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How Valuable is On-Farm Work to Farmers ?

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Résumé: Dans ce papier, nous estimons un modèle de ménages ruraux où les exploitants agricoles possèdent un goût spécifique à travailler sur l'exploitation. On montre d'abord que ce modèle est observationellement équivalent au modèle général de Lopez. Dans la partie empirique, on utilise deux enquêtes qui sont appariées par les caractéristiques suivant la méthode proposée par Arellano and Meghir. On réplique alors, sur ces données françaises provenant de l'enquête Actifs Financiers et l'enquête Emploi 1992, les résultats de l'article d'Elhorst obtenus en utilisant des données néerlandaises. Cet auteur présente des indices empiriques montrant que les salaires implicites sur l'exploitation des membres de la famille sont inférieurs à leurs salaires de marché. On présente enfin des estimations d'une borne inférieure au goût spécifique de travailler sur l'exploitation pour les femmes et les hommes, estimations qui sont positives et significativement différentes de zéro.

Mots-clés: Offre de travail, allocation du temps, marchés du travail agricole, ménages ruraux
Classification JEL : D190, J220, J430, Q120

Abstract: In this paper, we estimate a rural household model that allows specific tastes for working on-farm and can fit the data as well as the general model of Lopez. We use two samples that are matched by individual characteristics and we adopt the method for matched surveys proposed by Arellano and Meghir. We replicate using French data, the empirical finding of Elhorst who reports evidence that implicit wages of on-farm family labor are significantly below off-farm wages. We then provide estimates of the lower bounds for preferences for on-farm work for males and females which are significant and positive.

Keywords: Labor supply, Time allocation, Agricultural labor markets, Farm households
JEL Classification: D190, J220, J430, Q120

Introduction

There seems to be a consensus that in the United States income differences between farmers and the rest of the population, the so called "farm problem" has gradually disappeared over the last forty years (Gardner) even when considering wage-workers in the agricultural sector (at least the youngest group, see Gisser and Davila). In contrast to the US there is empirical evidence that it might not have been the case in Europe. First, few farmers also work off-farm in Europe. In 1993, only 10% of French farmers work off-farm and in 1997 the figure is hardly larger (12%, Delame) whereas it is around one-half in the US (Hallberg, Findeis and Lass). Second, Elhorst rejects the similarity of wage distributions across sectors when using micro-data on dairy farms in the Netherlands. Namely, when preferences for on-farm and off-farm work are the same, the marginal productivity of labor supplied by individuals working on-farm only should be greater or equal to off-farm wages. In contrast, Elhorst reports empirical evidence that implicit on-farm wages are significantly below off-farm wages. Third, Western Europe lagged behing the US in terms of the dramatic decrease in the farm population in the last 40 years which is still underway. 3.9% of the active population in France were farmers in 1990 at about the time of our empirical analysis and the rate kept on decreasing to 2.4% in 1999 (Census of the Population).

Whether or not there are still large differences of incomes or of hourly wages between agricultural and other occupations partly command the evaluation of agricultural policies. It is particularly the case when those policies aim at correcting welfare inequalities between sectors and/or slow down migrations out of rural areas as the European Union now routinely justifies its economic policies towards agriculture. Evaluations of these economic policies depend on a careful estimation of parameters that summarize the allocation of labor between the agricultural sector and the rest of the economy.

In this paper, we use French micro-data and we report empirical evidence which is similar to Elhorst. It first confirms that labor allocation in Europe followed a different path than in the US. We nevertheless show that we can reconcile data with a labor supply model if farmers have some "specific taste for working on-farm". We propose to estimate a lower bound for this parameter which could be used in models for policy evaluation.

We borrow two different buiding blocks from the literature. There is first a sizeable number of papers dealing with the arbitrage between on-farm and off-farm labor supply in developed countries that start with Polzin and MacDonald. These authors establish the neo-classical labor supply model that we are going to use in this paper. They demonstrate that at the aggregate level of US states, off-farm work strongly reacts to economic incentives such as relative on-farm and off-farm incomes or manufacturing employment in the state as predicted by theory. This branch of the literature continues with the seminal work of Hufman on education and a certain number of PhD thesis in the 1970s quoted in Sumner where the different arguments are summarized. Adding to the argument of Polzin and MacDonald about income maximisation in a certain environment, Sumner emphasizes the role of risk diversification in the decision of farmers to provide off-farm hours. If shocks in the farm and non-farm sectors are weakly correlated, insurance motives make farmers more likely to work off-farm. Liquidity constraints might add up to the previous argument if farmers are short of liquidity. In a different vein, the acquisition of experience and skills transforms the static trade-off between off-farm and on-farm work of the previous arguments into a dynamic trade-off. Finally, social determinants such as tastes for working on-farm derived from family tradition are alluded to (see also Hearn, McNamara and Gunter).

This branch is summarized at the beginning of the 90s by papers in the book by Hallberg, Findeis and Lass. Afterwards, the authors turn out to be more interested in the determination of off-farm hours, off-farm wages or migrations. They assess the impact of local conditions (Tokle and Hufman, Hearn, McNamara and Gunter for instance) or changing market wages on off-farm labor supply because of policy interventions or natural evolution (Howard and Swidinsky). They also study the simultaneity of labor supply decisions of spouses (Kimhi and Lee and references therein) or the migration between rural and urban counties (Mills and Hazarika).

In this recent literature, authors do not directly compare prices of labor of farmers' household members in different occupations (although see Sumner). This is where another line of research comes in and consists in the rural household model developped by Nakajima and by Singh, Squire and Strauss. In this literature, mainly data from less developed countries have been used (de Janvry, Fafschamps and Sadoulet, D. Benjamin, Jacoby) and it is not so popular in developed countries (although see C. Benjamin). In

this literature, authors are mainly interested in testing whether separation between production and consumption decisions of farmers hold. A necessary and sufficient condition for separation in the rural household model is that implicit prices of labor should be the same in all activities (Lambert and Magnac). Lopez using Canadian data and Elhorst using Dutch data reject this prediction. To reconcile these empirical findings with the model of rural households, one can use the richer framework of Lopez where tastes are allowed to differ between on-farm and off-farm work.

