PRODUCTION IMPACTS OF LABOR OUTMIGRATION IN AGRARIAN ECONOMIES: THE CASE OF CORN FARMERS IN CENTRAL AND SOUTHERN AREAS IN MEXICO*

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Abstract

Farm productivity in agrarian economies is frequently and considerably altered by the outmigration of household labor. Using household survey data we examine labor outmigration impact on corn farmers of the central and south regions of Mexico. Specifically, comparative changes in labor productivity are estimated in a sequential production technology specification with nonlinear components in the context of different agricultural environments.

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Introduction

Agricultural productivity and the well-being of rural families are frequently and considerably altered by the outmigration of family labor. As a result, the production organization and market participation of households are changed. How household production adapts to this migration, and the extent to which local institutions interact with this process, is the subject of this paper.

This research belongs those that analyze the availability, quality and participation of family labor as a relevant condition for the development of farm businesses and agrarian societies (see, for example, Carter and Kalfayan, 1989; Dasgupta, 1995, 1998; De Janvry, *et. al.,* 1991; Stark, 1991).[1] Overall, outmigration of family members may be considered an important source of multiple cumulative distortions with complex linkages to others "outside and inside" the rural economy (see Lipton, 1980; Todaro, 1980; Taylor and Martin, 2001). Rural families, often among the poorest in the developing world, are the most likely to be affected by outmigration; thus understanding these issues is imperative. In spite of that, there has been relatively little research on this groups of studies.

Objectives

The main objective of this research is to determine the impacts of outmigration in several agrarian communities of the central and south regions of Mexico. Specifically, this study will examines the microeconomic effects of outmigration on local labor relations in the presence of imperfect local markets and different institutional environments. The study focuses on migrants' farm productivity and whether farmers show changes in farming techniques when outmigration occurs. This study will also examine whether input requirements changes show significant differences when outmigration happens.

Conceptual Framework

Within the controversy regarding population growth, availability of resources and poverty, some argue that rural overpopulation reduces the possibilities of income growth and, to a great extent, increases poverty. Consequently, in the presence of labor surplus and a serious shortage of land to be farmed, outmigration largely increases labor returns at the origin and, therefore, any conceivable negative effect of outmigration is offset partially or totally by the gains in productivity and efficiency in the use of resources and by the reduction of local unemployment. However, labor surplus appears to be a generally contested result (see, for example, Schultz, W 1951, Schultz, P. 2001; for an opposite view, see Ranis, 1997). Empirical studies have shown that an exceptionally rapid growth of labor returns in rural areas and the ultimate decline in outmigration seldom happens. Moreover, population in many of the most densely settled places in the world enjoys higher returns, and many poor rural areas are sparsely settled.

[Figure 1 about here]

As a prelude to the details of the paper, Figure 1 provides a quick overview of the overall structure of the potential impacts of outmigration, and the specific and global hypotheses. For this paper we will focus in the productivity impact of outmigration (upper branch).

The Impact of Migration

Unexpectedly, three facts are found associated with migration: (1) Permanent migration happens not because of lack of resources (e.g., farm land) in the sending point that depress labor returns (Schultz, W. 1951). Conversely, "…there are not enough able-bodied inhabitants to expand production beyond very narrow limits; and capital and labor are the limiting factors of livelihood, not land" (Garcia-Barrios, 1994, Chap. 3).

(2) Migration is accompanied by an increase in local unemployment and likely by a semi-proletarization of the local population (De Janvry, *et. al.,* 1991; see also Dasgupta, 1995). Therefore, it is hypothesized that outmigration reduces the specific labor force of household farms and weakens the production organization.

(3) Migration is also accompanied by an inflow of investment resources, e.g., monetary remittances sent to families (Lucas, 1987, 1997 and Taylor and Martin, 2001). However, remittances may also distort traditional land tenure systems or "class orientations" (Mabogunje, 1989 and Massey, *et. al*., 1993) and, to an important extent, alter local income distribution, asset accumulation and consumption patterns (Taylor, 1992; Taylor and Wyatt, 1996; Barham and Boucher, 1998).

Preliminary Hypotheses

In the developing world, agriculture is, in a great part, artisan in nature and the quality of work is crucial in producing a good harvest. However, rural labor markets suffer typically from

[1] It has mainly been argued that local agrarian relations and patterns derived from contractual structures of production and finance play a major role in determining the fate of the poor and even that of the natural resources. Therefore, access to natural resources may not be a sufficient condition of rural household prosperity.

imperfections. Specifically, family labor is relatively distinct either because of the potential moral hazard problems of in-hired labor doing tasks that require intensive effort, or because critical levels of qualified traditional farming practices, farmer's knowledge and organizational leadership are hard to replace. The correction of such imperfections often implies costly supervision (Carter and Kalfayan, 1989) or adjustments to farm production (Dasgupta, 1993; see also Taylor and Martin, 2001). As both imperfections are associated with migration, they may be hypothesized as the source of household farms' inefficiencies. Specifically, it is hypothesized that outmigration reduces the productivity of farm resources and, to an important extent, causes a malfunctioning of the agrarian production system. In addition, farmers in agrarian economies usually show low liquidity status and tight borrowing constraints, which are inversely related to the size of land holdings. Therefore, variations in the access to land and assets endowments across households may allow the examination of differentiated adjustments to outmigration (see Katz and Stark, 1986; Rosenzweig, 1980; Carter and Zimmerman, 1998). Naturally, the importance of each factor will depend, among other things, on how sensitive family farms are to each of these rural labor characteristics.

Notwithstanding, agrarian societies develop mechanisms that alleviate market imperfection effects. With more or less success, systems based on the extended family authority govern land tenure, labor supply relations, access to resources and women's roles and status. *It is expected that such institutions evolve with migration*. It is hypothesized that agrarian communities adjust in different ways and degrees to labor outmigration depending on their capacity to restructure local labor institutions appropriately. For example, it is hypothesized that migration exacerbates tendencies toward individual land ownership and family nucleation.

A Brief Review of the Literature

Household Production in Agrarian Economies

Agricultural productivity is based on organizational systems that govern (a) the household decisions related to the access to resources, (b) the allocation of goods and services, and (c) the distribution and redistribution of cooperation's gains (Scott, 1976). Many of these institutions function by generating flows of information and providing access to fundamental organizational resources for production activities like the participation in and coordination of productive activities within the household or the hired-in labor supervision provided by household members. Consequently, in several cases, agricultural productivity and therefore the competitiveness of traditional agrarian economies rely not only on the access to natural resources.

Agricultural Labor Supervision and Migration

Both in industrial and agricultural organizations, the main role of supervision is reducing the potential moral hazard from hired labor, thereby controlling its effective productivity (Carter and Kalfayan, 1989). In peasant societies, the moral hazard may arise in places where there is an active labor market for casual agricultural labor (Dasgupta, 1993) and when labor effectiveness cannot be observed directly.

The necessity of supervising hired labor comes from the fact that rural employers are not able to adequately observe hired workers' real effort and ability at first sight. However, compared with other forms of production organization, rural families have access to *psychological* resources that stabilize an adequate level of participation, so that coordination and moral hazard problems are fewer. Typically, rural households regularly utilize their own labor resources before hiring in labor and, of course, make use of their own members as “supervisors” of labor productivity when it is hired in. "Hired labor are almost invariably supervised by someone in the employer's household who in fact works alongside them…"(Dasgupta, 1993, p. 238). On the other hand, "…Family labour does not require as much supervision as hired labour. This is partly because family members can be expected to share an emotional bond, and so to a great extent trust one another not to shirk. It is partly also because household members have a stake in household fortune....”, with family descendants being the residual claimants, as concludes Dasgupta (1993, p. 224).

Thus, labor contracts are operational for employers and employees only if labor is feasibly subject to relatively cheap supervision. One may imagine the implications of household labor out-migration on the quality of supervision resources available and thus on the whole household’s productivity, but this issue will be assessed after considering some general characteristics of the organization of rural production which will help more in this task.

Household Production Organization

Several authors have recognized the need to analytically differentiate the treatment of local peasant families within each rural community (Eswaran and Kotwal, 1985; Carter and Kalfayan, 1989; Isvan, 1991, Carter and Zimmerman, 1998). The purpose is to identify the causes of why families (and members) adopt differentiated strategies in similar situations. A key response difference seems to be the unequal and heterogeneous resource and wealth distribution inside rural communities[2] (see Bardan, 1984; Eswaran and Cotwal, 1986, Carter and Zimmerman, 1998). An important feature derived from this point is that a household's particular endowment status has strong implications in the form of market participation (capital, labor, insurance and land markets) and so to a great extent determines their capability to solve liquidity problems (Dasgupta, 1993)[3].

Therefore, even though rural markets are thought of being missing and/or very segmented, rural societies and families have mechanisms that ease access to private and specific information and thus enjoy less-risky contractual arrangements. For poor peasants with low access to either capital, land or agricultural equipment markets, their seed reserves, livestock holdings and children are vital "assets". Once a poor peasant faces a capital constraint larger than the minimum required for beginning any agricultural production activity, they will start considering migration as a more attractive real option (see Katz and Stark, 1986). In addition, peasant parents who have not enough land or other assets with which they could tie their young sons or daughters to an interchange of land (or other assets) for labor services, usually lose them through migration (Dasgupta, 1993).

Thus, rural capital market imperfections can affect local labor markets. The existence and functioning of inter-linkages depend on how local markets work and what is the relative liquidity level of parents that is, in turn, a function of their relative wealth levels. On the other hand, migration may reduce the probability of being considered a potential borrower even in informal credit markets or eventually raise credit transaction costs. Therefore, migration may by itself exacerbate organizational failure and *cumulatively* cause a major impact in rural production systems.

Migration and Production Distortions

Broadly speaking, two central and alternative hypotheses related to the effects of outmigration are present on the literature. The divergent idea of these two approaches is whether migration is neutral to production or not. The main arguments are outlined below.

The migration pseudo-neutrality hypothesis

Since the beginning of the 1950's, dual theory has experienced significant changes (see Lewis, 1954; Nurkse , 1957; Viner 1957; Ranis and Fei, 1964; Harris and Todaro, 1970; Cole and Sanders 1985; and Basu, 1997). However, some central aspects remain almost intact. It is still being

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[2] Such unequal distribution may have diverse origins like the differentiated allotments of wealth through generation (relatives and children families), the unequal wealth's accumulation capacity or accumulation possibilities prevailing among local politic or religious authorities and common peasants.

[3] A general results is that families endowed with little or no assets as credit-demanding collateral are not subject of lending in the formal market, but --and this is our point-- due to a certain institutional settings, they may have an easier access to the "informal" credit markets (Zeller, 1994). Such a dynamic can be observed through many associated contractual arrangements or linkages usually present in rural markets.

held, for example, that the "modern sector" can be developed by absorbing the "unlimited" supply of the "homogeneous" labor force from the traditional "subsistence" sector (at eventually invariant wage rates), without causing important production or organizational changes at the origin points (for important exceptions see Sen, 1960 and 1966)

The argument is that it is possible to reallocate the rural labor force without negatively affecting the agricultural production structures of agrarian economies. *In other words, out-migration processes may have no meaningful effects on the remaining productive factors, techniques and organization methods*. In terms of Viner (1957), this is a situation (dual economies) where, by taking off one unit of rural labor from a given combination of inputs, the output will not suffer any change and may even increase.[4] In sum, the importance of out-migration's effects on the structure of production is still marginally considered.

The non-neutrality of emigration hypothesis

On the other hand, an increasing number of authors have acknowledged the negatives (or at least significant) effects of out-migration on agrarian institutions and production (de Janvry and Garcia-Barrios, 1988; Binswanger, *et. al.* 1989; García-Barrios, 1994; Templeton, 1994). There are several ways how rural out-migration affects the quality of household and community transactional networks and by extension the institutions supporting labor and land productivity. First, out-migration, by reducing rural population, causes that "labor force available for agriculture drops or grows less than it otherwise would have done, reducing the years of use of land between fallows…" Likewise, "[l]and investment is inhibited (…); animal traction and soil fertility maintained through manure are discouraged;…" (Binswanger, *et. al.* 1989, pp. 138-139).

Second, the average costs of providing local infrastructure increases (Binswanger, *et. al.* 1989), although its quality and quantity may remain invariant, or even decrease. An example is the use of collective irrigation systems. Its proper functioning implies a permanent maintenance intensive in labor. With migration the participation cost (in labor effort and time) for procuring the same public good increases (Garcia-Barrios, 1994).

Third and related to the last points, migration may reduces the certainty of production and the continuity of repeated cooperative relations and, therefore, the entire stability. This is well illustrated by Massey, *et. al.* (1993, p 452): "[M]igrants are likely to purchase farmland, but they are more likely than nonmigrants to let the land lie fallow since …. wage labor is more lucrative than local agrarian

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[4] Sen (1966) has argued against the rationality underlying this conclusion by pointing out than the observed stability of rural output levels after having decreased the zero-productive labor force from rural areas is due simply to changes in the allocation of time between leisure and labor. On the other hand, Binswanger, *et. al.* (1989) contend for an increase in the marginal productivity of labor but only after a decrease in production.

production. This pattern of land use lowers the demand for local farm labor, thereby increasing the pressures for out migration."

Fourth, peasant households become, in general, more dependent on out-hiring labor's income, reduce their time available for agricultural activities, and substitute their development expectations based on the use of traditional community resources (e.g., peasant knowledge and methods of production) for the one based on technical or “pseudo-scientific” resources (machine-based or agrochemical-based productive processes, handbooks and brochures, etc.). "The more [out-]migration, the greater the capitalization of agriculture and the greater the displacement of labor, leading still to greater migration" (Massey, *et. al.* 1993, p. 452).

Fifth, migration often presupposes brain drain ("loss of wisdom"). Since migration tends to be selective, the most capable women and men with major entrepreneurial and leadership abilities are the first and most obvious potential candidates for migration (see Bencivega and Smith, 1997).

Sixth, migration may undermines intra-household links and fragments the local community’s mechanism of resource distributions and information flows (see Dasgupta, 1993). Migration involves cultural changes, that introduce alternative patterns of consumption and normative behavior for young members of communities and their families who increase their demand for urban services.

