Labor market imperfections and classes of farm households : a predictive typology of Mexican Ejidatarios

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Labor Market Imperfections and Classes of Farm Households:
A Predictive Typology of Mexican Ejidatarios

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I. Household Typologies in Agrarian Studies

Categorizing rural households in typologies is useful to simplify both the positive analysis of the differential impact of shocks, programs, and policy reforms across households, and the design of differential programs and policy interventions for particular household types. For this reason, the literature on agrarian studies is replete with formulations of alternative typologies. The traditional approach to constructing typologies has been to categorize households by labor regimes and to derive from this classification both the asset position (farm size most particularly) of these households and their performance levels. This is typical of some of the most classical typologies such as Barraclough (1973) for Latin America, Patnaik (1987) for India, and CEPAL (1992) for Mexico. We shall refer to this approach as *descriptive* typologies since households are assigned to categories ex-post relative to their behavioral choices of labor strategies. In recent years, introduction of the new institutional economics in agrarian studies has allowed to predict membership to labor regimes based on a set of exogenous asset endowments. Typologies of rural households can thus become *predictive* since membership to a labor regime is derived from behavioral choices given a household's asset position and a set of transactions costs that define its relation to the market. The most celebrated such predictive typology derives from the work of Roemer (1982) on endogenous class formation, and its rigorous application to agrarian classes by Eswaran and Kotwal (1986). In this latter case, households are endowed with different levels of asset (mainly land) and maximize expected utility in a stochastic environment characterized by access to working capital limited by collateral ownership and by moral hazards associated with hired labor, implying the need to incur supervision costs. Rational choice by these households leads them to chose differential labor strategies, and thus to belong to different labor regimes, i.e. social classes.

In this paper, we start by briefly reviewing these contrasted approaches to the construction of household typologies. We then propose an alternative model of household behavior that introduces transactions costs in access to labor markets and household labor qualities with differential opportunity costs. This allows us to construct four household classes corresponding to labor regimes, where the predictive characteristics are assets per unit of low-skill adult household labor, and endowment in high-skill labor. We then use data from a 1990 survey of ejidatario households in the State of Michoacan in Mexico to characterize membership to these categories.

We then extend the concept of assets to include productive assets, human capital assets, and social assets. Using a multinomial probit analysis, we predict membership to the different labor regimes on the basis of these household asset endowments. Comparative statics in the household model allows us to derive predictions

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regarding the differential intensity of labor use per unit of land across labor regimes when assets per unit of low-skill adult household labor increases. We test for this regularity using the Michoacan household data. The observed class-specific relation between labor intensity (or yield) and farm size per unskilled adult has important policy implications for the targeting of institutional assistance to different classes of farmers if the policy objective is to increase land productivity.

II. Types of Typologies

Labor regimes contrast households who sell labor (hire out), are self-sufficient in labor, and hire in (employers). Descriptive typologies then describe both the asset position of these household classes and regularities in their efficiency in resource use.

Barraclough distinguishes four labor regimes: sub-family farms (SF) which sell labor, family farms (F) which are self-sufficient in labor, multifamily medium farms (MFM) which hire a few workers, and multifamily large farms (MFL) which hire a large number of workers. The asset characteristics of these household types is then observed, particularly farm size. For performance, yields and other productivity indices are observed to see if there exists an inverse relation from SF to MFL, thus justifying redistributive land reform on an efficiency basis. The hunch is that there are labor market imperfections which allow smaller farms to benefit from cheap captive labor, and thus achieve higher levels of factor productivity. The systematic empirical application of these concepts across Latin American countries was fundamental in the subsequent design of land reforms in the 1960s and 70s, under the aegis of the Inter-American Committee for Agricultural Development.

Utsa Patnaik is concerned with social differentiation which is based, in her perspective, on the ability for some farmers to extract a surplus through the hiring of labor and the need for others to surrender surplus through the sale of labor. Her labor regimes are defined by a "labor-exploitation" index E defined as:

$$E = (h - f_o)/f_i,$$

where h = labor hired-in,
f_o = labor hired-out, and
f_i = family labor working on the farm.

Class	E-index	Hire out f_o	Own-farm work f_i	Hire in h
Landless	$E \rightarrow -\infty$	+++	0	0
Poor peasant	$E \leq -1$	++	+	0
Small peasant	$-1 < E \leq 0$	+	++	0
Middle peasant	$0 < E \leq 1$	0	++	+
Rich peasant	$E > 1$	0	+	++
Landlord	$E \rightarrow +\infty$	0	0	+++

Since the E-index measures the net between h and f_o, households could simultaneously sell and hire labor. The average asset position of each household category can then be observed. Assets include land, livestock, machinery, farm tools, and non-farm productive assets (see Akram-Lodhi (1993) for an application to Pakistan). Indicators of performance such as land and labor productivity and residual farm profits per hectare can be calculated by class.

