Evaluating the impact of rural development measures on farm labour demand: a spatial approach

Yann DESJEUX[*,1], Pierre DUPRAZ[1], Laure LATRUFFE[1], Elise MAIGNE[2], Eric CAHUZAC[2]

[1] INRA, UMR 1302 SMART, F-35000 Rennes, FRANCE

[2] INRA, US ODR, F-31326 Auzeville, France

Paper presented at

8èmes journées de recherches en sciences sociales INRA–SFER–CIRAD
11-12 December 2014, Grenoble, France

[*]. *Corresponding author: INRA UMR SMART, 4 allée Adolphe Bobierre - CS 61103, 35011 Rennes Cedex, France*
E-mail: yann.desjeux@rennes.inra.fr

Evaluating the impact of rural development measures on farm labour use: a spatial approach

Abstract

This article investigates the impact of various rural development measures on the evolution of farm labour in France between 2006 and 2011. Regionally-aggregated data were used, while potential spatial effects were taken into account. Results show that farm labour change was positively influenced by the participation to agroenvironmental schemes targeting the protection of water and biodiversity, but was not influenced by investment aids for farm modernisation, grassland premium, payments to organic farming conversion, or payments for the diversification of farm activities and rural tourism. Besides, delayed effects, related to the participation in the previous programming period (2000-2006), are observed.

Keywords: Rural development measures; Common Agricultural Policy; Farm labour; Impact evaluation; France

JEL codes: J43; Q18; Q52; R12

1 Introduction

This paper investigates the indirect effect of rural development measures (RDMs) of the European Common Agricultural Policy (CAP) on farm labour demand. Although farm labour increase per se is not among the official objectives of the CAP payments, investigating this issue is becoming more relevant in a context of increase of unemployment in Europe and in France.

In France, total on-farm employment decreased by 21.5% between the two agriculture censuses of 2000 and 2010. In 2000 there were 957,400 full-time equivalents on French farms, of which 239,300 were paid labour. In 2010 the respective figures were 751,400 and 218,500 (AGRESTE, 2012). Between 2010 and 2011 total on-farm labour continued to decrease, with 741,700 full-time equivalents in 2011. Paid labour force increased to 221,400 and represented in 2011 30% of the total full-time equivalents, but this increase failed to compensate the steady decline in family labour (AGRESTE, 2013). This national trend reflects the long term evolution of labour productivity improvement in the farm sector. However, at the regional level, RDMs may inverse this general trend in various ways. While investment subsidies may favour the substitution of labour with less costly inputs, they may also increase competitiveness, production and therefore labour demands. Subsidies for farm diversification and agroenvironmental practices may result in less labour intensive farming practices, but in opposite they may enlarge the scope of farm outputs and therefore enhance labour demand.

In this paper the investigation is performed with individual data aggregated at the LAU1 regional level[1]. In contrast to time series at the national level, spatial data enable to take advantage of the geographical heterogeneity of RDMs. Most of these measures are designed at the NUTS2 or NUTS3 regional level and are voluntarily adopted by the farmers. Hence, as far as other determinants of farm labour use are correctly taken into account in the analysis, spatial data are suitable to isolate the effects of RDMs. The application is for France during the 2006-2011 period.

The article is structured as follows. The first section presents the expected impact of each type of studied measures on farm labour, while the following section details the estimation strategy. The next section presents the indicators and data, and the fourth section presents the results. The final section provides some conclusions and discussions.

2 Rural development measures and farm labour demand

The CAP is conceptually based on two differentiated pillars. While the first pillar focuses on the agricultural sector and related markets through market interventions, direct income support and other (coupled or decoupled) subsidies, the second pillar is organised in three axes. Their respective aim is to increase the competitiveness of the agricultural and forestry sector (Axis 1), to improve the quality of the environment and of the countryside (Axis 2), and to enhance the quality of life in rural areas and to promote diversification of the rural economy (Axis 3).

[1] Nomenclature of territorial units for statistics (NUTS) has been set up by Eurostat as a single, coherent system for dividing up the EU's territory in order to produce regional statistics. Two levels of Local Administrative Units (LAU) have been defined: the upper LAU level (LAU1, formerly NUTS4) is defined for most, but not all of the countries, while the lower LAU level (LAU2, formerly NUTS5) consists of municipalities or equivalent units in the Member States.

