LICOS Centre for Institutions and Economic Performance

Centre of Excellence

LICOS Discussion Paper Series

Discussion Paper 315/2012

# Job Creation and Job Destruction in EU Agriculture

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# JOB CREATION AND JOB DESTRUCTION IN EU AGRICULTURE[1]

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**Abstract**

*This is the first paper to study job creation and destruction in EU agriculture. We disaggregate gross employment patterns and net job flows into detailed intra-sectoral labour adjustment dynamics based on a unique EU-wide farm level panel dataset for 1990-2005. We find that: (1) job creation and destruction rates in EU agriculture are comparable to other sectors; (2) there is some evidence of ongoing substitution of family labour for hired labour (3) there are important differences in job creation and destruction rates between different Member States; (4) these differences can be attributed to structural differences across countries, sectors and farm types; (5) time variation of job reallocation fluctuates countercyclically; (6) idiosyncratic effects are the main driver of time variance in job reallocation.*

**Keywords**: Job creation; job destruction; FADN; EU; labour adjustment in agriculture.

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[1] The authors are grateful to Unit L.3 Microeconomic analysis of EU agricultural holdings from the European Commission for granting access to the FADN data. The authors acknowledge financial support from the European Commission FP7 project 'Comparative Analysis of Factor Markets for Agriculture across the Member States'. The authors are solely responsible for the content of the paper. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

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# JOB CREATION AND JOB DESTRUCTION IN EU AGRICULTURE

## 1 INTRODUCTION

European and other developed economies' agricultural sectors experienced dramatic structural labour adjustments in the period after the Second World War. On the one hand, economic growth and rising agricultural productivity have led to a continuous net labour outflow from agriculture. On the other hand, specialisation and changes in the demand structure and in the scale of production have led to structural quantity and skills shifts in the demand for agricultural labour. Similarly, increasing agricultural price volatility and uncertainty on world and domestic markets, is likely to have important implications for on-/off-farm labour allocation decisions in European agriculture.

A better understanding of the dynamics in the agricultural labour market can provide important insights relevant for policy makers. One of the main priorities of the EU agricultural policy, as outlined in the European Commission strategic document for the future Common Agricultural Policy (CAP), is to maintain viable rural communities through agricultural employment. The background underlining the policy objective of creation and preservation of jobs and employment in rural areas is linked to structural problems persistent in EU rural areas such as emigration of workers, low employment rates and high unemployment rates, mismatch in skills and human capital, and a lack of opportunities for women and young people (European Commission 2012). In order to achieve these policy goals, various set of measures included in the CAP (e.g. rural development programmes, direct payments, investment support, rural diversification measures) target either directly or indirectly agricultural employment and farm viability (European Commission 2010). For policy makers it is utmost important to understand the causes of structural employment problems facing rural areas. Hence, insights in the changes in on-farm labour demand at a disaggregated level can help to identify potential structural behaviour and adjustments of agricultural employment and guide policy advice.

There are numerous studies that apply the job creation and job destruction methodology to manufacturing and services sectors. However, a study analysing job creation and job destruction in EU agriculture is still lacking. This is particularly surprising given the high policy priority and the significant farm labour adjustments that have been observed in EU agriculture in recent decades. As a result, the identification of structural problems of agricultural employment, differences between different types of farms that create jobs and that lay off labour, the role of farm specialisation, differences between family and hired labour adjustments, and their dynamics are not yet fully explored and understood.

Empirical findings from the existing literature on job creation and job destruction in manufacturing and service sectors, offer a number of hypotheses that are useful to be tested also for agriculture (Davis and Haltiwanger 1992; Blanchflower and Burgess 1996; Bilsen and Konings 1998; Mortensen and Pissarides 1994; Commander and Kollo 2008). First, job reallocation – the sum of total jobs created and total jobs destroyed – is inversely correlated with capital intensity.[5] Given that agricultural production is relatively capital intensive, this may reduce job creation/destruction in agriculture. Given the differences in capital intensity between agricultural sub-sectors, the empirical results may also yield different gross job creation and destruction rates across agricultural sub-sectors. Second, smaller and younger establishments create and destroy more jobs than larger and older firms. Given that agricultural farms are relatively small, this may increase job creation/destruction in agriculture. Third, at the firm level, the main cause of job turnover is idiosyncratic shocks, i.e. firm-specific shocks. Idiosyncratic shocks are particularly important in agriculture due to e.g. farm household life crises, shocks related to health status of farm family members, local differences in weather, and spread of diseases. Therefore, we expect high job creation/destruction in agriculture. Furthermore, due to structural differences between sectors and countries, the job creation and destruction rates may differ across countries and even across regions within a country. A final hypothesis relates to the unique character of the majority of farm households in that they combine residence and business objectives. It is often claimed that farm households may attach a value to farming as a way of life and, as a result, assign a shadow value to own labour that is lower than its opportunity cost (Ahearn et al., 2009). If this is the case, this can create 'stickiness' of agricultural (family) labour and mitigate some of the drivers towards high job creation and destruction in the agricultural sector.

