + \gamma' M_i + \alpha' R_i + \lambda' C_i + e_i \qquad (4\text{-}1)$$

This equation is estimated by maximum likelihood as an independent probit model. In this case, the dependent variable of the selection equation, L_i takes the value of 1 if the household *i* holds land and 0 otherwise. The independent variables, X_i account for demographic characteristics of the household, M_i, accounts for the migratory experience of the household, defined as the migration to the United States of at least one of the members in the household

[29] This method has been commonly used to study female labor market participation and to evaluate programs in the social science field correcting for the selectivity of the samples.

during 2002, R_i is a vector of regional characteristics, C_i is a vector of excluded repressor, and e_i is the error term.

Parameter estimates from the selection equation generate a vector of inverse Mills ratios. This vector represents the estimated expected error and is introduced into the regression equation as an explanatory variable. Only if the dependent variable from the selection equation equals 1, will the regression equation is computed. Thus, the selection equation is the one that determines whether an observation belongs to the regression equation or not (Heckman,1979). In this study for instance, the agricultural productivity of the household will only be computed if households are landholders.

Variables included in C_i are only used to estimate the first-stage of the estimation and are excluded from the regression equation. If the same variables in the selection equation are included in the regression equation, the estimates in the model become very imprecise. This occurs due to the collinearity caused from adding the inverse Mills ratios into the regression equation (Wooldridge, 2001). To avoid this imprecision in the parameter estimates, exclusion restrictions need to be a function of the selection equation but not of the regression equation. The next section discusses in detail the variables that will be included in the selection equation.

$$Y_i = \beta' X_i + \gamma' M_i + \alpha' R_i + \delta' I_i + \lambda_i + e_i \qquad (4\text{-}2)$$

$$e_i \sim N(0, \sigma^2) \qquad (4\text{-}3)$$

The dependent variable in the regression equation Y_i is the ratio of the total output of the household in pesos and the total days the household worked the land during 2002. The output is expressed in Mexican pesos[30] and the labor force in days per year. The independent variables in

[30] The output variable was created using information on crop production obtained from the survey and information on crop prices obtained from a Generic Index published by Banco de Mexico.

the regression equation include X_i explanatory variables that account for demographic characteristics of the household. M_i represents the migratory experience of the household as previously defined. R_i is a vector of regional dummy variables. I_i is a vector of variables that are only observed when the household holds land. λ_i is the inverse mills ratio generated in the selection equation and included as an extra explanatory variable in the regression equation and e_i is the error term. We assume the error term is normally distributed, with mean equal to zero and variance equal to a constant σ^2. The inclusion of the inverse Mills ratio into the regression equation removes the part of the error term correlated with the explanatory variable and deals with the sample selection bias problem. Next we turn to the variables that will be included in the regression equation.

Variables Description

Dependent Variables

Using sample A and sample B we estimate two models. In both, Model 1 and Model 2 the selection equation has as a dependent variable a binary variable taking the value of 1 if the household holds or 0 if it does not hold land (*land*). As mentioned in previous sections, this variable does not account for the form of land tenure; it only accounts for the fact that the household reported information on a plot of agricultural land at the time of the survey. As shown in Table 4-6, most of the households with land own at least one plot (82%), but the household could also be renting or leasing the land at the time of the survey.

On the other hand, the regression equation uses as a dependent variable a ratio of the total output of the household in pesos and the total days the household worked the land during 2002. This ratio serves as a measure of the household's labor productivity. This dependent variable measures the difference in labor productivity among the households. The existing literature on labor out migration has found that migration generates a shortage in the labor supply of the household. With this variable, we plan to measure if the shortages in labor affect the labor productivity of the migrant households compared to the non migrant households.

We calculate the dependent variable in two different forms. Model 1 estimates the household's head labor productivity (*prod*) using sample A. This variable is the ratio of the total production of the household in pesos and the total days the household head worked the plot during 2002. Model 2 estimates the household's total labor productivity (*prodtotal*) using sample B. This variable is the ratio of the household's total annual production and the number of days the members of the household worked the plot during the surveyed year. We assume the household's labor force consists of the head, wife, children, son-in-law, daughter-in-law and grandchildren.

There are two reasons why we want to measure the household head labor productivity apart. First the head of the household is the member of the household who spends on average the largest amount of time in agriculture (54 days). Second, the head is the member of the household with the largest migratory participation to the United States during 2002 (65.2% of the migrants).

Independent Variables

Table 4-5 and Table 4-6 summarize statistics of the selection and regression equation. As noted, Model 1 and Model 2 share the same independent variables. The dependent variable in the selection equation is also the same for both models. The only variable that changes is the dependent variable of the regression equation. Furthermore, the selection and regression equations also share certain variables, such as the demographic, migratory and regional variables. These variables are added in both equations because they affect not only the probability of having land but also the labor productivity of the household. We will first describe the variables both equations have in common and then explain separately the variables unique to each equation.

We are including in the model the following demographic variables: gender (*sex*), marital status (*union*), a dummy for children between zero and six years old (*children*), number of people living in the household, including children (*members*), indigenous language spoken in the household (*indiglanguage*), dummies for education level (*elementary1*, *middle1*, *high1* and *up*), the age of the household head and the age squared (*aged* and *aged2*). The dummy for no school is excluded from the model as comparison variable. The variable *union* accounts for both, marriage and living together. We are keeping both marital statuses together, since we are measuring the share of responsibilities within the household.

To avoid making the assumption that the demographic characteristics of the household head are the characteristics of the entire household we are including in the model the demographic characteristics of the spouse as well. These variables are education level (*wifeelementary*, *wifemiddle*, *wifehigh* and *wifeup*), age (*wifeaged*) as well as age squared (*wifeaged2*). The dummy for no school is also excluded from the model as comparison variable.

In addition to the demographic variables, a proxy variable for income has been created and introduced into both equations (*income*)[31]. This variable is created summing up all the utilities bills as well as other monthly expenses the households registered during 2002. It includes the expenses on water, gas, wood, electricity, transportation, gasoline, television and telephone. It is expected that households spending more are those that are better off.

A variable that controls for national migration will be included in the model (*natmigration1*) as well. The migration variable that accounts for international migration is (*migration2002*). This variable as described in chapter 4 and in the model encompasses those

[31] The *income* variable was divided by a scalar of 1000 to avoid zeros in the estimated parameters.

households that have at least one member in the United States during the survey year. In order to account for the dynamics of migration, a social network proxy (*morethan20*) will be used. Originally, a social network index was built considering the migratory experience of the whole family. However, this variable is potentially endogenous so a variable measuring the percentage of migrants in the community will be used instead.

In Mexico, the farming practices vary greatly across regions. In the Northern part of the country for example, where rainfalls are scarce, there is a well developed irrigation system and agribusinesses is also well developed, while in the South agriculture relies on rainfall and farmers' crops are mainly for subsistence. For this reason, regional dummy variables are also incorporated into the analysis to account for these differences across regions (*south*, *central*, *Midwest* and *northeast*). The dummy for Northwest is excluded from the model as comparison variable.

There are five exclusion variables introduced only in the selection equation. The selection of these variables was made considering those variables that affect the household's likelihood of holding land, but not its farming practices. The first exclusion variable that was chosen is inheritance (*inheritance*). The idea is that many households could have inherited their land and that is the reason why they reported plot information at the time of the survey. However, inherited land does not affect the way the household works the land.

Household's head first employment sector (*hhfirst*) is the second exclusion restriction. It is a dummy variable taking the value of one if the first sector the household head worked in was not the agricultural sector. To control for the possible migration of the household head to other places since his first employment, we take into account only those individuals that remained in the same community where they were first employed. The idea is that employment outside the agricultural sector decreases the probability of having land. For instance, being employed in the non agricultural sector suggests that the father of the head was not a farmer or that within the community there were other employment activities such as tourism, manufacturing and crafts among others.

On the other hand, the other three exclusion variables were created at the community level. The third exclusion variable is a dummy variable that accounts for those communities that have *ejidal* land rights (*perejidallandd*). The idea is that communities with *ejidal* lands increase the odds of households having land but not necessarily the odds of improving the farming practices of the land. The fourth exclusion variable is also a dummy variable that accounts for communities that have community land (*sharedland*). Community land is commonly used for grazing animals or hunting. As before, the communities with shared land increase the probability of holding land but do not affect the farming practices of the households. The fifth exclusion variable is a dummy variable that accounts for those communities where agriculture is an important source of income (*incomeag*). And households in communities dependent on agriculture are more likely to hold land but not necessarily to be more productive.

Independent variables introduced only in regression equation include all those variables related to land, such as: land size (*totalacres* and *plot*), land rights (*ownland* and *ejidalland*) and soil quality (*irrigation*). Dummies for participation in governmental programs are also incorporated in the model (*procampo* and *procede*).

In the case of labor inputs, the labor input we are controlling for in the model is the number of contracted workers (*contracted*), The non labor inputs included in the model are application of fertilizers (*fertilizer*), usage of HYV (*seed*) and usage of machinery (*machinery*).

Endogeneity Issues

Endogeneity problem emerges if an independent variable included in the model is correlated with unobservable variables in the error term. The existence of endogenous variables in the model violates the assumption of the classical linear regression model that the explanatory variable is uncorrelated with the stochastic disturbance term (Gujarati, 2003). In our research, the observable variable, which is migratory experience, can be correlated with unobservable variables not taken into account in the model that affect the likelihood of holding land and consequently the farming practices of the household. .

