TRENDS IN FAMILY LABOUR, HIRED LABOUR AND CONTRACT WORK ON FRENCH AND SWISS CROP FARMS: THE ROLE OF AGRICULTURAL POLICIES

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ABSTRACT

The objective of this article is to analyse the trends in on-farm labour use, including own family labour, hired labour and contract work, and to assess the factors driving their evolution in France and in Switzerland during 1990-2007. A particular attention is given to agricultural policies, namely the level and type of support. Results indicate that crop area payments discourage the different labour demands in both countries, while environment and investment payments favour contract and hired labour in France. Contract labour and family labour are substitute and hired labour and family labour are complement in France.

KEYWORDS: farm labour, hired labour, contract work, policies

1. INTRODUCTION

The objective of this article is to analyse the trends in on-farm labour use, including own family labour, hired labour and contract work, and to assess the factors driving their evolution in France and in Switzerland during 1990-2007. A particular attention is given to agricultural policies, namely the level and type of support, as a determinant of demand for hired labour and contract work, and supply for on-farm family labour. While farmer's or household's time allocation decisions between on- and off-farm work have been largely studied in the literature (e.g. Benjamin and Kimhi, 2006; El-Osta et al., 2008), decisions regarding the type of labour used on farm have rarely been investigated despite the fact that off-farm employment participation may be constrained by the possibility to substitute own labour by external labour force.

Existing studies on factors behind the demand for hired labour point out the role played by global trends in farm labour productivity and mechanisation, and by farm and household characteristics and environment, such as farm size, wages, other input prices, farm household's education and the number of children in the household (Bhati, 1980; Benjamin et al., 1996; Benjamin and Kimhi, 2006; Blanc et al., 2008). However, the issue of contract work, that is to say contracting a company for specific and one-off tasks (also called

outsourcing) has not been received consideration of researchers yet, although it is becoming increasingly common on farms worldwide due to its greater flexibility (Lee and Sivananthiran, 1996; Smart, 1997; Devey et al., 2007). Our paper therefore brings a substantial contribution to the literature on farms' input use decisions.

Moreover, we also contribute to the literature by investigating the role of agricultural policies on labour use, which has, to our knowledge, never been investigated. The evolution towards more and more decoupled policies raises the question whether farm labour structure will be modified in the future, which would in turn shape the rural economy. Some studies indicate that the part of hired labour in total farm labour in developed countries has increased over the last decades (Blanc et al., 2008). On the other hand, as several studies show, the introduction of decoupled payments decreases the incentives to produce and therefore may have negative effect on the use of production factors. The question is then which type of on-farm labour is firstly affected by the reduction of labour use. According to Schmitt (1991) and Beckmann (2000), the institution of family farming is competitive because of the lower transaction costs within families compared with external labour. This argument may lead to the hypothesis that farms would save external labour before they would restrict the use of their own labour. The paper explores the relationship between the three types of on-farm labour with the help of a farm household model. Determinants of hired labour and contract labour demands and of on-farm family labour supply are then investigated with a simultaneous equation system applied to farm-level data during 1990-2006. Such period enables to capture the introduction of decoupling through direct payments in Switzerland in 1999, and three reforms of the Common Agricultural Policy (CAP) in France (1992, 2000, 2003) gradually introducing more and more decoupled payments.

The rest of the paper is structured as follows. The next section develops the conceptual model. Section three describes the data and the methodology used. Section four presents the results, and section five concludes.

2. MODELLING THE FARM HOUSEHOLD BEHAVIOUR AND FARM LABOUR DECISIONS

The household objective function is represented by a household's utility function $U(.)$ positively depending on a consumption aggregate (I) and on leisure (Le) with the usual convexity properties (equation (1)). In particular, the increase in consumption decreases its own marginal utility and increases the marginal utility of leisure. Leisure is the difference

between the total available time of household members (T) and the time that household members actually spend in remunerated activities (equation (3)). On-farm (Lf) and off-farm (Lo) remunerated activities are distinguished.