In order to test these hypothesis empirically, we estimate the following job creation and destruction indicators for EU agriculture: (i) the magnitude of job creation,

[5] A general finding in the literature is that jobs are created and destroyed more rapidly for instance in services than in the manufacturing sector.

job destruction and job reallocation; (ii) cross-sectoral and farm-type differences in job creation and job destruction; (iii) the variation of these indices over time; and (iv) differences in labour types being created and/or destructed. Further, we apply a cell-based regression model to identify the main drivers of job creation and destruction in EU agriculture. The empirical analysis is based on a unique farm level panel dataset from the Farm Accountancy Data Network (FADN).

The remainder of the paper is organised as follows. First, we develop a theoretical framework for analysing job creation and destruction in agriculture, and introduce the key concepts that we use in the empirical analysis, such as farm growth, job creation rate and job destruction rate. In section 3 we explain our empirical strategy. Next, we present empirical results on job destruction and creation in EU agriculture. We conclude with a discussion of our findings and policy implications of these results.

## 2 THEORETICAL FRAMEWORK

### 2.1 Analytical approaches to labour adjustment

There are two main approaches in the literature that explain causes of changes in the sypply and demand of employment in the overall economy or at a sectoral level: household models and job creation and destruction models. The models based on farm household utility maximisation are extensively used to explain the observed patterns of adjustment in agriculture (Huffman, 1980; Huffman and Lange, 1989; Sumner, 1982). In particular, farm household models are employed to explain the allocation of household labour between leisure, off-farm labour and farm labour (Ahearn et al., 2006; Bojnec and Dries, 2005; Gould and Saupe, 1989; Mishra and Goodwin, 1997; Rizov and Swinnen, 2004; Serra et al., 2005; Woldehanna et al., 2000).

However, evidence from the empirical literature suggests that in most sectors labour behaviour is characterised by large simultaneous creation and destruction of jobs (Davis and Haltiwanger, 1992; Blanchflower and Burgess, 1996; Bilsen and Konings, 1998; Mortensen and Pissarides, 1999; Commander and Kollo, 2008). Farm household models, which in general assume representative/homogenous firms and/or homogenous shocks, are unable to explain the observed simultaneous divergence in job flows and intra-sectoral job flows (job creation and job destruction). For the purpose of this paper, the farm household model is therefore ill-suited.

Recent developments in the search and matching theory have put forward *firm heterogeneity* given by firms' structural differences and *idiosyncratic shocks* faced by firms as theoretical explanations of the creation and destruction of jobs (McCall, 1970; Mortensen and Pissarides, 1994; Pissarides, 2000; Petrongolo and Pissarides, 2001; Klein et al., 2003).

In the context of the present study, the main advantage of this approach – vis-à-vis farm household models – is that it is able to disaggregate the aggregate employment patterns and job flows into detailed sources of labour adjustment dynamics. It allows us to identify the sources of job growth and job losses among different types of farms, agricultural sub-sectors, labour types, and their variation over time. Moreover, the job creation and job destruction approach can identify structural challenges in agricultural employment. Therefore, the present paper adopts the job creation and job destruction approach to study the agricultural labour adjustments in the EU.

### 2.2 Conceptual model of job creation and job destruction

Job creation and job destruction can be the result of entry or exit of firms and of growth or decline in labour demand in existing firms. As such, job destruction and creation is undeniably connected to structural change in the agricultural sector and the change in farm size distribution (Ahearn et al., 2009). In order to simplify the theoretical exposition, the underlying conceptual model focuses primarily on the growth and decline in labour demand on existing farms. The exit and entry of farms is fully taken into account in the empirical analysis.

According to Klein et al. (2003), there are two sources of firm-specific gross job creation and destruction within a narrowly-defined industry. Firms may have *structural differences* or firms may have a common structure but face *idiosyncratic shocks*. In the context of EU agriculture, farm structural differences may arise due to technological differences (e.g. labour versus capital intensive production), differences in production structure (the mix of agricultural activities), labour type (family versus hired), and variation in subsidisation across agricultural sub-sectors. Idiosyncratic shocks include farm-specific shocks, which vary across farms in a given period, such as regional differences in weather, crop and animal diseases, productivity changes, farm household life crises, and/or shocks related to the health status of farm family members. Given that these idiosyncratic shocks are particularly important in the agricultural production, we expect that they expose agricultural sector to larger employment adjustments than other sectors.

The two sources of job creation and job destruction can be shown in a simple farm model of profit maximisation. Assume that labour demand of farm *i* is given by:

(1) $D_i = D(p, v, r, s, T_i, H_i)$

where $p$ is a vector of output prices, $v$ is the wage rate,[6] $r$ is a vector of other input prices, $s$ are subsidies, $T$ is farm technology and $H$ are other farm-specific characteristics which affect farm labour demand.