In this paper, we propose an intermediate model between Singh, Squire and Strauss and Lopez. In our model, preferences for on-farm and off-farm work can differ between two households but the difference is treated as a idiosyncratic parameter for a specific household. This parameter is called "specific taste for on-farm work" which can be acquired or can describe family tradition. We show that our model and the general model of Lopez cannot be distinguished using cross-section data and that the former model is easier to estimate. The intuition is that the discrepancy between implicit and market wages can be used to estimate this specific taste for on-farm hours.

The empirical analysis is original because of the data and because two different surveys are used. No survey in France contains good quality data on agricultural incomes and wages as well as on the number of hours worked. This is why we use on the one hand a survey where agricultural incomes are of good quality but no information is provided on hours worked, and on the other hand, another survey where information on hours worked is available but not on incomes. By using common covariates in both surveys, we can use a matching procedure which is akin to two-stage least squares. The estimation method follows Arellano and Meghir.

Using representative samples of French agricultural households, we obtain the same empirical finding that Elhorst. Implicit on-farm wages are below off-farm wages for both spouses in farm households. Holding fixed monetary rewards, on-farm hours of work are therefore given more value by farmers than off-farm hours of work. It is estimated that an hour of on-farm work brings at least the same utility than about an half of an hour of leisure for females, that tastes for farming are larger for males and that tastes are heterogeneous according to education and age.

The plan of the paper is as follows. We first set up the theoretical model and then give a brief description of the data and of the estimation methods. Results are then

reported and policy implications are discussed.

A Simple Theoretical Set-up

When tastes for working on- and off-farm are the same, the popular framework of rural household models as developed in Singh, Squire and Strauss, posits that household preferences are given as a function of aggregate consumption, C, and leisure, L, only. When tastes are different, preferences also depend on a taste parameter describing work conditions, say t, and the utility function is written as $U(C, L; t)$. The taste parameter depends on the amounts of on-farm hours, $t = t(H)$. In Lopez, preferences directly depend on on-farm work, H and off-farm hours, H^{off}, and not on L. The two models are equivalent because the time constraint relates the different time-uses, $L + H + H^{off} = 1$ if full time is normalized to 1. We prefer this presentation since it highlights that preferences depend on work conditions and that there is some externality or hedonic returns of those work conditions. The model is completed by writing the budget constraint as: $C = \pi(H) + wH^{off}$ where $\pi(H)$ is the profit function which could depend on other production factors such as land that are not written here. We could accomodate the fact that households are usually composed by more than one member by making the different variables be vectors instead of scalars. We concentrate on one-member households for simplicity.

Standard algebra yields that the marginal rate of substitution between leisure and work conditions verifies the following condition:

$$\frac{\frac{\partial U}{\partial t}.t'(H)}{\frac{\partial U}{\partial L}} \geq \frac{w - w^*}{w} \tag{1}$$

where the implicit wage of on-farm work is given by the marginal productivity, $w^* = \pi'(H)$, and where the equality binds whenever off-farm hours of work are positive.[1] If preferences for on and off-farm work are the same (i.e. $t'(H) = 0$) we can check the well-known result that the implicit wage, is greater than the off-farm wage ($w^* \geq w$) where equality binds if off-farm hours of work are positive.[2]

Equation (1) would permit to recover preferences related to on-farm labor from the data if all "prices" on the right-hand side could be observed. The difficulty with identifying household preferences in this model is that the implicit wage can never be observed.

It can however be computed from the estimation of a production function of the farm as shown by Jacoby for instance. Its expected value, say $a(z)$, conditional on farm and individual characteristics z can thus be recovered from the data:

$$a(z) = E(w^* \mid z)$$

Henceforth, only the expectation of (1) conditional on z can be used to recover preferences:

$$E\left(\frac{\frac{\partial U}{\partial t}.t'(H)}{\frac{\partial U}{\partial L}} \mid z\right) \geq \frac{w - a(z)}{w} \tag{2}$$

where we assume that we can also observe the wage w (see below).

Consider now a particular specification of the utility function such as, $U(C, L+b.H)$, where b stands for an effect which is household specific and is thus assumed random. Parameter b is the fraction of an hour of leisure that yields the same utility to the household than an hour of on-farm work because this parameter is equal to the marginal rate of substitution between leisure and on-farm work:

$$\frac{\frac{\partial U}{\partial t}.t'(H)}{\frac{\partial U}{\partial L}} = b$$

Equation (2) can be written as:

$$E\left(b \mid z\right) \geq \frac{w - a(z)}{w} \tag{3}$$

This latter equation is observationally equivalent to equation (2) because expectations are the only object that we can recover from the data. In other words, the original equation (1) adds nothing in terms of information to (3). Therefore, the specification $U(C, L + bH)$ cannot be distinguished from the general form, $U(C, L, t(H))$ using cross-section data. Using panel data it could be, if the taste parameter b is assumed to be constant across time.

To summarize this stage, it is enough to consider this model with an household specific taste to rationalize the data. The interpretation of $E\left(b \mid z\right)$ is straightforward since it is the utility valuation in terms of leisure of an hour of on-farm work. It is simple to estimate from wages and estimated marginal productivities as shown below.

There are selection issues though that we tackle in the econometric section because wages are not observed for those who do not supply off-farm hours. It is also simple to impose additional restrictions (that are testable) such as the one where $E(b \mid z)$ does not depend on z, for instance. Furthermore, the previous inequality holds when considering any other statistics such as medians or quartiles instead of means.

We conclude this section by noting as suggested by one referee that these models also belong to the literature about compensating differentials (see Rosen). An alternative modeling framework would allow for an hedonic return, say $r(H)$, to working on-farm that could be added to the profit function. Parameter b would then be interpreted as $\frac{r'(H)}{w}$ which is the marginal returns in terms of units of wages and therefore of units of value of leisure. Interpretations and procedures are similar to what we develop now.

Data Description and Empirical Methods

To estimate implicit wages in agriculture we need to estimate a conditional profit function which relates agricultural profits to the quantity of labor used on-farm (Jacoby). Because of selection issues, we also need to estimate off-farm wages for those who do not work off-farm. As already said, agricultural incomes are reported in one survey and the number of hours in another survey where off-farm wages are also available. As some variables are common to both surveys, we can match surveys by these variables (Arellano and Meghir). In this section, we first briefly describe the two surveys, then turn to the estimation method of the conditional profit function where the method of matching is explained. We end this section by showing how marginal productivities are computed and how off-farm wages are estimated.