Consumption is constrained by the incomes from these activities. On-farm and off-farm activities provide the farm income. The latter is represented by a restricted profit function $RP(.)$ depending on the annual input and output prices (p), on different fixed production factors (X), and on the different types of labour sources that is to say hired labour (HL) and contract labour (CL), minus the cost functions of each labour source $C(HL, wHL, wCL, Z)$ and $C(CL, wHL, wCL, Z)$ (with wHL *and* wCL respectively the prices of hired and contract labour, and Z the farm location characteristics grasping the local conditions of its physical, economic and institutional environment), plus the farm subsidies (s) and off-farm income (Io) (equation (2)). For hired labour, the cost does not only depend on the labour market's price but also on local institutional characteristics entailing transaction costs. Costs of hired labour are nil when there is no hired labour. The same remarks hold for the contract work. Family labour is used on farm according to a household internal equilibrium that depends on the trade-off between leisure and work and on the trade-off between on-farm and off-farm work.

In the model off-farm income (Io) and off-farm labour supply (Lo) are assumed exogenous.

The farmer's programme of household utility maximisation is given by equations (1), (2), (3), (4), (5):

$$\underset{Lf,HL,CL}{Max}\ U(I(Lf,HL,CL),Le(Lf,HL,CL)) \tag{1}$$

Subject to

$$\begin{aligned} I(Lf,HL,CL) = {} & RP(Lf,HL,CL,X,p) \\ & -C(HL,wHL,wCL,Z)-C(CL,wHL,wCL,Z)+s+Io \end{aligned} \tag{2}$$

$$Lf + Le(Lf,HL,CL) = T - Lo \tag{3}$$

$$HL \geq 0 \tag{4}$$

$$CL \geq 0 \tag{5}$$

Solutions for each type of labour demand (HL* and CL*) and supply (Lf*) are given by equations (6):

$$
\begin{aligned}
&Lf^*(T, Lo, Io, s, wHL, wCL, Z, X, p) > 0 \\
&HL^*(T, Lo, Io, s, wHL, wCL, Z, X, p) \geq 0 \\
&CL^*(T, Lo, Io, s, wHL, wCL, Z, X, p) \geq 0
\end{aligned} \tag{6}
$$

The derived demands, respectively supply, for each labour source used on farm are calculated out of this farm household model. The result is a simultaneous equation system where the different types of labour demands depend on each other. Hired labour (*HL**) and contract work (*CL**) may be censored variables, while used family labour (*Lf**) is not because it defines the farm household.

Analytical results regarding the expected effect of price or subsidy changes can be derived under particular conditions like a fully elastic supply of hired labour for instance. The uncertainty of the farm income may also be investigated. However, the aim of this theoretical framework is mainly to specify a structural econometric model in order to identify the determinants of each type of labour use.

3. DATA AND METHODOLOGY

Farm-level data are extracted from the national Farm Accountancy Data Network (FADN) databases for the period 1990-2007. Only crop farms are considered in this paper. However, it should be noted that the definition differs across both countries. In France, fieldcrop farms are selected, corresponding to the European standard classification Type of Farming 1 that is to say deriving at least 75 percent of their gross margin from cereals and other fieldcrops. In Switzerland, the share of arable land to total agricultural land is the decisive criterion and has to be above 70 percent (and fruits and vegetables have to be below 10 percent). In addition, arable farms have to have less then one livestock unit per hectare.

In both countries on-farm family (*Lf*) and hired labour (*HL*) are measured in Annual Working Units (AWU), corresponding to the number annual full-time equivalents, while contract labour (*CL*) is measured by the expenditure spent on such labour. The price of hired labour (*wHL*) is measured by the wages per paid AWU. For farms that do not employ hired labour, the (virtual) price of hired labour is an estimated value of the local market labour price. The latter is calculated as the predicted value from the Ordinary Least Squares (OLS) regression of the sample's farms' labour wage on regional and localisation dummies, and yearly dummies. The price of contract labour (*wCL*) cannot be calculated from the samples as the number of hours of such labour is not available. Only for the French sample a proxy is

available: it is not a farm-specific price, but a regionally-varying yearly price which is in fact the regional price index for contract labour, with base 1990.

The price of other inputs and outputs (p) is, for inputs, the price of land, calculated as the rental per hectare of rented land for those farms using external land. For the other farms, the strategy is as for the price of hired labour. For outputs, we tried several crop prices (e.g. cereals) calculated from the samples' farms are the revenue from a specific crop divided by the quantity produced. The other explanatory variables (Z) include farm size as the utilised agricultural area (UAA), farm technology as the UAA under irrigation, the share of rented land, the share of crop output in total farm output, the legal status of the farm, the farmer head's age and education, and localisation variables.

