Off-farm labour participation of Italian farmers, state dependence and the CAP reform

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Summary

We analyse the determinants of off-farm labour participation of farmers, an issue relevant in view of the agricultural sector coping with increasing productivity and in terms of rural development. We apply a farm-household theoretical model. The data for the empirical analysis are a 5 year (2003-2007) balanced panel of 3294 Italian farms, drawn from the Farm Accounting Data Network. The explanatory variable is the dummy indicator of the farm operator working or not off the farm. The explanatory variables comprise personal, household, and farm characteristics, and few variables of the local labour market. Since in the period a major reform of the Common Agricultural Policy (CAP) took place, we also add related variables. For estimation, we use different dynamic models, accounting for both heterogeneity and state dependence, as well as for the initial conditions (Heckmann, 1981; Wooldridge, 2005; Orme, 2001). Our results suggest that, when keeping into account all these features, present work state is almost totally explained by previous state and by idiosyncratic characteristics, which implies a strong persistence. Variables concerning personal characteristics found to be relevant in cross-sectional analyses are not found to be significant in the dynamic setting. Finally, the variables related to the reform have no statistically significant effect on the decision to work off-farm.

Keywords: off-farm work, farm household, state dependence, panel data, CAP reform.

JEL Classification codes: J220, J430, Q120, Q180

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1. INTRODUCTION

Off-farm labour participation of farmers is a structural feature of developed, as well as developing, economies, and off-farm income is an increasing part in farm household income (Oecd, 2003; Eurostat, 2002). It is part of the secular trend in declining agricultural employment, as productivity in agriculture increases and, due to land being finite, no additional productive and employment basis can be created in the sector. Combining on- and off-farm work, at the individual and/or at the household level (pluriactivity) is indeed an efficient use of households' labour resources. By taking into account income opportunities stemming from the farm and from alternative employments, it allows a growth and a stabilization of household income.

The analysis of off-farm labour participation is therefore relevant for the evolution of agriculture, but also for the issue of rural development. Though agriculture is often no more the principal source of employment in rural areas, it has undoubtedly a strong importance in shaping the territory and the patterns of population –or abandonment- of those areas.

The analysis of the determinants of off-farm labour participation already forms a large body of literature. Starting from the seminal paper by Sumner (1982), labour choices in farm households at the beginning have been widely analysed, initially considering off-farm labour participation of farm operators, later considering the joint decision making of off-farm labour participation of husbands and wives (e.g. Huffman and Lange, 1989; Tokle and Huffman, 1991; Lass and Gampesaw), also including the use of waged labour (Benjamin *et al*., 1996), on- and off-farm labour participation of operators, spouses and other household members (Kimhi, 1994 and 2004, Benjamin and Kimhi, 2006; Corsi and Salvioni, 2012). Most of the research nevertheless concerned the U.S., while not many analyses are devoted to the determinants of off-farm labour participation in the EU (Benjamin *et al*, 1996*;* Benjamin and Kimhi, 2006; Bjørnsen, 2004; Corsi, 1994; Salvioni *et al*., 2008; Weiss, 1997 and 1999; Woldehanna et al., 2000).

A common feature of this stream of research, with few exceptions, is that the analyses are based on cross-sectional samples. This prevents analysing the dynamic nature of off-farm labour participation choices, and disregards the persistence of the phenomenon. Persistence was actually observed in the few

cases in which panel data were available (Gould and Saupe, 1989; Weiss, 1997; Corsi and Findeis, 2000). Though, reason for persistence can be true state dependence and/or heterogeneity. Persistence, and its reason, are relevant for policy implications. Weiss (1997) noted that "asymmetric adjustment behaviour may cause serious problems for designing an appropriate policy to encourage (or impede) a specific form of agricultural production such as part-time farming", in particular because policies cannot be easily reversed. By contrast, as noted by Corsi and Findeis (2000), if heterogeneity is the principal source of state persistence more traditional instruments can be used.

This paper analyses off-farm labour participation of farm operators based on a dynamic model allowing for both true state dependence and heterogeneity. It is based on a panel sample of Italian for the period 2003-2007. Since in this period a major reform of the Common Agricultural Policy (CAP) took place, it also account for the relevant changes.