For Mexican households, CEPAL develops a typology which is also based on labor strategies. Households are classified into four categories of employers:

Peasants with less than 25 days of hired labor per year,
Transition farmers with between 25 and 500,
Small entrepreneurs with 500 to 1500,
Medium entrepreneurs with 1500 to 2500,
Large entrepreneurs with more than 2500.

Peasants are in turn divided according to the amount of land (in hectares of quality equivalent based on yield): infra-subsistence (≤4ha) for whom land is insufficient to feed the family and the household is a net buyer of food; subsistence (4–8ha) who can feed themselves but cannot cover depreciation of capital; stationary (8–12ha) who can cover both food and replacement needs; and surplus (≥12ha) who can save. Elaborate characterizations of the asset position and other characteristics of these household types are then given, as well as indicators of their performance.

Predictive typologies are based on extensions of the work of Eswaran and Kotwal. In their own work, they assume that households maximize a utility function in income and leisure, where income is derived from farm production, the sale (or hire) of labor, and the rental (out or in) of land. Credit is obtained on the basis of land owned $\overline{A}$ which serves as collateral. Credit is thus constrained by asset ownership. Total household assets B^* is thus the sum of the rental value of land owned at the rental rate r and the collateral value of this land $B(\overline{A})$:

$$B^* = r\overline{A} + B(\overline{A}).$$

There are in addition, moral hazards in hired labor (h) behavior, with the need to incur supervision costs, $s(h)$. Household time can thus be allocated to labor hired-out (f_o), own-farm work (f_i), or supervision of hired labor ($s(h)$). Optimal household behavior, given its initial asset position B^*, thus defines a typology of classes corresponding to endogenous labor strategies:

Asset position	Hire out f_o	Own-farm work f_i	Supervision $s(h)$	Class
$B^* < \overline{K}$	+	0	0	Agricultural worker
$\overline{K} \le B^* < B_1^*$	+	+	0	Laborer-cultivator
$B_1^* \le B^* < B_2^*$	0	+	0	Self cultivator
$B_2^* \le B^* < B_3^*$	0	+	+	Small capitalist
$B^* \ge B_3^*$	0	0	+	Large capitalist

Assets thus predict class membership. Optimum behavior in the constrained Pareto-efficient world of credit constraint and moral hazards on hired labor also predicts several regularities in yield and land-to-labor ratio across classes as assets rise. Specifically, the land-to-labor ratio is constant in the smallholder class and strictly increasing afterwards; yield is constant in the smallholder class, and strictly decreasing across the other classes.

Carter (1990) extends this model by specifying particular functional forms for the functions describing credit rationing and supervision. This allows to predict the shape of the restricted profit (land rent) function

across classes. The land endowment ($\overline{A}$) at which this function peaks is expectedly the farm size toward which land transactions would make farm holdings converge. He consequently uses this model to anticipate the type of land consolidation that may occur as farms compete for land and simulates how specific policy changes may affect the distribution of land across classes of households.

III. A Model of Household Behavior and Endogenous Labor Regimes

The model which we develop here has as a purpose to accommodate a commonly observed labor strategy, namely existence of households who both sell and hire labor. It also incorporates the existence of wide price bands in labor transactions costs, with low effective wages received and high effective wages paid. (Lopez, 1986). In subsequent extensions, we allow for the existence of some captive family labor, supervision costs on hired labor, and price bands in relating to the product market, implying that some households are net sellers of food, others self-sufficient, and yet others net buyers.

The household considered has two categories of family labor, unskilled labor in quantity f^1 and skilled labor in quantity f^2, with opportunity costs w_o^1 and w_o^2 on the labor market., respectively The household can also hire h workers at unit cost w_h. These costs include search in finding employment or in hiring, and supervision of hired workers. Unskilled labor is defined as family members which are cheaper than hired workers, while skilled labor are members with higher opportunity cost than the hired workers' cost to the farm: $w_o^1 < w_h < w_o^2$. Family labor allocates its time between on-farm work (f_i^1 and f_i^2), off-farm activities (f_o^1 and f_o^2), and home time or leisure (f_l^1 and f_l^2).