If the endogeneity problem is not taken into account, the OLS estimators are not only biased but also inconsistent (Gujarati, 2003). Previous works on labor out-migration and agricultural productivity have used instrumental variables to solve the endogeneity problem. For instance Mendola (2008) instruments migration using: the education level of the highest educated household member; the sample proportion of households in the village participating in a migratory experience; and a family chain migration variable. Miluka, et.al. (2007) used knowledge of the language of the destination country, the share of the male population between the ages of 20 and 39, and the minimum distance between the household and the two border crossings. Taylor and Lopez-Feldman (2007) used as instrumental variable historic migration such as a dummy for participation in the Bracero program as well as dummies for internal and international migration participation in the village. The inclusion of instrumental variables in the sample selection model, however, requires complex methods that are beyond the scope of this research.

We used a two-step procedure, as an alternative to the instrumental variable approach, to account for the endogeneity problem of the migration variable. First, a separate logit model for migration is run. Second, the fitted values are estimated and incorporated into the Heckman model replacing the original migration variable. Although this procedure is not optimal, this methodology serves as an alternative estimation procedure to solve the endogeneity of the migration variable. The specification of the logit model is the following:

$$M_i = \beta' X_i + \mu' V_i + \tau' L_i + e_i \qquad (4\text{-}4)$$

Where M_i takes the value of 1 if the household *i* has migratory experience to the United States in 2002, and 0 otherwise. The independent variables, X_i account for demographic characteristics of the household. V_i is a potential instrumental variable of migration. L_i is a dummy variable for holding land and e_i is the error term.

This study uses distance as potential instrumental variable. Two different measures of distance are tested. First, the distance from the capital city of the state where the community is located to the city in the United States that reported to be the primary destination of migrants in the community. Second, the distance from the closest city where the community is located to the nearest border between Mexico and the United States.

Distance can be used as instrumental variable because this variable is correlated with the migratory decision but at the same time uncorrelated with the error term. Distance discourages migration by increasing the transaction costs of migration. The other way around, the closer the community is to the border, the cheaper the transportation and transaction costs to cross. For example, communities near the border have greater access to information on employment opportunities and border enforcement laws making it easier to migrate. However distance does not impact the likelihood of holding land and the farming practices used by the household.

Conclusion

This chapter analyzed the database and the main statistics of our sample. It also presented the methodology of this research and the variables that will be included in our model to estimate the labor productivity of the household. The descriptive statistics clearly suggests demographic differences among households, especially between those holding and not holding land. In addition, migrant land holders exhibited in general greater investment in farming practices such as usage of chemicals and seeds than non migrant households. As opposed to our expectations, no differences in labor inputs were found across households.

In the description of the sample it also became evident the non randomness nature of the data and the importance to account for it in the model. A Heckman Two-Stage procedure is carried out to account for this truncation in the data and the inclusion of the logit predicted values into the sample selection model is used to account for the endogeneity of migration in the model. In the next chapter, I present and analyze results from the estimation.

Table 4-1. The ENHRUM community codes

R	Name	State	Name of Municipality	Name of Community	Code			
1	South-Southeast	Oaxaca	Magdalena Tlacotepec	Magdalena Tlacotepec	1	20	053	0001
			San Juan Bautista Cuicatlan	San Jose del Chilar	1	20	177	0007
			San Juan Juquila Vijanos	San Juan Juquila Vijanos	1	20	201	0001
			Santa Maria Comotlan	Santa Maria Comotlan	1	20	400	0001
			Santa Maria Peñoles	Duraznal	1	20	426	0007
			Santiago Jocotepec	San Miguel Lachixola	1	20	468	0008
		Veracruz	Acultzingo	Potrero, El	1	30	006	0012
			Chicontepec	Piocuayo	1	30	058	0101
			Espinal	San Francisco	1	30	066	0024
			Minatitlan	Rancho Nuevo Carrizal	1	30	108	0034
			Papantla	Caristay	1	30	124	0018
			Uxpanapa	Niñoes Heroes	1	30	210	0098
		Yucatán	Chankom	Xkopteil	1	31	017	0017
			Hunucma	Sisal	1	31	038	0004
			Tekom	Tekom	1	31	081	0001
			Tizimin	Sucopo	1	31	096	0069
2	Middle	Edo. Mex.	Aculco	Gunyo Poniente	2	15	003	0041
			Axapusco	San Pablo Xuchil	2	15	016	0015
			Coatepec Harinas	Tecolotepec	2	15	021	0031
			Ixtapan de la Sal	Salitre, El	2	15	040	0013
			Ixtapan del Oro	San Martin Ocoxochitepec	2	15	041	0006
			Ixtlahuaca	San Isidro Boxipe	2	15	042	0021
			Oro, El	San Nicolas El Oro	2	15	064	0048
			Acambay	Tixmadeje Barrio Dos	2	15	001	0112
		Puebla	Cuetzalan del Progreso	Santiago Yancuitlalpan	2	21	043	0037
			Naupan	Cueyatla	2	21	100	0004
			Pantepec	Ejido Carrizal Viejo	2	21	111	0008
			Santa Isabel Cholula	Santa Ana Acozautla	2	21	148	0004
			Tecamalchalco	Laguna, La	2	21	154	0005
			Tlacuilotepec	Rincon, El	2	21	178	0013
			Tzicatlacoyan	San Bernardino Tepenene	2	21	193	0008
			Xicotepec	Santa Rita	2	21	197	0022
3	Midwest	Guanajuato	Acambaro	Maguey, El	3	11	002	0032
			Ciudad Manuel Doblado	Calzada del Tepozan	3	11	008	0015
			Irapuato	Laguna Larga	3	11	017	0096
			Leon	Patiña, La	3	11	020	0394
			Leon	Ibarrilla	3	11	020	0340
			San Diego de la Union	Sauceda, La	3	11	029	0120
			San Luis de la Paz	Covadonga	3	11	033	0037
			Valle de Santiago	San Nicolas Quiriceo	3	11	042	0116

3	Midwest	Nayarit	Compostela	Puerta de la Lima, La	3	18	004	0141
			Xalisco	Aquiles Serdan	3	18	008	0004
			Santiago Ixcuintla	Tambor, El	3	18	015	0071
			Bahia de Banderas	Sayulita	3	18	020	0092
		Zacatecas	Loreto	Tierra Blanca	3	32	024	0043
			Ojocaliente	Cerrito de la Cruz	3	32	036	0009
			Villa de Cos	Sarteneja	3	32	051	0061
			Villa Garcia	Copetillo, El	3	32	052	0013
4	Northwest	B.C.N.	Ensenada	Nuevo Centro de Poblacion Padre Kino	4	02	001	0170
			Ensenada	Nuevo Uruapan	4	02	001	0598
			Mexicali	Represa Aurelio Benansini	4	02	002	0516
			Mexicali	Ejido Colima I	4	02	002	0143
			Mexicali	Ejido Xochimilco	4	02	002	0292
		Sinaloa	Culiacan	Agua Caliente de los Monzon	4	25	006	0098
			Escuinapa	Cristo Rey	4	25	009	0023
			Guasave	San Jose de Guayparime	4	25	011	0759
			Mazatlan	Castillo, El	4	25	012	0162
			Navolato	Bledal, El	4	25	018	0023
			Navolato	Campo Balbuena	4	25	018	0199
		Sonora	Empalme	Mi Patria es Primero	4	26	025	0033
			Hermosillo	Victoria, La	4	26	030	0669
			Huatabampo	Sirebampo	4	26	033	0085
			Opodepe	Querobabi	4	26	045	0068
			Villa Pesqueira	Villa Pesqueira	4	26	068	0001
5	Northeast	Chihuahua	Namiquipa	Namiquipa	5	08	048	0001
			Namiquipa	Cruces	5	08	048	0031
			Balleza	General Carlos Pacheco	5	08	007	0054
			Doctor Belisario Dominguez	San Lorenzo	5	08	022	0001
			Guerrero	Rancho de Santiago	5	08	031	0091
			Juarez	Millon, El	5	08	037	0643
		Durango	Canatlan	Nicolas Bravo	5	10	001	0083
			Durango	Colonia Hidalgo	5	10	005	0187
			Lerdo	Salamanca	5	10	012	0042
			Nazas	Perla, La	5	10	015	0020
			San Dimas	Vencedores	5	10	026	0110
			Santiago Papasquiaro	Cazadero, El	5	10	032	0024
		Tamaulipas	Gonzalez	San Antonio Rayon	5	28	012	0128
			Matamoros	Ebanito, El	5	28	022	0121
			Matamoros	Ranchito y Refujio, El	5	28	022	0265
			San Fernando	Punta de Alambre	5	28	035	0460

Source ENHRUM Codebook

Table 4-2. Landholder and non landholder mean differences

Description	Total	No land	Land	P value
Head age	48.1263	45.5797	51.3187	0.0000 **
Union	0.8401	0.8188	0.8670	0.0086 **
Indigenous language	0.1705	0.0638	0.3055	0.0000 **
Head no school	0.1699	0.1588	0.1839	0.1855
Head elementary school	0.2086	0.2069	0.2107	0.8521
Head middle school	0.0931	0.1219	0.0566	0.0000 **
Partner age	41.2492	38.4240	44.8215	0.0000 **
Partner no school	0.1399	0.1018	0.1881	0.0000 **
Partner elementary school	0.6102	0.5817	0.6464	0.0083 **
Partner middle school	0.1493	0.1801	0.1103	0.0001 **
Children	0.2911	0.3255	0.2475	0.0006 **
Members in household	4.8413	4.5749	5.1782	0.0000 **
First employment sector	0.2423	0.3568	0.0976	0.0000 **
Income	$7,983	$8,485	$7,350	0.0321 **
Inheritance	0.2561	0.1879	0.3423	0.0000 **
Loan	0.0387	0.0201	0.0622	0.0000 **
Account	0.1099	0.1264	0.0891	0.0178 **
Distance	8.4484	8.5664	8.2896	0.4457
Migration in community	0.2455	0.2875	0.1924	0.0000 **
International migration	0.1918	0.1935	0.1895	0.8410
National migration	0.4703	0.4351	0.5149	0.0015 **
Progresa	0.3510	0.2539	0.4738	0.0000 **
Midwest	0.1993	0.2282	0.1627	0.0011 **
Northeast	0.2005	0.2595	0.1259	0.0000 **
Northwest	0.1824	0.2274	0.0622	0.0000 **
Central	0.2036	0.1163	0.3140	0.0000 **
South	0.2142	0.1186	0.3352	0.0000 **