The 2003 reform (the so-called Fischler reform) has been the most important step in the process of change in the CAP from trade and market distorting measures to more neutral interventions, leading to a more decoupled, and hence less market distorting, support (Oecd, 2004). Though it was not only addressed to decoupling, its most important measure was the substitution for semi-coupled subsidies (i.e., subsidies per hectare of specific crops and per animal head) of the fully decoupled Single Farm Payment Scheme (SFP), providing income support to farmers independently of their current production decisions. Though Member States had the possibility to implement the reform gradually, in Italy the decoupling was immediately implemented in the first possible year (2005). Also, disregarding the possibility to introduce forms of regional distribution of the direct subsidies, Italy decided to stick to the so-called historical criterion. Farmers were granted their SFP according to an entitlement based on the semi-coupled subsidies they received in the reference period 2000-2002. Moreover, with regards to the cereal, oilseed, and protein crops (COP), Italy decided for a full decoupling.

The structure of the paper is as follows. Section 2 will present the theoretical framework and the econometric strategy. In Section 3 the data on which the analysis is based will be presented. The estimation results will be presented and commented in Section 4. Some considerations will conclude.

2. THEORETICAL MODEL AND ECONOMETRIC STRATEGY

The theoretical model is the well-known farm-household model (Nakajima, 1986; Singh et al. 1986; Huffmann, 1991), adapted according to Corsi (2007 and 2008) to keep into account the CAP reform. The Fischler reform is quite articulated, but its main feature is in essence a trade off of a semi-coupled support (subsidies linked to the area farmed with specific crops or to the number of animals) with direct payments, i.e., lump-sum transfer to farmers. While coupled payments can take many forms, their reduction is theoretically equivalent to a decrease in the average revenue received by farmers, i.e., is equivalent to a

price decrease[1]. The overall impact of the Fischler reform can be incorporated into the analysis as the introduction of i) a direct payment, compensating for ii) a price decrease (equivalent to the abolition or reduction of coupled payments).

Assuming a competitive labour market, and no farmer preference for farm rather than for off-farm work, the farmer (for simplicity, we consider a single farmer) is assumed to maximise utility over consumption and leisure, under income and time constraints. The income constraint comprises both farm income and off-farm wages. The model is as follows:

$$
\begin{aligned}
& Max\, U = U(C, L; H, Z_H) \\
& S.t.: \\
& T = F + M + L \\
& L > 0 \\
& F, M \geq 0, \\
& Q = f(F, X; H, Z_F) \\
& (p+s)Q - RX + WM + V = C
\end{aligned}
\qquad (1)
$$

where: C is consumption (or, equivalently under the assumption of a composite good, income); L is leisure; H is a vector of personal variables; ZH a vector of characteristics of the household; T is total available time; F and M are time spent working on the farm and off the farm, respectively; Q is the quantity of the good produced by the farm; p its price; s the coupled payment per unit of output; X is the vector of hired inputs and R the vector of their relevant prices; ZF the vector of farm characteristics; W is off-farm market wage; V is non-labour income. The utility function and the production function are assumed to be well-behaved.

The Kuhn-Tucker maximisation conditions yield the following off-farm participation conditions:

$$\delta(p+s)Q / \delta F \leq \mu / \lambda \qquad (2)$$

$$W \leq \mu/\lambda \qquad (3)$$

where μ and λ are the marginal utilities of leisure and income, respectively.

In a pluriactive farm, equations (2) and (3) hold as equalities:

$$\delta(p+s)Q / \delta F = W \qquad (4)$$

$$W = \mu/\lambda \qquad (5)$$

That is, the marginal value product of farm labour (inclusive of the coupled support) is equal to the market wage and to the leisure-income Marginal Rate of Substitution (MRS)[2].

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[1] Even when coupled payments are area-based or animal-head-based, for a given yield or animal production their reduction or abolition is the same as decreasing the received price. Of course, since yields and area-based coupled payments were different, and since following the reform the crop mix and the factor use can be changed, the "price decrease" is not the same for all farmers, which makes this effect different from an actual price change, that would be the same for all.

[2] Using this model, the impact of a direct payment has long been established (El-Osta et al., 2004; Ahearn et al., 2004; Corsi, 2007 and 2008): a decoupled direct payment is tantamount to an increase in non-labour income. Hence, for a farmer participating to off-farm work, a decoupled direct payment will decrease off-farm work. Though, if production

The reduced form usually employed in analyses of off-farm labour participation starts with defining the reservation wage w^*, obtained by setting to zero off-farm labour supply and solving for w. The reservation wage is compared to the market wage w, which is a function of personal characteristics and of the conditions of the local labour market. Therefore, participation (indicated by the dichotomous variable P being 1, otherwise 0) occurs if $w>w^*$, so that prob(P=1) = prob($w>w^*$). From the theoretical model, w^* is a function of the price of agricultural products, of variables affecting on-farm labour productivity, and of taste shifters. The market wage is a function of personal characteristics influencing human capital, and of labour market characteristics. Typically, the reduced–form equations are probit or logit equations estimating the influence of these variables on the probability of (w-w^*) being greater than zero. Three categories of explanatory variables are typically included: individual, farm and local market characteristics.