The role of agricultural policies is investigated on the one hand with the help of specific time period dummies accounting for the various reforms in both countries: 1990-1998 and 1999-2007 in Switzerland; 1990-1994, 1995-1999, 2000-2005 and 2006-2007 in France. Although the first CAP reform was decided in 1992, it was fully implemented in France in 1995 only; similarly, although the last CAP reform dates from 2003, it was only implemented in France in 2006. Thus, 1990-1998 in Switzerland and 1990-1994 in France are the benchmark periods (no decoupling), against which the other reform periods are compared. On the other hand, the effect of agricultural policies is analysed with subsidy variables (s). Subsidies received by farms are separated into various categories of subsidies, both first-pillar-like subsidies and second-pillar-like subsidies: area payments, payments to crop area ('crop subsidies'), payments to livestock headage ('animal subsidies'), agri-environmental subsidies, subsidies to farms situated in Less Favoured Area (LFA), and subsidies to farm investment. It should be noted that area payments are used only for Switzerland as the data about Single Farm Payments (SFP) were not yet available. In order to avoid capturing size effects, all subsidies are divided by the UAA ('subsidies to land'). Also, in order to check for a varying effect depending on the policy reform, subsidies are divided into periods; for example, the variable 'crop subsidies to land 90-95' represents the amount of payments to crop area received by the farms per hectare of land used during the period 1990-1995.

All value variables were deflated by the national consumer price indices.

Table 1 presents descriptive statistics for both samples. French farms are much larger than Swiss farms (118 *vs*. 25 hectares on average), but the difference is not so pronounced in terms of total labour use (1.71 *vs*. 1.58 AWU on average). Swiss farms resort more to hired labour

than French farms do: 0.46 AWU that is to say 41 percent of the total labour, *vs*. 0.37 AWU and 28 percent. Regarding the use of contract labour, in order to have a range of comparison, we divide the total expenditure spent on such labour by the average price of hired labour calculated for the sample as described above. This gives an approximation of the hours, and thus the number of AWU (one AWU is equivalent to 2,200 hours) for contract labour. In France, the number of AWU of contract labour is approximately 0.60 and in Switzerland 0.28. This reveals that French farms use 1.6 times as much contract labour as hired labour, while, by contrast, Swiss farms use 1.6 times as much hired labour as contract labour.

To design the econometric specification, *lHL* and *lCL* denote the latent variables associated to the observed hired labour (*HL**) and contract work (*CL**) respectively. When one of the latent variables is negative, its corresponding observed variable is nil because of its censure. In our samples, the observed contract work is never censored (most of the farms use such labour) although its distribution is highly asymmetric. As a consequence, *lCL* is useless. For the estimation we use a logarithm transformation of *CL** to fit its asymmetric distribution better.

We assume that the three variables *lHL*, *CL** and *Lf** are distributed according to a trinomial normal cumulative function. The deterministic part is a linear function of the explanatory variables of a vector x that gathers a constant term and the observed above-mentioned determinants $(T, Lo, Io, s, wHL, wCL, Z, X, p)$. Subscript j refers to the j-th observation for each variable while Greek letters are the parameters to be estimated. The observations are assumed independently and identically distributed. The sample's likelihood is calculated with φ_3 the joint density function of the reduced and centred trinomial normal distribution. Referring to equation (6) and taking into account that *CL** is uncensored, there are two types of observations: farm with hired labour and farms without hired labour. Accordingly, the sample's likelihood *L*(.) is provided by equation (7).