Note *income* is expressed in Mexican pesos

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 4-3. Migrant and non migrant mean differences

Description	Total	Non migrant	Migrant	P value
Head age	48.13	47.15	52.27	0.0000 **
Union	0.8401	0.8331	0.8697	0.1156
Indigenous language	0.1705	0.2017	0.0391	0.0000 **
Head no school	0.1699	0.1662	0.1857	0.4133
Head elementary school	0.2086	0.2110	0.1986	0.6344
Head middle school	0.0931	0.1020	0.0554	0.0114 **
Partner age	41.2492	40.2220	45.5785	0.0000 **
Partner no school	0.1399	0.1352	0.1596	0.2688
Partner elementary school	0.6102	0.5958	0.6710	0.0152 **
Partner middle school	0.1493	0.1638	0.0879	0.0008 **
Children	0.2911	0.3068	0.2248	0.0044 **
Members in household	4.8413	4.6468	5.6612	0.0000 **
Income	$7,983	$7,159	$11,450	0.0000 **
Inheritance	0.2561	0.2604	0.2378	0.4140
Loan	0.0387	0.0371	0.0456	0.4876
Account	0.1099	0.0997	0.1531	0.0071 **
Midwest	0.1993	0.1592	0.3681	0.0000 **
Northeast	0.2005	0.1862	0.2606	0.0003 **
Northwest	0.1824	0.1963	0.1238	0.0031 **
Central	0.2036	0.2110	0.1726	0.1339
South	0.2142	0.2407	0.0749	0.0000 **

Note *income* is expressed in Mexican pesos

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 4-4. Migrant landholder and non migrant landholder mean differences

Description	Total	Non migrant	Migrant	P value
Farm sizze	9.8235	8.6359	14.9021	0.0890 *
Cultivated area	5.1178	4.5645	7.4838	0.0000 **
Ejidalland	0.5530	0.5375	0.6194	0.0863 *
Irrigation	0.2405	0.2339	0.2687	0.3968
Total days worked	88.2588	89.9616	80.9776	0.4995
Total days head worked	54.1556	55.4049	48.8134	0.3822
Total days spouse worked	12.9901	12.8953	13.3955	0.9015
Total days son worked	11.2178	11.9808	7.9552	0.2562
Total days son-in-law worked	6.1726	6.4642	4.9254	0.4979
Total days grandson worked	3.7228	3.2164	5.8881	0.2126
Contracted workers	16.5958	16.7055	16.1269	0.8866
Machinery	0.4427	0.4171	0.5522	0.0045 **
HYV	0.2448	0.2267	0.3206	0.0247 **
Chemical purchase	$1,874.1170	$1,645.9600	$2,978.8790	0.0038 **
Pesticide purchase	$3,074.2280	$2,136.3180	$6,710.2350	0.0870 *
Seed purchase	$188.2628	$150.0360	$347.8818	0.0170 **
Output	$1,249,276	$1,251,436	$1,240,042	0.9813
Maize	$285,268	$297,026	$223,097	0.7368
Bean	$216,972	$243,778	$132,508	0.6912
Vegetables	$675,938	$606,808	$1,033,784	0.6122
Mainly production of maize	0.5149	0.5462	0.3806	0.0005 **
Mainly production of bean	0.0509	0.0401	0.0970	0.0070 **
Mainly production of vegetable	0.0537	0.0506	0.0672	0.4450
Traded volume	0.2031	0.1927	0.2505	0.0841 *
Subsistence volume	0.3904	0.4048	0.3248	0.0157 **
Cattle	2.3567	1.6638	5.2248	0.0000 **
Procampo	0.5431	0.5236	0.6269	0.0307 **
Procede	0.4696	0.4817	0.4179	0.1835
Progresa	0.3510	0.3640	0.2964	0.0257 **
Alianza	0.3616	0.3570	0.3811	0.4303

Note the monetary variables are expressed in Mexican pesos

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 4-5. Selection equation variables statistics

Variable	Description	Mean	Std. Dev.	Min	Max	Obs
land	the household holds land (1=yes)	0.4416	0.4967	0	1	1601
Demographics						
sex	Gender (1 = male)	0.8670	0.3397	0	1	1601
children	Children from 0 to 6 in the house (1=yes)	0.2911	0.4544	0	1	1601
union	Marital status (1= married or living together)	0.8401	0.3666	0	1	1601
members	Number of people in the household	4.8413	2.1555	1	14	1601
indiglanguage	Language spoken (1= indigenous language)	0.1705	0.3762	0	1	1601
elementary1	Schooling (1=elementary finished or not)	0.6084	0.4883	0	1	1601
middle1	Schooling (1=middle school finished or not)	0.1318	0.3384	0	1	1601
high1	Schooling (1=high school finished or not)	0.0369	0.1885	0	1	1601
up	Schooling (1=techinical, college or graduate)	0.0387	0.1930	0	1	1601
aged	Age of the head	48.1263	15.5604	15	95	1601
aged2	Age of the head squared	2558.1190	1614.3200	225	9025	1601
wifeelementary	Spouse schooloing(1=elementary finished or not)	0.6102	0.4878	0	1	1601
wifemiddle	Spouse schooloing(1=middle finished or not)	0.1493	0.3565	0	1	1601
wifehigh	Spouse schooling(1=high school finished or not)	0.0319	0.1757	0	1	1601
wifeup	Spouse schooling(1=technical, college or graduate)	0.0394	0.1945	0	1	1601
wifeaged	Age of the spouse	41.2492	15.2412	7	90	1601
wifeaged2	Age of the spouse squared	1933.6430	1414.2090	49	8100	1601
income	Proxy for household income	$7,983	$10,514	0	$149,100	1601
Migration						
natmigration1	National migration (1=yes)	0.4703	0.4993	0	1	1601
migration2002	Migratory experience in 2002 (1=yes)	0.1918	0.3938	0	1	1601
morethan20	Social network proxy	0.2455	0.4305	0	1	1601
Region						
south	Region (1=south-southeast)	0.2142	0.4104	0	1	1601
central	Region (1=middle)	0.2036	0.4028	0	1	1601
midwest	Region (1=middlewest)	0.1993	0.3996	0	1	1601
northeast	Region (1=northeast)	0.2005	0.4005	0	1	1601
northwest	Region (1=northwest)	0.1824	0.3863	0	1	1601
Exclusion Variables						
hhfirst	first labour sector (1= no agricultural sector)	0.2561	0.4366	0	1	1601
perejidallandd	Community has ejidal land (1=yes)	0.0843	0.2780	0	1	1601
sharedland	Community has shared land (1=yes)	0.7893	0.4053	0	1	1601
incomeag	Agriculture important source of income (1=yes)	0.5184	0.4998	0	1	1601
inheritance	Received inheritance (1=yes)	0.6202	0.4855	0	1	1601

Note All monetary variables are expressed in Mexican pesos

Table 4-6. Regression equation variables statistics

Variable	Description	Mean	Std. Dev.	Min	Max	Obs
prod0	Labor productivity of the household head	\$50,657	\$308,471	0	\$5,775,027	667
prodtotal0	Labor productivity of the household	\$34,929	\$247,697	0	\$5,775,027	707
Demographics						
sex	Gender (1 = male)	0.8670	0.3397	0	1	1601
children	Children from 0 to 6 in the house (1=yes)	0.2911	0.4544	0	1	1601
union	Marital status (1= married or living together)	0.8401	0.3666	0	1	1601
members	Number of people in the household	4.8413	2.1555	1	14	1601
indiglanguage	Language spoken (1= indigenous language)	0.1705	0.3762	0	1	1601
elementary1	Schooling (1=elementary finished or not)	0.6084	0.4883	0	1	1601
middle1	Schooling (1=middle school finished or not)	0.1318	0.3384	0	1	1601
high1	Schooling (1=high school finished or not)	0.0369	0.1885	0	1	1601
up	Schooling (1=techinical, college or graduate)	0.0387	0.1930	0	1	1601
aged	Age of the head	48.1263	15.5604	15	95	1601
aged2	Age of the head squared	2558.1190	1614.3200	225	9025	1601
wifeelementary	Spouse schooloing(1=elementary finished or not)	0.6102	0.4878	0	1	1601
wifemiddle	Spouse schooloing(1=middle finished or not)	0.1493	0.3565	0	1	1601
wifehigh	Spouse schooling(1=high school finished or not)	0.0319	0.1757	0	1	1601
wifeup	Spouse schooling(1=technical, college or graduate)	0.0394	0.1945	0	1	1601
wifeaged	Age of the spouse	41.2492	15.2412	7	90	1601
wifeaged2	Age of the spouse squared	1933.6430	1414.2090	49	8100	1601
income	Proxy for household wealth	\$7,983	\$10,514	0	\$149,100	1601
Migration						
natmigration1	National migration (1=yes)	0.4703	0.4993	0	1	1601
migration2002	Migratory experience in 2002 (1=yes)	0.1918	0.3938	0	1	1601
morethan20	Social network proxy	0.2455	0.4305	0	1	1601
Region						
south	Region (1=south-southeast)	0.2142	0.4104	0	1	1601
central	Region (1=middle)	0.2036	0.4028	0	1	1601
midwest	Region (1=middlewest)	0.1993	0.3996	0	1	1601
northeast	Region (1=northeast)	0.2005	0.4005	0	1	1601
northwest	Region (1=northwest)	0.1824	0.3863	0	1	1601
Plot Characteristics						
plot	Amount of plots per household	1.7072	1.0648	1	8	707
ownland	the household owns the land (1=yes)	0.8204	0.3842	0	1	707
ejidalland	propietary rights (1=ejidal)	0.5530	0.4975	0	1	707
totalacres	Total acres of land	9.8235	38.3945	0	537.5	707
irrigation	pattern (1=irrigation)	0.2405	0.4277	0	1	707
fertilizer	Input use (1=used fertilizer)	0.6280	0.4837	0	1	707
seed	Input use (1=high yield variety)	0.2348	0.4242	0	1	707
machinery	Input use (1=use machinery)	0.4427	0.4971	0	1	707
contracted	Total contracted workers	16.5958	42.2539	0	488	707
Programs						
procampo	Participates in procampo (1=yes)	0.5431	0.4985	0	1	707
procede	Enrolled in procede (1=yes)	0.4696	0.4994	0	1	707