A Brief Description of the Data

The data that we use come from two surveys undertaken by the French national statistical office (INSEE) in 1992. The aim of the first survey is to record household financial and other assets, the other survey is relative to labor force issues. The raw sample of the first survey (Enquête sur les Actifs Financiers) consists in 9530 households. It has several interesting characteristics. In contrast with similar surveys in 1986 and 1997, agricultural households were oversampled (25% of the sample). It therefore leads to a reasonable precision of our estimates. Household incomes are considered to be of

good quality and are reported according to their origin. Wages, agricultural profits and transfers can thus be easily distinguished. On the other hand, the Labor Force Survey is a much larger representative survey of French households. The number of agricultural households is almost on par with the number of households in the Financial Assets Survey. Information on hours of work is the best that one can find in a French survey though incomes for self-employment and in particular farming, are not reported. The advantage of using two surveys from the national statistical office, is that many variables are common and are supposed to have common definitions.

From these surveys, we extract samples of households where two partners are present, are between 20 and 65 years old and where one of them at least reports farming as his/her main occupation. We consider that farming is the main occupation of a person when this person provides hours of on-farm work above 1000 hours per year. This is our definition of farmers' households and it raises some selection issues. Some might argue that we might also be interested in the taste for on-farm work in the whole population and not only for farmers. Proceeding that way seems difficult to us because we would need to estimate marginal productivities of labor in agriculture for everybody. It is possible in theory though in practice the sensitivity to selection issues would be overwhelming. In order to assess a taste for farming we thus prefer to select the population of farmers only. It seems likely that the decrease in the farming population is going to continue in the future and providing empirical evidence about parameters in this particular population seems to be more interesting to us. For instance, the distribution of the taste for on-farm work among farmers commands the elasticity of migration between agriculture and other sectors of the economy to the wage gap.

We also restrict our analysis to households where both members are working either on-farm or as a wage-worker. It allows us to concentrate on the trade-off between on-farm and off-farm work and to avoid treating non-participation in the labor market as a separate state. First, we showed in the theoretical analysis that we need to know or to estimate male and female wages in order to estimate preferences for on-farm work. It will be made easier by leaving out non-participants, an economic status which is rare and in this sample, often related to retirement. Second, as non-participation is notoriously a vague concept for farm households, it does not seem to be a serious cause of concern.

The size of the working samples are respectively 556 in the Financial Assets Sur-

vey and 884 for in the Labor Force Survey. The subsample of households where both members work on-farm is slightly larger in the Financial Assets Survey (69.5%) than in the Labor Force Survey (60%). It can be explain by the different focus given by the two surveys. The first survey aims at recording assets and the information on hours of work is of lower quality than in the Labour Force Survey. The selection of households where both work on-farm more than 1000 hours is thus less severe in the first survey. In the Labor Force Survey some of these persons are likely presumed to be out of the labor force. It is confirmed by the fact that 26.2% (FAS) or 34.4% (LFS) of females work off-farm. Finally, off-farm work is much less prevalent among households where female's occupation is farming (7.6%, FAS, or 12.7%, LFS). Descriptive statistics of the explanatory variables are reported in table 1. Averages are quite similar in the two samples. Many usual demographic variables are recorded: age, education, demographic composition of the family, occupation of the parents as well as local characteristics. Average age is quite large. It translates that, even if the sample is truncated at 65 years old the "normal" retirement age for farmers, the farming population has dramatically decreased over the past 40 years. Around the two main members, some young children (under 18 years old) are present though fewer than young adults and elderly persons. Besides farming, wage-work is the main occupation before the other self-employed activities. Off-farm wages are similar in the two surveys. Only a few farm characteristics are reported. The only common variable is acreage and averages are almost equal in the two surveys at around 20 hectares. Furthermore, hired labor is scarce while unpaid family labor is quite common. Average farm incomes conform with what we know from other sources.

The Conditional Profit Function

We first specify the conditional agricultural profit function for all households. Household agricultural income, R_a, is supposed to be given by:

$$R_a = \pi(T, H_m, H_f, P_m, P_f; Z)$$

where π is the profit function, T is land acreage, H_m , H_f, on-farm male and female hours of work. Variables P_m and P_f are two dummy variables describing whether spouses effectively report farming as their main occupation ($P_i = 1$) or not ($P_i = 0$).[3] Variables

Z might be prices, farm characteristics and household characteristics. Apart from land and labor, the profit function implicitly depends on other quasi-fixed inputs or prices of other variable inputs and on product prices. Records of other inputs or their prices are missing in the surveys and we summarize prices and quasi-fixed inputs by regional dummies and by dummies describing the type of output of the farm, dummies that are included among characteristics Z. Other household characteristics in Z mainly include education which is assumed to be an augmenting productivity factor in the production function (Hufmann and papers quoted within).

Our most serious worry concerns the bad quality of the reports on on-farm hours of work, H_m and H_f in the Financial Assets survey. Individuals report in a credible way whether they are working on-farm or not (P_m and P_f) while information on hours seems to be unreliable to us. It is why we use the other source of information, the Labor Force Survey, to derive predictions of male and female on-farm hours of work as a function of variables describing individual and farm characteristics that are observed in the two surveys (Arellano and Meghir).

One principle dictates the specification that we use. Only known functions of labor quantities can be estimated using the Labor Force Survey. It restrains the specification of the conditional profit function though we test more elaborate specifications. We will assume that the production function is a modified version of Cobb Douglas:

$$\log R_a = \alpha \log T + \alpha_m P_m . \log H_m + \alpha_f P_f \log H_f + a_m P_m + a_f P_f + Z\gamma + \varepsilon \qquad (4)$$

where parameters α, a and γ are to be estimated and where ε is an unobserved heterogeneity component. Generalisations of this functional form can be obtained by making α or a depend on $\log T$ and Z and by including interactions between land, male and female hours of work. In this specification, hour variables $\log H_m$ and $\log H_f$ are defined when hours are positive only and it is why they are premultiplied by the indicators of on-farm work, P_m and P_f. These latter variables also enter in this equation in order to take into account any non-linearity between participation and non-participation regimes and any measurement errors in the reports of the participation status. Some spouses could provide a marginal number of on-farm hours without reporting it or because on-farm activity is their second activity only.