In sum, these arguments have four relevant implications for this paper: out-migration (a) increases the moral hazard in agricultural labor contracts, (b) decreases the absolute and relative quality and size of the household’s labor force, (c) reduces the supervision resources of peasants households; and (d) alters the situation of relative liquidity of peasant families by minimizing the linkages and inter-market arrangements between credit and labor markets. On the whole, these four implications increase transaction costs and decrease the total demand for labor and surplus generation. In fact, they can cause the emergence of the “resource trap” described by Robles and Garcia-Barrios (1994). Because of these arguments, it may well be, contrary to what is held by Lewis (1954), that out-migration *reduces* labor productivity along with its demand and increases unemployment in rural communities. Thus, the asymmetries and the migration process reinforce each other.

Migration and Income Distortions

Migration outflows come along with certain monetary inflows (remittances). Remittances, in some way, may reduce peasants' capital constraints (original or caused by migration). It is positively argued that “...migrant incomes may serve as a source of capital accumulation in rural areas...”. This argument affirms that “...labor departure may diminish agricultural output in the short run, while enhancing (local) productivity in the long run…" (Lucas, 1987, p. 327). This possibility exists and has also been observed by several authors (Massey, *et. al.* 1993 and Wood, 1981).

However, even though it is true that monetary remittances may raise household welfare, it is less probable that agricultural productivity increases beyond the self-consumption level. In general, monetary remittances tend to be small, unstable, not supporting physical capitalization of agricultural production or solving the transactional biases suffered by poor peasants in credit markets. Moreover, the additional income from migrant remittances reduces the need for credit and lowers its demand. This works against the development of rural credit market (Binswanger, *et. al.* 1989).

In addition, such flows of monetary resources cannot be used either to solve the above-mentioned transactional failures in local labor markets nor to generate organizational capital. Consequently, the transaction costs for agricultural capitalization may stay relatively excessive and, what is more, the remaining members of peasant families frequently address an important part of remittances' resources to other ends. A great part of it is consumed, or used to hire-in labor force to procure self-consumption levels of production, or in forms of savings like livestock and other durable goods and assets[5] not involved directly in farm's production. "The more outmigration, the more people have access to the funds necessary to buy land, leading to additional purchases by migrants and more land withdrawn from production creating still more pressure for outmigration." (Massey, *et. al.* 1993, p 452).

The Mexican Context

At the beginning of the twentieth century a land tenure system was established by land reform. It divides the rights over land between the private sector and the *ejidal* or communal sector. Each sector occupies approximately half of Mexico's arable land and half of the irrigated land. The social sector is composed of more 28,000 *ejidos* (communities), some of which are indigenous communities, which each contain a number of families that can range from as few as 20 to as many as four of five hundred, with an average of some 100 families. In this sector the land title is held by the community and individual households have used a plot of land and often have access to common grazing and forestry lands (Sadaulet, *et. al*. 1996). The *ejido* has been characterized by strong state intervention in its internal affairs, including its decision-making mechanisms, conditions for access to public resources, and the management of rural welfare (Gordillo, *et. al.* 1998). Before 1992, when Article 27 of the 1917 Constitution was amended, households in the *ejidos* were in principle forbidden to divide the land among descendants, but in practice much division has occurred. In the

[5] Including farm land, as Massey *et. al.*(1993) previously discussed.

indigenous communities, divisions were legal. The result is that the social sector today is highly heterogeneous (Sadaulet, *et al*. 1996).

Given this context, recent changes in Mexico may be influencing the *ejido* system. As most Latin American governments, Mexico reduced their role in the national economy over the past fifteen years when external debt and declining productivity led to policies of fiscal adjustment that favored the free market. In this context, rural communities are believed to have experienced several effects. In general, production has increased, while acreage and rural employment have declined in many *ejido* areas. There has been a sharp reduction in the number of small farmers, often accompanied by greater inequality. The reduced role of the state has left important gaps not (yet) filled by the private sector, with negative consequences in particular for small producers (David, *et. al.*, 2000).

Also, in early assessments of the North American Free Trade Agreement (NAFTA) evidence of the effects of economic liberalization is suspected on rural resource degradation in developing countries. The principal resource effects of concern are processes of land use change leading to forestland conversion, degradation and deforestation (Barbier, 2000). Although, Taylor *et. al.* (1999) believe that maize-price liberalization under NAFTA may have increased the productivity of family resources in household-farm production, the effects on migration are still far form being neutralizing.

These effects were exacerbated by changes in the structural and institutional support that previous government policies used to provide. Some of the programs that where eliminated are the extensive system of support prices for agricultural crops, the reduction of PROCAMPO subsidies and credit for small production. In addition, the commercialization institutions and systems for corn and other crops were also withdrawn. Consequently, outmigration from rural areas to the cities or international sites is considered an import response in the set changes of survival strategies of individuals and households.

It general, this strong set of interventions and reduction may be influencing the *ejido* system and inducing migration. Providing a broad idea of migration in Mexico both Table 1 and Figure 2 (composed using Table 5.4 form Pick and Butter, 1994; see Table 1A) show the migration flows and per capita rates of migration reflected in the 1990 and 2000 Censuses. Even being a very general view of Mexican migration, this information sheds light on some details. The *ejidos* covered in this research belong to the shaded states in Table 1A. Likewise, Figure 2 shows how out-migration is more a constant in the central and south states of Mexico than in the rest of the country. With the exemption of Chihuahua and Estado de Mexico[6], the states of the *ejidos* under this research show numbers of outmigration greater than those of immigration being Oaxaca the state with percentage values close to 20%. This pattern is confirmed by the information obtained from the 1999 Census in

Table 1A in the appendix. Moreover, Table 1 shows the percentages distribution of migration by migration condition and cause of migration, both in for women and men.

[Table 1 and Figure 2 about here]

With the exception of Estado de Mexico, all the stated present low levels of migration within their respective states (Municipal Migrant) compared to the national level (3.28 %). This is also the case for both women and men. Likewise, with the exception of Chihuahua and Estado de Mexico, the other states present percents of state migration lower that those at national level (4.40 %). Note that if we add state and municipal migration it will correspond to the total percentage of internal migration of Mexico. Also in this case Chihuahua and Estado de Mexico present percentage superior to the national percentage. In the case of international migration the exception is Michoacan. The percentage values of the total population is greater than one in Michoacan whereas the other states are far below 1% as is the case at national level (0.45%).

Also a broad overview of corn (maize) production Table 2 presents total values of maize and frijol production by state and the percentage participation of each state in the total national. The states under this study are shaded. As we observe, Chiapas and Estado de Mexico are the two most important states of corn production of corn in the country (each one with more than 15% o the national total). Both in total account for more than 30% of the total country's corn production. The main reason explaining such a big participation is due to the introduction of green revolution techniques: agrochemicals, high yielding varieties, mechanization. On the other hand, Durango (1.77%) and Chihuahua (2.43%) exhibit the lowest percentages. States which are conceived as traditional from the used of modern technology are Michoacan and Oaxaca; however, their percentage of maize production are higher that those of Durango a Chihuahua. Michoacan maize production is almost 6% of the country's total and Oaxaca accounts for 3.32%. Table 2 presents the value of frijol production which may be useful since corn tends to be intercropped with frijol.

[Table 2 about here]

Data and Methodology

This paper analyzes outmigration's effects using the “Determinant of Household's Income Survey"[7] database gathered in a bi-institutional project from CRIM-UNAM in Mexico and the University of California at Berkeley. As part of this project, a number of *ejidos* in Mexico were

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[6] The first one is close to the border with United States and the second is the surrounding state of Mexico City.

[7] This project started in 1993 under the former name of "*Reforms to the Ejido and Rural Development in Mexico* with the Centro de Investigacion y Docencia Economicas at Mexico and the University of California at Berkeley.

studied between 1993 and 1996 and on the second stage between 1997-00. Each *ejido* was visited only once and two surveys were simultaneously applied: a qualitative survey conducted among *ejido* authorities, ex-authorities and old *ejido* neighbors and a quantitative survey applied face-to-face to about 504 households in eighteen *ejidos*. The *ejidos* belong to the central and south regions of Mexico. They were selected to give a broad diversity in technological predominance as well as in the type of local institutions. Most of them are concentrated in the area of Oaxaca. The unit of study was the family farm and the survey questions focused on the process of agricultural production and the demographic characteristics of the household. The surveys comprised a fieldwork period of four to seven weeks per community and data were collected from the last two agricultural cycles.

Since livestock is present in different forms of arrangements across communities, we will limit the analysis to crop production, mainly corn. The collected data includes inventories, describing land and production during the last two agricultural cycles. It includes information regarding the number per plots, tenancy, area and production by plot. Technology, describing the requirements of labor (family, reciprocal and hired), machinery per tasks and days of use of such inputs. This area is great importance in this paper, since it presents the most detailed components of labor requirements. The unit of analysis is the plot. The survey information was collected from two plots out of the total number of plots per family/household. These two plots were selected trying to identify the two more distinct technologies (for example, hilled plots vs. flat plots). When the case was that households cultivated two plots or one the information was collected from those two plots. Similarly, when the case was that households cultivated/owned/rented only one.

Community Description and Household Typology

Tables 3 and 4 describe the main characteristics of communities and households in the sample. They includes households with very small farms who engage in both subsistence agriculture production and the sale of labor, a large number of households who are self-sufficient in labor: and households with farms that are large and/or better endowed in productive assets. Table 3 shows the size of land owned in a household per community, and the typical agricultural environment. Average amount of land owned by a household in the sample is 3.08 hectares. Givicia (9.29) and Francisco Villa (7.05) present the highest numbers, and Capulcapan (0.68) and San Andres Yutuni (0.75) the smallest. Although very important, we are limiting ourselves of making any distinction in terms of the nature of the land property and the quality of land. The term "owned" is more in the sense of access than property regime but it could be a combination of private property, *ejidal* or communal tenure and may need further distinction between holding, possession and prescription (For a complete list of terms and definitions about land tenure, see Lastarria-Cornhie, 1999). Likewise, land's quality may need a differentiation in terms of irrigated, rain fed, dry, etc.

[Table 3 about here]

On the other hand, in Table 3 we have the average number of members in a household per community and agricultural environment. The weighted mean is 6.9 with the highest being in *ejido* El Aleman (9.91) in Durango and the smallest in San Andres Yutumi (5.13). Also, Table 3 shows the percentage of household with migrated relatives and the percentage of households receiving remittances. Both San Andres Yutuni and Paso del Muerto present high percentages of households with migrants (around 45%), while Ixtal (21%) and Francisco Villa (26%) the lowest. Table 3 also presents the ratio between household size and land owned. It intends to illustrate the per capita relative access to land across communities. The smaller the number the more the land per capita in the community. In average there are almost four persons for each hectare of land. However, variation is high (8.98). Communities like Capulcapan (9.59) and Macuil (9.15) in Oaxaca the highest numbers while Alvaro Obregon(1.13) and Tangancicuaro (1.37) the smallest.

[Table 4 about here]

To better understand the characteristics of communities and households through our sample, we developed a household typology that describes with more details the household characteristics in our sample. Since households are far from being equal even within small and apparently homogeneous communities, they were differentiated in a typology to be able to assess adjustments to out-migration in different types of households. A household typology was used to identify three major economic groups. These groups have as a key distinctive characteristic their relative access to resources and market participation. The access or endowments of key resources determine the production organization and it is hypothesized that outmigration responds to household circumstances and thus their effect may vary with them. Differentiated access or ownership of land, livestock, agricultural machinery and family labor determines household participation in labor, credit, land and insurance markets. Large households with very little or no land may likely be inclined to supply labor off-farm, demand credit, rent in land and machinery, and borrow capital, while households endowed with relatively more land and agricultural machinery will tend to hire in labor in the local market, supply credit, rent out land and even supply credit resources. In the middle is a group of household with some endowments and access and with fluctuated or selected market participation. These three economic groups are constructed in our sample and household classified according to these parameters.

This typology will be later used for a differentiated analysis of outmigration effects. The results are presented in Table 4. Following a basic two-score Discriminant Analysis (DA) we can see that in both the analysis and the holdout samples the accuracy level is 90% and 92%, respectively. This indicates that the previous classification of households according to their access to resources creates three separate groups across the sample.

[Table 5 about here]

Also, we can see in the variables explaining the constructed household typology those related to endowments and access to resources. They appear in the interior part of Table 5, and are ranked by their relative importance in describing the typology through the score equation.

Migration Definition and Household Migration Status

Based on the household surveys, a wide definition of migration is used. Mainly, we will consider migration not only in those cases where definitive migration is present but also in cases where migration is partial or seasonal. In this paper we will not make much distinction between internal and international migration effects, although international migration may imply longer periods and less agricultural seasonality than internal migration might. A further analysis on these issues is desired and may provide with interesting insights. The idea behind such a wide definition is that labor task requirements are different and therefore partial migration can be associated with the possibility of household labor availability for some tasks but not for others. Migration is defined at the household level and later at the plot/farm level. The objective is to categorize and differentiate households with relative family-labor scarcity from those that are not facing such scarcity. In the definition of migration are also considered those cases where members of households present an important number of days as off-farm labor supply and whether they were performed out or during the agricultural cycle.

[Table 6 about here]

Table 6 describes the age distribution of out-migrants as was reported when the household head was surveyed. This table also describes the type of migration: international or national. These results are very preliminary since demographic information of migrants is not always complete in the data. The number of observations in each category of migration status seems to be appropriate. As we can see from Table 6 (also in Figure 1A in the Appendix) young people from 15 to 24 years represent the bulk of migration (about 70% for international and internal migration).

Following the migration definition stated above it is possible to separate households and classify them according to their migration status. In this case we use a simple Discriminant Analysis with one score equation to determine whether a particular household may be consider under a "migrant" or "non-migrant" status. This procedure partitions our household sample into two, namely households with absent members (migrants) and households without absent members (no outmigrants). Table 6 shows the analysis and holdout sample results.

[Table 7 about here]

Migration: Production Effects

Table 8 presents the corn production (in kg.) by agricultural environment and household typology. The information is differentiated by household migration status to describe the effects of outmigration. The information in this table is very important, since it accounts for the differences in production and productivity that households of different migration status may exhibit. The last column on the right side shows the values of a two-tailed t-test assuming different sample variances. The results show that in an important number of times the differences are significant. The case is more relevant across traditional and semi modern environment and for household with less endowments and access to resources. Interestingly, households with more access to resources seem to show little effects to outmigration. This is a very palatable result. However, the modern sector coefficients are contra-factual to our hypotheses.