The dependent variables *prod* and *prodtotal* are expressed in pesos/day

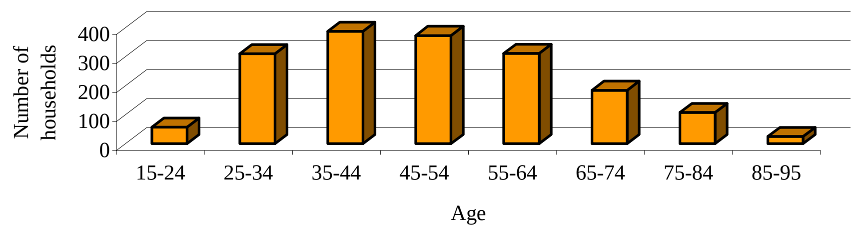

Figure 4-1. Age of the household head

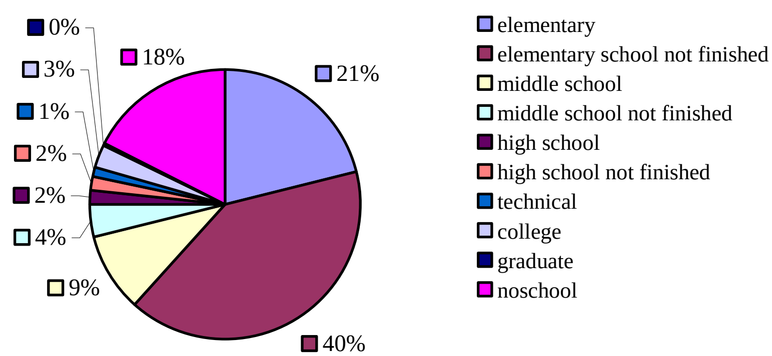

Figure 4-2. Education level of the household head

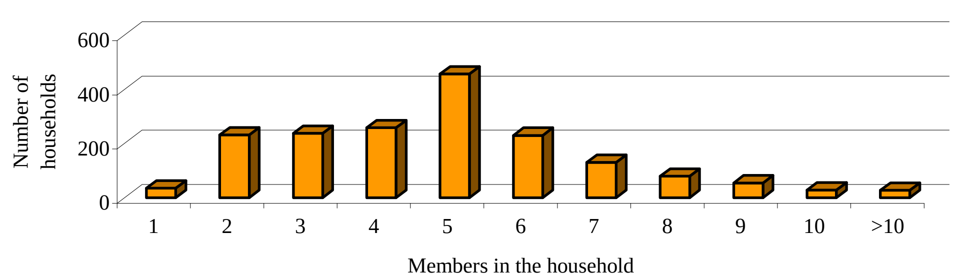

Figure 4-3. Number of members in the household

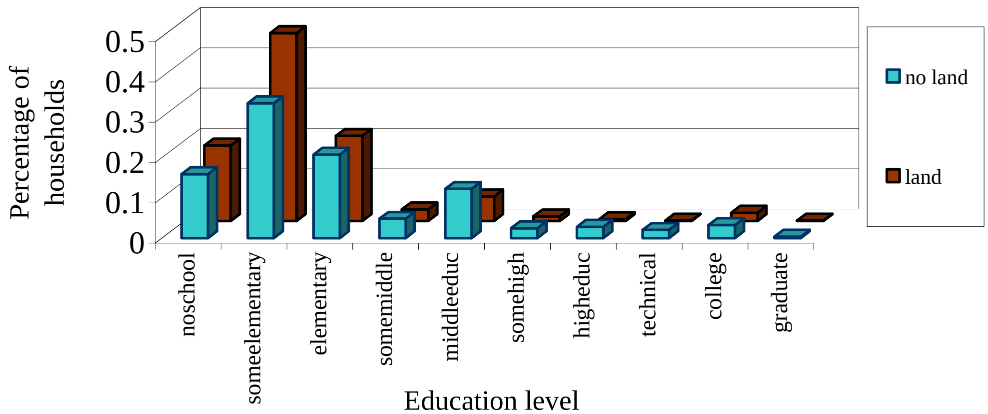

Figure 4-4. Comparison of education level by landholding status

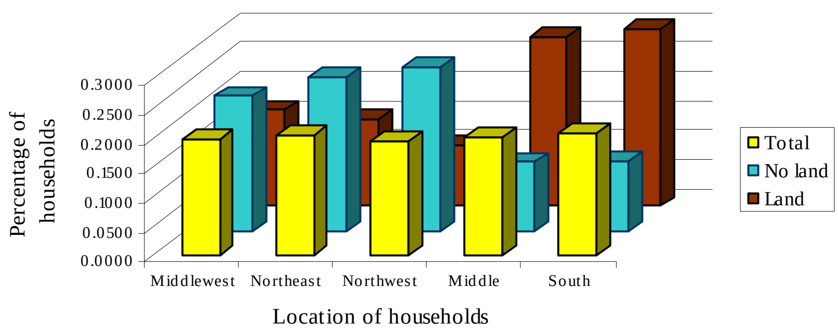

Figure 4-5. Landholder and non landholder spatial distribution

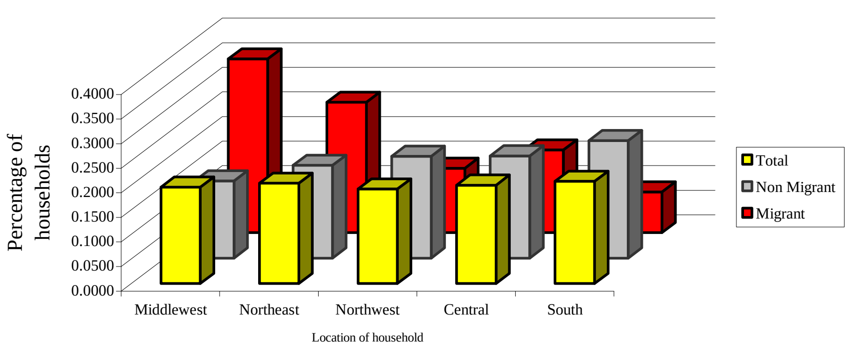

Figure 4-6. Migrant and non migrant spatial distribution

CHAPTER 5
RESULTS

Introduction

In this chapter, we present and analyze the results of econometric models using the Mexican National Rural Household Survey (ENHRUM). As mentioned in the previous chapter we differentiate between the labor productivity of the head (henceforth, Model 1) and the labor productivity of the entire household (henceforth, Model 2). With this distinction we aim to evaluate the New Economics of Labor Migration approach that states that in order to study the way labor out-migration influences the labor productivity of rural households, the analysis needs to rely upon the household as unit of analysis. In both models we estimate labor productivity accounting for the selectivity of landholding and introduce a variable of social network to capture how the formation of social networks impact the household labor productivity.

This chapter is structured as follows. We first run the OLS model and present the results[32]. The second section summarizes the results found when running the Heckman model[33]. The third section reviews the results obtained when the endogeneity of migration is taken into account in the model. The fourth section presents conclusions.

Estimation of OLS

We first estimate the regression equation of Model 1 and Model 2 by OLS. Although OLS does not take into consideration the sample selection problem as well as the potential endogeneity of the migration variable, this model is the simplest way to estimate labor productivity and will be used as a framework to compare the results found in more complex models.

[32] The models in this research were run using STATA
[33] The inverse of the Mills' ratio was first computed to test for the specification of the model and was found significant at a $p<0.05$. This result corroborates the existence of sample selection in our data and the need to account for it. The Heckman model was run using robust standard errors

Table 5-1 and Table 5-3 summarize the results found estimating the household head labor productivity (Model 1) and the household total labor productivity (Model 2) by OLS. An important finding of Model 1 is that it is not our migratory variable (*migration2002*) but the proxy for social network (*morethan20*) that is negative and statistically significant at a 95% confidence level. This finding suggests that the more a community is involved in migration, the less labor productive the household head is going to be. For instance, the labor productivity of the household head is $91,393.64 less in communities where social networks are strong.