The household produces a single output q with a fixed amount of capital (land) A and labor. Family labor and hired workers are perfect substitutes in agricultural activities, despite their differential skills and opportunity costs. The household maximizes a utility function, which is the sum of income and the utility of home time for family members:

$$\max_{h,f_i^1,f_i^2,f_o^1,f_o^2} q(A, h+f_i^1+f_i^2) - w_h h + w_o^1 f_o^1 + w_o^2 f_o^2 + f^1 u\left(1-\frac{f_i^1+f_o^1}{f^1}\right) + f^2 v\left(1-\frac{f_i^2+f_o^2}{f^2}\right),$$

subject to non-negativity constraints $h, f_i^1, f_i^2, f_o^1, f_o^2, f_l^1 = f^1 - f_i^1 - f_o^1$, and $f_l^2 = f^2 - f_i^2 - f_o^2 \geq 0$. The production function q is assumed to be linear homogenous, increasing, strictly quasi-concave, and continuously differentiable in its arguments. The utility function u is increasing and strictly concave in home time. These assumptions on $f(.)$ and $u(.)$ ensure that the problem admits only one solution given by the Kuhn-Tucker conditions:

(1) $q' - w_h + \mu_h = 0$

(2) $q' - u' - \mu_l^1 + \mu_i^1 = 0$

(3) $q' - v' - \mu_l^2 + \mu_i^2 = 0$

(4) $w_o^1 - u' - \mu_l^1 + \mu_o^1 = 0$

(5) $w_o^2 - v' - \mu_l^2 + \mu_o^2 = 0$

(6) $\mu_m^n \geq 0$, $f_m^n \geq 0$, and $\mu_m^n f_m^n = 0$ for $m = i, o, l$ and $n = 1, 2$

(7) $\mu_h \geq 0$, $h \geq 0$, and $\mu_h h = 0$

where q' is the marginal productivity of labor, and $\mu_h, \mu_i^1, \mu_i^2, \mu_o^1, \mu_o^2, \mu_l^1$, and μ_l^2 are the slack variables and Lagrange multipliers associated with the non-negativity constraints.

These non-negativity conditions imply the following properties for the solution:

Proposition 1. Skilled family labor never works on farm. This is shown by substituting (1) and (5) in (3), which gives:

$$\mu_i^2 = -q' + v' + \mu_l^2 = \mu_o^2 + (w_o^2 - w_h) + \mu_h > 0,$$

and hence $f_i^2 = 0$.

Proposition 2. If there is hired labor, no unskilled family labor works off-farm. If the household is hiring, $h > 0$ and $\mu_h = 0$. From (1), $q' = w_h$, and (2) and (4) give:

$$\mu_o^1 = \mu_i^1 + (w_h - w_o^1) > 0,$$

and hence $f_o^1 = 0$.

Proposition 3. If unskilled family labor works off-farm, there is no hired labor. Similarly, if $f_o^1 > 0, \mu_o^1 = 0$, and substituting (2) and (4) into (1) give:

$$\mu_h = -q' + w_h = \mu_i^1 + (w_h - w_o^1) > 0,$$

and hence $h = 0$.

We now turn to the derivation of the household's optimal labor strategies. Solution of the problem reveals that the household's optimal strategy depends on its initial land endowment per unit of unskilled family labor, $A^* = A/f^1$. This result thus explains how differential labor strategies emerge endogenously as a consequence of rational choice behavior in the context of unequal initial asset distribution. Note first that, from Proposition 1, the household's objective function is separable:

$$(8) \qquad \max_{h, f_i^1, f_o^1} \left[q(A, h + f_i^1) - w_h h + w_o^1 f_o^1 + f^1 u\left(1 - \frac{f_i^1 + f_o^1}{f^1}\right)\right] + \max_{f_i^2, f_o^2} \left[w_o^2 f_o^2 + f^2 v\left(1 - \frac{f_i^2 + f_o^2}{f^2}\right)\right].$$

Hence, skilled labor time is allocated between home time and off-farm work in order to equalize the marginal utility of home time with the wage:

$$v'(1 - f_o^2 / f^2) = w_o^2.$$

With constant returns to scale in production, the first term in (8) can be divided by f^1, and rewritten:

$$(9) \qquad \max_{h^*, f_i^{*1}, f_o^{*1}} \left[q(A^*, h^* + f_i^{*1}) - w_h h^* + w_o^1 f_o^{*1} + u\left(1 - f_i^{*1} - f_o^{*1}\right)\right],$$

where h^* is the ratio of hired workers per unit of unskilled family labor, and f_i^{*1} and f_o^{*1} are the shares of family labor spent on-farm and off-farm. The optimal household strategies regarding the allocation of unskilled family labor and the potential employment of agricultural workers are as follows:

Proposition 4. Labor regimes depend on land endowments per unit of unskilled family labor. These regimes, which define classes, are the following:

a. For $A^* < A_0^*$, $f_o^1 > 0$, $f_i^1 = 0$, and $h = 0$. The household does not cultivate, and all family labor is hired out.
b. For $A_0^* \le A^* < A_1^*$, $f_o^1 > 0$, $f_i^1 > 0$, and $h = 0$. The household cultivates with family labor, and hires out.
c. For $A_1^* \le A^* < A_2^*$, $f_o^1 = 0$, $f_i^1 > 0$, and $h = 0$. The household is self-sufficient in farm labor.
d. For $A^* \ge A_2^*$, $f_o^1 = 0$, $f_i^1 \ge 0$, and $h > 0$. The household cultivates with family labor and hired workers.

Households whose asset position A^* is so low that the marginal productivity of even one unit of their labor would be inferior to the off-farm opportunity wage w_o^1 do only off-farm work for a wage. Once $A^* \ge A_0^*$, households allocate their labor to both own-farm work and work hired out. They are thus worker-peasants or semiproletarians. As the assets become more abundant, all unskilled family labor is absorbed in the family farm. There is a range of asset positions (A_1^* to A_2^*) that corresponds to the family farms. With yet more assets, the households hire labor in.

This proposition is demonstrated as follows. Consider first the case where there is off-farm work of unskilled labor, $f_o^1 > 0$. From proposition 3, there is no hired labor, and equations (2) and (4) give $q'(A^*, f_i^{*1}) = w_o^1 - \mu_i^1$. Let A_0 be defined by $q'(A_0^*, 0) = w_o^1$. Since $q'(A^*, f_i^{*1})$ is an increasing function of A^* and a decreasing function of f_i^{*1}, for $A^* < A_0^*$, $q'(A_0^*, 0) < w_o^1$, hence $\mu_i^1 > 0$ and $f_i^{*1} = 0$. There is no cultivation, and all family labor is hired out. For assets above A_0^*, allocation of family labor between on-farm and off-farm work is defined by:

$$(10) \qquad q'(A_0^*, f_i^{*1}) = u'(1 - f_i^{*1} - f_0^{*1}) = w_o^1.$$

As A^* increases, on farm labor increases and off-farm labor decreases, until all family labor only works on-farm. This threshold A_1^* is defined by:

$$(11) \qquad q'(A_1^*, f_i^{*1}) = u'(1 - f_i^{*1}) = w_o^1.$$

For assets above A_1^* there is no off-farm work by unskilled family labor. Consider now the case where there is hired labor, $h^* > 0$. From proposition 2, there is no off-farm work of family labor, and equations (1), (2), and (4) give:

$$q'(A^*, f_i^{*1} + h^*) = u'(1 - f_i^{*1}) = w_h = w_o^1 + \mu_o^1.$$

Hence, the marginal utilities of family labor and of hired labor are equal to w_h. The shadow price of family labor $w_o^1 + \mu_o^1$ is equal to the hired workers' wage w_h. Since $u'(1 - f_i^{*1})$ is an increasing function of f_i^{*1}, this labor strategy is chosen for sufficiently large value of A^*. The lower limit at which the household hires workers is A_2^* defined by:

$$(12) \qquad q'(A_2^*, f_i^{*1}) = u'(1 - f_i^{*1}) = w_h.$$

Since $w_h > w_o^1$, (11) and (12) show that $A_2^* > A_1^*$. This leaves a range of values for A^*, $A_1^* < A^* < A_2^*$, for which households neither hire workers in nor hire unskilled family labor out. This defines the range of family farms. For these households, the shadow price of family labor $w_{sh}^1 = w_o^1 + \mu_o^1$ is defined by:

$$q'(A^*, f_i^{*1}) = u'(1 - f_i^{*1}) = w_{sh}^1.$$

It is a monotonic function of A^*, increasing from w_o^1 to w_h as A^* increases from A_1^* to A_2^*. This establishes proposition 4.