[Table 8 about here]

What is also equally revealing is the information on labor requirements also by agricultural environment and economic group (typology). Like Table 8, the information is in Table 9 makes a distinction by migration status of households. In this context, average values for family labor, reciprocal labor and hired labor requirements are calculated. The differences in labor requirements shown in Table 9 mirror production and productivity results previously analyzed. The exceptions are for hired labor in general terms and family labor in the modern environment. However, we may consider, in general, significant differences both in productivity and labor requirements. Note that this confirms the paradoxical idea discussed before that local unemployment may be a consequence of outmigration, since labor requirements of households with migrants is significantly lower than those with no migrants.

[Table 9 about here]

To have a more complete idea of these effects we will see the different types of labor requirements per agricultural task. The sequence of agricultural tasks are hypothesized to have specific demands of the different types of labor since their difficulties depend on the nature of the task. For example, sowing activities are hypothesized to require more qualified labor than harvesting or transportation. Therefore, household labor might be more unavoidable for pre-sowing and sowing than for harvesting or post-harvesting. This idea may be extended to the other tasks along the agricultural cycle. Moreover, we may think that labor requirements are different across agricultural environments. But before examining these possibilities we will define the sequential tasks along the agricultural cycle.

The wide range of tasks described in the survey were collapsed into 5 tasks, namely pre-sowing, sowing post-sowing, harvest, post-harvest. The grouping of tasks was done in order to simplify the different classification of task followed by the communities. Table 10 describes the name of reference name of detailed task descriptions. Note that the grouping and redefinition are shown in the last two columns of Table 10. This way of grouping will also help in the estimation of more parsimonious sequential production equations. (Table 2A in the appendix shows some descriptive statistics of labor requirements per task).

[Table 10 about here]

Therefore, we can now describe the labor requirements per task and agricultural environment. Table 11 presents the labor ratio per task by agricultural environment and migration status. These ratios are weighted by the amount of output so it means that the differences in labor requirements are independent of the production variation across migration status. With this in mind we can see that the major part of the mean labor ratios for both migration status categories are not very much different. For example, for the ratio between family labor and hired labor for sowing (Task 2) in a traditional environment, families with no migrants exhibit quite the same labor ratios than families with migrants. Comparison of labor ratios for the other tasks are also not much different. In almost a similar situation are the mean labor ratios for the semi-modern agricultural environment. More perceived differences are found in the modern agricultural environment, although the differences are still small. The case of the ratio between reciprocal and hired-in labor is a little distinct. In this case, the differences appear to go in both directions, favoring either migration status. The result may not be conclusive for the ratio between reciprocal and hired labor.

Going back to the first ratio across the task and agricultural environment. As we mentioned before the difference seem to be not significant across migration status. This may be an indication that at least households of both migration conditions are using the same technology or the allocation of resources is not different. However, if we bear in mind the results of Table 8 related to the significant levels of output differences across agricultural environments, the constancy of the ratio between family labor and hired-in labor may be an indication of some allocation inefficiencies. Specifically, by the same combination of variable inputs, households with migrants may be experiencing a decline in their production levels relative to those of households with no migrants. This inefficiency may be attributable to the outmigration of household labor, controlling for land cultivated and household size. Also, as migration is present, the constancy of labor ratios in critical tasks (pre-sowing and sowing) may be an indication of a decrease in the in-hired labor demand by the household. Consequently, we may expect some increase or form of unemployment originated by the decrease in the demand for local labor.

Technology Representation and Sequential Tasks

To have a more precise idea of migration production effects, we will estimate a sequential production function and estimate the productivity and elasticities of variable inputs, namely family, hired and reciprocal labor. Let's consider y_0 the original/initial set of conditions for the agricultural production. Then, the sequential production function will be defined as follows. Note that an additivity condition is implicitly required. Also, note that the non-task's-output presents a problem of specification that requires such assumptions. The initial unobserved and partial production function could be written as follows:

$$y_1 = f\left(x_{1,1},\ldots,x_{1,n},y_0,k_1\right)$$

where x_{ij} is the amount of a non-capital input "*j*" required by the task "*i*" and k_1 is the vector of capital resources needed for that case. On this process, an unobserved output is created from the application of inputs and use of capital. Such unobserved intermediate output will later be used as an input in the next task. Therefore, the partial production function of the second task could be written as follows:

$$y_2 = f\left(x_{2,1},\ldots,x_{2,n},y_1,k_2\right) \quad \text{or} \quad y_2 = f\left(x_{2,1},\ldots,x_{2,n},x_{1,1},\ldots,x_{1,n},k_1,k_2\right)$$

The previous equation represents an intermediate unobserved production technology, namely the one describing the second task. Note also that as part of the inputs needed to perform the second task we have the unobserved output of the previous task, namely y_1. It is easy to se that the main difference is on the use of y_1 as an input. By substituting the previous expression we end up with a partial production function expressed in the second part of the previous equation and that depends not only on the inputs specific of these task but also on those already employed in the previous one. Here arises an issue regarding the subsitutability or complementarity of these two sets of inputs used in the second task. Conditions of additivity or subadditiviy make substitutability among inter-tasks equal to zero (See, for example Just and Pope, 2001). In a similar form, we can represent the partial production function of the 3rd task and so for $y_3 = f\left(x_{3,1},\ldots,x_{3,n},y_2,k_3\right)$. Similarly up to the last task

$$y_T = f\left(x_{T,1},\ldots,x_{T,n},y_{T-1},k_T\right)$$

Note that the output of the last task, unlike the previous ones, is observable and is expressed as depending on the set of inputs of all the tasks. Therefore, it embodies the technological features of the sequential productions decisions made by the producer. A more appropriate form to generalize the last expression using Just and Pope (2001) but for cross-sectional data would be:

:

$$y = f^0(\boldsymbol{x}, y_0 / \boldsymbol{k}) = \max_{\{x,k\}} \left\{ f^*\left(f_1(\boldsymbol{x_1}, y_0, \boldsymbol{z_1}), \ldots, f_T(\boldsymbol{x_T}, y_{T-1}, \boldsymbol{z_T})\right) / \sum_t \boldsymbol{x_t} = \boldsymbol{x}, \boldsymbol{z_t} \leq \boldsymbol{k} \right\}$$

where $f_t(\cdot) = y_t$ is the unobservable output of task t in the sequential production function, $\boldsymbol{x}_t$ represent a vector of purchased variable inputs in t, and $\boldsymbol{z_t}$ represents a vector of uses of farmer-controlled inputs such as family labor in stage t. Also, $\boldsymbol{k}$ is a vector of maximum uses or availability of services made possible by the fixed stock of farmer-controlled resources such as land and machinery. In some periods, the optimal choice of $\boldsymbol{z}$ is $\boldsymbol{k}$ while in others it is some $\boldsymbol{z}_i < \boldsymbol{k}$. This generalization has strong implications for data requirements.

Specification

To proceed with the estimation strategy we need to test for two specification characteristics, namely the separability test and the functional form of the production function. The procedure is explained in the appendix. Table 3A in the appendix shows the values for the separability unitary (constant) elasticity tests. It is easy to see that the inter-task separability tests are more frequently significant that the intra task separability coefficients. This may be an indication that inputs like family labor used in different tasks (inter-task) are less related or interdependent than intra-tasks types of labor. Likewise intra-task inputs are more complementary than inter-task inputs. On the other hand, the functional form rejects the possibility of variable elasticities of substitution for the major part of the cases. That means that inter-task input ratios linearly depend on their inverse marginal productivity ratios (or their marginal rate of substitution).

Estimation Methodology

Estimation proceeds in two stages, each of which is comprised of several steps. In the first stage, we use a partially-linear (Kernel regression) model to estimate the coefficients on the freely variable factors: household labor, reciprocal labor, hired labor and variable materials. Agro-machine used and amount of land cultivated are our primary proxies for the fixed effects and hence are not included in this list; the estimate for agro-machine use and land cultivated will come from the second stage (Pakes and Olley 1995). Since in this paper we are interested in differential productivity of the diverse types of labor within the tasks, we will concentrate on the results of the first stage.

In this first stage, twenty one preliminary local quadratic least squares estimates are used in a non-intercept OLS estimator to obtain estimates of coefficients on the freely variable inputs. This process is performed for both set of households, namely those with migrants and those with no migrants. To be more specific, by adapting Levinsohn and Petrin (2000) to our sequential production estimation we can approximate the following production technology

$$Y_i = f\left(X_{i1},...,X_{iT},L_i,M_i,\exp(\mu_i),\exp(\omega_i)\right)$$

where X_{it} is the vector of inputs used in the t task by the farm i. Also, exp(μi) is a multiplicative error term and $exp(\omega_i)$ is also a multiplicative error term associated to technology characteristics not identified in the inputs but with significant implications on output and input use. As Levinsohn and Petrin (2000) mention, the ω error component could be associated with steeped or flat plots. Such a differentiation is assumed as part of a technology variation with effects on input use. Then, using a Cobb-Douglas technology to expand the previous expression we have:

$$y_i = \beta_0 + \sum_{j=1}^{J}\sum_{t=1}^{T}\beta_{jt}x_{ijt} + \beta_l l_i + \beta_m m_i + \mu_i + \omega_i$$

where x_{ijt} is the input j used in the t-taks by the farm i, J is the number of intra-task inputs and T is the number of tasks, y_i is the log of gross output in farm i, l_i is the log of the land cultivated, m_i the log of machinery input all of them denoting log-levels. We rewrite the previous equation as

$$y_i = \beta_0 + \sum_{j=1}^{J}\sum_{t=1}^{T}\beta_{jt}x_{jti} + \phi\left(m_i,l_i\right) + \mu_i$$

where

$$\phi\left(m_i,l_i\right) = \beta_0 + \beta_m m_i + \beta_l l_i + \omega_i(m_i,l_i)$$

It is easy to see that this equation is partially linear; namely linear in variable inputs, and non-linear in land and machinery. The goal in this first stage is to obtain estimates on the coefficients of the inputs that enter our estimation equation linearly (i.e. β_{jt} where j=1,…,J and t=1,…,T).

Smoothing Procedure

Robinson (1988) suggest a $\sqrt{n}$-consistent estimate in a semiparametric econometric multiple regression of the following form:

$$y_i = \beta' x_i + \varphi\left(z_i\right) + u_i \qquad E\left(u_i / x_i, z_i\right) = 0$$

where z_i is an observable vector but φ is an unknown function. This structural form is the one that is followed in our production estimation procedure. Robinson states that the previous structure " … can arise if the precise role of only a subset of a list of candidate regressors is known; from linear models with observed and latent explanatory variables in which the latter expectation, conditional on observable z_i, are unknown functions; from certain sample selectivity models in which the disturbances have distribution of unknown form, and possible also the response mechanism is insufficient well defined to parameterize the selectivity threshold; … " (Robinson, 1988; p.41). In the econometric application we can follow Robins suggestion allowing "… z_i to be stochastic vector of arbitrary degree s, and estimate β by subtracting from the previous expression its conditional expectation given z_i, replacing $E(x_i/z_i)$ and $E(y_i/z_i)$ by the kernel regression estimates, the using the OLS, the standard errors being analogous to the usual OLS form." (Robinson, 1988; p.41). Robinson employed the special "higher-order" Barlett kernel which assumed smoothness in φ so as to make the bias $o(n^{-1/2})$, as is necessary for the n-consistency.

As Härder (1990) recommends for kernel smoothing techniques, a conceptually simple approach to a representation of a weight sequence $\{W_{ni}(x)\}_{i=1}^{n}$ is to describe the shape of the weight function $W_{ni}(x)$ by a density function with a scale parameter that adjust the size and form of the weights near x named *kernel K*. Such a function is a continuous, bounded and symmetric real function K which integrates to one, $\int K(u)du = 1$. The weight sequence (similar to a moving average sequence) for a multidimentional predictor variable X_i (X_{i1} , …, X_{id}) is defined by a multidimentional kernel smoothers function under the form: $K(u_1,...,u_d) = \prod_{j=1}^{d} K(u_j)$

The kernel weights for this case are then defined as

$$W_{hi}(x) = \frac{\prod_{j=1}^{d} K_h(x_j - X_{ij})}{\hat{f}_h(x)} \text{, where } \hat{f}_h(x) = n^{-1}\sum_{i=1}^{n}\sum_{j=1}^{d} K_{h_n}(x_j - X_{ij})$$

is the kernel density estimator, and $K_{h_n}(u) = h_n^{-1}K(u/h_n)$ is the kernel with scale factor h_n also known as the bandwidth. The *Nadaraya-Watson* estimator will be

$$\hat{m}_h(x_j) = \frac{n^{-1}\sum_{i=1}^{n} K_h(x_j - X_{ij})Y_i}{n^{-1}\sum_{i=1}^{n} K_h(x_j - X_{ij})} \quad \text{for } j = 1,...,d$$

Following this approach we construct $E(y_i/m_i,l_i)$, and $E(x_{jt}/m_i,l_i)$ for all j=1,…,J and t=1,…,T. which are the estimates of the conditional moments. They are obtained by projecting yi on li and mi using a locally weighted quadratic least squares approximation .

A consistent estimator of $E(y_i /m_i = m^*, l_i = l^*)$ is then the intercept from this local quadratic (smoothing) regression. Rewriting the conditional expectation (conditional on conditional on(l_i, m_i)):

$$E(y_i / m_i, l_i) = \beta_0 + \sum_{j=1}^{J}\sum_{t=1}^{T} \beta_{jt} E(x_{ijt} / m_i, l_i) + \varphi(m_i, l_i)$$

If we assumed as in Pagan and Ullah, (1999) that E(μ_i/ m_i,l_i) = 0 and $E(\varphi(m_i,l_i)/ m_i,l_i)$ is itself, we can obtain:

$$y_i - E(y_i / m_i, l_i) = \sum_{j=1}^{J}\sum_{t=1}^{T} \beta_{jt}\left[x_{ijt} - E(x_{ijt} / m_i, l_i)\right] + \mu_i$$

Conveniently, these differences select $\varphi(m_i,l_i)$ out of the estimating procedure. And since μ_i is, by assumption, conditionally mean independent of the variable inputs, no-intercept Ordinary Least Squares can be used to obtain estimates of the parameters on all of the variable coefficients. Note that both the dependent and explanatory variables are constructed variables that depend upon the local least squares estimates, making the OLS standard errors biased for our application. A correction of such biased involves bootstrapping procedures.