The present study focuses on measures of CAP Pillar 2, also known as rural development measures for the 2007-2013 programming period. One may consider this as the second rural development programming period (RDP2).

Within the RDP2, the following measures (or sub-measures) are considered here: 121 (farm modernisation), 214A (grassland premium), 214D (conversion to organic farming), 214I (geographically targeted agroenvironmental measures for water or biodiversity protection), and an aggregation of 311 and 313 measures (diversification and tourism). The investment aids (121) are used for the modernisation of farm buildings and machineries. Although they may also target farm compliance with environmental regulation, they usually improve labour productivity. Clearly investment aids reduce the cost of farm equipment relative to the cost of labour and favour the substitution of labour by capital. When the production level is unchanged, investment aids are expected to decrease farm labour demand. However, whereas investment aids may contribute to expand production thanks to improved competitiveness and production capacity, they may also induce a labour demand increase as far as the production effect dominates the substitution effect. Using FADN individual data for French field crop farms in 1990-2007, Dupraz and Latruffe (2010) find a positive effect of investment aids, meaning that the production effect is more important than the substitution effect for the farms in the sector. However, their result does not take into account the exiting farms which are usually more labour intensive than currently operating farms. Petrick and Zier (2011), with an application of difference-in-differences approach on county-level data in three East German States between 1999 and 2006, find that investment subsidies did not affect agricultural employment. To conclude, the effect of investment aids is not clear cut and remains an empirical issue.

Agroenvironmental schemes (AESs), referred to as "Measures 214" in the RDP2, cover a large array of objectives. They are designed to compensate the forgone profits or the additional costs incurred by farmers who voluntarily adopt environment friendly practices. It is expected that they have a negative effect on labour demand (Bonnieux *et al.*, 1998). However, these measures may prevent agricultural land abandonment, especially for semi-natural habitats with low agricultural productivity (Dupraz and Rainelli, 2004). The reason is that farmers voluntarily contracting these measures do so when they are able to generate a profit which is sufficient to maintain their activity in targeted areas. It is expected that measures compensating for additional costs incurred by contracting farmers have a positive effect on labour demand. Additional costs are generated by new activities, as for instance the maintenance of ditches or hedges required by certain geographically targeted measures for water or biodiversity protection (214I). The measure subsidising the conversion to organic farming (214D) may be assimilated to an investment aid. Since organic farming requires greater workload but generates reduced yields, it is expected that the labour demand increases when converting from conventional to organic farming. This is confirmed by Petrick and Zier (2011), who find that payments to organic farming increased agricultural employment in Germany. One difficulty in evaluating the impact of AESs on farm labour is that they include many diverse measures that may have very different effects (Dupraz, 2003). In France Dupraz and Latruffe (2010) find a much higher positive effect of agroenvironmental payments on on-farm labour use than the effect of investment aids. This finding suggests that the maintenance or development of environment friendly activities in farms triggered by agroenvironmental payments is more important than the reduction of intensive production activities. In Germany during the period 2000-2005 Pufahl and Weiss (2009) report from a propensity score matching approach, that the participation to AESs had a positive effect on on-farm labour. To conclude, and based on these studies, the effect of AESs on farm labour may be expected to be positive.

Measures 311 and 313, part of the Axis 3 of RDP2, mainly support the diversification of farm activities, on-farm "green" tourism and related labour intensive service activities. Hence, it is expected that these measures positively influence farm labour demand since such activities are usually more labour intensive than agricultural activities (except for horticulture and wine making).

3 Estimation strategy

The analysis is carried out in two stages. In the first stage the uptake of RDMs is econometrically analysed, by using data at a fine geographical resolution (namely LAU1) with the objective to predict their uptake probabilities. In the second stage the effects of the policy measures are estimated on impact indicators. The first-stage predicted probabilities are included in the second stage in order to avoid endogeneity issues.