On the other hand, a head with high school education compared to a head with no education is more productive by $111,730.50. The education of the spouse at elementary and middle school level, however, has a negative impact on the labor productivity of the household head compared to a spouse with no school. For example, a spouse with middle school education is less labor productive by $121,921.20 compared to a spouse with no school. Internal migration of the household head to other places in the country impacts negatively the labor productivity of the household head by $46,457.16.

Measuring labor input we find that *contracted* is statistically significant at a 95% confidence level. An increase in one unit of wage worker increases the labor productivity of the household head by $740.28. This result suggests that contracted labor force can be used as substitute or complement of the household head labor. In the case of non labor inputs, the usage of fertilizers increases the labor productivity of the household head by $54,753.31 but the utilization of machinery reduces it by $58,404.49. On the other hand, the governmental program, *Procede* has a positive effect on the labor productivity of the household head increasing the labor productivity of the household head by $68,513.92, but *Procampo* has a negative impact reducing the labor productivity by $46,362.49. We also observe that the household head labor productivity is higher in Midwest but lower in the Central region compared to the Northwestern region.

In Model 2 the migratory variable is negative but not significant. The variable for social network (*morethan20*) is again negative and statistically significant at a 95% confidence level. However, the variable in Model 2 has a greater impact on labor productivity than in Model 1. In communities where migration represents more than 20% of the population, household head labor productivity is $93,465.52 less than in those communities where migration is not so important. It can be argued that in those communities where migration is a common practice, the labor market of the whole community is affected, decreasing the number of people available to work the land.

Other variables that were found statistically significant in Model 2 at a 95% confidence level were *wifemiddle*, *wifeup, fertilizer, machinery* and *Midwest.* The variables that were significant at a 90% confidence level were *wifeelementary, middle1, income, natmigration1, procampo* and *procede*. The major difference between the two model specifications is the *contracted* variable, this variable loses statistical significance in Model 2. It seems wage workers do not increase the labor productivity of the entire household. It can be argued that households employing the labor force of the entire household are less likely to hire wage workers compared to households where only the head of the households works the land. In this case, the hired in labor acts more as a substitute than a complement for the household labor force. For this reason, the *contracted* variable loses statistical significance in Model 2.

Heckman Two-Stage Estimation

Who holds Land?

As shown in Table 5-2 and 5-4, the selection equation from both models report similar results. The gender of the household head (*sex*) has a statistically significant effect on the likelihood of holding land. Female-headed households are less likely to own an agricultural asset and work in agriculture. Similarly, age (*aged*) increases the odds of holding land, but the squared age (*aged2*) has the opposite effect, meaning there is a breaking point where age no longer affects the likelihood of landholding. *Union* is negative and statistically significant but only in Model 2. This finding suggests that the marital status of the household affects the odds of landholding at the household level but not at the household head level. Couples that are married or living together are less likely to hold land. .

In both models, the sign of the indigenous language variable is positive and statistically significant, as expected. This means that households where an indigenous language is spoken are more likely to make a living from agriculture and consequently are more likely to have land than those households where Spanish is spoken. While the dummy for higher education level (such as technical, college and graduate) is negative and statistically significant, is positive and statistically significant the dummy variable for elementary school. These findings suggest that household heads with elementary school are more likely to have land compared to those with no schooling; however, households with a technical or college degree are less likely to hold land compared to households with no schooling. This means that households with higher education prefer to work outside the agricultural sector where the return to education is higher.

In terms of spatial distribution, the soil quality in the Southern part of Mexico and the weather conditions favor the growth of crops in this region. This fact is supported in our findings. For instance, we find that the dummy variables for the Southern, Central and Midwestern parts of the country are positive and statistically significant compared to the dummy variable for the Northwestern region. On the other hand, the dummy variable for the Northeastern part is also positive but not statistically significant compared to the Northwestern region.

National migration has a negative impact at a 95% confidence level on the likelihood of holding land only in Model 2. This finding suggests that households engaging in national migration are less likely to hold land. International migration variable is negative but not significant in both models. The social network variable however is positive and statistically significant. It can be argued that communities where migration is a common practice have a higher propensity to hold land.

On the other hand, the dummies that account for the existence of *ejidal* land rights (*perejidallandd*) and the existence of community land (*sharedland*) have a positive effect on the likelihood of holding land. These findings suggest that in those communities consisting of *ejidos*, the probability was higher that the households obtained land. The same reasoning applies for those communities sharing land.

Furthermore, the dummy that accounts for those communities where agriculture is an important source of income (*incomeag*) is also positive and statistically significant, meaning that those communities highly dependent on agriculture are more likely to have land holders than in communities where agriculture is not an important source of income. Inheritance also increases the odds of landholding. The *ejidal* land for instance, was commonly inherited through generations by the male in charge of the household. That is why it is nor surprising to find a positive relationship between inheritance and land. Finally, the first employment outside the agricultural sector is the only variable with a negative value, reducing the odds of households having land as predicted.

What affects Labor Productivity?

The results found in the regression equation differ between the two models. For this reason, the results of Model 1will be analyzed first followed by the results of Model 2.

Model 1 household head labor productivity (sample A)

As shown in Table 5-1, the education level of the household head (*middle1*) affects positively the labor productivity of the head by $111,725.80. This relationship, however, is only observable at a 90% confidence level. This finding suggests, as opposed to expected, that agricultural work becomes more productive with the level of education of the farmer. On the other hand, the education level of the spouse (*wifemiddle*) has a negative and statistically significant impact on the household head labor productivity. A household having a spouse with middle education is $122,025.20 less labor productive that a household having a spouse with no school.

Our migratory variable (*migration2002*) is negative but not statistically significant. National migration however (*natmigrtion1*) is negative and statistically significant at a 95% confidence level and social networks (*morethan20*) at a 90% confidence level. In general, it can be argued that migration indeed affect the labor productivity of the household head. Households engaging in internal migration to other parts in the country are less labor productive than those staying in the community by $46,431.76. Furthermore, in communities where social networks are strong, the household head is also less labor productive by $91,564.94.

Similarly to the results found in OLS, the usage of fertilizer increases the labor productivity of the household head by $54,768.26, but the utilization of machinery reduces it by $58,439.23. On the other hand, *contracted* is still positive and statistically significant. In this case, an additional wage worker increases the labor productivity of the household head by $740.03.

Regional dummy variables were not significant meaning that the location of the community does not play a role in determining the labor productivity of the household head. In terms of governmental programs, *Procede* is positive and statistically significant at a 95%

confidence level while *Procampo* is negative but only statistically significant at a 90% confidence level. Households enrolled in *Procede* increase the labor productivity of the household head by $68,562.32. However, households enrolled in *Procampo* seem to reduce the labor productivity of the head by $46,336.40. In this model we also found an inverse relationship between number of plots (*plot*) and labor productivity at a 95% confidence level. Although farm size is not a topic in this study, further research in this area is recommended.

Model 2 household labor productivity (sample B)

The results obtained in Model 2 are summarized in Table 5-3. Middle education level of the household head (*middle1)* as well as the age of the head squared (*aged2*) lost statistical significance in this model. The dummy variable accounting for middle education level of the spouse (*wifemiddle*) remains negative and statistically significant at a 95% confidence level, while the variable accounting for elementary school (*wifeelementary*) also remains statistically significance at a 90% confidence level. It seems that as the education level of the spouse increases, reduces the labor productivity of the household. For instance, households having a spouse with elementary education are $43,954.47 less labor productive and households having a spouse with middle education are $84,443.23 less labor productive than households that have a spouse with no school.

On the other hand, the proxy variable used to measure income is positive and statistically significant, suggesting that households with less liquidity constraints are those that achieve higher labor productivity. For instance, an increase of $1,000.00 in the expenditure level of the household increases the labor productivity of the household by $1,646.98.

We found that the variable of interest in this study (*migration2002*) is negative and statistically significant in this model. As opposed to expected, migrant households are less labor productive than households with no migratory experience by $28,655.31. On the other hand, the variables that account for national migration (*natmigration1*) as well as social network (*morethan20*) are also negative and statistically significant at a 90% and a 95% confidence level respectively. In general, it looks like migration, either national or international, reduces the labor productivity of the entire household.

Similarly to the results found in OLS, the usage of fertilizer increases the labor productivity of the household by $49,196.56 but the utilization of machinery reduces it by $41,890.97. It should be noticed, however, that at the household level the positive impact of fertilizer compensates for the lost of productivity in machinery, while at the household head level the net effect is negative. On the other hand, *Procampo* is still negative and statistically significant at the 90% confidence level. In this case, households enrolled in *Procampo* are $36,933.66 less productive than those not enrolled in the program.

Two regional dummy variables gain significance in this model. For instance, the dummy variables for South and Central are negative and statistically significant in Model 2. Households living in the Southern region are $71,102.08 less labor productive than those living in the Northwestern region. And households living in the Central region are $79,421.25 less labor productive than the households residing in the Northwester region. This result suggests the existence of regional differences in the agricultural labor productivity of the households.

Addressing Migration Endogeneity

In order to address the endogeneity of migration, we decided to use as potential instrumental variable the distance from the closest city where the community is located to the nearest border between Mexico and the United States (*kilometers*). This variable, however, was only found statistically significant using sample A, which represents the sample for the entire household. This finding suggests the instrumental variable is vulnerable to changes in the sample size and certainly might not be the optimal instrument for migration. However, given the scope of this research this is the instrumental variable that will be used to estimate Model 2.

The estimation of the logit model for migration is shown in Table 5-5. The instrumental variable (*kilometers*) is negative and statistically significant. This finding supports the idea that distance discourages migration by increasing the transaction costs of migration. The predicted values (*ivmig*) of the logit model are calculated and used to estimate the Heckman model.