Few studies of off-farm employment decisions have used longitudinal data. Exceptions are Gould and Saupe (1989), Weiss (1997), and Corsi and Findeis (2000). Though, these studies have used two-wave panels, so that a truly dynamic modelling was not possible. While Gould and Saupe (1989) and Weiss (1997) model entry and exit from off-farm employment from one period to the second one, Corsi and Findeis (2000) try to ascertain whether state dependence or heterogeneity are the main determinant of persistence in the state, but are unable to model both.

In a dynamic setting, expected values of income streams rather than absolute values of incomes are to be considered. Moreover, costs for shifting from one to the other work condition are to be taken into account. These costs are to a large extent sunk costs. For instance, taking on an off-farm job might imply search costs, and costs related to the adaptation of the farm operation to the new situation (e.g., a higher mechanization, or a change in the type of farming or in the farming intensity to cope with lower family labour input). Call C the costs for shifting from one condition to the other one and T the time-horizon for work incomes. Then, calling r the discount rate, the probability of participation in year t for a farmer not already participating is:

$$prob(P_t = 1|P_{t-1} = 0) = prob\left\{\sum_{t=1}^{T} E\left[w_t - w_t^* - C\,\frac{r(1+r)^{(T-t)}}{(1+r)^{(T-t)}-1}\right] > 0\right\} \qquad (6)$$

while the probability of participation for a farmer already participating is:

$$prob(P_t = 1|P_{t-1} = 1) = prob[\sum_{t=1}^{T} E(w_t - w_t^*)] \qquad (7)$$

In a symmetric way, the probability of not participating for a farmer previously participating is:

$$prob(P_t = 0|P_{t-1} = 1) = prob\left\{\sum_{t=1}^{T} E\left[w_t - w_t^* + C\,\frac{r(1+r)^{(T-t)}}{(1+r)^{(T-t)}-1}\right] < 0\right\} \qquad (8)$$

while the probability of not participating for a farmer not already participating is:

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and labour allocation decisions are not separate, it is unclear which work will be reduced. By contrast, a decrease in coupled support has both a wealth and a substitution effect. The decrease in the marginal value product of family farm labour induces a reduction of on-farm work. At the same time, the decrease in income decreases the MRS, so that the farmer consumes less leisure. Hence, the overall result is an increase in off-farm work. As the CAP reform is a combination of an income payment and of a decrease in the average revenue, the two effects operate in opposite directions.

$$prob(P_t = 0|P_{t-1} = 0) = prob\left[\sum_{t=1}^{T} E\left(w_t \ - w_t^*\right) < 0\right] \quad (9)$$

As a result, if C is strictly positive:

$$prob(P_t = 1|P_{t-1} = 1) > prob(P_t = 1|P_{t-1} = 0) \quad (10)$$

and:

$$prob(P_t = 0|P_{t-1} = 0) > prob(P_t = 0|P_{t-1} = 1) \quad (11)$$

This requires including past off-farm work state as an explanatory variable in the participation equation, as a proxy for the costs for shifting from one condition to another.

Unlike previous literature, we exploit the panel nature of our data to analyse the determinants of off-farm labour participation. The probability of a farm operator working off-farm is estimated by applying a dynamic non-linear (probit) random effects models accounting for both unobserved heterogeneity and true state dependence.

The non-linear dynamic random effect model we start from is:

$$\text{Prob}(y_{it}=1) = \Phi(\beta_0 x_{it} + \gamma y_{it-1} + u_i + \varepsilon_{it}) \quad (12)$$

where y_{it} is a dummy variable equal to 1 if the farm operator participates in off-farm work in year t (t=1,…,T), else 0; x is a vector of observable time-variant and time-invariant explanatory variables; β_0 and γ are parameters to be estimated; Φ is the normal cumulative density function; u_i is an individual idiosyncratic term; and ε_{it} is a random component, uncorrelated across individuals and years.