3.1 Stage 1: Predicting the probabilities of uptaking measures (probit)

At the LAU1 resolution, the uptake of some RDMs by farmers is frequently nil. For this reason, a first stage is carried out estimating the probability of RDM adoption through a probit model. The estimation is performed twice, accounting for ('spatial probit') and ignoring ('simple probit') spatial spillover effects. In the first case the spatial lag model uses a spatial weight matrix that considers the immediate neighbours of each observation. Some agricultural characteristics observed in 2006 for each LAU1 are included in the explanatory variables. The objective is to capture the geographical targeting of the measures.

For each LAU1 region *i* (for *i*=1, ..., *n*), and for an uptake indicator yi, the following binary variable is created:

$$y_i^* = \begin{cases} 1 & if \;\; y_i > 0 \\ 0 & otherwise \end{cases}$$

For the simple probit model, the following linear function is considered: $y_i = \beta x_i + u_i$

where x_i is the vector of the k explanatory variables, β is a vector of coefficients to estimate, and u_i is a random term.

If u_i are independent, identically and normally distributed we can estimate the probability:

$$Prob(y_i^* = 1|x_i) = \Phi(x_i\beta)$$

where Φ represents the standardised normal distribution function.

For the spatial probit, we consider the following model: $y_i = \beta x_i + \rho W y_i + u_i$

where W is a $(n \times n)$ neighbour matrix. Wy_i is the spatial lag and ρ the corresponding coefficient to estimate.

The model can be rewritten as: $y_i = (I - \rho W)^{-1}\beta x_i + \varepsilon_i \quad$ with $\quad \varepsilon_i = (I - \rho W)^{-1}u_i$

and the following probability can be obtained: $Prob(y_i^* = 1|x_i) = \Phi([(I - \rho W)^{-1}x_i\beta])$

The spatial weight matrix (*W*) is built for neighbouring regions with contiguous boundaries, sharing one or more boundary points, in which regions are either listed as neighbours or are absent. The final matrix is a *n* (in our case, *n*=3699 LAU1) by *n* weights matrix, row standardised. Matrix rows are set as zero for any region with zero neighbours.

3.2 Stage 2: Explaining the impact of measures (OLS)

In the second stage the determinants of impact indicators are estimated with Ordinary Least Squares (OLS), both ignoring and accounting for spatial effects. The main impact indicator of interest here is the change in labour demand between 2006 and 2010. The second impact indicator considered is the evolution of farm size during this period. Investigating the determinants of this impact indicator can bring additional insights in the evaluation of the effect of predicted measure uptakes on labour change.

Such estimation may be affected by the problem of endogeneity. Indeed, it is possible that the availability of farm labour, especially underused labour, explains the uptake of measures. For this reason, predicted probabilities from the first-stage probits (i.e. *Pred_variables* for the predicted probabilities from the 'simple probit' models, and *PredS_variables* for the predicted probabilities from the 'spatial probit' models) are included in the explanatory variables.

4 Data

The full period considered runs from 2006 to 2011. However, in the empirical analysis the period is shorter for some measures, depending on data availability. Individual observations are aggregated at the fine geographical resolution of LAU1, although some LAU1 regions have been split to account for the limits of Less Favoured Areas (LFA).

4.1 The indicators

The various uptake (or participation) and impact indicators computed at LAU1 level are presented in Table 1.

Table 1. Details on the indicators used.

	Name	RDP measure	Calculation
Uptake/Participation Indicators	*121.payment*	Farm modernisation (Measure 121)	Average amount (€) of investment aid (measure 121) received during the period 2007-2011 per hectare of UAA (2007)
	214A.area	Grassland premium (Measure 214A)	Share of area (ha) engaged under the 'grassland premium' (measure 214A) between 2007 and 2009, in the whole area (ha) of permanent and temporary grasslands (2007)
	214D.area	Conversion to organic farming (Measure 214D)	Share of area (ha) engaged under the 'conversion to organic farming' measure (measure 214D) between 2007 and 2009, in the whole UAA (2007)
	214I.area	Local AESs targeted towards water or biodiversity protection (Measure 214I)	Share of areas (ha) engaged under 'water or biodiversity local AESs' (measure 214I) between 2007 and 2011, in the whole UAA (2007) *NB: To account for targeting restrictions in the calculation, this indicator is computed only for LAU1 regions having been 214I recipients at least once over the period.*
	Axis3.benef	Farm diversification and support to rural tourism (311 and 313 measures)	Share of beneficiaries engaged in 'diversification into non-agricultural activities' (measure 311) and/or in 'encouragement of tourism activities' (measure 313) between 2007 and 2011, in the overall number of farms (2007) *NB: Due to small numbers of beneficiaries within each 311 and 313 measures, and given that both measures have the same global objective, a single aggregated indicator is used.*