As Table 5-6 Model 2a summarizes, the variables of interest *morethan20* and *migration2002* lose their significance when the endogeneity of migration is taken into account, meaning migration has no impact on the labor productivity of the household. Variables such as *middle1*, *south* and *central* also lose significance. The regional dummies also lose significance. The variables that remained statistically significant at a 95% confidence level were *fertilizer, wifemiddle* and *income*. The variables that remained statistically significant but at a 90% confidence level was *wifeelementary*, *contracted*, *procampo*, *machinery* and *natmigraation1*.

We present results from the selection equation estimation in Table 5-7 Model 2a. The results suggest that the predicted values of migration generate no significant differences in the estimation. The only change occurs in the variable of *ivmig.* The variable remains negative but gains statistical significance at a 95% confidence level. This means that households having a migrant in the United States during 2002 are less likely to hold land.

There are different ways to interpret the lost of significance in the migration (*migration2002*) and social network variable (*morethan20*) when the predicted values of migration are included in the model. We would argue that the predicted value of migration (*ivmig*) can possibly be correlated with the social network variable reducing the significance in both variables. The argument behind is that households with strong social networks tend to be those located nearer the border between Mexico and the United States. In order to test this argument we removed from the model our social network variable (*morethan20*) to measure the effect of the predicted value (*ivmig*) alone.

In Table 5-6 and Table 5-7, Model 2b we summarize the results. As expected, the migration variable (*migration2002*) gains statistical significance in the regression equation and loses statistical significance in the selection equation. These findings suggest that, once corrected for endogeneity, migration reduces the labor productivity of the household by $367,465.30, but has no effect on the likelihood of landholding.

Conclusion

This chapter described the results of the model. Different estimation methodologies were used to evaluate the results. The results found in the Heckman selection model support the idea that the likelihood of landholding depends not only on the demographic characteristics of the household but on the specific location of the household. It was proven that communities with *ejidal* land and community land increase the odds of landholding.

Our model suggests that migrant households are $28,655.31 less labor productive than those households with no migratory experience. The formation of social networks in the community also has a negative effect. However, when we solve for the endogeneity problem using a potential instrumental variable the impact of international migration and social network becomes less clear. For a better understanding of the impact of migration on labor productivity, further research needs to be carried out, dealing more properly with the endogeneity problem of migration. My future research includes finding new instrumental variables that are correlated with migration but not with the formation of social networks to be able to account for the impact of both, migration and social networks on labor productivity.

Table 5-1. Model 1 household head labor productivity

	Model 1 OLS Estimates				*Model 1 Heckman selection model*			
	Number of obs		667		Number of obs		1561	
	F(36, 630)		4.69		Censored obs		894	
	Prob > F		0.0000		Uncensored obs		667	
	R-squared		0.2113		Log pseudolikelihood		########	
	Adj R-squared		0.1662		Wald chi2(36)		49.84	
	Root MSE		2.80E+05		Prob > chi2		0.0623	
prod0	Coef.	Robust Std. Err.	t		Coef.	Robust Std. Err.	z	
sex	22156.04	58800.80	0.38		21530.38	60281.05	0.36	
union	-48224.82	48051.15	-1.00		-48098.81	63517.30	-0.76	
children	-28451.91	33894.03	-0.84		-28444.99	20871.31	-1.36	
members	3624.18	5928.29	0.61		3629.23	2894.48	1.25	
indiglanguage	18899.77	32021.58	0.59		18449.74	28300.47	0.65	
elementary1	28989.99	31918.02	0.91		28865.51	34059.74	0.85	
middle1	111730.50	50393.88	2.22	**	111725.80	60700.14	1.84	*
high1	145698.60	95537.32	1.53		145764.70	231717.60	0.63	
up	-106050.30	95377.49	-1.11		-105728.10	89321.10	-1.18	
aged	-6072.11	6611.69	-0.92		-6123.01	7796.20	-0.79	
aged2	89.74	61.00	1.47		90.17	92.96	0.97	
wifeelementary	-51338.69	31208.07	-1.65	*	-51439.26	34044.48	-1.51	
wifemiddle	-121921.20	48961.85	-2.49	**	-122025.20	49117.96	-2.48	**
wifehigh	-55404.49	105966.40	-0.52		-55409.56	100788.60	-0.55	
wifeup	417508.20	92128.15	4.53	**	417548.70	396237.60	1.05	
wifeaged	-1660.19	5020.46	-0.33		-1654.77	2687.34	-0.62	
wifeaged2	-18.35	49.76	-0.37		-18.47	39.72	-0.46	
income	5271.19	1119.29	4.71	**	5265.83	3333.46	1.58	
natmigration1	-46457.16	24157.57	-1.92	*	-46431.76	22447.38	-2.07	**
migration2002	-35733.82	32126.28	-1.11		-35726.83	35255.50	-1.01	
morethan20	-91393.64	42643.25	-2.14	**	-91564.94	51326.15	-1.78	*
contracted	740.28	273.81	2.70	**	740.03	298.32	2.48	**
ejidalland	-38637.08	26178.17	-1.48		-38725.38	26707.39	-1.45	
ownland	24948.89	32831.79	0.76		24886.86	16179.14	1.54	
plot	-17658.74	11593.58	-1.52		-17679.92	8350.82	-2.12	**
irrigation	-31732.82	29143.47	-1.09		-31737.23	29104.16	-1.09	
totalacres	92.51	302.37	0.31		92.34	199.17	0.46	
procampo	-46362.49	26635.78	-1.74	*	-46336.40	25128.67	-1.84	*
procede	68513.92	28874.97	2.37	**	68562.32	31486.36	2.18	**
seed	44213.59	29621.04	1.49		44228.12	31041.52	1.42	
fertilizer	54753.31	24507.97	2.23	**	54768.26	24479.08	2.24	**
machinery	-58404.49	24398.91	-2.39	**	-58439.23	26682.26	-2.19	**
south	-88759.02	59996.48	-1.48		-89662.71	67552.83	-1.33	
central	-95113.27	57616.47	-1.65	*	-96269.61	70440.76	-1.37	
midwest	95621.20	58076.67	1.65	*	95050.16	98307.66	0.97	
northeast	24942.84	61015.85	0.41		24609.01	86014.14	0.29	
_cons	289831.40	176746.00	1.64		293594.60	181212.20	1.62	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 5-2. Model 1 Heckman selection model (first-stage)

land	Coef.	Robust Std. Err.	z	
sex	1.0653	0.1368	7.79	**
union	-0.1306	0.1257	-1.04	
children	0.0310	0.0789	0.39	
members	-0.0177	0.0153	-1.16	
indiglanguage	1.0448	0.0791	13.21	**
elementary1	0.1858	0.0841	2.21	**
middle1	-0.0936	0.1262	-0.74	
high1	0.0485	0.2257	0.21	
up	-0.5337	0.2365	-2.26	**
aged	0.1041	0.0147	7.06	**
aged2	-0.0009	0.0001	-6.74	**
wifeelementary	0.1112	0.0820	1.36	
wifemiddle	0.2050	0.1253	1.64	
wifehigh	0.1192	0.2251	0.53	
wifeup	-0.2290	0.2023	-1.13	
wifeaged	-0.0005	0.0131	-0.04	
wifeaged2	0.0002	0.0001	1.30	
income	0.0133	0.0026	5.20	**
natmigration1	-0.0854	0.0593	-1.44	
migration2002	-0.1093	0.0742	-1.47	
morethan20	0.2315	0.0815	2.84	**
south	1.1042	0.1159	9.53	**
central	1.7134	0.1139	15.05	**
midwest	0.6826	0.1181	5.78	**
northeast	0.0908	0.1148	0.79	
inheritance	0.3687	0.0629	5.87	**
hhfirst	-0.3390	0.1416	-2.39	**
perejidallandd	0.4337	0.0699	6.20	**
incomeag	0.6555	0.0619	10.60	**
sharedland	0.3737	0.0673	5.55	**
_cons	-6.1941	0.3894	-15.91	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 5-3. Model 2 household labor productivity