The Second Stage Procedure

To estimate the coefficients of land and machinery we have to focus on the specification of $\phi(m_i, l_i) = \beta_0 + \beta_m m_i + \beta_l l_i + \omega_i(m_i, l_i)$. We implied that the ω term was related to the specific technological opportunities given in each community and available for each household. In fact, it may describe a combination of economic group and agricultural environment determined by the parameter ϖ . We can think that there is a systematic pattern across the sample and that pattern is one of the reasons for the nonlinearity part of our estimated equations. In other words we can assume that $\omega_i = E(\omega_i / \varpi) + \xi_i$. This element will help us to adopt the methodology of Levinsohn and Petrin (2000) for our cross-sectional data. In that sense, applying the GMM estimator to find the parameters we identify the following coefficient moments:

$$E(\mu_i + \xi_i / l_i) = E(\mu_i / l_i) + E(\xi_i / l_i) = 0$$

$$E(\mu_i + \xi_i / m_i) = E(\mu_i / m_i) + E(\xi_i / m_i) = 0$$

Both conditions state that the amount of total land used and machinery employed are independent of the variations in productivity across agricultural environment and households. Moreover, this specification is consistent with the idea of labor production variability across migrations status.

In the procedure of iteration to obtain ($\hat{\beta}_l, \hat{\beta}_m$), again we follow Levinsohn and Petrin to estimate first $\hat{\varphi}(\cdot)$ by regressing $y_i - \hat{\beta}_0 - \sum_{j=1}^{J}\sum_{t=1}^{T} \hat{\beta}_{jt} x_{jti}$ on m_i and l_i. Also y is regressed on m_i and l_i

to obtain starting values of (β_l^*, β_m^*). This last step will allow us to calculate two important values the expected value: $\hat{\omega} = \hat{\varphi}(\cdot) + \beta_l^* l + \beta_m^* m$ and $\mu \hat{+} \xi = y_i - \hat{\beta}_0 - \sum_{j=1}^{J}\sum_{t=1}^{T}\hat{\beta}_{jt}x_{jti} + \beta_l^* l + \beta_m^* m$.

Finally, applying locally weighted least squares we regress $\mu \hat{+} \xi$ on $\hat{\omega}$. So now we can construct our moment equation that after minimization will help us to calculate ($\hat{\beta}_l, \hat{\beta}_m$), namely:

$$\min_{\beta}\left[\left(\sum_i\left(\mu_i \hat{+} \xi_i\right)l_i\right)^2 + \left(\sum_i\left(\mu_i \hat{+} \xi_i\right)m_i\right)^2\right]$$

Computation of Standard Errors

While the previous two sections explain how the parameters are estimated using intermediate inputs as a proxy, we did not discuss the estimation of the standard errors. Estimation of these standard errors requires us to account for every source of variance in every estimator that enters our routine. The intermediate steps used in the regression introduce "noise" into the estimation routine. Pakes and Olley (1995) provide the theoretical details of how one would compute the asymptotic standard errors. With that in mind and using a bootstrap technique suggested by Levinsohn and Petrin (2000), we corrected for the standard errors.

<u>Findings of the Estimation</u>

Results of the production estimation are used to develop a migration-status differentiated analysis of three issues: (1) the marginal productivity of labor, mainly focused on hired-in labor; (2) the intra-task elasticities of substitution between family and hired labor, and (3) the household demand differences of hired-in labor in local markets. The idea is that according to the hypotheses explained in the first part of this paper, labor productivity of hired labor should change (so its demand) in the absence of family labor. Specifically, we want to see whether households with absent relatives have a lower productivity than those with no migrants. If that happens, it will indicate that the production organization is affected and not only the output. Secondly, the elasticities of substitution are hypothesized to be small in both groups because hired-in labor would be a poor substitute for family labor. This should be certain for both groups independent of migration status. Thirdly, the differences in the elasticities of substitution are hypothesized to be insignificant which we believe supports the idea that reduced migration labor also contracts the hired-in demand, an issue that we observed before when we were analyzing the labor ratios across migration-status groups. Overall, a more insightful analysis might be conducted making differentiations by household typology and agricultural environment but we will limit to the general case in this paper.

Table 12 shows the estimation of the production function. Three estimations were developed: one with the whole sample (pooled) and the other two in a separated way by migration conditions using their respective samples. The correction for endogenity, usually required in the estimation of production functions, was performed using intermediate procedures. The results of these procedures (for the pooled regression) are presented in the Table 3A in the appendix. Likewise, descriptive statistics of the constructed dependent and independent variables appear in Table 3A, also in the appendix.

As we can see from Table 12 shows the marginal values grouped by tasks. The pooled regression tends to have coefficients less significant than the other two (2.5% for almost all the variables in families without migrants). This aspect may be an indication in favor of the separated estimation. Analyzing the results task by task, we can see that in the case of family labor (C_LFAM__) families with no migrants exhibit coefficients significantly higher than those of family labor in families with migrants. This is particularly more important for the first two tasks (pre-sowing and sowing). Likewise, hired-in labor also presents larger coefficients for the case of families with no migrants than those with migrants. The exception is in the case of the second task, but the coefficient of hired labor (C_JORNSOW) is significant only at 10%. Since the variables are in logarithms, the value of the coefficients may be understood as absolute elasticities. Despite the limitation of making comparison among absolute eslaticities (we will analyze later partial elasticities), we can see that all the coefficients in the separated estimations are below one. Households might be considering the different types of intra-task labor more as complements than as substitutes and this seems to be case even for the reciprocal labor (C_LREC__). Therefore, their demand of one type may be directly conditional on the demand on the other types.

To complete this analysis we calculated the partial (Allen) elasticities of substitutions. Table 13 presents their values separated by migration conditions. These elasticities were calculated for ratios of variables inputs. R(i,j,t) describes the input ratio between input i and input j in task t. For example, the entry $R(i,j,1)$ and (1,3) presents the value of the elasticity between family labor and hired-in labor in the first tasks. With this description in mind we can see, with very few exceptions that the elasticity values are mostly below one. But these elasticities are telling us a little more. The substitution between family labor and reciprocal labor tend to be higher than family labor and hired labor. If we compared for example, the entries $R(i,j,1)$ and (1,2) with $R(i,j,1)$ and (1,3) for both migration status. The values are higher in the first case than in the second case. It happens almost the same across tasks (going down in the columns). Although no statistical test is presented, these results are very suggestive.

On the other hand, the bottom part of Table 13 presents the squared differences between the two migration conditions for all the entries. The values in this part are significantly low, which is an indication of similar elasticities across inputs and tasks for households in both migration status. Then we may infer that there are not significant differences in terms of technology that may be explaining the differences in output that we observed in Table 8. Therefore, within the limitations of our analytical strategy, we may also infer that families absent relatives (migrants) manage farms' production with less efficiency in the allocation of resources and in the organization of production.

Summary

Mexican agrarian economies are impacted by labor out-migration. The impact is differentiated by agricultural environment and economic group of households. In this paper, we sought to analyze the impact of outmigration on agrarian societies of central and southern Mexico. Specifically, we focus on production effects. Regarding the production effects of outmigration, we saw from both the descriptive analysis as well as the estimation procedure that the effect of outmigration might be significant for rural households, particularly for those in traditional settings and for those in low and high economic groups. This is observed in different forms.

First are the mean differences in output. Controlling for agricultural environments, land cultivated and economic group, output and productivity are markedly different between migration status groups. What is more interesting is that households of both groups seem to have the same technology or at least allocate the same combination of inputs to the production of corn. Labor ratios are fairly constant, which is an indication of some inefficiency, if we consider output and productivity differences.

Second, the estimation allows us to compare productivities and elasticities across migration condition groups. The most important result is that some form of differential productivity is observed, despite the similarity in the elasticities of substitution (not significantly different across migration conditions). This is more relevant in some tasks than others. Specifically, some tasks that are very crucial for agricultural production like pre-sowing and sowing exhibit higher elasticities for families without migrants than for those with migrants.

Third, the calculation of partial elasticities reveals that most of them are small (lower than one) which might be an indication of intra- and inter-task complementary across inputs. The smallest numbers are those of intra-task, suggesting the complementary characteristic of inputs. This may be linked to the fact that labor ratios, controlling for land and output, do not vary much. Again, it might be indicating some form of inefficiency hidden in the production organization of families with migrants.

On the whole, agricultural productivity and the well-being of rural families are altered by the outmigration of family labor. As a result, the production organization and market participation of households are changed. The adaptation of differentiated strategies in the face of dramatic agricultural change will be conditioned on asset endowments (economic group) and agricultural environment. It seems that households in traditional settings and low asset endowments are more likely to be affected and in a greater magnitude by outmigration. Households in semi-modern environments are not excluded form such effects. Households with some endowments are also exposed to this impact, independent of agricultural environment. Both groups form the major part of the social *ejidal* sector. Therefore, the effects seem to be far from being negligible.

References

Barbier, Edward B. (2000) "Links between Economic Liberalization and Rural Resource Degradation in the Developing Regions." *Agricultural Economics*; Vol. 23 No. 3, September 2000, pp. 299-310.

Barham, Bradford and Stephen Boucher (1998) "Migration, Remittances, and Inequality: Estimating the Net Effects of Migration on Income Distribution," *Journal of Development Economics,* Vol. 55, pp.307-331.

Bardhan, K. P. (1984). Land, Labor and Rural Poverty: essays in development economics. Columbia University Press, NY.

Basu, Kaushik (1997) "Analytical Development Economics, the Less-Developed Economy Revised" MIT press, Cambridge Massachusetts.

Bencivenga, Valerie R. and Bruce D. Smith (1997) "Unemployment, Migration and Growth" *Journal of Political Economy*, Vol. 105, No. 3, June.

Binswanger, Hans, John MacIntire and Chris Udry (1989) "Production Relation in Semi-arid African Agriculture," in Pranab Bardhan (ed.) The Economic Theory of Agrarian Institutions, Oxford: Clarendon Press.

Carter, Michael R. and Frederick Zimmerman (1998) "The Dynamic Cost and Persistence of Asset Inequality in an Agrarian Economy" *Department of Agricultural Economics*, Madison (Staff Paper Series No. 416): University of Wisconsin.

Carter, Michael R. and John Kalfayan (1989) "A General Equilibrium Exploration of the Agrarian Question," *Department of Agricultural Economics*, Madison (draft paper): University of Wisconsin.

Cole, William E. and Richard Sanders (1985) "Internal Migration and Urban Employment in the Third World*" The American Economic Review* Vol. 7, No. 3, June 1985, pp. 481-494.

Dasgupta, Partha (1993) An Inquire into Well-being and Destitution, Oxford: Clarendon Press.

________(1998) "The Economics of Poverty in Poor Countries," *Scandinavian Journal of Economics*; Vol. 100, pp. 41-68.

________(1995) "Poverty Institutions and the Environmental Resource-Base," in J. Behrman and T. N. Srinivasan (eds.) Handbook of Development Economics, Chapter 39, Vol. III, Netherlands: Elsevier Science B.V.

David, M.Beatriz de A.; Martine, Dirven, and Frank Vogelgesang (2000) "The Impact of the New Economic Model on Latin America's Agriculture." World Development; Vol. 28 No. 9, September 2000, pp. 1673-88.

Davis, George C.; Ni Lin; Richard Shumway C. (2000) "Aggregation without Separability: Tests of the United States and Mexican Agricultural Production Data." American Journal of Agricultural Economics; Vol. 82 No..1, February 2000, pp. 214-30.

De Janvry, A. and R. García-Barrios (1988). "Rural poverty and environmental degradation in Latin America: causes, effects, and alternative solutions". Paper presented at *the International Consultation on Environment, Sustainable Development, and the Role of Small Farmers*, International Fund for Agricultural Development, Rome, October 11-13.

De Janvry, A., Marcel Fafchamps and Elisabeth Sadoulet (1991) "Peasant Household Behavior with Missing Markets: Some Paradoxes Explained," *Economic Journal*, Vol. 101, pp. 1400-1417.

Eswaran, M. and A. Kotwal (1985) "A Theory of Contractual Structure in Agriculture, " *American Economic Review*, 75 (3): pp. 352-368.

Eswaran, M. and A. Kotwal (1986) "Access to Capital and Agrarian Production Organization, " *The Economic Journal*, (June), pp. 482-498.

Garcia-Barrios, Raul (1994) "Institutional Change and Endogenous Behavior: New Theoretical and Empirical Approaches (Ethics, Game Theory)," Doctoral Dissertation, Department of Agricultural Economics and Natural Resources. University of California at Berkeley.

Gordillo,-Gustavo; Alain de-Janvry and Elisabeth Sadoulet (1998) "Between Political Control and Efficiency Gains: The Evolution of Agrarian Property Rights in Mexico" CEPAL Review; No. 66, December 1998, pp. 151-69.

Hädler, Wolfgang (1990) Applied Nonparametric Regression. Cambridge University Press; New York.

Harris, John R. and Michel Todaro (1970) "Migration, Unemployment and Development: A Two-Sector Analysis," *The American Economic Review*, 60, March 1970.

Isvan, Nilüfer A. (1991) "Demographic Structures and Power Hierarchies in Peasant household," *American Sociological Review*. Vol. 56, No. 1 Pp. 132-40 February 1991

Just, Richard and Rulon Pope (2001) "The Agricultural Producer: Theory and Statistical Measurement." in Bruce L. Gardner and Gordan C. Rausser, (eds.) Handbook of Agricultural Economics, Elsevier Science, New York.

Katz, E. and Oded Stark (1986) "Labor Migration and Risk Aversion in Less Developed Countries," *Journal of Labor Economics*, Vol. 4, pp. 131-149.

Kawagoe, Toshigico; Keijiro Osuka and Yujiro Hayami (1986) "Induce Bias of Technical Change in Agriculture: The United States and Japan: 1880 -1980." *Journal of Political Economy*, Vol 94, No. 3, part 1, pp. 523-544.

Lastarria-Cornhiel, Susana, Jolyne Melmed-Sanjak and Beberly Phillips (1999) "Land Tenancy in Asia, Africa and Latin America: A Look at the Past and a View to the Future." Land Tenure Center, University of Wisconsin-Madison, Working Paper, No. 27

Levinsohn, James and Amil Petril (2000) "Estiamting Production Functions Using Inputs to Control for Unobservables" Draft Paper, University of Michigan.

Lewis, W. A. (1954)" Economic Development with Unlimited Supplies of Labor," Reproduced in Agarwala and Singh (ed.) The Economic of Underdevelopment, Pp. 400-449 NY, 1958. USA

Lipton, Michael (1980) "Migration from Rural Areas of Poor Countries: The Impact on Rural Productivity and Income Distribution," *World Development,* Vol.8, pp.10-20.