$$
\begin{aligned}
&\left(lHL_j, CL^*_j, Lf^*_j\right) \approx N\left(x_j\beta, x_j\alpha, x_j\gamma, \sigma_1^2, \sigma_2^2, \sigma_3^2, \rho_{12}, \rho_{13}, \rho_{23}\right) \\
&L(HL^*_j, CL^*_j, Lf^*_j, \beta, \alpha, \gamma, \sigma_1^2, \sigma_2^2, \sigma_3^2, \rho_{12}, \rho_{13}, \rho_{23}) = \\
&\prod_{j/Hl^*=0}\left(\int_{u_1=-\infty}^{u_1=-x_j\beta/\sigma_1} \varphi_3(u_1, ((CL^*_j - x_i\alpha)/\sigma_2), ((Lf^*_j - x_i\gamma)/\sigma_3), \rho_{12}, \rho_{13}, \rho_{23}) du_1\right). \\
&\prod_{j/Hl^*>0}\left(\varphi_3(((HL^*_j - x_i\alpha)/\sigma_2), ((CL^*_j - x_i\alpha)/\sigma_2), ((Lf^*_j - x_i\gamma)/\sigma_3), \rho_{12}, \rho_{13}, \rho_{23})\right)
\end{aligned}
\tag{7}
$$

The parameters β, α, γ, ρ and σ are then estimated by the maximum likelihood estimator. Several explanatory variables identified as potential key determinants were not retained in the final model based on convergence and significance criteria.

4. RESULTS

Table 2 presents the econometric results for the French sample, while Table 3 displays those for the Swiss sample. Table 2 reveals that the price of contract labour significantly influences the demand for contract labour and the supply of family labour. The positive effect on contract labour is unexpected and indicates that the amount of contract labour may be influenced rather by the supply than by the demand side. As for the negative effect on family labour, it suggests that contract labour and family labour are substitute. The price of hired labour significantly influences the demand of hired labour and the supply of family labour, both negatively, and the squared price significantly influences both variables as well, both positively. This finding indicates that hired labour is a normal good whose demand is negatively linked to its price, but the effect is fading with higher price. Moreover, the positive effect of the interaction term between the price of hired labour and the UAA, on the demand for hired labour, reveals that the price effect is decreasing with farm size; in other words, larger farms' hired labour demand is less affected by an increase of this labour price. As for the negative effect of the hired labour price on the family labour, it suggests that both types of labour are complement. The price of land has a positive effect on both types of external labour (contract and hired), indicating that such labour acts as a substitute to land.

Farm size (proxied by the total UAA) has a positive effect on both types of external labour, which is intuitively plausible. As for the technology proxy, namely the UAA under irrigation, its positive effect on the contract labour demand and negative effect on the supply of family labour, it suggests that such technology requires specific labour skills or labour that is necessary only on a one-off basis. The share of rented land positively influences all three types of labour, maybe revealing the need of labour to produce and being able to pay rentals. The share of crop output in total farm output, that is to say the extent of specialisation in crop production, has a negative impact on the demand for contract labour and the supply of family labour, but a positive impact on the demand for hired labour in France. This suggests that own labour and contract labour are necessary for animal activities, while hired labour is mainly used for crop activities. The legal status dummies indicate that partnerships use more own labour than companies and also than individual farms (the benchmark); this reveals a size effect (partnerships and companies are usually larger than individual farms), as well as the

availability of own labour (partnerships have more own labour than companies). Companies use more hired labour, while partnerships outsource more. The age of the farmer head has a positive effect on all types of labour, indicating the need of more labour force in general to help on aged farmers' holdings. Regarding education dummies (the benchmark is no or primary education), farmer heads with higher education use more external labour (both contract and hired labour), but use less own labour. This is highly plausible due to the higher opportunity costs of well-educated farmers. As for the localisation dummies, farms located in LFA use less labour of all type: in terms of external labour, it may reflect the shortage in its availability in these unfavoured areas, while in terms of own labour, it may reflect the need to resort to an off-farm activity to maintain the farm activity in these areas. Farms in higher altitude use more contract labour, may be also because hired labour is in shortage in these areas, while farms in middle altitude use less hired labour.

Finally, the last part of the discussion concerns the policy reform periods and the subsidies. The period dummies indicate that, compared to the benchmark period 1990-1994, the use of contract labour and hired labour increased, while the use of own labour decreased. More precisely, the demands for external labour largely increased in the first reform period (1995-1999) that is to say following the introduction of the first decoupled payments. Regarding own labour, the decrease was triggered by Agenda 2000 (period 2000-2005). Looking more deeply at the various types of support, the crop subsidies decrease own labour use (in particular during the periods 1996-1999 and 2006-2007), while animal subsidies and LFA subsidies over the whole period and investment subsidies post-1995 increase its use. Crop subsidies also decrease the use of contract labour during 1990-1999, while the effect is opposite during the whole period for the use of hired labour. Agri-environmental subsidies clearly favour the use of external labour during the whole period. LFA subsidies increase the use of hired labour. Investment subsidies increase the resort to external labour during the whole period, except for contract work during 1990-1995.