Impact Indicators	*Evol.farmsize* -	Average farm size (ha) in 2009, over the average farm size (ha) in 2007
	Evol.labour -	Difference between on-farm labour in 2010 and in 2006, over the on-farm labour at the beginning of the period (2006) *NB: Labour is measured in Annual Working Units (AWU), and includes AWU from farmers, the members of their family and hired labour*

In the first stage (probit models) the uptake and participation indicators are modelled as dummy variables. For example, the dummy for 121.payment takes the value 1 if the average amount of measure 121 received during the period 2007-2011 per hectare of UAA is strictly positive in the LAU1 considered, and 0 if it is zero. The two impact indicators are used in the second stage (OLS models) in continuous form.

4.2 Descriptive statistics

Basic statistics on the indicators used as dependent variables are presented in Table 2.

Table 2. Descriptive statistics on indicators used as dependent variables.

Variable	NAs	Zeros	Min.	25.	50.	Mean	75.	Max.	Std. Dev
121.payment	8	209	0	11.019	25.423	41.300	49.350	1664.645	68.899
214A.area	57	1027	0	0	0.059	0.154	0.238	1.241	0.206
214D.area	8	1915	0	0	0	0.005	0.004	0.304	0.017
214I.area	0	1525	0	0	0.012	0.050	0.056	2.453	0.114
Axis3.benef	13	2837	0	0	0	0.006	0	0.500	0.023
Evol.farmsize	17	0	0.066	0.995	1.043	1.052	1.093	3.248	0.158
Evol.labour	0	0	-0.708	-0.124	-0.080	-0.073	-0.031	1.390	0.109

Participation indicators France-wise show moderate values (0.5% of UAA converted into organic farming, and 0.06% of farms were beneficiaries of Axis3 measures, for instance) but many of the 3,699 LAU1 have no beneficiaries or areas under contract at all (for example 2837 regions had no beneficiary of Axis3 measures). Measures 121 and 214A (to a lesser extent) were the most contracted, with respectively 94% and 74% of LAU1 regions having at least one beneficiary, or one hectare under contract. Maximum values above 1, observed for the shares of UAA under measure 214A and 214I (respectively 7 and 6 observations) occur in LAU1 regions where grassland areas or UAA in 2007 were larger than those observed in 2009 or 2011.

Regarding the impact indicators, the average farm size at LAU1 levels increased on average by 5.2% over the period, and only 12 LAU1 regions show an increase in the average farm size above 100%. In the meantime, on-farm labour demand had decreased, reflecting the national trend mentioned above. Nevertheless an increase in labour use over the period is noticed in some regions, confirming the need for a spatial analysis. As shown by Figure 1, this positive trend is quite scattered over the territory, with some clusters (e.g. South-Eastern France).