Lucas, Robert E. B (1987) “Emigration to South Africa’s Mines,” *The American Economic Review,* Vol. 77, June 1987.

_____________(1997) “Internal Migration in Developing Countries," in M. R. Rosenzweig and O Stark (eds.) Handbook of Population and Family Economics, Vol. 2., Chapter 13. Amsterdam, New York: Elsevier Sciences.

Mabogunje, Akin L (1989) “Agrarian Responses to Outmigration in Sub-Saharan Africa*,” Population and Development Review*, Vol. 15 (Supplement), pp. 324-342.

Massey, Douglass, Joaquin Arango, Craeme Hugo, Ali Kouaouci, Adela Pellegrino and Edward Taylor (1993) “Theories of International Migration: A Review and Appraisal,” *Population and Development Review,* Vol. 19, pp. 431-466.

McFadden, Daniel (1978) "Estimation Techniques for Elasticities of Substitution and Other Parameters" in Melvyn Fuss and Daniel McFadden (eds.) Production Enonomics: A Dual Approach to Theory and Application Amsterdan North Holland.

Nurkse, Ragnar (1957) “Labor Surplus on the Land,” *Malayan Economic Review.* Reproduced in G. Meier (ed.) “Leading Issues in Economic Development“ 4th Edition. Oxford University Press.

Pagan, A. and A. Ullah (1999) "Nonparametric Econometrics". Themes in Modern Econometrics. Cambridge University Press.

Pakes, A. and S. Olley (1995) "A Limit Theorem for a Smooth Class of Semiparametric Estimatiors", *Journal of Econometrics*, Vol. 65. No.1, pp. 292-332.

Pick, James and Edgard Butter (1994) The Mexico Handbook: Economy and Demography: Maps and Statistics Boulder : Westview Press.

Ranis, Gustav (1997) "Microeconomics of the Surplus Labor" Ecobnomic Growth Center, Paper 772. Yale University.

Ranis, Gustav and J.C. Fei (1961) “A theory of Economic Development." American Economic Review, Vol. 51: pp. 533-565.

Robinson, P. M. (1988) "Semiparametric Econometrics: A Survey," Journal of Applied Econometrics, vol. 3, pp.35-51.

Robles, Hector and R. Garcia (1994) “Fallas estructurales del mercado de maiz y la logica de la produccion campesina,” *Economia Mexicana*, Vol. 3, No. 2, 2ndo Semestre, 1994.

Rosenzweig, Mark R. (1980) "Neoclassical Theory and Optimizing Peasant: An Econometric Analysis of Market Family Labor Supply in a Developing Country," *Journal of Econometrics* Vol. 24, pp.181-96.

Sadaulet, Elizabeth; Alain de Janvry and Catherine Benjamin (1996) "Houeshold Behaviour with Imperfect Labor Markets." Working Paper No 786. Univiersity of California at Berkeley.

Schultz, Theodore W.(1951) "The Declining Economic Importance of Agricultural Land," *Economic Journal,* Vol. 61, pp. 725-740. Reproduced in Julian Simon (ed.) (1997) The Economic of Population: Key Modern Writings, Vol 1, An Elgar Reference Collection, Great Britain.

Schultz, Theodore P.(2001) "Women's Role in Agricultural Household: Bargaining and Human Capital" in Bruce L. Gardner and Gordan C. Rausser, (eds.) Handbook of Agricultural Economics, Elsevier Science, New York.

Scott, J. C. (1976) The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia, (New Haven, Conn.: Yale University Press)

Sen, Amartya K. (1960) “Choice of Techniques,” reproduced in G. Meier (ed.) Leading Issues in Economic Development 4th Edition. Oxford University Press.

_______________(1966) “Peasants and Dualism with or without Surplus Labor,” *Journal of Political Economy*, 74 October. Pp. 425-50. Reproduced in A. K. Sen (1984) Resources Values and Development Basil Blackwell.

Stark, Oded (1991) The Migration of Labor, Cambridge, Massachusetts, USA; Oxford: Basil Blackwell.

Taylor, J. Edward (1992) "Remittances and Inequality Reconsidered: Direct, Indirect and Intertemporal Effects," *Journal of Policy Modeling,* Vol.14, pp.187-208.

Taylor, J. Edward and Philip L. Martin (2001) "Human Capital: Migration and Rural Population Change," in Bruce L. Gardner and Gordan C. Rausser, (eds.) Handbook of Agricultural Economics, Elsevier Science, New York.

Taylor, J. Edward and T.J. Wyatt (1996) "The Shadow Value of Migrant Remittances, Income and Inequality in a Household-farm Economy," *Journal of Development Studies*, Vol. 32, pp.899-912.

Taylor, J. Edward; Antonio Yunez-Naude; Steve Hampton (1999) "Agricultural Policy Reforms and Village Economies: A Computable General-Equilibrium Analysis from Mexico" Journal of Policy Modeling; Vol. 21 No. 4, July 1999, pp. 453-80.

Templeton, Scott R. (1994) “The effect of Market Factors on Investment in Land Quality: Evidence from a Econometric Analysis of Non-Paddy Terracing in the Philippines” *Department of Agricultural and Resource Economics*, University of California at Berkeley, (draft paper). CA 94720. USA

Todaro, Michael P. (1980) "Internal Migration in Developing Countries: A Survey," in Richard A. Easterlin (ed.) Population and Economic Change in Developing Countries, London, Chicago, pp. 361-402: University of Chicago Press

Viner, Jacob (1957) “The Concept of Disguised Unemployment,” reproduced in G. Meier (ed.) Leading Issues in Economic Development 4th Edition. Oxford University Press.

Wood, Charles H. (1981) “Structural Changes and Household Strategies: A Conceptual Framework for the Study of Rural Migration,” in *Brief Communications of Human Organization* Vol. 40 No. 4.

Zeller, M. (1994) “Determinants of the credit rationing: A study of informal lenders and formal credit groups in Madagascar,” *World Development*, Vol. 22 No. 12, (December), pp. 1985-2008.

Appendix

Tests of Separability and Unitary (constant) Elasticity of Substitution

For both tests of separability and constant (unitary) elasticity of substitution we have considered the following procedure presented in Kawagoe *et al*. (1986) which is also based on McFadden (1978). Since our production estimation is much more complicated our procedure will vary in several steps. The separability test assumes that inter-task substitutability is zero across variable inputs. Moreover, the sequence of production tasks might be though as lesser related the more distant they are in the production process. By the opposite argument, intra-task variable inputs should present higher values of relationship because their interaction is fundamental in the consecution of intermediate un-observable outputs. On the other hand, the constancy of technical substitution elasticities is assumed for the specification of the functional form. The idea is that variable inputs ratios are related linearly to the inverse of their respective marginal rates of substitutions. This will help to analyze the performance of variable input ratios across tasks in agricultural environments.

Separability Test

Remember that our model has 5 tasks and 4 variable inputs in each task. The number of sequential inter-task per variable input is 4. For example, family labor ratios presented in a sequential form of inter-tasks are the following: $x_{f,1}/x_{f,2}$, $x_{f,2}/x_{f,3}$, $x_{f,3}/x_{f,4}$ and $x_{f,4}/x_{f,5}$. Note that we are not including in the test all the possibilities. Likewise, it is easy to see that the number of intra-tasks input ratios is 6 and so will be for the number of MRS_{ij} to be calculated. Also, the number of inter-task marginal rates of technical substitution for each input ratio is 6. Therefore, our test equation will be:

$$\ln Ra(i,j,t) = \alpha_{0,t} + \sum_{k=1} \alpha_{k,t} \ln \hat{MRS}_{-j,-i,t} + \sum_{m=1} \beta_{m,t} \ln \hat{MRS}_{j,i,t} \qquad \text{for all } i \;\; j \text{ and } t=1,\ldots,T$$

where $Ra(i,j,t)$ is the input ratio for input i and input j in the task t. Note that our equation to test presents an *inter-intra* decomposition of marginal rates of substitution. The first part of the equation captures the inter-task component while the second the intra-task. The null hypotheses to test for separability is the following $Ho: \alpha_{k,t} = 0$. for all k=1,…,5, where k is the number partial and different *MRS* than those of the input ratio and t=1,…, 5 is the number of tasks. Also $MRS_{i,j} = MPx_i/MPx_j$ (where MPx_i = marginal productivity of input i) is calculated using an auxiliary regression of output on inputs i and j. The required procedure for calculating $MRS_{i,j}$ is the following:

first, we regress y on x_i and x_j to obtain $\hat{\alpha}$ and $\hat{\beta}$. Second, to obtain the sample size series $\{\hat{a}_i\}$ we calculate $y = \hat{a}_i \bar{x}_i + \beta\, \bar{x}_j$. Similarly for $\{\hat{b}_j\}$ we calculate $y = \alpha\, \bar{x}_i + \hat{b}_j \bar{x}_j$. Third, we collect $\hat{a}_i$ and $\hat{b}_j$. And fourth, we construct the marginal rates of technical substitution for each plot or farm, namely MRSij= ($\hat{a}_i / \hat{b}_j$) for all i=1…N.

Results are presented in Table 2A. The F-calculated values that appear for the intra-task separability test do reject our hull hypothesis in most of the cases at 5% level of significance. Exceptions seem to concentrated in ratios where household labor is not present. Unlike intra-task case, most of the F-calculated values for the inter-task separability test do not reject the null hypothesis.

Elasticity of Substitution Tests

Note that we assumed zero inter-task substitutions per input. Since the MRS_{ij} are assumed as partial and derived only from an auxiliary regression it will be misleading to calculate and analyze the substitution elasticities using these results. A proper test for the elasticity of substitution will be performed once we have the de production function estimations. Our general equation for testing substitution elasticities among variable inputs is:

$$\ln Ra(i,j,k) = \delta_{0,i,k} + \delta_{1,i,k} \ln \hat{MRS}_{j,i,k} + \delta_{2,i,k}\left(\hat{MRS}_{j,i,k}\right)^2 \text{ for all } k = 1,\ldots,4 \text{ and for all } i \quad j$$

The null hypotheses (Ho) are that each $\delta_{2,i,k} = 0$ for all i, k = 1,…, 4. In order to have constant elasticities of substitution the null hypothesis should not be rejected.

Table 2A shows the results of the F-statistics for the elasticity tests. In the upper part of the table the calculated F values for the intra-task elastcities are in general greater that the critical value at 5% level of significance. The exceptions are mostly in the case of ratios between reciprocal and hired labor (2,3). This means that the hypothesis of a linear relation between inputs ratios and the inverse of their marginal productivity ratio does not holds for intra-task inputs. As we can see most exhibit values of F-statistic that are not large enough to of reject the null hypothesis. Therefore, our hypothesis holds for the inter-tasks case.

FIGURE 1. POTENTIAL IMPACT OF LABOR OUTMIGRATION IN AGRARIAN SOCIETIES

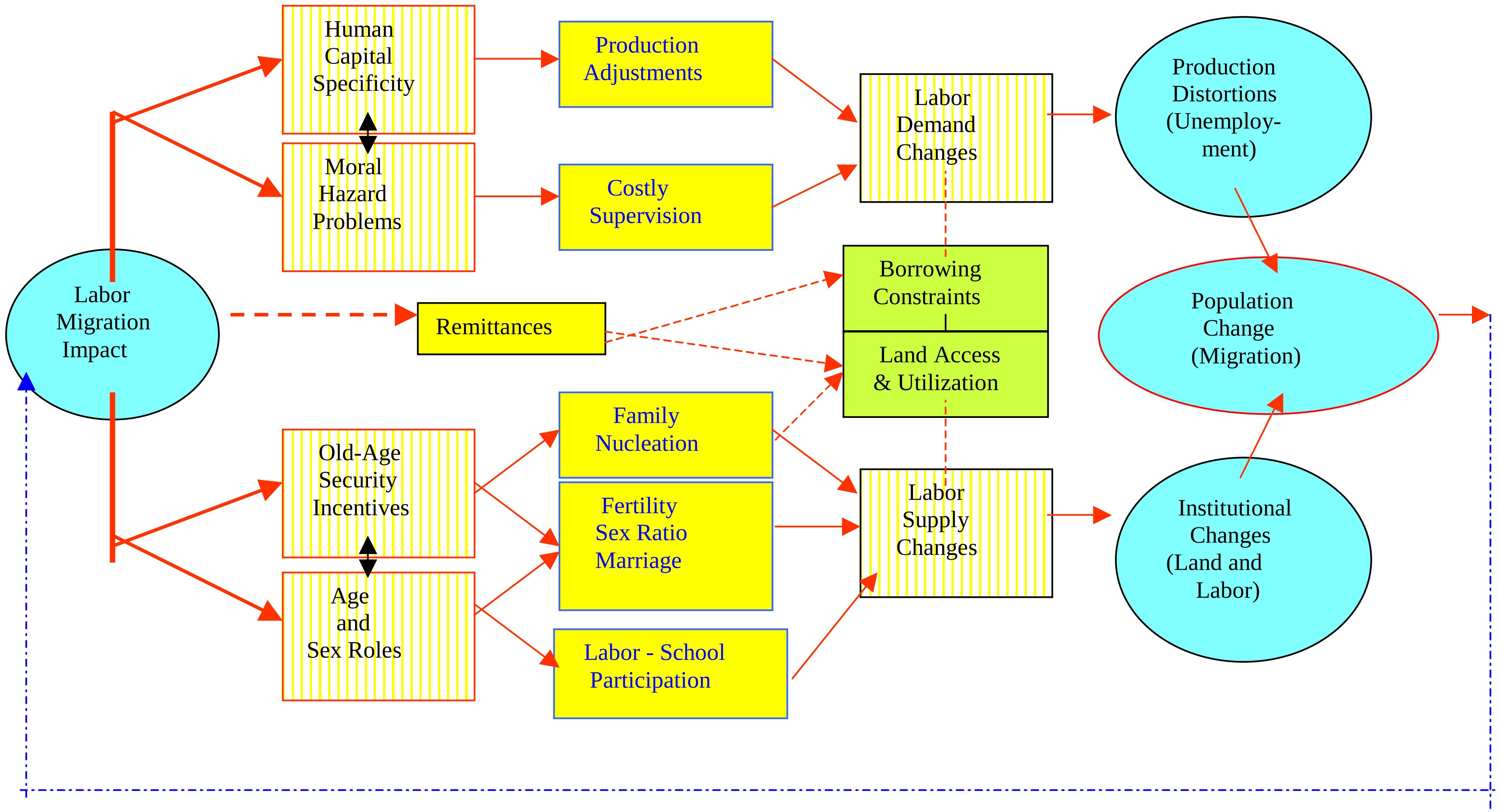

Table 1. Immigrants and Emigrants during the last 5 years by State Included in this Study.