Table 3 shows that in Switzerland the price of hired labour only influences, negatively as expected, the demand for hired labour as in France. Also conform to the intuition, farm size (proxied by the UAA) increases the use of all three types of labour similarly as for the French sample. The share of crop output in total output has a negative impact on the demand for hired labour and family labour, suggesting that such types of labour are necessary for animal activities (while it was contract labour and family labour in France). Opposite to France is the result regarding farmer head's age: while the effect on all types of labour was positive in

France, it is negative for Switzerland. As for the farm localisation, farms in LFA and in higher altitude use less labour, as in France, also suggesting that the external labour market is not developed in those areas and family labour is used for off-farm activities.

Regarding the effect of policies, the introduction of direct payments does not significantly alter the use of all labour types (non-significant period dummy). Few subsidies influence the use of labour: crop subsidies post-decoupling decrease the demand for hired labour and the supply of own labour, while animal subsidies increase the demand for hired labour.

5. CONCLUSION

This paper investigates French and Swiss farms' use of various types of labour. Farms are defined by their farm area and the farm household's characteristics. The database contains the results of the labour market equilibriums at the farm levels. Some significant explanatory variables clearly reflect some determinants of the external labour demands and own labour supply, like farmer's age, while some others may reflect the local labour supply characteristics, like the farm location in LFA or mountainous areas. The first main findings are that contract labour and family labour are substitute and hired labour and family labour are complement in France. The second main findings concern the effects of the different types of farm subsidies on the labour demands. Crop area payments clearly discourage the different labour demands, while environment and investment payments favour contract and hired labour.

Some statistical results question the analytical model and the econometric specification. First of all, the contract labour price, which was totally exogenously built by using regional price series in France, does not present the expected negative effect on the demand of contract labour. This result means that farms using more contract labour are located in regions where the price is higher. It also suggests that the contract labour market is characterised by supply constraints that are not controlled by our available variables. Another explanation might be that the price integrates a labour quality dimension which is not incorporated in our model where contract labour is assumed homogenous. This would mean that farms spending more money into contract labour look for highly qualified contract labour.

Considering the family labour demand, several key determinants are unknown because they are not registered in our database. These would be for example total available labour force of the farm household, the household labour force allocated to off-farm work, and off-farm revenue. For this reason, we assumed that farm labour decisions are determined by farmland

availability, either family-owned land or rented land. This assumption is probably very questionable. Although rented land derives from a land market highly imperfect and rigid, it might be an endogenous variable which is simultaneously adjusted with family and hired labour. The modelling and the statistical analysis should be further developed towards that direction.

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TABLE 1. Descriptive statistics for France and Switzerland; averages for the whole period

	France	Switzerland
UAA (ha)	118	25
Total labour use (AWU)	1.71	1.58
Total output produced (euros)	144,307	138,785
Share of crop output in total output (%)	66	54
Total area subsidies (euros)	-	9,290
Total crop subsidies (euros)	26,145	2,954
Total animal subsidies (euros)	1,182	365
Total agri-environmental subsidies (euros)	298	2,414
Total LFA subsidies (euros)	59	109
Total investment subsidies (euros)	398	12,086
Farmer head's age	46.0	45.9
Hired labour (AWU)	0.37	0.46
Family labour (AWU)	1.34	1.11
Total expenditure on contract labour (euros)	6,967	6,955
Approximated contract labour (AWU)	0.60	0.28
Price of hired labour (euros per hour)	5.27	11.14
Number of observations over the period	35,113	2,665