The lagged outcome variable allows us to test the hypothesis of true state dependence. This means that the event of off-farm labour participation may have a causal effect on future decisions of participation. The 'lagged dependent variable' approach, also referred to as non linear dynamic random effects model, has been widely employed for the analysis of social assistance dynamics (Andrén; 2007; Cappellari and Jenkins, 2009; Hansen, Lofstrom 2006; and Hansen, Lofstrom, and Zhang, 2006), to study the dynamics of unemployment (Arulampalam, Booth, and Taylor, 2000; Stewart, 2007) and that of poverty dynamics (Biewen, 2004).

The standard random effects model assumes that the unobserved individual-specific components u_i are uncorrelated with the observed explanatory variables. In the real world, this assumption may not hold. In order to address this limitation and allow for the possibility that off-farm participation may be correlated with the individual effect, Mundlak and Chamberlain (Mundlak, 1978; Chamberlain, 1984) suggested to parameterize the individual effect. More in detail, the so-called specification or correlated random effects (CRE) assumes that the individual effect is represented by:

$$u_i = X_i + \varepsilon_{it} \quad (13)$$

where X_i refers to within farms averages of the time invariant explanatory variables.

A further issue that may result in biased estimates of the parameter of the lagged variable, hence of the magnitude of state dependence, is that commonly referred to as initial conditions problem– whether y_{i1} is independent of u_i. The problem is caused is by the presence in the equation of both the past value of the

dependent variable and of an unobserved heterogeneity term, and by the correlation between them. The treatment of initial conditions is crucial since misspecification will result in an inflated parameter of the lagged dependent variable that measures the magnitude of the cost of shifting employment.

In recent years, several estimators for the nonlinear dynamic panel data model have been proposed (Heckman, 1981; Wooldridge, 2005; and Orme, 2001), and it has been shown (Arulampalam and Stewart, 2009) on the basis of simulation experiments that none of the three estimators dominates the other two in all cases. In most cases, all three estimators display satisfactory performance, except when the number of time periods is very small.

In this paper we allow for the possibility of the individual term to be correlated to the regressors and we take into account the initial conditions problem following the approach by Heckman (1981), Wooldridge (2005) and Orme (2001).

The Heckman approach to the initial conditions problem involves assuming the following specification of the initial value of the dependent variable:

$$y_{i1} = z_{i1}\pi + \eta_I \qquad (14)$$

where z_{i1} is a vector of exogenous variables including x_{i1} and other instrumental variables (for example pre-sample variables) and η_i is assumed to be correlated with α_i, but uncorrelated with u_{it} for $t \geq 2$. Then η_i can be written as $\eta_i = \theta\alpha_i + u_{i1}$ ($\theta > 0$), with α_i and u_{i1} independent of one another. It is also assumed that u_{it} and α_i are normally distributed with variance 1 and σ_α, respectively. The function for the initial time period is therefore specified as

$$y_{i1} = z_{i1}\pi + \theta\alpha_i + u_{i1} \qquad (15)$$

and this equation is estimated jointly with the one of the remaining time periods. The output is therefore an estimate of the initial year equation, and of the following years equation, including the correlation term.

In Wooldridge's approach, the individual term is assumed to be a function of the initial condition and of the means of the explanatory variables:

$$u_i = \alpha_0 + \alpha_1 y_{i1} + \alpha_2\mu_\iota + \nu_i \qquad (16)$$

where y_{i1} is the state in the first observed year; μ_i is a vector of the means of the explanatory variables over the whole observed period; and ν_i is a random individual component, uncorrelated across individuals.

The overall model is therefore:

$$\text{Prob}(y_{it}=1) = \Phi(\alpha_0 + \beta_0 x_{it} + \gamma y_{it-1} + \alpha_1 y_{i1} + \alpha_2\mu_\iota + \nu_\iota + \varepsilon_{it}) \qquad (17)$$

The model is estimated as a random effects probit.

Since the initial conditions problem is due to the correlation between the y_{it-1} regressor and the individual heterogeneity term, the Orme's approach is to insert a correction term in the equation. He substitutes u_i with another unobservable term uncorrelated with the initial observation, under the assumption that u_i and ε_{it} follow a bivariate normal distribution. This term:

$$h_i = E(u_i|\eta_{i1}) = (2y_{i1}-1)\sigma_\upsilon\phi(\pi*'z_i/\sigma_u)/\Phi[(2y_{i1}-1)\pi*'z_i/\sigma_u] \qquad (18)$$

is the generalised error term from a probit estimated for the initial year, where z are the covariates, π the relevant parameters, ϕ and Φ the normal density and distribution functions. The generalised error terms are inserted as regressors in a random effect probit model for the remaining years, so that the overall model is:

$$\text{Prob}(y_{it}=1) = \Phi(\alpha_0 + \beta_0 x_{it} + \gamma y_{it-1} + \tau h_i + \nu_i + \varepsilon_{it}) \qquad (19)$$

We experiment all these approaches and confront them with the estimates based on cross-sectional models as well as among them.