These labor strategies give the following typology of households:

Classes	Assets $A^* = A/f^1$	f_o^1	f_i^1	h	f_o^2	f_i^2	Cost of farm labor
Agricultural worker	$A^* < A_0^*$	+	0	0			
Without skilled labor					0	0	
With skilled labor					+	0	
Worker-peasant (seller)	$A_0^* \le A^* < A_1^*$	+	+	0			w_o^1
Without skilled labor					0	0	
With skilled labor					+	0	
Family farmer (self-sufficient)	$A_1^* \le A^* < A_2^*$	0	+	0			w_{sh}^1
Without skilled labor					0	0	
With skilled labor					+	0	
Rich farmer (employer)	$A^* \ge A_2^*$	0	+	+			w_h
Without skilled labor					0	0	
With skilled labor					+	0	

Proposition 5. Labor intensity $(f_i^1 + h)/A$ (or equally land yield) is constant over the assets range of the worker-peasant class, strictly decreasing for the family farmer, and constant although at a lower level for the rich farmers. *Labor productivity* $q/(f_i^1 + h)$ is constant over the assets range of the worker-peasant class, strictly increasing for the family farmer, and constant at a higher level for the rich farmers.

With a CRS production function, the marginal productivity of labor is a monotonic decreasing function of labor intensity, and average labor productivity $q/(f_i^1 + h)$ is a monotonic decreasing function of labor intensity. Hence proposition 5 derives directly from the variation of marginal productivity of farm labor across classes established above.

IV. The Data and a Descriptive Typology

The Mexican land tenure system established by the land reform of 1917 divides property rights over land between the private sector and the social sector. Each sector occupies half of Mexico's arable land and half of the irrigated land. The social sector is composed of 28,056 ejidos and ethnic communities which each contain a number of families that can range from as few as 20 to as many as four or five hundred, with an average of some 100 families. In this sector, the land title is held by the community and individual households have usufruct of a plot of land and often access to common grazing and forestry lands. While households in the ejidos were in principle forbidden to divide the land among descendants, in practice much division has occurred.

In the ethnic communities, divisions were legal. The result is that a significant share of the social sector today is composed of very small farms where households engage in both subsistence agricultural production and the sale of labor. The majority of farms are self-sufficient in labor, while yet others, larger and better endowed in productive assets or with smaller families, engage in the hiring of salaried labor.

In December 1991, the Mexican Congress approved a constitutional amendment that put an end to further land redistribution and offered to ejidos and communities the right to assign individual titles, which can be privately traded, to those currently usufructing the land. While little titling has yet occurred, as the legal process of identifying individual rights over land is highly complex and conflictual, the reform is well under way. In addition, as part of structural adjustment induced by response to the debt crisis, Mexico has engaged in thorough reforms of the role of government in agriculture, with massive descaling of state functions and privatizations of most parastatals engaged in marketing and the provision of inputs. Further, trade has been liberalized, including through joining GATT and NAFTA, and extensive credit and factor subsidies have been terminated. Only corn and beans remain protected, but their prices are being rapidly brought to the international market price level, and a scheme of direct income transfers, PROCAMPO, has been initiated to compensate farmers for the welfare loss.

These massive reforms of the land tenure system and of the institutional context for agriculture have generated considerable interest in obtaining a better characterization of households in the social sector, and in particular in developing a typology of these households. This typology should be able to capture the great degree of heterogeneity in that sector, and yet summarize it according to the main determinants of differential performance. Of specific importance is to anticipate how different categories of households in the social sector will respond to the reforms in progress and what type of complementary reforms should be put into place to prevent this sector from rapid disintegration, and its households from abandoning the land and migrating enmasse to the cities and the United States.

The data we use are from a 1990 survey of the social sector conducted by the Ministry of Agriculture and Hydraulic Resources (SARH) and the Economic Commission for Latin America (CEPAL). We work with data for the state of Michoacan, where the traditional coexistence between social sector and private lands is well represented and where there is an extensive peasantry as well as an active labor market, both local and through seasonal migration to the United States. The survey consists in 1204 complete observations of households in ejidos and communities. The extension service regroups these farms in 13 Rural Development Districts (DDR) which are defined to have agroecological homogeneity and which we use to characterize the regional context of each ejido.

We divide, in Table 1, the households based on the six labor regimes (excluding agricultural workers for which we have no data) identified in the household model. The three categories--sellers of unskilled labor, self-sufficient, and employers--can all sell skilled labor if they have some. A laborer has been classified as skilled either if he/she is employed in the manufacturing, services, or construction sectors and/or if he/she has at least six years of education. In Table 1, the self-sufficient households are used as the reference category relative to which t-tests on differences of means are calculated.

The data show that 62% of the households are self-sufficient in farm labor, 33% are employers, and 5% are sellers of unskilled labor. However, when the sale of both unskilled and skilled labor is taken into account, 17% are sellers. These figures still under-represent the extent of participation to the labor market because labor income for these households mainly derives from migration to the United States which was under-reported as

the survey focused on household members present in the farm. For one ejido community in Michoacan, Fletcher and Taylor (1992) report 11% of household income derived from wages, commerce, and handicrafts, 28% from remittances, and 61% from agriculture, livestock, and fisheries. However, for our analysis, with remittances derived from skilled labor, the opportunity cost of labor for farm work remains unaltered by this missing information.