	Migrant Population > 5years	Percentage of In or Out Migration from Tot Pop (by Place of Birth)			Percentage Distribution by Migration Condition						
					Not State Migrant				State Migrant	Internati. Migrant	Not Specif.
		Immigr.	Emigr.	Net	Total	No-migr. Munici.	Municip. Migrant	Not Specified			
Mexico	4,171,919	18.52	18.52	0.00	94.84	96.40	3.28	0.32	4.40	0.45	0.31
Men	2,072,926	18.15	18.15	0.00	94.69	96.48	3.20	0.32	4.42	0.56	0.33
Women	2,098,993	18.88	18.88	0.00	94.97	96.33	3.35	0.32	4.39	0.34	0.30
States											
Chiapas	52,642	3.11	8.99	-5.88	97.74	97.51	2.18	0.31	1.39	0.16	0.51
Men	26,488	3.19	8.81	-5.62	97.90	97.62	2.07	0.31	1.42	0.16	0.52
Women	26,154	3.03	9.17	-6.14	97.99	97.41	2.29	0.30	1.35	0.17	0.49
Chihuahua	173,878	18.65	6.82	11.83	93.16	97.05	2.31	0.64	5.77	0.70	0.37
Men	95,462	19.19	6.46	12.73	92.46	97.16	2.20	0.64	6.31	0.83	0.40
Women	78,416	18.10	7.18	10.92	93.83	96.93	2.43	0.64	5.24	0.58	0.35
Durango	47,667	11.69	33.19	-21.50	97.91	98.28	1.45	0.27	3.06	0.71	0.32
Men	24,038	11.70	32.37	-20.67	95.74	98.27	1.46	0.27	3.06	0.86	0.34
Women	23,629	11.68	33.97	-22.29	96.09	98.28	1.44	0.28	3.06	0.56	0.29
E.Mexico	787,386	41.68	5.57	36.11	92.92	94.77	4.93	0.30	6.60	0.18	0.30
Men	378,617	41.00	5.26	35.74	92.99	94.86	4.83	0.31	6.49	0.22	0.30
Women	408,769	42.32	5.87	36.45	92.86	94.68	5.02	0.30	6.70	0.15	0.29
Michoacan	127,505	8.59	23.82	-15.23	95.96	97.83	1.78	0.39	2.64	1.02	0.38
Men	68,770	8.64	22.46	-13.82	95.46	97.90	1.68	0.40	2.79	1.36	0.39
Women	58,735	8.55	25.06	-16.51	96.43	97.76	1.86	0.38	2.50	0.71	0.36
Oaxaca	89,160	5.96	25.34	-19.38	96.66	96.77	2.83	0.40	2.69	0.28	0.37
Men	45,789	5.87	24.84	-18.97	96.46	96.91	2.70	0.39	2.79	0.40	0.38
Women	43,371	6.04	25.80	-19.76	96.89	96.62	2.96	0.42	2.59	0.17	0.35

Source: Modified from "The Amplified Survey, 2000 National Census of Population", INEGI.

Table 1 continues…

Table 1. (cont.) Immigrants and Emigrants duringthe last 5 years by State Included in this Study.

	Migrant Population > 5 years	Percentage Distribution by Cause of Migration							
		Job Search	Family Reunion	Job Place Change	Study	Marriage Union	Health + Violence	Other Cause	Not Specif.
Mexico	4,171,919	16.75	19.75	8.49	3.56	5.14	3.41	13.90	29.00
Men	2,072,926	20.42	17.43	11.10	3.75	2.78	3.29	13.58	27.65
Women	2,098,993	13.14	22.04	5.90	3.39	7.47	3.53	14.22	30.32
States									
Chiapas	52,642	11.72	20.21	11.63	3.53	4.53	4.07	8.33	35.98
Men	26,488	14.57	18.12	15.41	3.39	1.82	3.36	8.02	35.31
Women	26,154	8.84	22.32	7.80	3.67	7.28	4.78	8.64	36.67
Chihuahua	173,878	35.47	21.76	5.48	1.60	2.25	0.78	6.46	26.11
Men	95,462	41.67	17.66	6.82	1.47	1.02	0.75	5.78	24.83
Women	78,416	27.92	26.76	3.85	1.77	3.74	1.00	7.29	27.67
Durango	47,667	11.13	24.16	7.74	2.81	6.43	3.82	14.68	29.20
Men	24,038	15.62	21.55	9.39	3.49	4.07	3.52	14.26	28.10
Women	23,629	6.56	26.81	6.06	2.12	8.83	4.19	15.12	30.31
E.Mexico	787,386	8.99	12.41	5.33	1.57	7.63	3.38	29.55	31.14
Men	378,617	10.84	11.11	6.90	1.63	5.70	3.20	30.65	29.97
Women	408,769	7.27	13.62	3.87	1.50	9.43	3.55	28.53	32.23
Michoacan	127,505	13.10	28.23	7.64	3.77	4.09	4.25	10.87	28.05
Men	68,770	17.96	25.65	9.92	4.39	5.05	4.17	10.17	25.69
Women	58,735	7.41	31.23	4.98	3.05	6.47	4.35	11.71	30.80
Oaxaca	89,160	12.66	24.06	9.21	3.66	3.89	4.22	8.97	33.33
Men	45,789	15.88	21.87	12.78	4.03	1.87	4.07	8.37	31.13
Women	43,371	9.27	26.36	5.45	3.26	6.02	4.39	8.61	35.64

Figure 2. Migration in Mexico Based on 1990 Census:
Per Capita Units

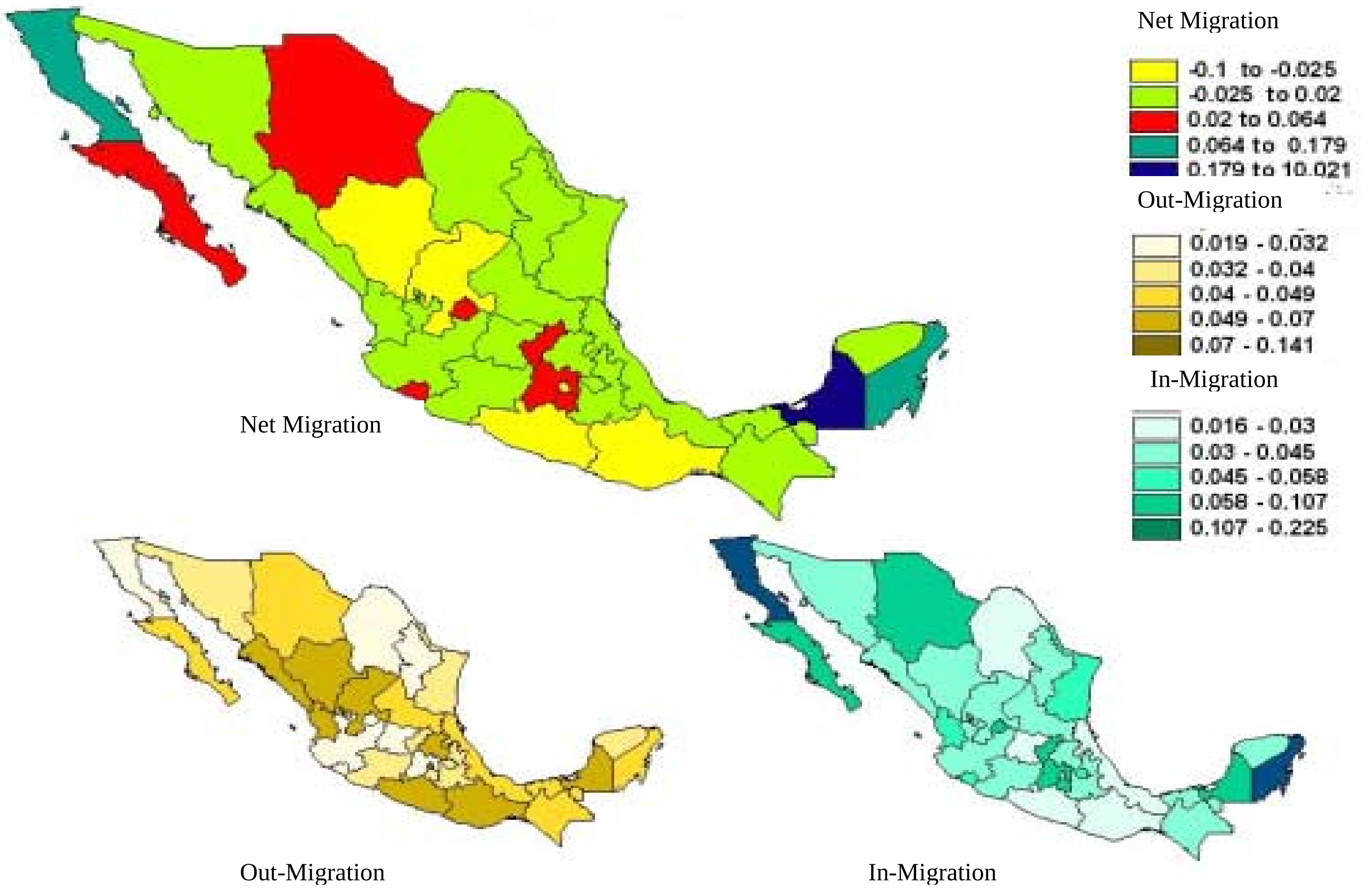

Table 2. Corn (Maize) and Bean (Frijol) Production, in Pesos, 1985.

No.	State	Value of Maize Prod.	Percent of Nation	Value of Frijol Prod.	Percent of Nation
1	AGUASCALIENTES	2,531,031	0.32	1,070,810	0.76
2	B.CALIFORNIA	1,175,037	0.15	0	0.00
3	B.CALIFORNIA SUR	411,742	0.05	267,954	0.19
4	CAMPECHE	2,545,149	0.32	8,700	0.01
5	COAHUILA	1,823,122	0.23	756,066	0.54
6	COLIMA	3,451,273	0.44	0	0.00
7	CHIAPAS	124,497,541	15.81	8,232,299	5.85
8	CHIHUAHUA	19,154,783	2.43	10,294,170	7.32
9	DISTRITO FEDERAL	1,493,325	0.19	123,000	0.09
10	DURANGO	13,969,605	1.77	21,844,500	15.53
11	GUANAJUATO	26,125,474	3.32	9,030,373	6.42
12	GUERRERO	42,916,068	5.45	1,176,557	0.84
13	HIDALGO	22,431,909	2.85	7,163,047	5.09
14	JALISCO	109,406,564	13.90	4,899,300	3.48
15	E.MEXICO	123,163,326	15.65	2,483,119	1.77
16	MICHOACAN	46,588,066	5.92	2,888,671	2.05
17	MORELOS	3,735,130	0.47	469,237	0.33
18	NAYARIT	7,852,771	1.00	3,280,538	2.33
19	NUEVO LEON	2,484,971	0.32	163,100	0.12
20	OAXACA	26,142,332	3.32	3,550,370	2.52
21	PUEBLA	54,590,590	6.93	4,646,612	3.30
22	QUERETARO	7,377,167	0.94	1,968,622	1.40
23	QUINTANA ROO	446,587	0.06	105,275	0.07
24	SAN LUIS POTOSI	8,681,083	1.10	2,438,378	1.73
25	SINALOA	8,245,598	1.05	3,290,639	2.00
26	SONORA	9,915,908	1.26	0	0.00
27	TABASCO	5,309,484	0.67	0	0.00
28	TAMAULIPAS	33,719,307	4.28	1,565,837	1.00
29	TLAXCALA	17,995,359	2.29	0	0.00
30	VERACRUZ	38,267,719	4.86	1,203,445	0.86
31	YUCATAN	5,009,167	0.64	922,666	0.66
32	ZACATECAS	15,763,155	2.00	46,841,465	33.3
Total National		787,220,343		140,684,750	
Mean		24,600,636	3.13	4,396,398	3.13
Median		9,298,496	1.18	1,384,641	0.98
S.D.		34,234,998	4.35	8,929,321	6.35
C.V.		139	139.16	203.11	203.11
Minimum		411,742	0.05	0	0.00
Maximum		124,497,541	15.81	46,841,465	33.30

DEFINITION: 1985 maize production figures are shown in thousands of pesos. Maize for grain and feed are included. 1985 frijol production figures are shown in thousands of pesos.
SOURCE: Modified from Table 4.2.1 of "1988-1989 Anuario Estadistico", INEGI.
Also in Table 8.4 of Pick and Butter (1994)

Table 3. Households and Land Access by Community/ Ejidos and Agricultural Environment.

Community or Ejido	State	Period of Survey	Agricultural Environment	Number of Households Surveyed	Average Size of Land Owned	Standard Deviation	Min.	Max.	Range	Mean Conf. Level(95 ..0%)
Cheran Atzicurin	Michoacan	93-96	Traditional	19	1.33	1.11	0.25	6	5.75	0.24
Tangancicuaro	Michoacan	93-96	Traditional	22	5.08	2.38	1	20	19	0.39
Ixtal	Oaxaca	98-99	Traditional	53	2.61	10.6	0.02	80	79.98	2.84
Teococulco St Marcos	Oaxaca	98-99	Traditional	40	0.82	0.74	0.05	4	3.95	0.2
Paso del Muerto	Michoacan	93-96	Semi-Modern	20	2.01	1.73	0.25	20	19.75	0.25
Quinceo	Michoacan	93-96	Semi-Modern	18	3.94	6.97	0.5	65	64.5	1.4
Hierbabuena	Oaxaca	93-96	Semi-Modern	25	2.89	2.93	0.25	15	14.75	0.57
San Juan Michis	Durango	93-96	Semi-Modern	20	2.1	1.34	0.5	7	6.5	0.33
El Aleman	Durango	93-96	Semi-Modern	12	3.18	2.09	0.5	7	6.5	0.86
San Juan Coyula	Oaxaca	93-96	Semi-Modern	25	1.31	0.92	0.25	6	5.75	0.2
Capulcapan	Oaxaca	98-99	Semi-Modern	40	0.68	0.7	0	4	4	0.18
Alvaro Obregon	Chihuahua	93-96	Semi-Modern	20	6.79	6.56	1	40	39	1.76
Macuil	Oaxaca	98-99	Semi-Modern	41	0.78	1.19	0	8	8	0.21
San Andres Yutuni	Oaxaca	98-99	Semi-Modern	40	0.75	0.62	0.01	4	3.99	0.15
Luviano	Edo. Mex.	93-96	Modern	20	6.43	17.95	0.5	184	183.5	3.42
San Juan -San Agustin	Edo. Mex.	93-96	Modern	23	3.33	5.95	0.25	60	59.75	0.72
Francisco Villa	Chiapas	93-96	Modern	42	7.05	6.09	0	139	110.7	2.45
Guivicia		93-96	Semi-Modern	24	9.29	15.18	0.25	100	99.75	2.87
Total				504	3.08					

Table 4. Households and Migration by Community/Ejidos and Agricultural Environment.