In equation (1) structural differences are determined by the mix of output produced and farm-specific technology, $T_i$. An asymmetric change in output prices, input prices and/or subsidies (e.g. due to changes in market intervention policy) would induce a differentiated employment response between farms. For example, farms specialised in products for which the relative output prices increase, will create jobs, while farms specialised in products for which the relative prices decrease, will release jobs. The idiosyncratic shocks affect farm labour through the specific characteristics of the farm household, $H_i$, and through farm-specific technology, $T_i$. Farms affected, for example, by animal diseases or bad weather will release jobs, while farms experiencing good weather and no diseases will create or maintain jobs.

### 2.3 The impact of idiosyncratic shocks on job creation and job destruction

To illustrate the gross job creation (GJC) and gross job destruction (GJD) effects in agriculture, we assume two farms, i.e. farm 1 (dairy farm) and farm 2 (crop farm) with their respective initial labour demand given by $D_{10}$ and $D_{20}$ (upper panel in Figure 1). The horizontal summation of $D_{10}$ and $D_{20}$ yields the aggregate labour demand, $D$. The equilibrium employment of farm 1 and farm 2, the aggregate employment, and the equilibrium wage are $n_d^*$, $n_c^*$, $N^*$, $v^*$, respectively.

Consider an idiosyncratic shock in a given period which reduces productivity for the dairy sector (e.g. due to animal diseases), while it increases productivity of the crop sector to (e.g. due to good weather). This implies that farm 1, which is specialised in dairy, will reduce its labour demand (from $D_{10}$ to $D_{11}$), whereas farm 2, which is specialised in crop production, will increase its labour demand (from $D_{20}$ to $D_{21}$). In equilibrium farm 1 destroys $n_d^* - n_{d1}^*$ jobs, whereas farm 2 creates $n_{c1}^* - n_c^*$ jobs.

[6] We assume a small agricultural sector in the overall economy implying an exogenous wage rate.

Assuming that GJC is equal to GJD ($n_d^* - n_{d1}^* = n_{c1}^* - n_c^*$), the aggregate equilibrium labour is not affected and remains at $N^*$. The lower panel in Figure 1 shows the GJC and GJD curves. Even though, the aggregate employment is not affected, there are important (hidden) structural changes taking place in agricultural employment. Jobs are destroyed in the dairy sector while new jobs are created in the crop sector, both equal to $GJD^*$, where $GJD^* = n_d^* - n_{d1}^* = n_{c1}^* - n_c^* = GJC^*$.

Next, consider an idiosyncratic shock which implies a higher increase in crop productivity (e.g. adoption of new crop varieties), and the same decrease in productivity of the dairy farm. Everything else equal, this implies the same shift in the labour demand of dairy farm 1 (from $D_{10}$ to $D_{11}$), but a stronger increase in the labour demand of crop farm 2 (from $D_{20}$ to $D_{22}$). Now the GJC exceeds the GJD ($n_{c2}^* - n_c^* > n_d^* - n_{d1}^*$) and aggregate employment increases to $N_2^*$, which is given in the upper panel of Figure 1. The GJC curve is above the GJD curve if the idiosyncratic shock induces an increase in aggregate farm employment, implying that more jobs are created than destroyed (bottom panel of Figure 1). The GJC curve is below the GJD curve, if the shock leads to a reduction in aggregate agricultural employment. At $N^*$ the GJC and GJD curves intersect. The type and the magnitude of shocks determine the shape and the position of the GJC and GJD curves. Different types of shocks may change the shape and/or may move the GJC and GJD curves up or down.

## 3 EMPIRICAL STRATEGY

In this section we explain the methodology for empirical analysis. First, we define and explain the method we employ for calculating the rates of job creation and job destruction. Then we introduce the econometric approaches we employ to identify patterns of job creation and job destruction in EU agriculture: (i) a cell-based regression model to identify factors affecting job creation and destruction; and (ii) the variance decomposition to analyse job reallocation dynamics.

### 3.1 Job creation and job destruction rate

Following Davis and Haltiwanger (1992), with employment $n_{it}$ at farm *i* at time *t*, total employment at time *t* can be expressed as:

$$(2) \quad N_t^T = \sum_{i \in F_t} w_{it} n_{it}$$

where $F_t$ denotes the set of farms in the sample and $w_{it}$ is the sample weight of farm *i*, which equals the reciprocal of its sampling probability. Sample weights are suppressed in what follows to simplify the notation but they are applied in the actual construction of the measures.