All variables in (4) are observed in the Financial Asset Survey except $P_f \log H_f$ and

$P_m \log H_m$. In the Labor Force Survey these quantities are observed. Provided that information on common variables is reported in both surveys, instrumental auxiliary regressions, using the Labor Force Survey, are supposed to be given by:

$$j = m, f;\ P_j \log H_j = X_j \beta_j + \eta_j \tag{5}$$

Not only those variables X_j should be reported in the two surveys but also some X_js should be excluded from equation (4) in order to be able to identify α_m and α_f. This condition describes the usual identifying restrictions in simultaneous equation models. In the emprical application, we suppose that labor incomes of other members in the household, income transfers that are not means tested, the number of children by age groups and dummy variables describing whether fathers of both spouses were farmers or not are excluded from equation (4). It seems reasonable since (4) is supposed to describe the production function and technological relationships do not depend on demographics. We also used other instruments and we tested for the validity of instruments and for over-identifying restrictions (Bowden and Turkington, 1987). We thus assume orthogonality of regressors and errors:

$$E(Z'\varepsilon) = E(X_j'\eta) = 0$$

without assuming that participation dummies (P_m and P_f) are exogenous. As will be shown, empirical evidence is that they are not.

To conclude, we proceed in the following order. First, we estimate hours of work equations in the Labor Force Survey and predict hours of work in the other survey. We then estimate the profit equation using these predictors as well as other explanatory variables including participation dummies. We run OLS and 2SLS regressions to control for the endogeneity of the latter dummies using household level variables as identifying instruments.

Implicit and Off-Farm Wages

Implicit wages are equal to marginal productivities derived from (4). The marginal productivity of household members who work on-farm ($P_i = 1$, $i = m, f$) is given by:

$$w_i^* = \frac{\partial R_a}{\partial H_i} = \frac{\alpha_i R_a}{H_i}$$

in the case of a Cobb-Douglas production function. Equivalently:

$$\log w_i^* = \log \alpha_i + \log R_a - \log H_i$$

These quantities can be predicted in one or the other survey but it is always with a margin of error since $\log R_a$ is not observed in the Labor Force Survey and $\log H_i$ is not observed in the survey on Financial Assets. Our aim is to evaluate differences between implicit and off-farm wages. As off-farm wages can be constructed in the Labor Force Survey only because hours are missing in the other survey, we compute predictors of (log) implicit wages using the sample derived from the Labor Force Survey. One should then predict variable $\log R_a$ by its expression given by (4). To deal with unobserved heterogeneity, we use simulated errors drawn in the normal distribution for any observation in the sample. The variance of errors is the estimated variance of the logarithm of income equation (4). We add those errors to the deterministic prediction. Under the maintained assumption that random terms are normal, any statistics related to implicit wages can then be consistently estimated by the corresponding sample statistics of the simulated variable. In particular, we use below sample means or medians of implicit wages in levels instead of logarithms.

Predictions for off-farm wages in the Labor Force Survey sample are computed using the following technique. For each household member [4], we estimated a selection model of wages on the whole sample with two regimes (Heckman):

$$\begin{cases} P_i = 0 \text{ and } w_i = X_i^{(w)}\beta^{(w)} + \varepsilon_i^{(w)} & \text{if } X_i^{(s)}\beta^{(s)} + \varepsilon_i^{(s)} \geq 0 \\ P_i = 1 & \text{if } X_i^{(s)}\beta^{(s)} + \varepsilon_i^{(s)} < 0 \end{cases}$$

The second regime comprises individuals who report farming as their main occupation, the first regime comprising individuals reporting wage-work as their main occupation and for whom off-farm wages are observed. Random terms $\varepsilon_i^{(w)}$ and $\varepsilon_i^{(s)}$ are assumed to be normal. We include human capital variables (education and age as a proxy for experience) in the wage equation. Robust identification relies on variables in the selection equation which are excluded from the wage equation. Household variables such as the number of children or farm characteristics are used as such instruments. Using these estimates, we can predict off-farm wages for anybody in the sample. As in the construction of implicit wages, we deal with unobserved heterogeneity by adding up simulated errors to this prediction. For any observation in the sample, simulated

errors are drawn from a normal distribution. The variance of errors is set equal to the estimated variance of the random term, $\varepsilon_i^{(w)}$, in the wage equation.[5]

Given these predictions, one can compute the expectation (or median or any other quantile) of the ratio of implicit and off-farm wages taken conditionally or not on individual characteristics z:

$$b_0(z) = 1 - E(\frac{w^*}{w} \mid z), \tag{6}$$

which is a lower bound of $b(z)$, the specific taste for farming (see equation (1)).

Results

We first report primary results about profit and off-farm wages. We then turn to the estimates of the taste parameter for on-farm work for males and females.

Profit and Wages

To recover the conditional profit function, two estimation steps are necessary. We first estimate equation (5) using the Labor Force Survey. Both regressions for husbands and wives are well determined especially for husbands. If we group variables into four categories, husband's individual characteristics, wife's characteristics, household variables and farm variables, all groups have significant power to explain hours of work. Table 2 reports these results only since it proves the point that instruments are strong enough. We nevertheless comment now the complete results which are available upon request. The main determinants in the regressions are the occupations of the fathers of husbands and wives as well as land acreage. Interestingly though, their effects are opposite for males and females. When the father of the husband is/was a farmer, it positively affects male on-farm hours and negatively female on-farm hours. It is just the opposite when the father of the wife is/was a farmer since the female is likely to work more on-farm hours (and the husband less). Land acreage also affects male on-farm hours positively but female hours negatively. It might indicate that negative assortative mating could be pervasive among farmers' families. For females, other variables are significant. On-farm hours decrease with education and increase with the number of adults and children between 6 and 18 years old. Local conditions such as the local unemployment rate or the share of the rural population locally are never significant.