Community or Ejido	State	Period of Survey	Agricultural Environment	Households Surveyed	Average Household Size	Standard Deviation	% with Migrants	% Received Remittance	Household size / Land Owned	Confidence Level (95.0%)
Cheran Atzicurin	Michoacan	93-96	Traditional	19	8.89	2.52	0.23	0.23	6.68	0.24
Tangancicuaro	Michoacan	93-96	Traditional	22	6.95	1.59	0.34	0.33	1.37	0.39
Ixtal	Oaxaca	98-99	Traditional	53	5.56	5.93	0.21	0.21	2.13	2.84
Teococulco St Marcos	Oaxaca	98-99	Traditional	40	6.7	2.77	0.32	0.38	8.17	0.2
Paso del Muerto	Michoacan	93-96	Semi-Modern	20	9.6	2.27	0.45	0.41	4.78	0.25
Quinceo	Michoacan	93-96	Semi-Modern	18	8.11	4.09	0.32	0.07	2.06	1.4
Hierbabuena	Oaxaca	93-96	Semi-Modern	25	6.6	2.14	0.34	0.33	2.28	0.57
San Juan Michis	Durango	93-96	Semi-Modern	20	8.65	1.88	0.28	0.25	4.12	0.33
El Aleman	Durango	93-96	Semi-Modern	12	9.91	1.96	0.42	0.37	3.12	0.86
San Juan Coyula	Oaxaca	93-96	Semi-Modern	25	7.08	2.05	0.29	0.23	5.40	0.2
Capulcapan	Oaxaca	98-99	Semi-Modern	40	6.52	3.17	0.38	0.16	9.59	0.18
Alvaro Obregon	Chihuaha	93-96	Semi-Modern	20	7.7	3.61	0.42	0.48	1.13	1.76
Macuil	Oaxaca	98-99	Semi-Modern	41	7.14	3.29	0.23	0.19	9.15	0.21
San Adres Yutuni	Oaxaca	98-99	Semi-Modern	40	5.13	2.32	0.45	0.26	6.84	0.15
Guivicia	-	93-96	Semi-Modern	24	6.01	7.78	0.44	0.24	0.65	2.87
Luviano	Edo. Mex.	93-96	Modern	20	10.2	9.44	0.43	0.18	1.59	3.42
San Juan -San Agustin	Edo. Mex.	93-96	Modern	23	6.48	3.55	0.33	0.02	1.95	0.72
Francisco Villa	Chiapas	93-96	Modern	42	5.23	3.26	0.26	0.18	0.74	2.45
Total				504	6.92		0.34	0.25	3.99	

Table 5. Classification of Households by Asset Endowments or Access Using Discriminant Analysis.

Analysis Sample		**Predicted Membership**					
Actual	**Number of Cases**	**HOUSTY1**	**HOUSTY2**	**HOUSTY2**	**Accuracy**	**Press Q**	**Pchance**
HOUSTY1	141	127	11	3	90.43	198.10	
%		90.07	7.80	2.13			
HOUSTY2	103	6	92	5			
%		5.83	89.32	4.85			
HOUSTY2	59	0	4	55			
%		0.00	6.78	93.22			
	303				90.43	198.10	0.37

Holdout Sample		**Predicted Membership**					
Actual	**Number of Cases**	**HOUSTY1**	**HOUSTY2**	**HOUSTY2**	**Accuracy**	**Press Q**	**Pchance**
HOUSTY1	95	87	8	0	92.54	145.48	
%		91.58	8.42	0.00			
HOUSTY2	70	3	65	2			
%		4.29	92.86	2.86			
HOUSTY2	36	0	2	34			
%		0.00	5.56	94.44			
	201				92.54	145.48	0.37

Discriminant Score	**Discriminant Loading**			**Standar-dized**
Variable	**Value**	**Rank**	**Mean**	**Weights**
Labor Hired Out (off-farm)/ Labor On-Farm	0.44	5	0.11	0.21
Agro Machine Ownership (1=yes, 0=no)	-0.52	3	0.53	NI
Household Members (>15 years)/Land Cultivated	0.42	6	0.88	0.31
Land Rented Out (1=yes, 0=no)	-0.77	1	0.17	NI
Household Per Capita Output (Tons.)	-0.58	2	0.73	-0.57
Credit Borrowing (1=yes, 0=no)	0.48	4	0.77	NI

Table 6. Age Distribution of Out-migrants According to Place of Residence at Survey Date.

Age	International	Internal
0-15	2.81	11.11
15-19	41.8	47.3
20-24	29.3	23.98
25-29	11.02	7.46
30-34	5.84	2.95
35-39	3.21	2.37
40-44	3.52	1.03
45-49	1.17	1.44
50 +	1.33	2.36
Total	100	100
% Male	77.3	56.1
N	234	627

Source: Calculation based on 1993-96 and 1998-99 surveys.

Table 7. Classification of Households by Migration Status Using Discriminant Analysis.

Analysis Sample		Predicted Membership				
	Number of Cases	FWNM	FWM	Accuracy	Press Q	Pchance
Actual						
FWNM	184	157	27	86.80	164.12	
%		85.33	14.67			
FWM	120	14	106			
%		11.67	88.33			
	303			86.80	164.12	0.54

Holdout Sample		Predicted Membership				
	Number of Cases	FWNM	FWM	Accuracy	Press Q	Pchance
Actual						
FWNM	137	120	17	86.57	6.68	
%		87.59	12.41			
FWM	64	10	54			
%		15.63	84.38			
	201			86.57	107.51	0.54

Discriminant Score	Discriminant Loading			Standar- dized
Variable	**Value**	**Rank**	**Mean**	**Weights**
Children (>10 years)/Household Members	0.14	7	0.10	0.16
Wife Education/Wife Age (years)	0.27	5	0.05	0.31
Remittances (1=yes 2=no)	0.41	4	0.33	NI
Household Members(>15 years)/Land Cultivated	0.21	6	0.88	0.37
Migrants Relatives (1=yes, 0=no))	0.81	1	0.37	NI
Household Per Capita Output (Tons.)	-0.49	2	0.73	-0.69
Household Head Migration Experience (1=yes, 0=no)	0.44	3	0.21	NI

Table 8. Corn Production (in Kg.) by Agricultural Environment and Household Typology, Both Differentiated by Family Migration Status.

		FWNM Mean	SD	Max	Min	FWM Mean	SD	Max	Min	T-Test (c.) Mean Diff.
Whole Sample	Corn Pcc	1009.75	985.86	2646	0	1061.30	991.06	2102	0	27.00
	Productivity	1279.80	219.73	1739	0	1275.07	255.88	2130	0	0.91
	Livestock	1.48	16.33	55	0	1.41	17.07	61	0	0.00
Agricultural Environment (a)										
1	Corn Pcc	1306.67	841.42	2558	179	1171.48	754.54	1942	128	97.71
Trad.	Productivity	1693.24	103.14	1911	194	1619.38	190.24	1838	269	166.10
n=4	Livestock	1.90	8.26	31	0	1.75	11.63	38	0	0.01
2	Corn Pcc	1062.83	167.23	2646	182	1015.21	631.89	2100	36	34.41
Sem-Mod.	Productivity	1691.77	232.55	2397	113	1581.97	123.37	2055	0	418.91
n=10	Livestock	1.41	23.15	14	1	1.89	17.67	21	0	0.07
3	Corn Pcc	1862.39	1094.18	2352	180	1903.80	29.91	2102	0	8.58
Modern	Productivity	1886.94	119.62	1739	0	1976.00	1231.09	2130	0	45.20
n=3	Livestock	1.22	13.23	55	0	1.98	17.53	61	0	0.17
Household Typology (b)										
	Corn Pcc	1775.47	122.09	2300	8	1601.97	1244.28	2029	125	280.31
Housty 1	Productivity	1507.35	213.62	1565	197	1311.64	1156.37	368	0	377.63
47 (%)	Livestock	0.93	8.78	29	0	0.97	0.14	9	0	0.00
	Corn Pcc	1791.06	1290.73	2046	72	1556.17	267.79	2102	93	354.82
Housty 2	Productivity	1255.22	927.87	1611	18	1155.37	1008.02	2130	18	66.78
34 (%)	Livestock	1.10	13.38	30	0	1.91	16.39	29	0	0.29
	Corn Pcc	653.06	29.88	2623	18	740.41	1431.12	1750	36	42.97
Housty 3	Productivity	782.35	176.13	794	0	781.72	78.20	676	0	0.01
19 (%)	Livestock	2.29	1.47	55	0	2.07	1.86	61	0	0.14

a Weighted by the amount of land cultivated and household size.
b Weighted by the amount of land cultivated.
c Heterocedastic test (assuming unequal variances).
n = number of communities (*ejidos*).

Table 9. Total Labor Requirements (in days) by Agricultural Environment and Household Typology Both Differentiated by Family Migration Status.

		FWNM Mean	SD	Max	Min	FWM Mean	SD	Max	Min	T-Test (c.) Mean Diff.
Whole	Family	50.49	49.29	180	0	48.07	49.55	109	0	1.19
Sample	Reciprocal	26.98	15.60	100	0	18.75	26.51	79	0	28.40
	Hired	27.69	19.90	144	0	28.73	53.64	134	0	0.23
Agricultural Environment (a)										
1	Family	60.33	17.07	106	10	42.31	7.30	109	11	99.00
Trad.	Reciprocal	43.66	10.69	72	12	19.83	9.51	44	15	239.72
n=4	Hired	28.21	7.12	47	0	19.76	21.21	56	0	21.85
2	Family	39.09	8.36	62	15	28.59	19.44	60	2	51.09
Sem-Mod.	Reciprocal	29.59	11.63	61	8	17.23	6.17	28	0	106.08
n=10	Hired	50.91	17.41	98	1	46.70	48.16	129	0	3.41
3	Family	13.12	54.71	160	1	12.86	13.99	37	0	0.01
Modern	Reciprocal	14.35	8.60	37	0	12.56	13.55	36	0	1.29
n=3	Hired	67.87	41.57	144	0	61.34	55.07	155	0	3.93
Household Typology (b)										
	Family	42.48	16.16	68	11	30.95	12.30	70	7	68.88
Housty 1	Reciprocal	25.37	10.68	36	11	20.50	2.82	25	0	21.61
47 (%)	Hired	22.65	27.58	36	0	9.19	0.91	39	0	65.62
	Family	34.94	14.54	74	4	27.81	13.39	51	6	23.26
Housty 2	Reciprocal	48.39	16.39	92	1	17.16	19.40	56	2	355.01
34 (%)	Hired	50.24	12.03	83	0	46.20	51.48	134	0	3.06
	Family	18.86	13.33	86	1	17.02	20.40	51	2	0.97
Housty 3	Reciprocal	3.47	8.81	54	0	3.84	24.91	46	0	0.04
19 (%)	Hired	19.85	4.25	97	5	19.49	3.29	25	7	0.14

a Weighted by the amount of land cultivated and household size.
b Weighted by the amount of land cultivated.
c Heterocedastic test (assuming unequal variances).
n = number of communities (*ejidos*).

Table 10. Definition of Agricultural Tasks for Cultivation.

Reference Name of Detailed Tasks Description	Tasks	Detailed Description of Agricultural Practices (in Spanish) According to the Disaggregated Classification	New Generic Description of Tasks	Reference Name of Generic Tasks Description
Task No. 1	Cleaning	Limpia, Barbecho, Cercado (Fencing)	Pre-sowing	Task No. 1
Task No. 2	Plowing	Rastra, Cruza, Surcado	Pre-sowing	Task No. 1
Task No. 3	Sowing	Sembrado	Sowing	Task No. 2
Task No. 4	Weeding	Deshierbe	Post-sowing	Task No. 3
Task No. 5	Fertilizing	Fertilizacion	Post-sowing	Task No. 3
Task No. 6	Harvesting	Cosecha	Harvest	Task No. 4
Task No. 7	Post-Harvest	Acarreo, Desgrane, Almacenamiento (storing), Trillado, Venteado	Post- Harvest	Task No. 5
Task No. 8	Other	Riego (irrigate), Cercado (fencing), Crop-Selection	Post- Harvest	Task No. 5

Tasks: They are referred to the set of agricultural tasks performed at the plot ranging from simple preparation to post- harvest activities; these practices are: 1. Limpia de terreno, 2. Barbecho, 3. Rastra ó 2º Barbecho, 4. Cruza, 5. Surcado, 6. Siembra, 7. Fertilización, 8. 2ª Fertilización, 9. Deshierbes, 10. 2º Deshierbe, 11. Cosecha, 12. Acarreo, 13. Desgrane, 14. Almacenamiento, 15. Trillado, 16. Venteado, 17.Tapado, 18. Riego, 19. Paleado, 20. Sepas Abono, 21. Trasplante, 22. Poner ramas, 23. Secado, 24. Amontonado, 25. Juntar, 26. Quebrar, 27. Almácigo, 28. Revolver, 29. Nivelar, 30. Controlar maleza, 31. Corte, 32. Asoleado, 33. Arrime, 34. Desoje, 35. Picar zacate, 36. Reparar cercos, 37. Extendido, 38. Caballo propio, 39. Cal, 40. Taponeo, 41. Cortar frijol, 42. Repartición, 43. Recogida de mazorca, 44. Resembrado, 45. Selección de maíz, 46. Selección de mazorca, 47. –picar el zacate, 48.colgar el zacate, 49.otro(especifique).

Table 11. Labor Ratios per Task by Agricultural Environment.
(weighted by the amount of output).