Households who are sellers of labor have a higher number of adults and also of unskilled adults than the other categories, but there is no difference in the number of unskilled adults within each category between those who sell skilled labor and those who do not. The average age of adults is clearly younger in all classes for households who sell skilled labor than for those who do not. And the average level of education of adults is higher for all skilled labor-selling households. Skilled workers thus appear to be additional adults within each households and younger adults. Education plays a further role: employers have a higher level of education than self-sufficient and seller households. Education thus appear to be related to both the sale of skilled labor and the employment of others.

The reason to sell or hire unskilled labor is clearly established by the productive assets position of the households relative to the number of unskilled workers. Sellers have smaller farm sizes, less irrigated land, and less animals of all types than self-sufficient households. Employers have more land and perennial crops, with irrigation the key differentiating factor. They do not have more animals as livestock is a labor extensive activity that does not create significant employment.

Among social assets, greater access to (constrained) credit is a distinguishing feature of employers. In addition, those who sell skilled labor also have more access to credit among both sellers and employers, suggesting the key role of education in accessing credit.

Different regions offer different opportunities to join organizations (an endogenous choice). The opportunity to join an organization is represented by the regional density of farmers participating to organizations. The data shows that households who sell labor are in regions with less organizations while those who employ are in regions with more credit organizations. Labor market conditions are also quite varied across regions. Those who hire out unskilled labor do so more when the local (municipio and state) markets are more active. By contrast, those who hire out skilled labor do so more in DDR where there is more participation to the national or international labor market. Among those who employ, there is more hiring when there is more participation to the local and international labor market. This suggests that hiring-in is in part to replace migrants. High skills are exported and replaced by local unskilled workers. The self-sufficient are located in areas where there is a less active local labor market and less participation to international migration. It is thus interesting that the more intense the labor market, the more both sale and purchase of labor.

Among indicators of performance, use of capital equipment such as tractors and trucks is more prevalent among those who hire labor and also among those self-sufficient and sellers who have skilled labor. The role of participating to the labor market as a source of liquidity that can compensate for lack of access to credit is revealed by observing household behavior within the self-sufficient class. Those with skills have less access to credit, but more use of capital equipment, suggesting that liquidity derived from skilled labor wage earnings substitutes for credit.

Labor intensity shows no significant differences among household classes, suggesting the need to control for the influence of other variables as we will do in what follows. Participation to the product market as seller

of a marketed surplus is also a very important determinant of falling into the employer category. This may reflect larger farm size and a higher share of irrigated land in a trivial manner, or it may reveal more subtle differences for which we need to control for the relative influence of determinants of labor regimes. Those who hire labor out have much less participation to the product market.

V. A Predictive Typology

We now turn to a multinomial logit model to predict belonging to the three labor regimes: sellers of unskilled labor, self-sufficient, and employers (Table 2). We should recall that the model in Section III predicted that educated labor which commands an opportunity cost above the cost of hired labor should be hired out, and eventually replaced by unskilled hired labor. It also predicted household appurtenance to labor regimes on the basis of assets per unit of unskilled household labor. In the multinomial logit analysis, average adult education and productive assets per unit of unskilled labor should thus be predictors of labor regime.

With these three labor regimes, the sale of skilled labor is present in all three regimes. However, education should influence differentially the probability of pertaining to a regime. For the sellers of unskilled labor, education would increase the sale of skilled labor, and decrease the sale of low skill labor for a given family size. Hence, the average level of adult education would tend to reduce the likelihood of being a seller of unskilled labor. By contrast, higher education among employers would increase the sale of skilled labor and increase the employment of substitute unskilled labor. Hence, education should increase the probability of belonging to the employer class.

In Table 2, the self-sufficient group is again the reference group. We can see that there are well recognizable exogenous household characteristics which allow to predict labor regime. However, the predictive power of the logit for the seller group is zero, in spite of several significant explanatory variables (Table 3). This is because the criterion used in logit maximizes predictive ability for the whole sample, thus discriminating against the predictive power of small groups. In this case, the seller group is only 5% of the total number of observations. It is not surprising that this group is poorly represented in the overall estimation. For the other two groups, the logit predicts correctly 70.7% of the self-sufficient households and 65.6% of the employers.