3. DATA

This study relies on data collected by the Italian Farm Accountancy Data Network (FADN) survey. The survey started to be conducted on a statistically representative basis in 2003. The sample is stratified according to criteria of geographical region, economic size (ESU) and type of farm (TF)[3]. The field of observation is the total of commercial farms, that is, farms with an economic size greater than 4 ESU (4,800 euro).

In this study we employ a 5 waves balanced panel of 3294 farms for which information were collected in all years from 2003 to 2007. We only kept family farms[4]. The random effects probit model is estimated over the period 2004-2007, since year 2003 is used to define the initial condition. Table 1 presents the descriptive statistics for the dependent and explanatory variables over the 5 years.

Table 1 about here

The dependent variable is a dummy variable indicating whether the farm operator works off the farm. The share of farms operators having an off-farm job is 6.6 percent over the whole 2003-2007 period. It increases from 6.3 percent in 2003 to 7.3 percent in 2007, with a drop to 6 percent in 2004.

Following previous research, we use three categories of explanatory variables to specify the model for off-farm participation decision: individual, farm and local market characteristics.

Individual attributes include age, age squared and gender of the operator, while it was not possible to control for the effect of education since this information is not collected by the survey. Previous research typically found a positive effect of age on participation, but with a curvilinear pattern, reaching a peak and then declining.

The household non-labour incomes, i.e., capital income and pensions, are used to explore the existence of a wealth effect. Larger values are expected to have a negative effect on off-farm participation. Unfortunately, we can only measure the presence of these kinds of incomes with dummy variables.

[3] The Farm Accounting Data Network of the European Union defines a farm as specialised in a TF if the Standard Gross Margin (SGM) for the particular production covers more than 2/3 of total SGM. SGMs are calculated as the balance between a standard value of production and a standard value of certain specific costs, determined for the various crop and livestock characteristics within each region, and are stratified in European Size Units (ESUs).

[4] Farms that were not sole ownership or private partnership were not considered in this analysis.

Farm characteristics include farm size (in hectares); farm location (Mountain, Hills and Plains as base category); total debts in thousand Euro; degree of mechanization (horse power per hectare of used land); working capital in thousand Euro; specialization in the production of labour intensive seasonal and all year round products; presence of direct selling and a dummy for organic farming. Farm size is usually expected to decrease off-farm participation, since larger farms are usually more profitable, which makes off-farm labour comparatively less attractive. Mountain and hill farms are typically characterized by low returns. Accordingly, the farm location in Mountains and Hills should be expected to positively affect off-farm participation of farm household members trying to increase total household income with alternative off-farm incomes. Nevertheless, these areas typically also provide less employment opportunities, which would have the opposite effect. The higher the debt the higher the service farmers have to pay to lenders. This might provide an incentive to farm households to work off-farm in order to find new sources of income to pay back the debt. There are no clear theoretical expectations regarding the sign of the coefficient of mechanization. The use of machines could reduce the labour hours required on farms and in this way increase the probability of off-farm labour participation. On the contrary, a high investment in machinery could be a sign of a deep commitment of the household in the farm activities and, more importantly, could raise farm income. High levels of working capital are expected to increase productivity and to lower off-farm labour attractiveness. Off farm work is expected to be discouraged in those cases in which farms are specialized in all year round labour intensive as well as, to a lesser extent, in seasonal labour intensive type of faming. The use of organic farming is anticipated to reduce the likelihood of off-farm work, given the higher labour requirements of these farming systems, as compared to conventional farming. Finally, direct selling is labour intensive, and should reduce off-farm activities.

The variables describing the local labour market and the external economic environment are at Provincial level (Province are administrative bodies corresponding to the NUTS-3 level of Eurostat). All data are drawn from National accounting data published by Istat, i.e. the national official statistical agency. Value Added per employed in agriculture as a percentage of overall Value Added per employed is introduced trying to capture the average labour income differential between agriculture and the overall economy at the local level. The agricultural to total employment ratio is introduced to account for employment opportunities outside agriculture[5].