Following Davis and Haltiwanger (1992), for each farm we define its size, $x_{it}$, as the average employment between periods *t* and *t*-1. Subsequently, farm growth, $g_{it}$, is measured as:

$$(3) \quad g_{it} = \frac{n_{it} - n_{it-1}}{x_{it}}$$

GJC in sub-sector *s* at year *t* is the sum of employment gains in year *t* at expanding farms in that sub-sector and GJD is the sum of employment losses in shrinking farms. In the empirical analysis we use job creation (JCR) and destruction rates (JDR) by normalising the gross measures by the size of the sub-sector in year *t*:[7]

$$(4) \quad JCR_{st} = \sum_{i \in S, g_{it} > 0} \left( \frac{n_{it}}{N_{st}} \right) g_{it}$$

$$(5) \quad JDR_{st} = \sum_{i \in S, g_{it} < 0} \left( \frac{n_{it}}{N_{st}} \right) g_{it}$$

### 3.2 Cell-based regression model

We conduct a cell-based regression analysis to identify the main drivers affecting job creation and destruction. Following Dunne et al. (1989), Davis (1998) and Davis and Haltiwanger (1999), we specify the following regression model:

$$(6) \quad Y_{ijkl} = \sum_{i}^{6} \alpha 1_i \, year + \sum_{j}^{6} \alpha 2_j \, country + \sum_{k}^{4} \alpha 3_k \, size + \sum_{l}^{8} \alpha 4_l \, \mathrm{sec}tor + \sum_{m}^{6} \beta_m X_{ijkl} + \varepsilon_{ijkl}$$

where $Y_{ijkl}$ represents JCR and JDR, year, country, size and sector are dummy variables represent each of the time periods, EU Member States, size categories and sectors respectively, while $X_{ijkl}$ represents a vector that includes structural variables related to the average farm characteristics in each cell. These structural variables include: measures of output; input use; degree of subsidisation; assets; family labour use; indebtedness.

[7] The size of the sub-sector is defined as average employment in the sub-sector between years *t* and *t*-1.

This methodology regroups all farms into data cells and uses all observations within each cell to consistently estimate parameters of the distributions of the realised net job creation and destruction rates for all farms within the cell. The regression model (6) is then used to summarise the across-cell variation in these estimates. The underlying assumption is that all farms within a cell are homogeneous up to a random disturbance with a zero mean and constant, cell-specific variance. In the context of the present study, the grouped data technique that we employ has several important advantages. For example, any distributional assumptions are avoided. Therefore, a great degree of nonlinearity is allowed for in the mean and variance of the observed values. As a result, we can avoid the difficulty of separating sample selection, heteroskedasticity, and the nonlinear effects of explanatory variables on the conditional mean of the latent variable distribution (Dunne et al. 1989).

### 3.3 Job reallocation dynamics

According to Davis and Haltiwanger (1992), firm-level employment growth rates can be represented as follows:

(7) $$g_{it} = \tilde{g}_{it}^{ST} + g_{st} + g_t$$

where $g_t$ is the overall annual growth rate, $g_{st}$ is sector-level growth rate and $\tilde{g}_{it}^{ST}$ is the residual idiosyncratic component of the farm-level growth rate. In other words, each farm's growth rate at time *t* is the sum of an aggregate effect, a sector-time effect and a time-varying idiosyncratic effect. Based on this decomposition, we can measure the relative importance of aggregate, sectoral and idiosyncratic components of time variation in job creation, job destruction and job reallocation rates (JRR)[8], as well as the co-variation of components. The approach proposed by Davis and Haltiwanger (1992) starts by calculating the JCR, JDR and JRR adjusted for aggregate-time and sector-time effects based on the distribution of $\tilde{g}_{it}^{ST}$. For example, the job reallocation rate resulting from idiosyncratic effects (i.e. the absolute deviation of the growth rate from the overall and sectoral means) is given by:

(8) $$\overline{JRR}_t^{ST} = \sum_i \frac{n_{it}}{N_t} \left| \tilde{g}_{it}^{ST} \right|$$

and the variance decomposition for job reallocation can be derived as:[9]

[8] JRR is defined as the sum of the job creation rate and the absolute value of the job destruction rate.
[9] The variance of job creation and job destruction rates is decomposed in a similar way.

(9) $$\operatorname{var}(JRR_t) = \operatorname{var}\left(\overline{JRR}_t^{ST}\right) + \operatorname{var}\left(JRR_t - \overline{JRR}_t^{ST}\right) + 2\operatorname{cov}\left(\overline{JRR}_t^{ST}, JRR_t - \overline{JRR}_t^{ST}\right)$$

The ratio of $\operatorname{var}\left(\overline{JRR}_t^{ST}\right)$ to $\operatorname{var}(JRR_t)$ equals zero if the distribution of $\tilde{g}_{it}^{ST}$ is time-invariant. On the other hand, a large ratio indicates that the inter-temporal variation in the cross-sectional variance of $\tilde{g}_{it}^{ST}$ accounts for a significant part of the inter-temporal variation in job reallocation. The covariance term can be interpreted as the part of inter-temporal variation in job reallocation that cannot unambiguously be attributed to either aggregate and sectoral effects or to idiosyncratic effects.