	Model 2 OLS Estimates				*Model 2 Heckman selection model*			
	Number of obs		707		Number of obs		1601	
	F(36, 670)		4.29		Censored obs		894	
	Prob > F		0.0000		Uncensored obs		707	
	R-squared		0.1874		Log pseudolikelihood		-10452.8	
	Adj R-squared		0.1437		Wald chi2(36)		52.58	
	Root MSE		2.30E+05		Prob > chi2		0.0366	
prodtotal0	Coef.	Robust Std. Err.	t		Coef.	Robust Std. Err.	z	
sex	39708.74	43032.38	0.92		37356.29	80298.22	0.47	
union	-50293.66	37316.21	-1.35		-49534.68	54401.42	-0.91	
children	-15422.31	26898.12	-0.57		-15421.46	15954.31	-0.97	
members	2427.40	4703.18	0.52		2436.32	2075.05	1.17	
indiglanguage	-5708.15	25181.74	-0.23		-7645.38	8991.74	-0.85	
elementary1	18974.67	24870.10	0.76		18374.13	24733.69	0.74	
middle1	74869.70	40384.59	1.85	*	74834.65	48948.84	1.53	
high1	-58011.55	75710.42	-0.77		-57592.38	69222.37	-0.83	
up	-68255.98	73248.88	-0.93		-66858.30	65656.63	-1.02	
aged	-5548.46	4876.22	-1.14		-5745.15	5659.00	-1.02	
aged2	77.37	44.11	1.75	*	78.90	70.74	1.12	
wifeelemenetar	-43485.95	24804.56	-1.75	*	-43954.47	24167.21	-1.82	*
wifemiddle	-83941.08	38712.39	-2.17	**	-84443.23	37430.47	-2.26	**
wifehigh	12680.68	71455.62	0.18		12196.17	39422.10	0.31	
wifeup	425349.60	71733.19	5.93	**	425457.90	372003.90	1.14	
wifeaged	1380.37	3676.32	0.38		1384.71	2375.37	0.58	
wifeaged2	-42.09	36.46	-1.15		-42.39	27.81	-1.52	
income	1670.64	893.34	1.87	*	1646.98	751.02	2.19	**
natmigration1	-33910.61	19050.50	-1.78	*	-33735.25	19171.59	-1.76	*
migration2002	-28648.77	25184.21	-1.14		-28655.31	14614.80	-1.96	**
morethan20	-93465.52	33979.27	-2.75	**	-94257.02	41681.22	-2.26	**
contracted	277.93	220.14	1.26		276.84	163.63	1.69	*
ejidalland	-22836.02	20761.91	-1.10		-23273.56	25967.88	-0.90	
ownland	19492.39	25955.63	0.75		19266.95	12126.63	1.59	
plot	-10274.86	9260.78	-1.11		-10363.87	7418.71	-1.40	
irrigation	-15749.38	22979.14	-0.69		-15741.79	23073.91	-0.68	
totalacres	170.10	245.25	0.69		169.27	182.16	0.93	
procampo	-37047.90	21064.19	-1.76	*	-36933.66	22155.06	-1.67	*
procede	42227.89	22727.55	1.86	*	42430.69	27140.45	1.56	
seed	22502.10	23200.80	0.97		22602.03	20652.55	1.09	
fertilizer	49146.51	19444.91	2.53	**	49196.56	20153.34	2.44	**
machinery	-41698.15	19263.46	-2.16	**	-41890.97	24872.56	-1.68	*
south	-66894.88	47159.96	-1.42		-71102.08	35214.74	-2.02	**
central	-74207.25	45421.68	-1.63		-79421.25	37540.04	-2.12	**
midwest	99111.80	46141.59	2.15	**	96582.44	85615.68	1.13	
northeast	48548.02	48494.34	1.00		47024.89	52231.18	0.90	
_cons	190808.60	135449.50	1.41		206998.40	128378.20	1.61	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 5-4. Model 2 Heckman selection model (first-stage)

prodtotal0	Coef.	Robust Std. Err.	z	
sex	0.8583	0.1221	7.03	**
union	-0.2304	0.1119	-2.06	**
children	0.0367	0.0771	0.48	
members	-0.0108	0.0144	-0.75	
indiglanguage	1.0073	0.0752	13.39	**
elementary1	0.2280	0.0805	2.83	**
middle1	-0.0873	0.1223	-0.71	
high1	0.0192	0.2235	0.09	
up	-0.4961	0.2310	-2.15	**
aged	0.0865	0.0142	6.11	**
aged2	-0.0007	0.0001	-5.47	**
wifeelementary	0.1053	0.0789	1.33	
wifemiddle	0.2297	0.1203	1.91	
wifehigh	0.2088	0.1993	1.05	
wifeup	-0.1218	0.2130	-0.57	
wifeaged	0.0097	0.0125	0.78	
wifeaged2	0.0000	0.0001	0.40	
income	0.0130	0.0025	5.09	**
natmigration1	-0.1258	0.0577	-2.18	**
migration2002	-0.0734	0.0721	-1.02	
morethan20	0.2191	0.0805	2.72	**
south	1.1475	0.1128	10.17	**
central	1.7027	0.1135	15.00	**
midwest	0.6758	0.1156	5.85	**
northeast	0.0993	0.1131	0.88	
inheritance	0.3528	0.0620	5.69	**
hhfirst	-0.2908	0.1309	-2.22	**
perejidallandd	0.4673	0.0681	6.87	**
incomeag	0.6545	0.0599	10.92	**
sharedland	0.3700	0.0631	5.86	**
_cons	-5.8038	0.3783	-15.34	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 5-5. Logit model for migration

	Number of obs		1601	
	LR chi2(26)		275.6900	
	Prob > chi2		0.0000	
	Pseudo R2		0.1762	
	Log likelihood		-644.6571	
migratipn2002	Coef.	Std. Err.	z	
sex	-0.3932	0.2917	-1.35	
union	0.2942	0.3063	0.96	
children	0.2468	0.2172	1.14	
members	0.1429	0.0377	3.79	**
indiglangu~e	-1.2749	0.3480	-3.66	**
elementary1	0.1594	0.1966	0.81	
middle1	-0.4495	0.3159	-1.42	
high1	-0.2057	0.4829	-0.43	
up	-0.7173	0.5096	-1.41	
aged	0.0602	0.0374	1.61	
aged2	-0.0004	0.0003	-1.27	
wifeelementary	0.0866	0.2116	0.41	
wifemiddle	-0.2840	0.3192	-0.89	
wifehigh	0.4914	0.4635	1.06	
wifeup	0.4192	0.4690	0.89	
wifeaged	0.0104	0.0294	0.35	
wifeaged2	-0.0001	0.0003	-0.22	
income	0.0249	0.0065	3.82	**
natmigration1	-0.0082	0.1528	-0.05	
morethan20	1.1803	0.1776	6.65	**
south	0.5353	0.3553	1.51	
central	0.8490	0.2926	2.90	**
midwest	1.1595	0.2439	4.75	**
northeast	0.3268	0.2475	1.32	
kilometers	-0.0005	0.0003	-2.00	**
land	-0.0641	0.1642	-0.39	
_cons	-5.0046	1.0023	-4.99	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

Table 5-6. Model 2 household labor productivity solving for the endogeneity problem

	Model 2 Heckman model solving for endogeneity I				*Model 2 Heckman model solving for endogeneity II*			
	Number of obs		1601		Number of obs		1601	
	Censored obs		894		Censored obs		894	
	Uncensored obs		707		Uncensored obs		707	
	Log pseudolikelihood		-10449.8		Log pseudolikelihood		-10454.9	
	Wald chi2(36)		55.62		Wald chi2(35)		53.22	
	Prob > chi2		0.0194		Prob > chi2		0.0249	
prodtotal0	Coef.	Robust Std. Err.	z		Coef.	Robust Std. Err.	z	
sex	30614.49	77062.35	0.40		26054.65	76060.74	0.34	
union	-38873.74	50761.51	-0.77		-33840.62	50033.45	-0.68	
children	-8893.97	14177.55	-0.63		-5784.87	13870.25	-0.42	
members	6220.25	3844.22	1.62		8177.06	4114.40	1.99	**
indiglanguage	-31123.46	19691.93	-1.58		-43080.13	21140.83	-2.04	**
elementary1	22806.79	26713.46	0.85		24859.45	26971.08	0.92	
middle1	62648.85	46126.74	1.36		57586.65	46411.67	1.24	
high1	-64244.12	69979.59	-0.92		-66250.80	70120.06	-0.94	
up	-93667.19	74610.05	-1.26		-104607.80	76001.90	-1.38	
aged	-4581.28	5406.57	-0.85		-3996.13	5391.99	-0.74	
aged2	72.04	68.66	1.05		68.79	68.49	1.00	
wifeelementary	-39486.65	22918.57	-1.72	*	-37201.08	22761.56	-1.63	
wifemiddle	-92463.46	40865.54	-2.26	**	-96850.80	41370.82	-2.34	**
wifehigh	24649.61	42727.38	0.58		31153.82	44150.11	0.71	
wifeup	436487.80	375889.20	1.16		442094.00	377044.20	1.17	
wifeaged	1227.86	2405.19	0.51		1208.13	2425.16	0.50	
wifeaged2	-40.64	27.70	-1.47		-40.43	27.79	-1.45	
income	2625.82	1233.11	2.13	**	3078.39	1287.29	2.39	**
natmigration1	-33925.76	19126.52	-1.77	*	-32735.28	18828.50	-1.74	*
ivmig	-254718.40	156318.70	-1.63		-367465.30	167205.40	-2.20	**
morethan20	-40070.38	25865.51	-1.55		.	.	.	
contracted	268.11	157.61	1.70	*	255.67	156.01	1.64	
ejidalland	-24406.25	26181.74	-0.93		-24954.02	26340.37	-0.95	
ownland	19368.83	12293.48	1.58		20135.76	12322.57	1.63	
plot	-9743.90	7171.46	-1.36		-9307.14	7126.42	-1.31	
irrigation	-15370.02	23037.16	-0.67		-15953.96	23147.02	-0.69	
totalacres	152.96	174.46	0.88		139.56	173.10	0.81	
procampo	-34960.07	21093.03	-1.66	*	-34946.04	21098.86	-1.66	*
procede	43710.56	26884.89	1.63		44168.24	27012.47	1.64	
seed	23338.20	20566.25	1.13		23360.09	20565.21	1.14	
fertilizer	47455.76	19059.87	2.49	**	45898.68	18802.11	2.44	**
machinery	-40628.53	24114.23	-1.68	*	-40055.73	24019.69	-1.67	*
south	-50323.44	36786.03	-1.37		-38422.72	35430.63	-1.08	
central	-49829.31	39932.84	-1.25		-34160.81	38298.23	-0.89	
midwest	140533.00	108893.50	1.29		157611.70	111280.30	1.42	
northeast	58345.67	57551.03	1.01		57602.22	57245.49	1.01	
_cons	147747.30	115067.90	1.28		116272.10	111967.10	1.04	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

ivmig represents the predicted value of the logit model for migration

Table 5-7. Model 2 Heckman selection model solving for the endogeneity problem (first-stage)