We introduced the amount of Single Farm Payments (SFP) annually received by individual farms to detect the effect of the CAP reform. It is both an indicator of the policy structural change (since it is zero before the reform implementation in 2005) and of the intensity of the intervention. Since SFP is allocated based on historical production mix, it can be considered as exogenous (in fact, decoupling aims at making

[5] It would have been desirable to introduce two other important variables concerning local labour markets, the activity rate and the employment rate. Unfortunately, Istat changed in 2004 the methodology of the labour force surveys, so that the series from 2004 onward is not comparable to the one of previous years. For this reason, we could not add these variables.

public support exogenous to production choices). The amount of the SFP is farm-specific, and its impact is a pure wealth effect. Prior to the introduction of the SFP, eligible farms received partially coupled payments (per hectare or per animal head) represented by the relevant variable. The overall effect of these latter payments is ambiguous, since they may have both an income and a substitution effect.

4. RESULTS

Table 2 reports the results of the different models. We will present the results in sequence, so to highlight the changes deriving from tackling the different econometric issues. To save space, the estimates of those variables never found to be significant in any model are dropped. We start with the estimation of a static pooled probit model that assumes no heterogeneity and no state dependence. The second model is a random effects dynamic model, including a past state and an initial state condition variable. Then we pass to dynamic settings accounting for heterogeneity and state dependence, as well as for the initial condition problem. All models are estimated for the 2004-2007 period, so to allow for comparisons. Heckman's, Wooldridge's and Orme's models also use information from year 2003 for the dynamic setting and for dealing with the initial year issue. All models are overall highly significant.

Table 2 about here

Column [1] gives the standard pooled probit estimates. This is tantamount to having cross-sectional estimates, so that it is in a sense a benchmark for "traditional" analyses of off-farm labour participation. Actually, the results are to a large extent similar to the ones typically found in cross-sectional analyses. The probability that the farm operator participates in off-farm work is found to be significantly affected by the idiosyncratic characteristics of the farmer (age, sex) and of her household (presence of pensions and of capital income) while no statistically significant influence is found for the socio-economic conditions at the provincial level. As for the farm characteristics, higher mechanization rates, higher percentages of owned land, the farm being located in mountainous areas and making use of direct selling, and a higher single farm payment increase the probability of working off farm. On the contrary, using organic farming techniques, higher percentages of working capital as well as being specialized in the production of all-year-round labor-intensive agricultural products decreases the probability of the operator working off-farm.

We then move to dynamic settings accounting for the effect of y_{t-1}, i.e. the past off-farm labour state. In all of them, the effect of the past state is strong and highly significant.

Column [2] gives the dynamic pooled probit estimates. This model accounts for state dependence, but does not deal with the issue of the initial conditions. The parameter related to the past state is strongly significant and large. In addition, this model, as compared to the pooled sample model, presents a dramatic increase in the log-likelihood. A likelihood ratio test strongly rejects the restriction implied by the static pooled sample. This means that a dynamic model is statistically superior to the cross sectional one. Dramatic

changes occur even in the covariates since, apart from y_{t-1}, only the two non-labour income variables and the location in mountainous areas exhibit statistical significant coefficients[6].

The third model adds to the past state the state in the initial year and allows for individual heterogeneity. As compared to the previous one, the parameter of the past state is strongly reduced, since its effect is partly absorbed by the initial year state parameter and by heterogeneity, represented by the correlation term, both of which are highly significant.

The following three models control, in different ways, the issue of the initial conditions, while still allowing for both state dependence and heterogeneity. The results are to a large extent similar among them. In all three models the past state is highly significant, and its effect is larger than in model 3. To compare the parameters of random effects models, they must be rescaled by multiplying them by $\sqrt{1-\rho}$, where ρ is the constant cross-period error correlation (Arumpalam, 1999). After rescaling, the past state parameters for the Heckman's, Wooldridge's, and Orme's models are of comparable magnitude, i.e., 0.874, 0.763 and 0.806 respectively, as compared to 0.704 for model 3. I.e., not controlling for the initial conditions would lead to underestimate the effect of the past state. Also, the values of the correlation coefficient, measuring the effect of unobserved heterogeneity, are of similar magnitude (0.619, 0.604, and 0.573, respectively, for Heckman's, Wooldridge's, and Orme's models). Third, all parameters involved in the correction of the potential bias due to the initial conditions are significant: the *theta* parameter in Heckman's model, the *h* parameters in Orme's, and the initial state, as well as some means of the explanatory variables (not reported in the table) in Wooldridge's model. From the methodological point of view, this suggests that coping with the initial conditions issue is important to avoid biased estimates. Also, the results suggest that both true state dependence and heterogeneity are important in determining persistence. Heterogeneity represents individual unobservable factors, but its effect is symmetrical like the other covariates, and the issue of heterogeneity is basically an econometric one, implying biased estimation if not properly controlled. By contrast, true state dependence creates an asymmetry in farmers' behaviour, and is an economic issue, stemming from true changes in farm setting. Existence of true state dependence is not simply an econometric issue, it is a behavioural issue.