## 4 DATA AND EMPIRICAL RESULTS

### 4.1 Data

The main source of the data we use in the empirical analysis is the Farm Accountancy Data Network (FADN), which is compiled and maintained by the European Commission. The FADN is a European system of sample surveys that take place each year and collect structural and accountancy data on farms. In total there is information about 150 variables on farm labour – measured as full-time equivalents – farm structure and yield, output, costs, subsidies and taxes, income, balance sheet, and financial indicators. The yearly FADN sample covers approximately 80,000 agricultural farms in the EU. They represent a population of around 5,000,000 farms, covering approximately 90% of the total utilised agricultural area and accounting for more than 90% of the total agricultural production.

FADN provides a harmonised source of micro-economic data (the bookkeeping principles are the same across all EU Member States) and is representative of the commercial agricultural holdings in the EU. Holdings are selected to take part in the survey based on sampling plans established at the level of each region in the EU. FADN is a panel dataset, which means that farms that stay in the panel in consecutive years can be traced over time using a unique identifier.

Job creation and destruction in EU agriculture is analysed over the time period 1990 – 2005. Successive accession rounds within this time frame have changed the size and composition of the EU agricultural sector that is represented in the FADN panel. Therefore, we will focus our analysis on those EU Member States that were already included in the FADN panel in 1990.[10]

[10] We refer to this sub-sample as EU-12, including Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxemburg, The Netherlands, Portugal and the United Kingdom.

Farm exits and entries are likely to represent an important aspect of job creation and destruction in EU agriculture. The application of farm weights in the definition of JCR and JDR allows us to take the exits and entries – as well as on-farm labour adjustments – into account in the empirical estimation.[11] Farm weights are derived from the Farm Structure Survey (FSS).[12] Because these census data are only updated every two or three years,[13] we present the average annual job creation and destruction rates in two- and three-year intervals.

### 4.2 Job creation and destruction in the EU

Table 1 reports the average annual job creation and destruction rates for the EU-12 over the period 1990-2005. In line with our expectations and results from aggregate farm labour adjustment studies, we find that JDR tends to be larger than JCR. In other words, there is net labour outflow of workers from agriculture in the EU. Figure 2 provides a graphical representation of this trend. According to Figure 2, movements in JCR and JDR are strongly correlated. In periods, when more jobs are created, also more jobs are destroyed, and vice versa.

Second, we find that on average the JCR and JDR in agriculture are 11.0% and 14.2%, respectively. The variation between years ranges from 8.4% to 14.6% for JCR, and from 11.7% to 18.1% for JDR. These results are in line with other studies. In a study on several OECD countries by Contini et al. (1995), the JCR and JDR varied between 8% and 15% in the 1984-1992 period. Davis and Haltiwanger (1992) report JCR and JDR between 6% and 16% for the US manufacturing sector over the period 1972 and 1986. Smeets and Warzynski (2006) report slightly lower estimates for the Polish economy for the period between 1997 and 2000: 3% - 10%.

On the one hand, one may expect higher JCR and JDR in agriculture compared to other sectors due to three reasons: larger (and more frequent) idiosyncratic shocks, the importance of seasonal labour and the relatively small size of establishments in agriculture. First, idiosyncratic shocks such as weather and diseases are largely specific to agriculture and may lead to large fluctuations in production and hence in employment

[11] It should be noted that weights have been adjusted after merging FADN samples in consecutive years. This was necessary because in each year *t* some farms from the *t*-1 sample are dropped, while some new *t* farms – that were not yet present in the *t*-1 sample – are included. Since we can only calculate employment changes in farms that are in the sample both at *t* and *t*-1, weights have to be adjusted.

[12] The FSS is carried out by all EU Member States every 10 years (the agricultural census) with intermediate sample surveys being carried out three times between the basic surveys (Eurostat 2010).

[13] The years when the FSS censuses/ intermediate sample surveys were organized are 1990, 1993, 1995, 1997, 2000, 2003, 2005 and 2007.

compared to other sectors. Second, agriculture, unlike most other sectors, relies heavily on seasonal labour. The employment of seasonal workers is easy to adjust since often seasonal labour is based on verbal agreements or contracted on a short-term basis only to cover the labour needs in the high season. Moreover, family labour which makes up an important share of agricultural employment is often flexible to adjust its labour allocation between on and off-farm activities. Third, studies from other industries have shown that, on average, smaller establishments create and destroy more jobs than larger plants (Acquisti and Lehmann 1999; Mortensen and Pissarides 1999). Given that in terms of employed labour, farms are relatively small enterprises, the JDR and JCR should be higher in agriculture.