The results show that average adult education lowers the probability of being a seller household and has a non-significant effect on the employer category. Productive assets per unskilled labor lower the probability of hiring out, particularly farm size and cattle ownership, while they raise the probability of being an employer, particularly farm size and the share of land which is irrigated. The other variables are shifters which enrich the concept of assets used in the model beyond education and productive assets per unskilled labor. Tractor and truck are used as indicators of technological regimes, and they increase the likelihood of being an employer. Access to credit, an exogenous variable under a severely credit constrained regime, is also a strong determinant of being an employer. Those with larger marketed surpluses sold on the market are also more likely to be employers. This is after controlling for farm size and irrigation. Since credit is constrained, it should indicate greater insertion in the money economy, and hence greater ability to generate the liquidity needed to hire workers. It also may signal households who are more effective in reducing transactions costs in accessing product markets.

Regional availability of organizations is only significant for access to equipment and it increases the probability of being an employer for those located in a DDR with higher density of such organizations. Local labor market conditions increase the likelihood of selling labor (while decreasing that of hiring which is not

correct). Greater regional opportunities for migration to national and international labor markets, using a social network concept where the density of regional migration increases the expected net benefits from migration, also induces more selling of labor.

Policy implications are interesting. Say that the objective of policy is to break away from self-sufficiency which is associated with poverty and high exposure to natural shocks. The two roads are sale of wage labor and becoming a successful small scale entrepreneur who can start to hire labor. For the first road, the key policy instruments are (1) education that will increase the sale of skilled labor and reduce that of unskilled, and (2) a more developed local labor market and better established migratory networks. For the second road, the key instrument is to capitalize households, particularly in irrigation, animals, and capital equipment. Access to credit and availability of local organizations for access to equipment are also important. This stresses the importance of institutional development, and this in a context where government support has been withdrawn from credit and technology as a consequence of privatizations and descaling of government budgets. Reconstructing new institutions able to deliver these services to households of the social sector is thus fundamental.

VI. Performance Indicators by Labor Regimes

If the household model with differential labor skills and with price bands in accessing the labor market is correct, the reduced form of the model predicts that labor intensity $(f_i^1 + h)/A$ should be unrelated to assets per unit of adult labor in the seller and employer categories, and falling in the self-employed category. As was shown in proposition 5, this is because the first two categories have exogenous labor costs equal to w_o^1 and w_h, respectively, while the shadow wage w_{sh}^1 of family labor rises with assets per adult worker. In Table 4, we test this proposition by giving the results of a regression analysis of labor intensity within each labor regime.

We see that the proposition holds clearly true for the self-sufficient group: for them, labor intensity falls sharply as land area per unskilled adult rises. Labor intensity is decreased by use of labor saving technology (tractors), increased by irrigation, and increased by greater participation to the product market (greater liquidity and lower transactions costs).

For the employers, we find that there is a large fringe of small employers, with a share of hired labor in total labor less than half, where the relation between labor intensity and assets per worker continues to decline. This suggests that the effective wage continues to rise, even though the wage of hired workers should be the (constant) opportunity wage. In the tradition of moral hazards and supervision costs, this indicates that there are rising supervision costs that need to be incurred, but that there are economies of scale in supervising, with the result that wages ultimately stabilize and the relation between labor intensity and farm size per adult becomes insignificant. This is what is observed in the group of 73 large employers.

We test this proposition by introducing a supervision variable in the labor intensity equation for employers. Since all employers are relatively small, supervision is insured by family members who work along with hired workers. The supervision variable is thus the share of family workers in total farm labor, $f_i^1/(f_i^1 + h)$ (Frisvold, 1994). Since this variable is endogenous, we instrumentalize it with the set of assets that characterize the household. The results in Table 5 show that supervision does indeed matter and that it increases labor intensity with an elasticity of 0.78. Farm size per unskilled adult remains significant, but with an elasticity of -0.46 which is smaller than the elasticity without supervision.

For small sellers, the model is not confirmed, suggesting that some other labor story is required to explain observed facts. In that category, labor intensity falls with farm size per adult, even though the off-farm wage obtained by family members who hire out should be the constant opportunity cost of family labor. This suggests that not all family labor is perfect substitute. For instance, it may be that, once men with a well established opportunity cost on the labor market have been fully hired out, the rest of the family is semi-captive labor, with low opportunity cost. In this case, shadow wages would behave as they do in the category of self-employed. Indeed, this would explain why we find the same inverse relation between labor intensity and assets per adult in the seller category as we do in the self-employed category.