As to the other explanatory variables, some results are common to all three models. The two variables related to the household income (pensions and capital income) are strongly significant in all these models. Non-labour income (capital and pension income), is –admittedly poorly- measured by dummy variables. If the household has any capital income, the probability of off-farm labour participation is significantly increased. Since theoretically non-labour income should reduce off-farm work, a possible interpretation of

[6] If heterogeneity is added to this model, i.e., if the model including the past state among the explanatory variables is estimated as a random effects model, the estimate of the correlation coefficient is zero. When estimating a random effects model without the lagged state variable, the model does not reach convergence. Since the following models, controlling for state dependence, heterogeneity, and initial conditions do converge, the implication is that controlling for the initial conditions problem is crucial for distinguishing between state dependence and heterogeneity.

this result is that off-farm employment is induced by off-farm high wages that, in turn, provide more financial assets that yield capital incomes. This probably concerns the wealthiest farms. If a household member has a pension income, the probability that the farm operator has an off-farm job significantly decreases. A possible interpretation is that for poor farm households, off-farm income stemming from pensions of other members decreases the income needs, thus raising the off-farm reservation wage of the operator. In alternative, it is possible that the presence in the household of elders and individuals with a disability increases the time to be devoted to caring activities, in this way discouraging off-farm work.

For other variables, the results are less homogeneous across the different models. For instance, the farm location in mountain area is significant in Orme's and Wooldridge's models, but not in Heckman's. Farms in those areas are typically less profitable, which might induce more pluriactivity. In addition to this, the ratio of agricultural to total Value Added per Labour Unit is (weakly) significant, and positive in the same models. This result is counter-intuitive, since one might argue that a higher income gap between agriculture and the overall economy should induce more off-farm labour participation. But an interpretation could be that the most profitable agricultural areas (especially in the North of Italy) are also the ones where more job opportunities are available, an interpretation that could be reinforced by the (also weakly) significant and positive effect of the average value added per employed. All-year-round labour-intensive types of farming are found to significantly decrease the likelihood of working off the farm, though this result is not significant in Wooldridge's model (which is the one in which less variables are significant). The share of land in property also has a significant positive effect in the same models, probably because this share is generally larger in small farms. Finally, the amount of working capital is found to be significant and positive in Heckman's model, and significant and negative in Orme's. But in both cases the effect is very small, so that in economic terms it is negligible.

Probably the most striking result –also robust across all models- is that, after introducing state dependence and heterogeneity and controlling for the initial state conditions, in none of these dynamic models the idiosyncratic farmer characteristics have statistically significant effect on the probability of the operator working off farm. Also, many of the farm characteristics found to be significant in cross-sectional models are no more significant in this dynamic setting. Though further analyses based on other samples and for other countries are needed to make this conclusion general, this makes a remarkable difference with the current literature based on cross-sectional samples, where typically personal, farm and labour market characteristics are found to be important determinants.

Finally, it is interesting to note that the variables intended to capture the effects of the CAP reform (Single Farm and Coupled Payments) are not significant apart from SFP in the Heckman's model that is weakly significant. These results on Italian farms are nevertheless consistent with the findings of US studies, that found indeed very small effects of decoupled payments on off-farm labour (El-Hosta et al. 2004; Goodwin & Mishra 2004; Ahearn et al. 2006; Serra et al. 2005).

5. SUMMARY AND CONCLUSIONS

In this paper we examine the issue of off-farm labour participation of farm operators. Unlike most of the current literature, we take into consideration the possible dynamic effects of past off-farm labour participation. We estimate different models allowing for both heterogeneity and true state dependence, and also coping with the problem of the initial conditions, using a panel sample of Italian farms.

The results show that cross-sectional analyses are unable to properly represent farmers' behaviour, since a strong persistence in the state can be observed. The conclusion is that past labour state is the main determinant of off-farm labour participation choices of Italian farmers. Persistence is also explained by unobserved heterogeneity. Variables usually found significant determinants of these choices, and also appearing as such in pooled sample estimation, are no more significant when true state dependence and heterogeneity are controlled for.