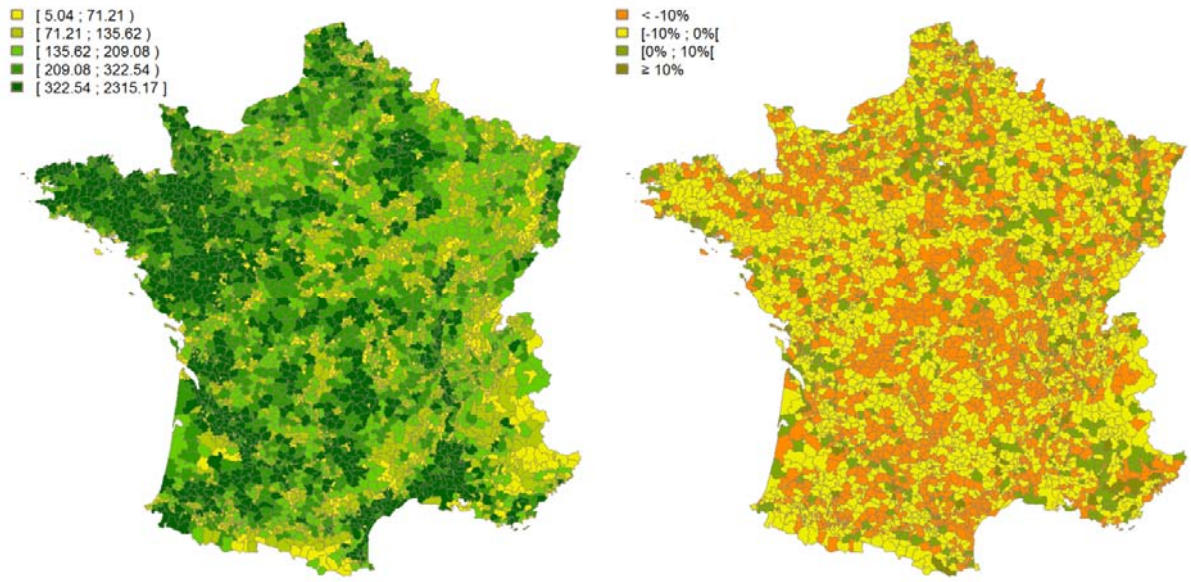

Figure 1: On-farm labour (in AWU) by 'revisited' LAU1, in 2006 (left) and relative change over the 2006-2010 period (right)

Possible 46 explanatory variables include topographic, demographic, sociological and agricultural descriptors. Besides, to test the potential delayed effect of policy measures of the previous (2000-2006) rural development programming period (RDP1), dummies were included, each indicating whether the region benefited from the corresponding measure under RDP1. In the regressions all 46 variables have been tested, but not all have been retained in the final model specification based on model quality statistics. The descriptive statistics of the retained determinants are provided in Table 3.

Table 3. Descriptive statistics on the variables used as determinants.

		FRANCE (n=3699)					
		NA's	**Zeros**	**Min.**	**Mean**	**Max.**	**Std. Dev**
sh_grassl_2000	*Share of grassland within the UAA, in 2000*	0	25	0.00	0.32	1.00	0.28
log_lab06	*Log value of labour present on farm (farm heads, family labour and hired labour in AWU) in 2006*	0	0	1.60	5.03	7.75	0.90
D.mecha.rdp1	*Dummy variable for previous existence of 'mechanisation' payments from RDP1*			0 : 3234 1 : 465			
D.aes.rdp1	*Dummy variable for previous existence of 'AES payment' (other than grassland or crop diversification) payments from RDP1*			0 : 125 1 : 3574			
D.aesdiv.rdp1	*Dummy variable for previous existence of 'AES crop diversification' payments from RDP1*			0 : 2909 1 : 790			
D.YF.rdp1	*Dummy variable for previous existence of payments for setting up of young farmers from RDP1*			0 : 103 1 : 3596			
D.affor.rdp1	*Dummy variable for previous existence of 'afforestation' payments from RDP1*			0 : 589 1 : 3110			
D.train.rdp1	*Dummy variable for previous existence of 'training' payments from RDP1*			0 : 3294 1 : 405			
D.LFA.rdp1	*Dummy variable for previous existence of 'Less Favoured Area' (LFA) payments from RDP1*			0 : 1958 1 : 1741			
D.AO.rdp1	*Dummy variable for previous existence of Agricultural Orientation Premium*			0 : 2801 1 : 898			
D.retir.rdp1	*Dummy variable for previous existence 'early retirement payments' from RDP1*			0 : 1169 1 : 2530			

5 Econometric results

5.1 Probabilities of uptake (first stage)

The results from the estimation of the first-stage probit models show that the spatial lag effect is significant in all cases, and particularly strong for the uptake indicators related to measures 214 (i.e. 214A, 214D, and 214I) and Axis3 measures. Comparing the results across indicators highlights the fact that accounting for spatial effects decreases some significant effects, and suggests that the coefficients encompass part of the spatial effect when the latter is not specified. Besides, considering the spatial lag (ρ) never changes the sign of significant explanatory variables and has little effect on estimates.

5.2 Impact indicators (second stage)

Table 4 presents estimation results for the two impact indicators, the change in farm size and the change in labour use. Results on the two impact indicators are presented for both simple OLS model ("simple") and OLS model considering spatial lags ("spatial").