Source: national FADN databases and authors' own calculations

TABLE 2. Econometric for results for France

	Estimate for log of contract labour cost		Estimate for hired labour		Estimate for family labour	
Intercept	6.4018	***	-4.7350	***	1.0835	***
Price of contract labour	0.0017	**	-0.0012		-0.0007	**
Price of hired labour	0.0056		-0.1852	***	-0.0248	***
Price of hired labour squared			0.0024	***	0.0004	***
UAA × Price of hired labour			0.0007	***		
Price of land	0.0006	***	0.0036	***		
UAA	0.0046	***	0.0055	***		
UAA irrigated	0.0067	***	-0.0001		-0.0003	***
Share of rented land	0.0016	***	0.0017	***	0.0004	***
Share of crop in total revenue	-0.0011	**	0.0324	***	-0.0018	***
Dummy partnership	0.2213	***	0.1315	***	0.5806	***
Dummy company	0.0221		0.5152	***	0.2719	***
Farmer head's age	0.0014	*	0.0132	***	0.0064	***
Dummy lower-secondary education	0.1131	***	0.1341	***	-0.0321	***
Dummy higher-secondary education	0.2523	***	0.3056	***	-0.1047	***
Dummy LFA	-0.1077	***	-0.0888	***	-0.0326	***
Dummy altitude <300m	0.3738	***	-0.3374	**	-0.0234	
Dummy altitude 300-600m	0.3357	***	-0.2000		0.0040	
Dummy period 95-99	0.3231	***	0.8564	***	0.0279	
Dummy period 00-05	0.1255	***	0.7756	***	-0.2200	***
Dummy period 06-07	0.1795	***	0.6490	***	-0.2282	***
Crop subsidies to land 90-95	-0.0004	***	0.0018	***		
Crop subsidies to land 96-99	-0.0012	***	-0.0006	**	-0.0007	***
Crop subsidies to land 00-05	-0.0001		0.0002	*		
Crop subsidies to land 06-07	0.0008		0.0009		-0.0008	***
Animal subsidies to land 90-07	0.0028	***	0.0022	***	0.0005	***
Agri-environment subsidies to land 96-99	0.0053	***	0.0086	***	0.0001	
Agri-environment subsidies to land 00-05	0.0037	***	0.0053	***	0.0003	
Agri-environment subsidies to land 06-07	0.0027	**	0.0019		0.0005	
LFA subsidies to land 90-07	-0.0006		0.0073	***	0.0019	***
Investment subsidies to land 90-95	-0.0001	*	0.0002	*		
Investment subsidies to land 96-99	0.0010	***	0.0013	***	0.0002	**
Investment subsidies to land 00-05	0.0018	***	0.0039	***	0.0005	***
Investment subsidies to land 06-07	0.0004	*	-0.0003		0.0001	**
Number of observations	35,089					
Log likelihood	-113,893					
Correlation contract labour - hired labour	0.221 **					
Correlation contract labour - family labour	0.011 ***					
Correlation hired labour - family labour	-0.050 ***					

Source: authors' own calculations

Note: ***, **, * represent significance at 1, 5, 10 percent.

TABLE 3. Econometric for results for Switzerland

	Estimate for log of contract labour cost	Estimate for hired labour	Estimate for family labour
Intercept	9.3813 ***	0.3837 ***	1.6089 ***
Price of hired labour	0.0003	-0.0005 **	-0.0001
UAA	0.0170 ***	0.0280 ***	0.0094 ***
Share of crop in total revenue	-0.0011	-0.0014 *	-0.0035 ***
Farmer head's age	-0.0056 ***	-0.0059 ***	-0.0014 **
Dummy LFA	-0.2348 ***	-0.2117 **	-0.0969 *
Altitude	-0.0005 ***	-0.0003 *	-0.0008 ***
Dummy period 99-07	0.4794	-0.3026	-0.3024
Area payments to land 99-07	-0.0002	0.0001	0.0002
Crop subsidies to land 99-07	-0.0007	-0.0014 ***	-0.0009 ***
Animal subsidies to land 99-07	0.0010	0.0012 *	0.0003
Agri-environment subsidies to land 99-07	-0.0001	0.0002	0.0000
LFA subsidies to land 99-07	-0.0014	0.0011	-0.0005
Number of observations	2,664		
Log likelihood	-6,669		
Correlation contract labour - hired labour	-0.007 **		
Correlation contract labour - family labour	0.015 **		
Correlation hired labour - family labour	0.061 **		

Source: authors' own calculations

Note: ***, **, * represent significance at 1, 5, 10 percent.