Our results have implications both for research and for policy. Though more research is needed to generalize our results, they cast doubt on a whole stream of literature based on cross-sectional samples. From the policy point of view, our results suggest that, given state dependence, if any policy has to be implemented concerning off-farm labour participation of farmers, much initial effort is needed to change it, but after this initial treatment, incentives are less needed to sustain in time the desired behaviour.

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Table 1 - Descriptive statistics of the variables (2004-7 unless otherwise stated)

	Mean	Std.Dev.
share of off-farm labour participants 2003-2007	0.066	0.066
share of off-farm labour participants 2003	0.063	0.013
share of off-farm labour participants 2004	0.060	0.012
share of off-farm labour participants 2005	0.067	0.013
share of off-farm labour participants 2006	0.070	0.014
share of off-farm labour participants 2007	0.073	0.015
UAA (ha)	33.7	69.74
Share of land in property	0.67	0.39
Total Debts (1000 Euro)	11.87	106.42
Hp/UAA	19.03	44.27
Working capital (1000 Euro)	128.04	357.75
Pension income (0,1)	0.23	0.42
Capital income (0,1)	0.01	0.11
Labor intensive all year	0.36	0.48
Labor intensive seasonal	0.33	0.47
Direct sales (0,1)	0.21	0.41
Organic farming (0,1)	0.04	0.19
Agritourism (0,1)	0.03	0.16
Hills (0,1)	0.45	0.5
Mountain (0,1)	0.19	0.39
Plains (0,1)	0.37	0.48
Operator's age	54.19	13.6
Operator's age squared	3121.84	1513.44
Operator's gender (1=M, 0=F)	0.83	0.38
Coupled Payments (1000 Euro)	3.48	33.79
Single Farm Payment (1000 Euro)	7.84	33.21
Agricultural to total employment (%)	6.35	4.03
AV per inhabitant (1000 Euro)	21.72	5.23

Table 2 -Estimates of the models of off-farm labour participation

	Pooled Coeff.		Dynamic pooled Coeff.		Dynamic Coeff.		Heckman Coeff.		Orme Coeff.		Wooldridge Coeff.	
y(t-1)	-		2.650	***	1.143	***	1.417	***	1.223	***	1.234	***
y(0)	-		-		2.953	***	-		-		2.724	***
Personal characteristics												
Operator's age	0.011		-0.011		-0.031		-0.015		-0.019		0.029	
Operator's age squared	0.000	**	0.000		0.000		0.000		0.000		0.000	
Operator's gender (1= male)	0.258	***	0.091		0.092		0.164		0.203		0.045	
Household characteristics												
Pension income (0,1)	-0.271	***	-0.362	***	-0.781	***	-0.771	***	-0.818	***	-1.384	***
Capital income (0,1)	0.641	***	0.536	***	0.903	***	0.735	**	0.868	***	0.695	**
Farm characteristics												
Share of land in property (%)	0.370	***	0.267	***	0.410	*	0.515	***	0.390	***	0.140	
Working capital (1000 Euro)	-0.001	***	0.000	***	0.000		-0.001	**	0.000	**	0.000	
Non seasonal	-0.380	***	-0.255	***	-0.392	***	-0.298	**	-0.496	***	0.129	
Seasonal	-0.091	**	-0.032		0.042		0.047		-0.011		0.258	
Mountain (0,1)	0.107	**	0.139	**	0.272		0.202		0.272	**	0.276	**
Direct sales (0,1)	0.175	***	0.109	*	0.096		0.132		0.156		-0.019	
Organic farming (0,1)	-0.296	***	-0.191		-0.226		-0.172		-0.254		-0.135	
Hp/UAA	0.001	**	0.000		0.001		0.001		0.001		0.001	
Single Farm Payment (1000 Euro)	0.002	***	0.001	*	0.002		0.002	*	-0.002		0.002	
Economic environment												
Agricultural to total employment	0.001		0.007		0.021		0.009		0.017		-0.005	
AV per inhabitant (1000 Euro)	0.000		0.009		0.027	*	0.013		0.018	*	0.085	**
Constant	-1.660	***	-0.187		-3.000	***	-2.773	***	-2.759	*	-2.839	***
Rho	-				0.620	***	0.619	***	0.602	***	0.573	***
theta							1.255	***				
h									1.367	***		
log l	-3030.7		-1640.5		-1537.4		2269.2		-1545.9		-1509.5	