On the other hand, findings from the literature suggest that job flows are inversely correlated with capital intensity and firm age (Mortensen and Pissarides 1999). The agricultural sector is a capital intensive industry with assets such as buildings, machinery, equipment and breeding livestock dominating the fixed asset structure of farms particularly in developed economies (Barry and Robinson 2001). Similarly, the ageing of farmers is a widespread structural problem in EU agriculture (Carbone and Subioli 2008). Hence, capital intensity and the ageing of the farm population may partially offset the effect of idiosyncratic shocks, seasonal labour and the small size of agricultural establishments on farm labour adjustments. Furthermore, the uniqueness of family farms of serving not only as income generators but also as residence and family heritage may be an additional factor that offsets expected labour adjustment dynamics (Ahearn et al., 2009).

Further investigation suggests that both family and hired labour have job creation and destruction rates that are similar to the aggregate rates shown in Table 1. The variation between years in job creation and job destruction ranges from 8.7% - 15.0% (JCR) and 11.9% - 19.3% (JDR) for family labour and from 9.6% - 21.1% (JCR) and 12.0% - 17.3% (JDR) for hired labour. This could be due to the fact that both are relatively flexible: for hired labour it may be a result of the seasonal nature of their employment while for family labour this could be the result of higher flexibility of leisure, on-farm and off-farm employment decisions. Generally, the JCR appears to be slightly higher for hired labour than for family labour, while the JDR does not show a consistent difference between the two types of labour. This structural difference may indicate a substitution of family for hired labour, whereby the latter type of labour tends to be preferred to the former in satisfying farm job needs. These finding are in line with the aggregate development of farm labour allocation. According to the FADN data, the average share of hired labour in total labour increased from around 18% in 1989 to around 26% in 2007 in EU-12. Given the structural change over time in the agricultural sector towards a larger share of large-scale farms (Ahearn et al., 2009), this increase the use of hired labour is also not surprising.

Table 2 decomposes the overall job creation and destruction rates for farms in different size classes. The results reported in table 2 support the hypothesis that small farms relocate more jobs than big farms. This is consistent with empirical findings from the literature, which suggest that smaller establishments create and destroy more jobs than larger plants (Acquisti and Lehmann 1999; Mortensen and Pissarides 1999).

There are three factors which may explain these results: stronger idiosyncratic shocks in small farms, structural changes and labour contracts. First, small farms may face stronger idiosyncratic shocks. This can be due to the fact that small farms are more exposed to family crises (big farms are likely to use more hired labour than family labour in relative terms). Furthermore, small farms have fewer possibilities to diversify production and economies of scale in (quasi-)fixed production factors may allow big farms to reduce uncertainty over production outcomes (e.g. through irrigation, pest control, crop/animal disease prevention, fertiliser use, insurance). Second, there is a trend of continuously increasing farm sizes in the EU over time, implying more job destruction (less job creation) in small farms than in big farms. Finally, many large farms are commercial farms and a substantial share of labour may have a long-term employment contract, which makes them more rigid in terms of labour adjustment, resulting in smaller fluctuations in labour flows.

Table 3 shows that there is a significant fluctuation in job creation and destruction rates between countries. Generally, the net flows are negative in the EU-12 with only one exception: Spain. Furthermore, the table shows that farm size is an important factor in explaining differences in job creation and destruction rates between Member States. Member States with a lower average farm size have a higher JCR and JDR.

### 4.3 Cell-based regression results

Following Dunne et al. (1989) and Davis and Haltiwanger (1999), we have regrouped all observations based on the year of observation in the FADN sample, country, and categories of farm size and sector.[14] The average annual job creation and job destruction rate is calculated – based on expressions (4) and (5) – for each cell using the observations on all farms in the cell. Furthermore, for each cell we calculated summary statistics that typify the characteristics of farms per cell at the begin of the observation period. These cell characteristics include measures of output (average output per ha); input use (average labour use per ha); degree of subsidisation (average subsidies per ha); assets (average assets per ha); family labour use (average ratio of family to total labour); indebtedness (average liabilities over assets ratio). Next, the regression model (6) is estimated to examine across-cell patterns of job creation and destruction, where the cell characteristics are used as structural variables in the regression model to identify the role of farm characteristics in explaining the job creation and destruction rates.