		FWNM				FWM			
		Family/Hired		Recipro/Hired		Family/Hired		Recipro/Hired	
	Task	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Whole Sample	1	7.688	4.637	0.470	0.253	7.144	0.829	0.001	2.112
	2	4.075	8.473	2.180	0.351	4.537	1.102	1.912	1.071
	3	3.226	1.356	1.034	1.665	3.271	2.786	0.736	0.402
	4	1.091	1.702	3.981	0.690	3.543	1.275	0.399	2.481
	5	0.049	9.231	0.396	1.258	4.069	0.268	9.718	0.231
Agri. Environment									
1 Trad.	1	1.014	0.212	11.883	0.332	0.080	2.066	1.688	0.295
	2	9.822	4.425	2.174	0.227	0.002	0.038	4.105	2.117
	3	7.857	0.078	0.005	0.450	1.493	1.830	0.222	0.517
	4	3.668	2.825	3.035	1.649	3.056	1.540	0.059	0.021
	5	0.072	1.436	0.005	0.016	1.933	0.087	2.660	0.062
2 Semi-Mod.	1	2.003	0.739	0.194	0.789	0.592	0.087	1.003	0.976
	2	2.478	0.916	3.099	0.405	2.938	0.925	1.380	0.749
	3	1.010	0.675	0.002	0.201	0.704	0.443	2.886	1.376
	4	1.014	0.725	5.909	0.840	10.838	19.417	0.005	2.015
	5	1.031	0.045	0.001	0.713	9.097	7.883	0.730	0.294
3 Modern	1	0.017	0.708	2.799	1.121	1.303	0.714	51.363	0.690
	2	0.294	0.343	0.167	1.653	0.241	0.202	0.160	0.165
	3	0.648	1.005	0.005	0.103	0.631	0.104	5.689	2.116
	4	3.002	0.599	1.523	1.749	0.148	1.395	0.276	0.592
	5	0.025	0.113	0.210	2.101	0.750	1.012	6.233	0.378

Table 12. Sequential Production Function Non-Intercept OLS Regression: Constructed Output on Constructed Independent Variables.

Variable Definition		Beta	Pooled Coefficient	Pooled S.D.(a)	Without Migrants Coefficient	Without Migrants S.D.(a)	With Migrants Coefficient	With Migrants S.D.(a)
C_LFAMCLR	*Xfc*	βfc	0.1626	0.1205	0.1347 *	0.0078	0.0635 *	0.0055
C_LJORNCLR	*Xjc*	βjc	-3.097	-0.0534	0.0131 *	0.0207	0.0106	0.0188
C_LRECICLR	*Xrc*	βrc	0.0201	0.0643	0.0277	0.0471	0.1034 *	0.0501
C_LINSCLR	*Xic*	βic	5.633 *	0.2087	0.2457 *	0.0153	0.1587 *	0.0114
C_LFAMSOW	*Xfs*	βfs	0.5009 *	0.0645	0.10504	0.0172	0.1014 **	0.0145
C_LJORNSOW	*Xjs*	βjs	-0.1792	-0.0465	0.2665 *	0.0174	0.2834 ***	0.194
C_LRECICSOW	*Xrs*	βrs	0.0306	0.0742	0.1657 *	0.0039	0.2724 *	0.0048
C_LINSSOW	*Xis*	βis	2.7889 *	0.2059	0.0452 *	0.0017	0.1153 *	0.0013
C_LFAMWEFE	*Xfw*	βfw	5.7029 *	0.2101	0.175 **	0.0938	0.1792 *	0.0874
C_LJORNWEFE	*Xjw*	βjw	4.5984 *	0.2131	0.041 *	0.025	0.0306 ***	0.0503
C_LRECIWEFE	*Xrw*	βrw	0.0011	0.0693	0.418 *	0.0808	0.1626 *	0.0578
C_LINSWEFE	*Xiw*	βiw	0.0635	0.0683	0.2617 *	0.043	0.097 *	0.0284
C_LFAMHARV	*Xfh*	βfh	-0.0106	-0.0518	0.1912 *	0.0828	0.0201 *	0.0815
C_LJORNHARV	*Xjh*	βjh	0.1034	0.1199	0.0706 *	0.0181	0.0011	0.0152
C_LRECIHARV	*Xrh*	βrh	0.1587	0.1041	0.178 *	0.0405	0.1712 *	0.0307
C_LINSHARV	*Xih*	βih	-0.1014 *	-0.0169	0.1417 *	0.0087	0.0566 *	0.0103
C_LFAMPOH	*Xfp*	βfp	0.2834 *	0.0873	0.057 *	0.0362	0.041	0.0378
C_LJORNPOH	*Xjp*	βjp	0.2724 **	0.1168	0.0546 *	0.0538	0.0442	0.0513
C_LRECIPOH	*Xrp*	βrp	-0.1153	-0.0490	0.0586 *	0.062	0.2531 *	0.0289
C_LINSPOH	*Xip*	βip	0.147 **	0.0794	0.0068 ***	0.0529	0.3186 *	0.0296
L_LAND	*L*	βl	0.0210 *	0.0004	0.0018	0.0045	0.0017 *	0.0005
L_MACH	*M*	βm	0.0018 ***	0.0010	0.0009 ***	0.0006	0.0082 ***	0.0055
N			567	-	362	-	205	-
R-Squared			0.36		0.425		0.204	

Statistical significance: * means least than 2.5%, ** 5%, and *** means 10%

(a) Corrected through bootstrapping. SD are asymptotically consistent.

Table 13. Partial (Allen) Elasticities of Substitution Differentiated by Household Migration Status.

Families with Migrants (*i no equal to j*)						
Variable Inputs	**(1,2)**	**(1,3)**	**(1,4)**	**(2,3)**	**(2,4)**	**(3,4)**
Ra(i,j,1)	0.707	0.681	0.323	0.891	0.414	0.154
Ra(i,j,2)	0.350	0.430	0.446	0.874	0.714	0.147
Ra(i,j,3)	0.642	0.665	1.199	0.853	1.045	0.619
Ra(i,j,4)	0.489	0.493	0.191	0.020	0.916	0.314
Ra(i,j,5)	0.344	0.578	0.321	0.671	0.367	0.228
Families with No Migrants						
Variable Inputs	**(1,2)**	**(1,3)**	**(1,4)**	**(2,3)**	**(2,4)**	**(3,4)**
Ra(i,j,1)	0.991	0.320	0.505	0.700	0.359	0.051
Ra(i,j,2)	0.773	0.244	0.629	0.480	0.499	0.599
Ra(i,j,3)	0.191	0.737	0.543	1.043	0.771	0.133
Ra(i,j,4)	0.406	0.222	0.912	0.326	0.380	1.379
Ra(i,j,5)	0.933	0.849	1.521	0.858	0.436	0.667
Squared Differences						
Difference Variable	**(1,2)**	**(1,3)**	**(1,4)**	**(2,3)**	**(2,4)**	**(3,4)**
SDRa(i,j,1)	0.080	0.131	0.033	0.037	0.003	0.011
SDRa(i,j,2)	0.179	0.034	0.034	0.155	0.046	0.205
SDRa(i,j,3)	0.204	0.005	0.430	0.036	0.075	0.237
SDRa(i,j,4)	0.007	0.073	0.520	0.093	0.287	1.134
SDRa(i,j,5)	0.348	0.074	1.440	0.035	0.005	0.193

Table 1A. Migration in Previous Five Years, 1990.

State	No. of Inmig.*	Per Cap. Inmig.*	No. of Outmig.*	Per Cap. Outmig.*	No. of Net Inmig.*	Per Cap. Net Inmig.*
AGUASCALIENTES	44012	0.071	17452	0.028	26527	0.043
BAJA CALIFORNIA	220848	0.155	40309	0.028	180255	0.126
BAJA CALIF. SUR	29539	0.107	11735	0.043	17725	0.064
CAMPECHE	34500	0.076	24697	0.054	9762	10.021
COAHUILA	69278	0.040	80748	0.047	(11554)	-0.007
COLIMA	31123	0.084	18356	0.049	12747	0.034
CHIAPAS	43947	0.016	69824	0.026	(27502)	-0.010
CHIHUAHUA	118343	0.056	40146	0.019	77933	0.037
DISTRITO FEDERAL	299285	0.041	1035758	0.141	(737523)	-0.100
DURANGO	41301	0.035	82359	0.070	(41211)	-0.035
GUANAJUATO	98926	0.029	94976	0.028	3443	0.001
GUERRERO	46959	0.021	120236	0.054	(73619)	-0.033
HIDALGO	67114	0.041	85909	0.053	(18945)	-0.012
JALISCO	178259	0.039	138366	0.030	39645	0.009
EDO. MEXICO	787020	0.092	271421	0.032	514946	0.060
MICHOACAN	106146	0.035	121134	0.040	(15532)	-0.005
MORELOS	91322	0.087	39613	0.038	51614	0.049
NAYARIT	35934	0.051	38769	0.055	(2904)	-0.004
NUEVO LEON	114049	0.042	66247	0.024	47597	0.017
OAXACA	74083	0.029	138780	0.053	(64888)	-0.025
PUEBLA	126056	0.035	139132	0.039	(13446)	-0.004
QUERETARO	67976	0.076	29264	0.033	38593	0.043
QUINTANA ROO	92895	0.225	18969	0.046	73841	0.179
SAN LUIS POTOSI	64531	0.038	77650	0.045	(13251)	-0.008
SINALOA	83139	0.043	105330	0.055	(22519)	0.012
SONORA	72307	0.045	53840	0.034	18281	-0.005
TABASCO	47965	0.037	54412	0.042	(6597)	-0.005
TAMAULIPAS	115424	0.058	75599	0.038	39697	0.020
TLAXCALA	35906	0.054	25028	0.038	10830	0.016
VERACRUZ	163924	0.030	236281	0.044	(72695)	-0.013
YUCATAN	38395	0.032	47384	0.040	(9020)	-0.008
ZACATECAS	36731	0.033	68784	0.063	(32230)	-0.029
National Total	3477237		3468508		0	
Minimum	29539	0.016	11735	0.019	(737523)	-0.100
Maximum	787020	0.225	1035758	0.141	514946	0.179

Source: Reproduced and modified from Pick and Butter (1994) Table 5.4.
Shaded states are covered in this research.
Negative numbers in parentheses.

Table 2A. F-Statistics for Testing Separability and Unitary (or Constancy) Elasticity of Substitution

INTRA-TASK (*i not equal j*)

Separability

	(1,2)	(1,3)	(1,4)	(2,3)	(2,4)	(3,4)
Ra(i,j,1)	2.491	2.535	2.793	1.921	2.627	1.075
Ra(i,j,2)	3.470	1.957	1.703	3.684	3.235	1.760
Ra(i,j,3)	1.660	3.243	3.195	1.970	7.910	2.231
Ra(i,j,4)	3.774	1.764	8.391	2.305	2.580	3.448
Ra(i,j,5)	2.168	3.864	2.533	3.909	1.066	2.971

Elasticity of Substitution

	(1,2)	(1,3)	(1,4)	(2,3)	(2,4)	(3,4)
Ra(i,j,1)	10.375	4.540	2.904	1.994	2.723	3.530
Ra(i,j,2)	4.017	3.536	3.969	2.683	2.612	2.999
Ra(i,j,3)	2.704	3.076	2.794	3.247	4.471	3.175
Ra(i,j,4)	3.580	3.869	3.064	2.697	3.955	3.810
Ra(i,j,5)	3.890	5.360	1.009	11.406	3.712	1.826

INTER-TASK (a)

Separability

	MRS(1,2,k)	MRS(2,3,k)	MRS(3.4,k)	MRS(4,5,k)
Ra(i,j,1)	0.288	2.996	2.979	2.152
Ra(i,j,2)	3.093	3.496	4.127	2.360
Ra(i,j,3)	2.082	2.723	1.610	0.777
Ra(i,j,4)	2.756	2.369	3.056	1.535

Elasticity of Substitution

	MRS(1,2,k)	MRS(2,3,k)	MRS(3.4,k)	MRS(4,5,k)
Ra(i,j,1)	2.999	0.682	0.000	0.152
Ra(i,j,2)	2.594	0.204	0.768	0.010
Ra(i,j,3)	0.636	0.074	0.725	0.662
Ra(i,j,4)	1.439	0.057	1.198	0.820

Note: Critical Values for F (6,572) at 5% is 2.09, at 1% 2.80 and at 0.1% 3.74 and Critical Values for F (2,576) at 5% is 2.99, at 1% 4.60 and at 0.1% 6.91

a Sequential pairs only

Table 3A Locally Weighted Least Squares Regression.
(variables in logarithms)

Variable	Land Cultivated		Machinary Used		R Squared	N	Hausman Test Chi Squared One d.f.
	Mean Kernel	Std.	Mean Kernel	Std.			
LOUTPUT	1.745	0.571	18.848	13.152	0.318	572	22.358
LFAMCLR	7.153	1.576	5.282	6.49	0.12	520	27.979
LJORNCLR	2.331	0.846	0.063	0.243	0.044	531	526.313
LRECICLR	5.955	1.944	0.53	0.499	0.249	581	73.869
LINSCLR	0.071	1.188	0.398	0.489	0.08	485	316.757
LFAMSOW	0.488	1.206	8.96	4.091	0.201	532	201.343
LJORNSOW	0.383	0.59	16.942	13.631	0.109	515	70.398
LRECICSOW	0.074	1.018	4.728	6.358	0.19	539	21.623
LINSSOW	0.199	7.76	0.157	0.364	0.098	523	6.692
LFAMWEFE	0.109	3.185	0.579	0.494	0.103	545	2.504
LJORNWEFE	0.578	1.713	5.074	2.263	0.238	572	6.764
LRECIWEFE	4.828	2.805	0.56	0.807	0.182	572	1.884
LINSWEFE	0.048	3.06	0.196	0.397	0.047	516	4.027
LFAMHARV	0.516	6.813	0.094	0.292	0.065	498	41.472
LJORNHARV	0.38	6.024	0.574	0.495	0.048	549	7.198
LRECIHARV	0.141	0.214	0.085	0.279	0.056	485	14.48
LINSHARV	0.202	0.5	0.05	0.218	0.042	519	10.917
LFAMPOH	1.33	0.485	0.182	0.386	0.135	515	5.915
LJORNPOH	9.418	0.348	6.912	8.022	0.04	569	2.856
LRECIPOH	17.001	0.402	0.029	0.169	0.295	573	2.144
LINSPOH	4.239	9.432	0.588	0.492	0.398	545	1.246

Mean Kernel based "Indirect" estimates

Figure 1A. Internal and International Migration