We then predicted on-farm hours of work for both spouses in the FA Survey and we use them as explanatory variables in the estimation of the conditional profit function (4). Results are reported in table 3. The first column presents results of an OLS procedure using a parsimonious structure. Column 2 reports results obtained by 2SLS where instruments comprise all individual, household and farm characteristics except the two variables related to the occupations of spouses (farming or not, P_m and P_f). In the last column, we report results using a less parsimonious structure which we explain and comment below. There is a slight difference between results given in columns 1 and 2 especially with respect to the coefficient of (log) hours worked by the wife that indicates, as expected, that her effective work on the farm is an endogenous decision. If we first concentrate on results of the more parsimonious structure reported in column 2, they are as expected. Marginal labor productivities of spouses and marginal productivities of land are positive although the coefficient on land is very small though significant (see below). Constant returns to scale with respect to the three factors of production that we consider here (land, male and female hours) cannot be rejected mainly because standard errors are large. Imprecision in these estimates even leaves room for other quasi-fixed factors of production such as capital without necessarily putting into question the constant returns hypothesis. It is interesting to note that the higher husband's education is, the higher is the profit function. We interpret this effect as a Hicks neutral upward shift in the production function due to managerial abilities for instance. Wife's education was not significant but it may be due to the strong correlation between spouses' education levels. Interactions of education levels with (log) hours worked were never significant.

Agricultural incomes are significantly lower in the southern and central regions. Results concerning the type of main output are less significant. It is partly due to the fact that this variable is missing for 30% of the sample and it is why we consider the missing category as the reference. Estimates indicate that Cattle and sheep and Mixed breeding are less profitable than Poultry and other intensive farming practices. A strong correlation between land and these dummy variables could partly explain why the coefficient on land is so small. This interpretation is confirmed by results reported in the last column where land is interacted with hours worked by the wife and the dummy variables describing main farm outputs. For the reference alternative and at the mean point of the sample for wife's hours of work, the coefficient on land is now equal to 0.49.

The specification in terms of land and these variables seem to be perfectible but such a goal is difficult to achieve using this sample. These variables indeed, partly pick up the effects of other inputs such as capital and prices that are unobserved. The main conclusion is that the coefficients of the main variables of interest, hours of work, are stable with respect to differences in specification reported here and many others that we tried. We interacted male hours with land and male and female hours in order to test the Cobb-Douglas specification. None of these interactions entered one by one came out significantly.[6]

Table 4 reports results concerning the estimation of male and female off-farm wages correcting for selection biases. As the number of males working off-farm is small, the male wage equation is not precisely estimated. Covariates have the expected sign though the only significant variable is the local unemployment rate which negatively affects wages. Selection effects are absent since the coefficient of correlation between the wage and selection equations is not significantly different from zero. We ran again this regression without selection and results are very much the same. It is the equation without selection that we will use below since it is more robust to departures from the normality assumptions. For females, the precision is much better. The education and age coefficients are very precisely estimated and conform with the standard predictions of human capital theory. Wages increase with education and age though they are hardly affected by local conditions. Selection effects are negative which agrees with the theoretical model only if on-farm participation and off-farm wages are strongly and positively correlated.

Preferences for On-Farm Work

Implicit and market wages are predicted using the estimations reported above. Two words of caution are in order. First, the information on whether someone is working at the same time on-farm and off-farm is unreliable. We are therefore in the case where we are able to estimate a lower bound only for preferences for on-farm work as described by equation (3) because we do not know if households are at a corner solution.

Second, we believe that implicit wages can be computed with a reasonable degree of accuracy only in the sample of individuals who report themselves as farmers and work more than 1000 hours a year ($P_i = 1$). Namely, we cannot credibly estimate marginal productivities either for non-participants ($P_i = 0$) because of the use of logarithms

in specification (4) or even for participants working very few hours of on-farm work because our sample construction was such that "participants" work more than 1000 hours a year. For males, the number of on-farm hours worked per year is concentrated between 2000 and 4000 with a mode equal to 3000. For females, the number of on-farm hours worked per year lie between 1200 and 2800 with a mode at 2200. We thus chose to compare wages on the smaller sample of males and females both working on-farm. As we imputed simulated normal errors to both implicit and off-farm wages as explained above, selection effects are implicitly taken care of. We test below for the sensitivity of the results to specification issues.

First, a graphical representation of our results reporting implicit (log) wages as functions of off-farm (log) wages are given in figures 1 and 2 respectively for husbands and wives in the sample of households where both work on-farm. The straight solid line with circles is the hypothetical line when on-farm and off-farm (log) wages are equal. The other curve is the locus of medians of implicit (log) wages conditional on the off-farm wage on the x-axis using a smooth spline graphical representation. If there were no positive preference term $b(z)$ for on-farm work, this curve should lie above the straight solid line because it is computed using the sample of individuals who effectively provide on-farm work. If $b = 0$ indeed equation (1) predicts that $w^* > w$. As the medians of impicit wages lie below the 45° line for any value of off-farm wages, the hypothesis that $b(z) = 0$ seems far from true for both spouses. We turn now to empirical evidence about the magnitude and significance of such an effect.

Table 5 reports the results of estimating equation (6). Estimates and standard errors of these estimates were obtained by bootstrapping the whole procedure on the two samples.[7] It might be possible to follow usual practice and compute the asymptotic standard errors of the predictions of implicit wages on the one hand and of off-farm wages on the other hand. Computing the covariance between these predictions is however untractable and bootstrapping offers a comfortable and secure alternative to the analyst. If different observations are independent as assumed here, standard results show that bootstrapped average and standard errors of coefficients are consistent (Horowitz). We also report the mean of the bootstrapped distribution for the median replacing equation (6) by:

$$b_M(z) = Median(1 - \frac{w^*}{w} \mid z), \tag{7}$$

because the estimation of means is very sensitive to outliers. The estimates of means are very large or very small and standard errors are huge. The reason for the presence of these outliers is that the estimation of a wage equation under selection is very sensitive to the size of the sample. In some bootstrapped samples, the number of males working off-farm becomes very small and it causes an outlier in the distribution of the bootstrapped mean $b(z)$. The median is a much more robust statistic. We used 200 replications when the value of the median stops being affected by increasing the size of the sample. The minimum and maximum of the empirical distribution are within sensible ranges and the empirical distribution is well behaved.