Table 4 reports results of the cell-based regression model. Several conclusions can be drawn with respect to the determinants of job creation and destruction in EU agriculture. First, farm-level structural variables do not contribute to the explanation of job creation rates. This seems to indicate that productivity (output / ha) or technological differences (input or capital intensity) between farms cannot be identified as drivers of job creation. This is an interesting result in view of the policy dilemma to create productivity gains in the agricultural sector (which often include the introduction of labour-saving technologies) and creating jobs at the same time. The current result seems to suggest that the relationship between both dynamics does not necessarily need to be negative. Second, job creation seems to be much higher in Spain than in the other EU Member States. This could be due to south-north differences in the pattern of job creation. The estimated results for Southern European countries reveal a smaller difference in job creation with Spain as compared to Northern European countries. The absolute value of estimated coefficients for Greece, Italy and Portugal are lower by a factor between 1.5 and 2.3 relative to Northern European countries. Third, job creation increased in the middle of the 1990s and again after 2003. Again this is an interesting result from a policy perspective as these periods follow two major agricultural policy reforms (the MacSharry reform in 1992 and the mid-term reform in 2003). While

[14] Years include the FSS periods 1990-1993; 1993-1995; 1995-1997; 1997-2000; 2000-2003; 2003-2005. Countries include the 12 EU Member States that span the whole period 1990-2005: Belgium; Denmark; Germany; Greece; Spain; France; Ireland; Italy; Luxemburg; the Netherlands; Portugal; UK. Size categories include size1 (< 6 ESU); size2 (6-12 ESU); size3 (12-40 ESU); size4 (>40 ESU). Sectors include Cereals (cereals, oilseed and protein crops); Field crops; Permanent crops (horticulture; vineyards; fruit and citrus fruit; olives); Milk; Grazing livestock (cattle rearing and fattening; cattle dairying, rearing and fattening combined); Sheep and goats; Pigs and poultry; Mixed farms (various crops and livestock combined).

several policy impact studies find weak or negative aggregate effects of these reforms on agricultural employment (e.g. Ooms and Hall 2005), the results in table 4 show that there has also been a positive employment effect because significant job creation has occurred in these periods (e.g. Olper, et al. 2011). Finally, job creation is more pronounced in mixed farms than in specialised crop and dairy farms.

On the other hand, structural variables do play a role – albeit limited – in explaining the job destruction rates in agriculture. More input intensive farms display higher job destruction rates, while more indebted farms have lower rates of job destruction. Farm size also plays a role, with smaller farms having higher rates of job destruction than larger farms. These results are in line with general findings in the literature (Acquisti and Lehmann 1999; Bilsen and Konings 1998; Commander and Kollo 2008; Mortensen and Pissarides 1999). Job destruction rates in EU agriculture are higher in recent years than in the beginning of the 1990s. There are distinct differences between EU Member States. Finally, there is little econometric support for the link between job destruction and capital intensity, to the extent that different agricultural sub-sectors do not display significant differences in job destruction.

### 4.4 Job reallocation dynamics in the EU

Table 5 shows the total job reallocation rate at EU-12 level. Job reallocation ranges from 20% to 33% which represents a significant annual adjustment of the agricultural labour force. The correlation between the job reallocation and net job growth (NET) over time is around 0.25, -0.38, -0.55 and -0.47 at EU-12, country, sector and farm size level, respectively. These correlations indicate that job reallocation exhibits significant countercyclical variation. For example, between the business cycle peak[15] in 1991/2 and the trough in 1993/4, the job reallocation rate increased by 12 percentage points. This indicates that there is a close relationship between job reallocation and the business cycle. An interesting question is why the job reallocation rate fluctuates counter-cyclically. In order to address this question we follow the approach by Davis and Haltiwanger (1992), and attempt to identify what share of inter-temporal variation in job reallocation can be attributed to mean responses of the farm-level growth rate density and which share is accounted for by mean sectoral responses to aggregate disturbances.

[15] Business cycle information is based on Ozyildirim et al. (2008) and CEPR data (www.cepr.org/data/dating/).

Table 6 decomposes the time-variance of job reallocation, creation and destruction rates for the total sample, per country, sector and size class. The top panel shows that aggregate and sectoral effects account for only a small share of the total time variation in job reallocation (from 0.1% using the sectoral classification to 4.8% based on size class). Even if we assign all of the covariance to the aggregate and sectoral effects, this category still accounts for a maximum of 10.2% of the time variation in job reallocation. This is valid across countries, sectors and size classes. Conversely, idiosyncratic effects are the main driver of time variance in job reallocation (accounting for more than 90% in JRR variability). This confirms our expectations of high importance of firm-specific shocks in agricultural labour adjustments.

The two bottom panels of Table 6 show results for the job creation and destruction rates. Similar to the job reallocation rate, the results indicate that idiosyncratic effects play a dominant role in explaining the variation in job creation and destruction rates. They account for more than 65% and 74% in the variability of the JCR and JDR, respectively. Also the sectoral and aggregate effects play a prominent role in explaining variation in the job creation and destruction. However, the impact of aggregate and idiosyncratic effects combined (the covariance term) shows a different pattern across the two rates. For job destruction the positive sign and large magnitude of the covariance terms indicate that idiosyncratic effects strongly reinforce the countercyclic movements in gross job destruction associated with aggregate mean effects. In other words, aggregate job destruction rises more with than without idiosyncratic effects during the contraction in agriculture, whereas it falls more during the recovery. In contrast, the negative sign for job creation and the large magnitude of the covariance terms indicate that idiosyncratic effects strongly counteract the procyclic fluctuations in job creation associated with aggregate mean effects. This implies that aggregate job creation falls less with than without idiosyncratic effects during agricultural contraction, whereas it rises less during the recovery. These differentiated patterns of job creation and destruction lead to the countercyclical behaviour of job reallocation. Taken together, the covariance terms from the JCR and JDR decompositions explain how the idiosyncratic component dominates fluctuations in job reallocation. While job creation falls and job destruction rises during economic contractions, idiosyncratic effects counteract the fall in gross job creation while they reinforce the rise in gross job destruction.