Table 4. Econometric results on the determinants of impact indicators.

	Evol.farmsize		**Evol.labour**	
	Simple	Spatial	Simple	Spatial
Intercept	0.722 ***	0.707 ***	-0.126 ***	-0.124 ***
sh_grassl_2000	0.013 .	0.013 .	-0.008	-0.008
log_lab06	0.002	0.002	-0.003	-0.001
D.mecha.rdp1	-0.004	-0.003	0.009	0.009
D.aes.rdp1	0.018	0.018 *	0.023	0.026 *
D.aesdiv.rdp1	-0.006 *	-0.005	0.007	0.006
D.YF.rdp1	-0.027	-0.026 **	0.041 .	0.041 **
D.affor.rdp1	0.004	0.004	-0.001	-0.001
D.train.rdp1	0.001	0.001	0.017 *	0.017 **
D.LFA.rdp1	-0.001	-0.002	-0.003	-0.004
D.AO.rdp1	-0.002	-0.002	0.003	0.003
D.retir.rdp1	-0.003	-0.002	-0.018 ***	-0.017 ***
Pred_121.benef	-0.006		-0.012	
Pred_214A.area	-0.006		-0.012	
Pred_214D.area	-0.002		-0.012	
Pred_214I.area	0		0.053 ***	
Pred_axis3.benef	-0.003		0.005	
PredS_121.benef		-0.012		-0.006
PredS_214A.area		-0.006		-0.007
PredS_214D.area		0.002		-0.013
PredS_214I.area		0		0.033 ***
PredS_axis3.benef		-0.006		0.001
R2	0.01		0.02	
AIC		-9069		-5793
N	3676	3676	3685	3685
ρ		0.022		0.124 ***

Note: Significance levels : "." = 0.1 ; "*" = 0.05 ; "**" = 0.01 ; "***" = 0.001
The column "simple" shows results from estimations where spatial effects are ignored.
The column "spatial" shows results from estimations with the spatial lag specifications.
AIC: Akaike information criterion
N: Number of observations
ρ: Parameter of the spatial dependence of the lagged dependent variable

Although the spatial model is the correct specification for changes in farm labour demand (*Evol.labour*) as ρ is significant, considering the spatial lags in both the estimation of the predicted probabilities of measure adoption and in the farm labour demand regression does not change the results but only increases their precision.

Results for the spatial model reveal that the changes in farm labour demand significantly depend on several RDP1 measures. In particular, the aid to promote the settlement of young farmers (*D.YF.rdp1*), the training scheme (*D.train.rdp1*) and the combined investment and agroenvironment payments (*D.aes.rdp1*) have a positive delayed impact, while the early retirement scheme (*D.retir.rdp1*) has a very significant negative delayed effect. All these measures have an investment component that may explain the delayed effect on farm labour. In particular, the opposite effects of the young farmers' settlement aid and of the early retirement scheme are very interesting. In the context of general trend of farm enlargement, it suggests that the settlement aid increased the number of farms in our LAU1 regions and decreased the enlargement possibilities of each farm in place in the current period. This is confirmed by the significant negative delayed effect of the settlement aid on farm enlargement (*Evol.farmsize*) in the current period. Theoretically, a similar effect of the early retirement schemes might have been expected since payments to early retirees were conditioned to the settlement of young farmers, who usually applied for the settlement aid as well. In fact, early retirement per se has no significant delayed effect on farm enlargement. Moreover it decreases farm labour demand change in the current period. The exit of farmers and of other farm workers thanks to the early retirement scheme seems to have been too fast to be balanced by the settlement of young farmers, and eventually results in a decrease in total farm labour. This means that the early retirement scheme was the opportunity, or even an incentive, to increase the acreage per farm worker, despite the associated settlement of young farmers. In contrast, RDP1 AESs, training subsidy and settlement aids created the conditions, such as investments in physical and human capital, to increase the on-farm labour demand, probably associated with an increase in marketed and sometimes non-marketed farm products.