Assuming first that tastes for farming are homogenous ($b_M(z) = b_M$), the expected value of preferences for farming (valued as a proportion of an hour of leisure) are estimated as $b_M = .80$ for males and $b_M = .52$ for females (see table 5) in the sample of households where both work on-farm. Specific tastes for on-farm work are significant at the 5% level for males and females though more for males. It is also interesting to compute these estimates according to different individual characteristics such as education and age (other columns of Table 5). For males, education and age do not seem to make much difference at least a significant difference. For females, the taste for farming is smaller for more educated and younger women and for them it is not different from zero at a 5% confidence level. It conforms with figure 2 where we have seen that the difference between implicit and market wages disappear for large market wages. In general, results show that the average value of an hour of on-farm work varies between 10% (young or more educated women) and 85% (young or more educated males) of the value of an hour of leisure.

In the other lines of table 5, we report some experiments that we performed to assess the robustness of the results. In line 2, we simply estimate market wages in logarithms instead of levels to conform with the standards when estimating wage equations. Given the sensitivity of simulations to distributional assumptions (normality), this procedure provides a useful benchmark against which the validity of those assumptions can be assessed. For all samples, estimation is barely affected. The importance of selection issues is tested by another experiment reported in line 3. We changed the sample that we used to estimate the farm production function in the first place. We now only consider households where both work on-farm. We run a regression as above and compute directly the

implicit wages of husbands and wives. For predicting market wages however, we still use the complete sample and estimate the market wage equation in levels. As shown, results are not different for males but slightly higher for females without being significantly different from what we reported above. The major difference is that standard errors increase in response to the smaller sample that we use. Selection issues do not seem to be severe.

Discussion and Policy Implications

These results confirm what Elhorst obtained. We interpret them as meaning that there is a significant taste for working on-farm in Europe. It provides a *rationale* for why farmers are willing to supply more hours of on-farm work than hours of off-farm work at the same level of wages. These preferences should be taken into account when modeling the allocation of labor between the agricultural sector and the rest of the economy. We provided estimates of the medians of lower bounds of these preference parameters. We also proposed a model of the allocation of labor between on-farm and off-farm work that is easier to estimate than the general model of Lopez.

There are many other interesting interpretations though distinguishing them from the current one requires additional information. One possible explanation for our results is that hours of work are measured with error because farmers systematically overreport on-farm hours. The taste for on-farm work is conceptually indistinguishable from overreporting and it is impossible using our data to correct for these measurement errors. One needs to have additional checks on the number of reported hours (by tasks for instance).

More substantive issues are related to to dynamic effects, the distinction between the short run and the long run and the partial irreversibility of farmers' decisions (Weiss). It may have happened that at the beginning of their life-cycle, implicit and market "permanent" wages for farmers were closer. Farmers made then sunk-cost investments in specific human capital though as wages drifted away the so called hold-up problem made it costly to change decisions afterwards. These irreversibilities would be translated into specific tastes for farming to justify the differing rates of return in various occupations. Were the argument true however, specific tastes for farming should be larger for older farmers because their decisions were taken a long time ago. In a sample where the average age is 50, this argument is not fully supported by our results since the age effect

for males is not significant and it goes in the reverse direction for females.

There is a sense however in which this argument could be true. On top of the "variable" taste for working on-farm which is the taste attached to work conditions and the number of hours worked, there would also exist a "fixed" taste for working on-farm which would not depend on hours and which would include the irreversibility effects mentioned above. It would act as (the opposite of) a fixed cost of participation in the labor market. Fixed costs or tastes are not modelled here as a structural determinant of being a farmer (*i.e.* the participation dummy standing for working on-farm that we used) though our analysis is consistent with such an analysis that would require further research. The hypothesis of fixed tastes has some appeal since our results could agree with the fact that variable tastes are smaller for males and larger for females while the reverse holds for fixed tastes. This gender-biased result could mean that marginal calculations are more valid as a description of the behaviour of second-earners in the household if females are more likely to be second-earners.

The previous argument also depends on the degree of development and reactivity of local labor markets. There is a consensus that mobility is much more prevalent in the US that in Europe. Global and local unemployment rates are larger in France and wages do not seem to adjust as quickly as in the US. Off-farm wages in the sense that is used here should then be discounted by search costs or opportunity costs measuring the expected waiting time for a job. Discounting decreases the estimated values of the specific tastes for farming. Even if costs are mainly incurred in the short-run, it seems doubtful though that values estimated in this paper can be explained by the magnitude of such costs.

Other departures from the framework used in this paper might be worth exploring. The data we had on off-farm hours was not reliable enough for those who declare farming as their main occupation. Were off-farm hours available, one could estimate a fully structural labor supply model. It would permit to recover the elasticity of both types of labor supply and give a point estimate of the preference parameter for on-farm hours instead of a lower bound. It would also give some indication on the fixed taste for farming we were alluding to above. We have seen however that off-farm work for farmers is not frequent and the imprecision of such estimations could be large. Another direction still is that on-farm activities are more risky than most other activities. A risk premium

should be accounted for in preferences for on-farm work. It reinforces the conclusion we arrived at in this paper since such a risk premium makes our estimates downward biased. Information on hours of work and incomes at several periods would permit to dig more deeply into the issue of modeling individual risks for farmers (Mishra and Goodwin) and the premia that should be attached to these risks.

Finally, these results can be used to evaluate how relevant are some economic policies such as income support for farmers. At the time of the surveys that we use, agricultural policies in the European Union were mainly based on direct market intervention and the use of support prices. They directly affected marginal productivities as we measured them here. After 1992 income support started to be provided through transfers coupled with land. It could be expected that marginal productivities of labor (the unsupported resource) might have increased through substitution effects. The replication of this study in France in more recent years is difficult due to the absence of two surveys such as those that are used here but it might be attempted in other European countries to check if the argument holds. Furthermore, the future (in Europe at least) seems to be made of policies inciting farmers to take up other activities than farming in order to keep them or their children in rural areas. It would then be interesting to know to what feature this specific taste is attached. Farm programs for instance might have an impact on the formation of such "tastes" or hedonic returns to farming. Tastes may also be attached to the very activity of farming as a family tradition argument would put it or to other features such as a specific social status in the countryside. The success or failure of these policies might hinge on the careful design of such incentives in order to take account (or advantage) of these specific tastes.

NOTES

1. We also assume that the marginal productivity of on-farm hours is large enough when on-farm hours are close to zero so that the household always provide positive on-farm hours and we neglect all fixed costs of participation.