The main policy implication of the observed inverse relationship between labor intensity (or equivalently yields) and assets per adult is to stress the relative efficiency of the family farm as a labor regime. This superiority of the family farm originates in its low effective labor costs. The social sector reforms initiated in 1991 in principle free this family farm sector from government controls and should allow it to reach higher levels of technical and allocative efficiency. However, in the overall context of reforms--that occurred mainly after the 1990 survey on the basis of which this relationship has been estimated--, this family farm sector is now exposed to rapid elimination. This is because the reforms have dismantled the web of institutions through which this sector had access to credit, markets, modern inputs, technology, and information. Privatization of these services means that delivery by private agents is now principally reaching the larger commercial farms, mainly in the private sector, bypassing family farms in the social sector. To take advantage of the labor superiority of the family farm sector which emerges from the social sector reforms, a new set of institutions needs to be developed that can cater to this sector and increase its competitiveness. These institutions need to emerge from civil society, with selective assistance from the state within its reduced fiscal means. These agrarian institutions have been the object of analysis of the new institutional economics (Bardhan, 1989; Hoff, Braverman, and Stiglitz, 1993) as well as of international development agencies (Anderson and de Haan, 1992). They include service cooperatives, group lending and credit unions, decentralized water users associations, privatized or mixed public/private extension services, grassroots organizations, etc. Like in many societies in Africa and Eastern Europe which emerge from decades of strong government control, these institutions are still largely missing in Mexico. Non-governmental organizations (NGOs) have a fundamental role to play in assisting this institutional reconstruction and in targeting it on the needs of poorer households. Freeing the land market without putting into place these supportive institutions creates the risk of rapid elimination of the family farm sector, at a high social cost. In our predictive typology of Mexican social sector farmers, predictions may well be that the family farm sector will rapidly disappear unless it receives urgent attention to consolidate is physical, human, and social capital.

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Table 2. Results of the multinomial logit model

	Hire out (sellers) n=59		Hire in (employers) n=403	
	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	-1.27	-2.0	-1.86	-6.6
Household characteristics				
Average adult education	-0.11	-1.7	0.03	1.0
Productive assets per unskilled labor				
Farm size	-0.54	-3.5	0.07	3.3
Share of irrigated land	-0.81	-1.4	1.07	5.6
Cattle	-0.34	-2.3	0.03	1.8
Technology				
Use of a tractor	-0.10	-0.4	0.76	5.0
Use of a truck	-0.07	-0.2	1.00	5.4
Access to credit				
Credit use	-0.37	-1.1	0.41	2.9
Sellers on product market	0.08	0.3	0.35	2.2
Local availability of organizations				
For access to credit	-1.87	1.7	-0.68	-1.7
For access to equipment	1.20	0.6	1.77	2.8
Labor market conditions				
In the municipio	5.70	2.0	-3.75	3.1
In the state	-11.50	-1.2	12.78	2.9
Out of state or abroad	8.55	2.5	1.31	0.7

Table 3. Predicted versus observed typology of labor strategy

	Predicted				
Observed	Sellers	Self-sufficient	Employers	Total	Percent correct
Sellers	0	54	5	59	0
%				4.9	
Self-sufficient	0	648	94	742	87.3
%				61.6	
Employers	0	214	189	403	46.9
				33.5	
Total	0	916	288	1204	
%	0	76.1	23.9	100	
Percent correct		70.7	65.6		69.5

Table 4. Estimation of labor intensity by labor regime

	Sellers n=59		Self-sufficient n=742		Employers Small* n=330		Large n=73	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	3.87	49.8	4.42	129.9	4.78	68.1	3.43	13.5
log (farm size/unskilled adult)	-0.71	-8.0	-0.68	-25.8	-0.59	-16.8	-0.10	-0.9
Productive Characteristics								
Sellers on product market			0.18	4.3				
Use of tractor			-0.11	-2.5	-0.22	-4.4	-0.37	-1.9
Share of irrigated land			0.22	3.4	0.11	1.8	-0.75	3.7
Cattle per unskilled adult	0.17	2.3	0.01	1.6	-0.01	-1.7		
Goodness of fit								
Adjusted R-square	0.52		0.51		0.49		0.27	

* small employers are defined by a share of hired labor to total labor lower than 0.5

Table 5. Labor intensity with supervision costs

	Employers n=403	
	Coefficient	t-ratio
Intercept	3.76	10.9
log (farm size/unskilled adult)	-0.46	-8.5
Supervision		
log(estimated share of family labor)	0.78	2.4
Productive Characteristics		
Use of tractor	-0.19	-3.0
Share of irrigated land	0.24	3.3
Goodness of fit		
Adjusted R-square	0.34	