Regarding the current RDP, only the geographically targeted measures for water and/or biodiversity protection (*Pred_214I.area*) have a significant (positive) impact on farm labour change. This means that their "additional cost" effect dominates their "forgone profit" effect in labour demand terms. Few of these measures are clearly "additional cost" measures. The only benefit of this 214 sub-measure is the decrease of fertiliser use that does not compensate for the additional costs of seeds, energy and labour implied by the implementation of the sub-measure. Otherwise most of the locally targeted AESs promote extensive agricultural use of land with agricultural input or animal density limitations: costs are reduced and yield accordingly, with entailed profit losses. Such measures are expected to decrease farm labour demand if the reference scenario is a more intensive use of agricultural inputs to maximise the unconstrained profit. The opposite holds if the counterfactual situation is land abandonment. In these designated areas, the main scenario seems to be land abandonment, resulting in the positive impact of the corresponding measures on farm labour.

Another important result is that other RDP2 measures have no significant effect on the change in on-farm labour. In particular, investment aids (*PredS_121.benef*) have no significant effect: they do not seem to increase labour substitution by physical assets, more than increasing the derived labour demand from an increasing farm output. The result may also come from the fact that investments within such measure may be implemented to comply with the environmental regulation, with no production or productivity side-effects. The non significance of the conversion to organic farming (*PredS_214D.area*) is more surprising. Indeed, increased labour demand is frequently mentioned by organic farming promoters and lobbies as a positive social side-effect of adoption of organic technology (Ollivier and

Guyomard, 2013; Nettier *et al.*, 2012; Offermann and Nieberg, 2000). The same remark holds for Axis3 measures promoting the diversification of farm activities (*PredS_axis3.benef*). Indeed, it could have been expected that the promoted activities, mainly green tourism related activities, are more labour intensive than usual agricultural production ones. The grassland premium (*PredS_214A.area*) has no significant effect, on average. This is a bit surprising since it is the measure with the largest entered area. As for geographically targeted measures, they may have a positive effect where land abandonment is reduced and a negative one where more profitable intensive practices, i.e higher animal density, are limited.

These results may be explained by limitations in the data used, especially the absence of expected effects. Measures with investment components, such as investment support, conversion to organic farming and diversification aids, may induce significant effects in the future, as farm labour usually adjusts with delay. The available data did not enable investigating the delayed effect, and for this reason only simultaneous effects on labour demand in the early stage of the implementation of these rural development measures were evaluated. Nevertheless cross measure effects bring additional insight in the debate. While the geographically targeted measures for water and/or biodiversity protection (*Pred_214I.area*) have a significant positive impact on farm labour change, in parallel they discourage the uptake of conversion to organic farming and Axis3 diversification measures. Asymmetrically, measures for conversion to organic farming and diversification encourage the uptake of geographically targeted measures. Indirectly, these measures may affect farm labour demand when they are associated with geographically targeted measures.

6 Conclusion

This article has investigated the impact of various CAP measures targeted to rural development, on the evolution of on-farm labour change at a fine geographical resolution (LAU1) in France during the period 2006-2011. The analysis has been carried out with several refinements. Firstly, regionally-aggregated data were used and potential spatial effects were taken into account. Secondly, predicted probabilities of uptaking the RDMs were included as explanatory variables instead of uptake indicators per se in order to avoid endogeneity problems. Thirdly, participation in RDMs in the previous RDP period was considered in the explanatory variables, in order to assess whether effects of RDMs on farm labour may be delayed. Finally, determinants of farm size change were estimated in parallel to determinants of farm labour change in order to help the interpretation of the latter.

The first main finding is that no RDMs significantly reduced farm labour in France during the period considered. This is in line with results from Dupraz and Latruffe (2010) suggesting that the decrease in farm labour in France is due to first Pillar payments rather than second Pillar payments.