2. As is standard, we assume that family labor cannot be substituted perfectly with hired labor. It explains why on-farm wages can be greater that off-farm wages (Lambert and Magnac). Second, as our purpose is to study the trade-off between on and off-farm hours, the other relationship that we can derive from the decision program, between the marginal rate of substitution between consumption and leisure and the wage is not useful.

3. As one spouse at least is engaged in farming, then necessarily $(1-P_m)(1-P_f) = 0$.

4. A more efficient procedure would to be to estimate a model of joint off-farm decisions for both spouses (Kimhi and Lee for instance). As we selected only households where one of them is working on-farm it slightly differs from the usual case. Estimating by two simple Probits as we do is still a consistent procedure and efficiency losses are usually not very large.

5. These errors are simulated independently from the errors in the implicit wages.

6. In the case where the interaction between male and female hours is used, we also predicted this interacted variable using the Labor Force Survey along the lines of what is explained above (see equation (5)).

7. One iteration is: We sample with replacement in FAS and get one bootstrapped sample and then sample in LFS and get the second sample. We then run the whole procedure to derive the one bootstrapped estimate. The empirical distribution that we use is of such estimates.

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Table 1: **Descriptive statistics**

Surveys	**Financial assets**		**Labor force**	
Number of observations	556		884	
	Mean	**Std Deviation**	**Mean**	**Std Deviation**
Family Variables				
Male age	50	11	46	10
Female age	47	11	43	10
Number of :				
Children less than 3 years old	.1	.3	.1	.3
Children less than 6 years old	.2	.6	.2	.5
Children less than 18 years old	.9	1.2	.9	1.0
Young (less than 26 years old)	1.3	1.3	.7	.9
Adult (26 to 59 years old)	2.2	1.2	2.5	.9
Elderly (60 years old or over)	.5	.8	.2	.5
Occupation Variables				
Number of family members :				
Working	2.02	.7	2.9	1.1
Farmers	1.4	.8	1.7	.6
Other self-employed	.1	.3	.7	.9
Wage workers in agriculture	.05	.2	.04	.2
Wage workers	.4	.6	.5	.6
Farm Characteristics				
Land acreage	20	57	19.6	4.90
Production value (Euro)	75281	86241	-	-
Number of :				
Full time wage workers	.2	2	-	-
Part time wage workers	.0	.4	-	-
Full time unpaid family worker	1.3	.7	-	-
Part time unpaid family worker	.2	.5	-	-
Male working hours	-		2672	1152
Female working hours	-		1450	1186
Income Variables (in Euro) *				
Family annual farm income	13900	17070	-	-
Male monthly wages	1055	859	1418	1846
Female monthly wages	949	441	874	398
Monthly earnings of other members	937	640	1201	620
Local Indicators				
Rural population rate	25.82	17.32	27.81	16.54
Unemployment rate	10.95	2.34	11.06	2.25
Share of services	8.48	2.11	8.09	2.05

Population : Farmers' households 20-65 years old. See text
Note: * Earnings are taken conditionally on wages being positive

Table 2 : Instrumental regressions of both male and female on-farm hours of work: Fisher statistics.

Variables		**(1)**	**(2)**
Characteristics of	- Male	5.91	1.51
		($<1.10^{-5}$)	(.14)
	- Female	2.18	15.23
		(.02)	($<1.10^{-5}$)
	- Farm	3.19	2.78
		(.0005)	(.002)
Family variables		1.88	3.10
		(.07)	(.003)
Local indicators		1.83	.80
		(.14)	(.49)
Number of observations		848	848
R-Square		.15	.34

Notes: The dependent variable in regression (1) for males (respectively (2) for female) is the log of on-farm hours of work when on-farm hours are positive and equal to zero in the absence of on-farm participation.
Fisher statistics for the null hypothesis that coefficients of all variables in a group are equal to zero
p-values are between parenthesis

Table 3 : Conditional profit function

Number of observations : 556

	Ordinary least squares	Instrumental variables	Instrumental variables with interactions
R-square	.12	.	.
Explanatory Variables	Parameters	Parameters	Parameters
Intercept	11.788 (.556)	11.921 (.867)	11.633 (.854)
Agricultural Working time :			
Male log hours of work	.340 (.342)	.446 (.405)	.465 (.421)
Female log hours of work	.357 (.177)	.615 (.252)	.545 (.254)
Occupation :			
Male is Farmer	-2.255 (2.700)	-4.205 (3.538)	-4.130 (3.607)
Female is farmer	-2.431 (1.321)	-4.345 (1.909)	-3.605 (1.938)
Male's education level :			
Primary or no diploma	Ref.	Ref.	Ref.
Secondary	.100 (.100)	.086 (.108)	.066 (.113)
Baccalaureate	.300 (.117)	.314 (1.28)	.287 (.134)
University level	.680 (.182)	.612 (.195)	.651 (.210)
Land acreage :			
Log of land acreage	.048 (.020)	.044 (.021)	.494 (.194)
Missing land acreage	-.040 (.244)	-.072 (.357)	.033 (.362)
District demographic indicators :			
Rural population rate			
Unemployment rate			
Service employment rate			
Interactions between land acreage and :			
Female farm hours of work			-.042 (.023)
Missing value			Ref.
Mixed farming			-.261 (.135)
Market gardening or horticulture			-.338 (.163)
Vineyard or fruit growing			-.135 (.134)
Cattle and sheep			-.203 (.120)
Poultry			-.440 (.156)
Mixed farming and breeding			-.115 (.179)
Mixed breeding			-.128 (.204)
Other output			-.288 (.145)
Main output :			
Missing value	Ref.	Ref.	Ref.
Mixed farming	-.117 (.241)	-.031 (.268)	-.080 (.280)
Market gardening or horticulture	-.284 (.295)	-.393 (.303)	-.594 (.349)
Vineyard or fruit growing	-.028 (.254)	-.065 (.260)	-.021 (.273)
Cattle and sheep	-.508 (.217)	-.527 (.224)	-.537 (.235)
Poultry	.068 (.299)	.084 (.314)	.120 (.327)
Mixed farming and breeding	-.193 (.335)	-.240 (.354)	-.244 (.369)
Mixed breeding	-.691 (.349)	-.704 (.361)	-.706 (.390)
Other output	-.689 (.288)	-.776 (.295)	-.770 (.323)
Regions :			
Northern region	Ref.	Ref.	
Western	-.336 (.164)	-.183 (.159)	-.243 (.175)
Eastern	-.304 (.185)	-.131 (.186)	-.213 (.202)
South	-.343 (.175)	-.336 (.160)	-.440 (.173)
Central	-.835 (.175)	-.580 (.170)	-.669 (.184)