	Model 2 Heckman model solving for endogeneity I				*Model 2 Heckman model solving for endogeneity II*			
land	Coef.	Robust Std. Err.	z		Coef.	Robust Std. Err.	z	
sex	0.7874	0.1256	6.27	**	0.8660	0.1219	7.10	**
union	-0.1714	0.1128	-1.52		-0.2408	0.1110	-2.17	**
children	0.0902	0.0807	1.12		0.0338	0.0782	0.43	
members	0.0315	0.0203	1.55		-0.0160	0.0159	-1.00	
indiglanguage	0.8543	0.0915	9.34	**	1.0256	0.0787	13.03	**
elementary1	0.2743	0.0810	3.39	**	0.2237	0.0812	2.76	**
middle1	-0.1762	0.1280	-1.38		-0.0853	0.1231	-0.69	
high1	-0.0280	0.2217	-0.13		0.0105	0.2228	0.05	
up	-0.6779	0.2381	-2.85	**	-0.4846	0.2278	-2.13	**
aged	0.0964	0.0146	6.60	**	0.0848	0.0142	5.97	**
aged2	-0.0008	0.0001	-5.84	**	-0.0007	0.0001	-5.39	**
wifeelementary	0.1336	0.0802	1.67	*	0.1010	0.0791	1.28	
wifemiddle	0.1692	0.1202	1.41		0.2356	0.1209	1.95	*
wifehigh	0.3215	0.2040	1.58		0.1937	0.1999	0.97	
wifeup	-0.0420	0.2145	-0.20		-0.1368	0.2125	-0.64	
wifeaged	0.0111	0.0126	0.88		0.0111	0.0126	0.88	
wifeaged2	0.0000	0.0001	0.39		0.0000	0.0001	0.29	
income	0.0211	0.0036	5.82	**	0.0125	0.0029	4.37	**
natmigration1	-0.1139	0.0581	-1.96	**	-0.1390	0.0579	-2.40	**
ivmig	-1.9068	0.5881	-3.24	**	0.1021	0.3009	0.34	
morethan20	0.6039	0.1508	4.00	**	.	.	.	
south	1.2547	0.1183	10.61	**	1.0922	0.1084	10.07	**
central	1.8850	0.1282	14.71	**	1.6471	0.1084	15.19	**
midwest	1.0033	0.1567	6.40	**	0.6835	0.1294	5.28	**
northeast	0.2095	0.1176	1.78	*	0.1462	0.1143	1.28	
inheritance	0.3520	0.0619	5.69	**	0.3452	0.0617	5.60	**
hhfirst	-0.3039	0.1310	-2.32	**	-0.3042	0.1295	-2.35	**
perejidallandd	0.4516	0.0690	6.54	**	0.4784	0.0676	7.08	**
incomeag	0.6503	0.0598	10.87	**	0.6645	0.0598	11.11	**
sharedland	0.3792	0.0632	6.00	**	0.3643	0.0631	5.77	**
_cons	-6.3319	0.4316	-14.67		-5.7139	0.3849	-14.84	

* statistically significant at a 90% confidence level

** statistically significant at a 95% confidence level

ivmig represents the predicted value of the logit model for migration

CHAPTER 6
CONCLUSION

This study aimed to capture the impact of international labor-out migration on the agricultural production of Mexican rural households. Using the Mexican National Rural Household Survey (ENHRUM) database and estimating a Heckman Two-Stage model we were able to capture the labor productivity of the household accounting for the selectivity of landholding.

Our findings suggest that landholding households in rural areas are more likely to have a low level of education, speak an indigenous language and be located in the central and southern part of the country compared to non landholding households. The study supports Assies, (2008) assessment of the existence of regional differences in the agricultural sector. We noticed that households located in the Southern and Central part of the country are less labor productive by $71,102.08 and $79,421.25 respectively, than those located in the Northwestern region. This finding suggests the need to generate incentives to promote the agricultural production in the southern part of the country as measure to close the existing regional gap in the agricultural sector.

Another important factor determining the labor productivity of the household is the level of education. For instance, we found that household heads that have middle education level are more labor productive by $111,725.80 than household heads that have no school. The education level of the spouse, however, has the opposite effect on labor productivity. As the education level of the spouse reaches middle education, decreases the labor productivity of the household head by $122,025.20 and of the entire household by $84,443.23. These findings suggest the importance of improving the education level in rural areas. With this result it also became evident the importance of combining the education level of women with their empowerment in other markers such as the credit or land rental market as strategy to increase the labor productivity of the household.

We did not find any change in the intra-household allocation of labor. The amount of time the household wife and son spend on agriculture does not affect the labor productivity of the head or of the entire household overall. Studying the role women play in the labor productivity of the household we found that female-headed households are less likely to own land and work in agriculture compared to male-headed households. *Procampo*, which is an income transfer program, was found to have a negative impact on the labor productivity of the household. It reduces the labor productivity of the household head by $46,336.40 and of the entire household by $36,933.66. As Assies (2008) suggests, it seems that the program has been insufficient to help the rural sector achieve competitiveness.

In our study we also noticed that *ejidos* remain an important type of tenure of ownership in Mexico. We found that the existence of *ejidos* in the community as well as of community land increases the household's odds of holding land. When measuring the effect of land tenancy status on labor productivity, we observed no impact on labor productivity. Households participating in the governmental program, *Procede,* achieved greater labor productivity of the household head by $68,562.32. These results support the belief that small farmers, with the assistance of governmental programs promoting productivity, will have greater incentives to achieve competitiveness (Quintana, Borquez and Aviles, 1998).

On the other hand, we observed that hired in labor increases the labor productivity of the household head by $740.03. However, we did not find the same relationship when analyzing the labor productivity of the entire household. Future studies should measure how the family labor force and wage workers complement or substitute themselves at the presence of migration in the agricultural sector. The only capital-intensive resource that seems to increase the labor productivity of the household is fertilizer. The usage of chemicals increases the labor productivity of the household head by $54,768.26 and of the entire household by $49,196.56. Further research on the way the technology adoption of HYV can increase the labor productivity of the households is recommended.

Other important concept analyzed in this study was the formation of social networks. Studying those communities where the percentage of migrants is larger than 20 per cent; we found that households living in these communities are more likely to hold land. Our study, however, found that the formation of social networks reduces the labor productivity of the household head by $91,564.94 and of the entire household by $94,257.02. This result suggests that the existence of social networks in the community can be leading to an overall reduction in the labor force availability constraining even more the household's capability to substitute or complement the family labor with waged workers. This finding, however, does not hold when the potential instrumental variable of distance is added into the model. This can be explained by the possible correlation existing between the predicted values of the instrumental variable and the social network variable.

To analyze migration we differentiated between national and international migration. Households with national migratory experience are less likely to hold land and are also to be less labor productive. National migration reduces the labor productivity of the head by $46,431.76 and of the household by $33,735.25. In the case of international migration, we observed no relationship between international migration and access to landholdings. However, we found as Miluka et.al. (2007) that international labor out-migration has a negative impact on the household labor productivity. International migration reduces the household labor productivity by $28,655.31.

As mentioned before, this result suggests that migrant households are less labor productive than non migrant households. This finding rejects the hypothesis in our study. In general, it seems that migration, either national or international, reduces the labor productivity of the entire household. An explanation for this result is that migrant households are not investing enough in capital-intensive resources to compensate for the reduction in labor supply affecting negatively the labor productivity of the household.

However, one needs to be cautious in interpreting these results. These findings do not hold when the potential instrumental variable of distance is added into the model. Furthermore, the coefficient of the predicted value is significantly greater than the coefficient of the original migration variable, suggesting a greater impact of international migration on labor productivity. In order to make better inferences on the way labor out-migration impacts labor productivity, further research needs to be carried out, dealing more properly with the endogeneity problem of migration.

The contribution of this study to the current literature can be summarized in three main points. First, we tested the New Economics of Labor Migration approach and proved that migration represents indeed a household strategy. Contrasting the way labor out-migration influences the labor productivity of rural households we found that international migration affects labor productivity at the household level but not at the household head level. Second, taking into account landholding selectivity we reached the same result found in the case of Albania (Miluka, et.al, 2007), that international migration is affecting negatively the labor productivity of the household. Third, when we introduced the social network variable into the model, we reaffirmed the finding that migration has a negative impact on labor productivity in the agricultural sector.

Limitations of this research are three. First, the database presents some drawbacks to the analysis as the fact that it is cross sectional data, it does not provide information on return migration or duration of trips, and some of the farming practices were aggregated at the household level instead of the desired parcel/plot level. Second, the study of labor productivity and migration require complex methods that are beyond the scope of this research. Third, the utilization of instrumental variables represents a challenge in the research since no econometric method can guarantee that the selected instrumental variable is the correct one to solve for the endogeneity problem.

Future research will include finding instrumental variables that are correlated with migration but not with the formation of social networks to be able to account for the impact of both, migration and social networks on labor productivity. We will also try to develop more complex methods that are able to account for a common endogenous regressor in the selection and regression equation in the sample selection model (Kim, 2006).

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BIOGRAPHICAL SKETCH

Melissa Ramirez was born in 1981, in Puebla, Mexico. The younger of two children, she grew up in Puebla, graduating from the American School High School in 2000. During her undergraduate studies, she had the opportunity to participate in a 1-year exchange program in Tubingen, Germany. She earned her B.S. in economics from the Universidad de las Americas, Puebla. In 2006 she gained an assistantship to come to the University of Florida to continue her studies. Melissa graduated in summer 2008 with a Master of Science in food and resource economics and a certificate in supply chain management.