The second main finding is that farm labour change in 2006-2010 was positively influenced by the participation to locally targeted AESs aiming at the protection of water and biodiversity, but was not significantly influenced by investment aids for farm modernisation, grassland premium, payments to organic farming conversion, or payments for the diversification of farm activities and rural tourism. While the non-significant impact of measures related to investments (121 and Axis 3) may be explained by the fact that opposite effects are at play and is in line with some literature, the finding regarding organic farming is unexpected as organic farming requires a greater workforce than conventional farming. Two reasons may be invoked. One reason is that conventional farms choosing to convert may have been the ones that already implemented practices close to organic ones. This has for example

been shown for a sample of dairy farms in Western France by Latruffe *et al.* (2013). In this case, the labour force employed before and after conversion may not change much. A second reason is that, in the period studied here, subsidies for conversion to organic farming may have attracted farms that are "subsidy-hunters" in organic farming rather than interested by this type of farming per se, as suggested by Pietola and Oude Lansink (2001) and Tzouvelakas *et al.* (2001). Such farms may therefore not be ready to implement the organic technology in the optimal way and may therefore not change their labour use.

The third main finding is that participation in RDMs in the previous programming period (2000-2006) significantly influences farm labour change in the current programming period. More precisely, measures relating to investments (i.e. the aid to promote the settlement of young farmers, the training scheme and the combined investment and agroenvironment payments) that were uptaken before 2006 positively influence farm labour change after 2006. This may explain the second finding that current uptakes of investment measures have no significant influence: the effect may be observed after the current programming period. This strongly calls for accounting for potential delayed effects in the evaluation of policy measures on farm indicators.

7 Acknowledgements

This research was carried out as part of a research project entitled "SPARD; Spatial Analysis of Rural Development Measures", funded by the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement No 244944.

8 References

AGRESTE (2012). Population active. In AGRESTE (Eds), *Graphagri France - Edition 2012*, 35-40.

AGRESTE (2013). Le bilan annuel de l'emploi agricole (BAEA) - Résultats 2011, Chiffres et Données - Série Agriculture n° 220.

Bonnieux, F., Rainelli, P. and Vermersch, D. (1998). Estimating the supply of environmental benefits by agriculture: a French case study. *Environmental and Resource Economics* 11(2): 135-153.

Dupraz, P. (2003). Mesures agro-environnementales et demande de travail agricole. Working paper No. 03-04, INRA-ESR, Rennes, France.

Dupraz, P. and Latruffe, L. (2010). Trends in family labour, hired labour and contract work on French fieldcrop farms: the role of agricultural policies. Contributed paper presented in the 4th annual French Conference of Rural Social Sciences ('Journées INRA-SFER-CIRAD'), Rennes, France.

Dupraz, P. and Rainelli, P. (2004). Institutional approaches to sustain rural landscapes in France. In Brouwer, F. (eds), *Sustaining Agriculture and the Rural Economy*. Edward Elgar Publishing, 162-182.

Latruffe, L., Nauges, C. and Desjeux, Y. (2013). Drivers Inducing and Preventing Conversion to Organic Farming for Dairy and Vegetable Farmers: Findings of a Large-Scale Survey in the French Regions of Brittany and Pays de la Loire. Deliverable No.2, Research Project

'PEPP' ("Role of Farm and Sector Economic Performance and Public Policies in the Development of Organic Farming in France"), INRA, France.

Nettier, B., Dufour, A., Chabrat, S. and Madelrieux, S. (2012). Conversion to organic farming and consequences on work organisation and work perception. 10th European IFSA Symposium, Aarhus, Denmark.

Offermann, F. and Nieberg, H. (2000). Economic performance of organic farms in Europe. University of Hohenheim / Department of Farm Economics, Germany.

Ollivier, G. and Guyomard, H. (2013). Performances sociales de l'AB. In Guyomard, H. (Eds), *Vers des agricultures à hautes performances. Volume 1: Analyse des performances de l'agriculture biologique*, 131-169.

Petrick, M. and Zier, M. (2011). Regional employment impacts of Common Agricultural Policy measures in Eastern Germany: A difference-in-differences approach. *Agricultural Economics* 42: 183-193.

Pietola, K. and Oude Lansink, A. (2001). Farmer response to policies promoting organic farming technologies in Finland. *European Review of Agricultural Economics* 28(1): 1-15.

Pufahl, A. and Weiss, C. (2009). Evaluating the effects of farm programmes: Results from propensity score matching. *European Review of Agricultural Economics* 36(1): 79-101.

Tzouvelekas, V., Pantzios, C.J. and Fotopoulos, C. (2001). Technical efficiency of alternative farming systems: The case of Greek organic and conventional olive-growing farms. *Food Policy* 26: 549-569.