Notes: Source: Financial Asset Survey

Additional instrumental variables : spouse education level, number of children, labor income of others household members, and household demographic composition (see table 2 for auxiliary regressions) ; Standard errors in parenthesis

Table 4 : Estimation of the log wage function
(Heckman selection model -- two-step estimates)

	Parameters	
	Male	**Female**
Intercept	3.68	2.59
	(1.14)	(.45)
Education level		
Primary or no diploma	Ref.	Ref.
Secondary	-.016	.35
	(.12)	(.12)
Baccalaureate	-.09	.36
	(.16)	(.13)
University level	.39	.59
	(.26)	(.14)
Age		
Age*(age<30)	.02	.03
	(.04)	(.01)
Age*(29<age<40)	.02	.03
	(.03)	(.01)
Age*(39<age<50)	.02	.03
	(.02)	(.01)
Age*(age>49)	.01	.02
	(.02)	(.01)
Local indicators :		
Rural population rate	0	0
	(.01)	($<1.10^{-3}$)
Unemployment rate	-.06	0
	(.02)	(.01)
Service activity rate	0	-.02
	(.04)	(.02)
	Log likelihood : -232.38	Log likelihood : -503.39
	Mills ratio : -.051 (.127)	Mills ratio : -.196 (.099)
	Correlation : -.142 (.525)	Correlation : -.486 (.181)
	Standard error : .35 (.035)	Standard error : .403 (.030)

Notes : Source: Labor Force Survey

Standard errors of the coefficients are in parenthesis

Variables used in the selection equation are :

1. All variables of the regression (education, age and districts)
2. farm occupation of father and mother
3. log of the land acreage and the missing value of land acreage
4. Number children les than 3 years old, less than 6 years old less than 18 years old
5. Number of young people in the household (less than 26 years old)
6. Number of adults (26 to 59 years old)
7. Number of elderly people in the household (60 years old and over)
8. wage of other family members

For male : number of obs = 606 Censored obs = 543 Uncensored obs = 63
Wald chi2(20) = 43.61 Prob > chi2 = .002

For female : number of obs = 807 Censored obs= 565 Uncensored obs = 242
Wald chi2(22) = 97.72 Prob > chi2 $<.10^{-5}$

Table 5 : Estimation of medians of specific tastes for on-farm work in households where both spouses are farmers

	Total	Primary, no diploma or Secondary	Baccalaureate or University level	Younger than 50	Older than 50
			Male		
(1)	.80	.77	.83	.86	.69
	(.14)	(.14)	(.13)	(.11)	(.18)
(2)	.79	.77	.82	.85	.69
	(.14)	(.14)	(.15)	(.12)	(.18)
(3)	.77	.75	.79	.82	.68
	(.18)	(.17)	(.22)	(.20)	(.20)
			Female		
(1)	.52	.62	.11	.20	.67
	(.20)	(.16)	(.48)	(.39)	(.14)
(2)	.47	.58	.03	.12	.64
	(.20)	(.17)	(.47)	(.39)	(.15)
(3)	.65	.71	.43	.47	.74
	(.22)	(.18)	(.47)	(.37)	(.17)

Notes : Boostrapped means of the empirical distribution of medians of one minus the ratio of implicit to market wages (see equation 7). 200 replications. Boostrapped standard errors are in parenthesis

(1) Baseline model (see text)

(2) The wage equations are estimated in logarithms.

(3) The production function is estimated using only the sample where both members are working on-farm.

Figure 1 : On and off-farm log male wages

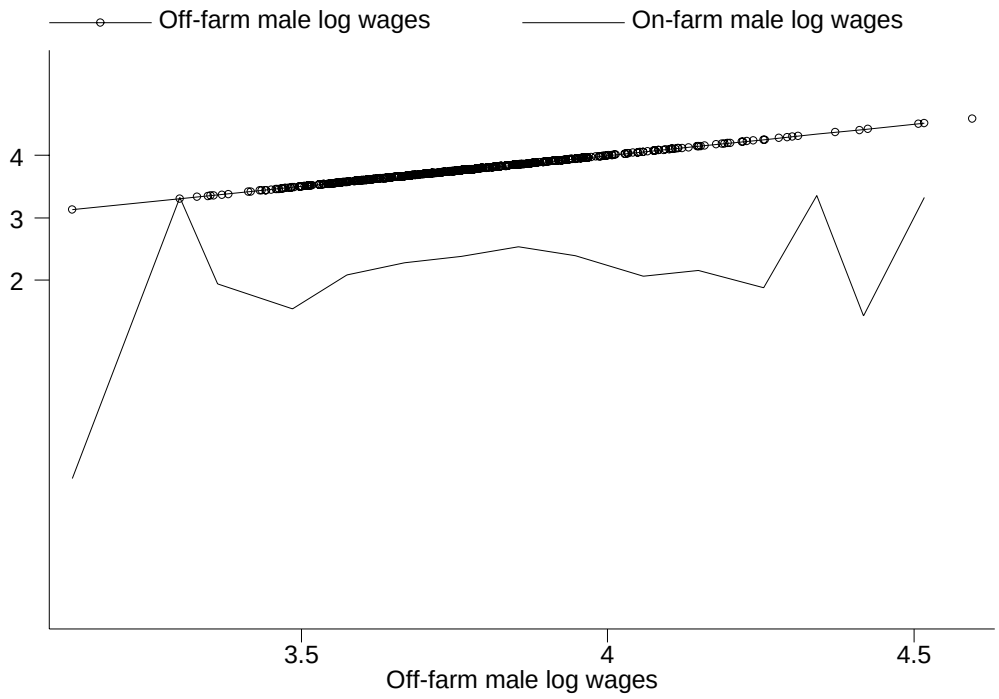

Figure 2 : On and off-farm log female wages