## 4 CONCLUSIONS

This paper studies agricultural labour adjustments in the EU. Employing the job creation and job destruction approach allows us to disaggregate the overall employment patterns and net job flows into detailed intra-sectoral labour adjustment dynamics. Despite that there are numerous studies that apply the job creation and job destruction methodology to the manufacturing and service sectors, a study analysing job creation and job destruction in EU agriculture is still lacking. This is rather surprising, given the high policy priority and significant farm labour adjustments that have been observed in EU agriculture in recent decades. As a result, the identification of the types of farms that create jobs and that lay off labour, the role of farm specialisation, and of differences between family and hired labour adjustments, and their dynamics are not yet fully explored and understood.

Employing a unique EU-wide firm-level panel data set, we find a number of policy-relevant results. First, job creation and destruction in agriculture seems to be similar to the average job creation and destruction rates in the manufacturing sector and the overall economy, implying that structural characteristics of agriculture do not create a different behavioural pattern in labour allocation. While the uniqueness of the agricultural sector – e.g. because of the combination of production and household choices in farm households, the relatively high instability in agricultural commodity markets and the high level of interest in preserving the farming way of life (Ahearn et al., 2009) – is often emphasised, this does not seem to translate in different patterns of job creation and destruction.

Both the family and the hired labour flow rates are similar to the aggregate labour flow rates reported in the literature (Davis and Haltiwanger 1992; Blanchflower and Burgess 1996; Bilsen and Konings 1998; Mortensen and Pissarides 1994; Commander and Kollo 2008). However, our results also suggest that the JCR appears to be consistently higher for hired labour than for family labour, suggesting a possible substitution of family labour for hired labour. This finding is consistent with the observed structural change towards larger farms, which typically use higher shares of hired labour.

Furthermore, job creation and destruction rates differ strongly between countries, sectors and farm sizes. This observation can be linked to structural differences of the farm sector in different Member States. Our econometric results indicate that job creation responds more to structural differences across countries and sectors, whereas job destruction is more determined by structural differences across farms (farm size, input use and indebtedness).

The inter-temporal decomposition of variation in job flows suggests that job reallocation tends to fluctuate counter-cyclically. One of the main factors causing this pattern of labour adjustments is idiosyncratic effects. Idiosyncratic effects are found to be the main driver of time variance in job reallocation and they lead to divergent behaviour of job creation and destruction. Idiosyncratic effects reinforce the change in job creation, while they counteract the adjustment in job destruction over agricultural business cycles. The sectoral and aggregate effects play a minor role in explaining job reallocation.

In summary, our findings indicate important labour adjustments in agriculture. Generally, the patterns of labour adjustment seem to be consistent with dynamics in other sectors of the economy. Furthermore, we find that farm structural differences (e.g. farm size, specialisation, labour type) and idiosyncratic effects are the key factors determining job creation and job destruction in agriculture, which is in line with the job creation and job destruction literature for other sectors of the economy.

These findings are highly important for policy makers. First of all, our results seem to indicate that differences in productivity or technology between farms cannot fully explain differences in job creation. This is an interesting result in view of the policy dilemma to create productivity gains in the agricultural sector (which often include the introduction of labour-saving technologies) and creating jobs at the same time. Our results suggest that the relationship between productivity gains and job creation need not be negative. Further, we find evidence of increased job creation in two periods following major agricultural policy reforms (the MacSharry reform in 1992 and the mid-term reform in 2003). While many existing studies emphasize the negative effects of these reforms on agricultural employment, we highlight that such aggregate effects can hide significant positive employment effects as a result of increased job creation.

The evidence provided in this paper suggests that the disaggregation of agricultural labour adjustment patterns, using the job creation and destruction methodology, can provide important insights for policy makers in the exploration and quantification of the dynamics in the EU agricultural labour market. The insights obtained by disaggregating the gross employment patterns and net job flows into detailed intra-sectoral labour adjustment dynamics are important for agricultural policies. Based on these results, agricultural policies can be better targeted and hence designed more efficiently, as different policy instruments are required for addressing job creation versus job destruction, the employment of family labour versus hired labour, farm exit/entry versus farm scale of operation, etc.

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**Figure 1. Job creation and job destruction**

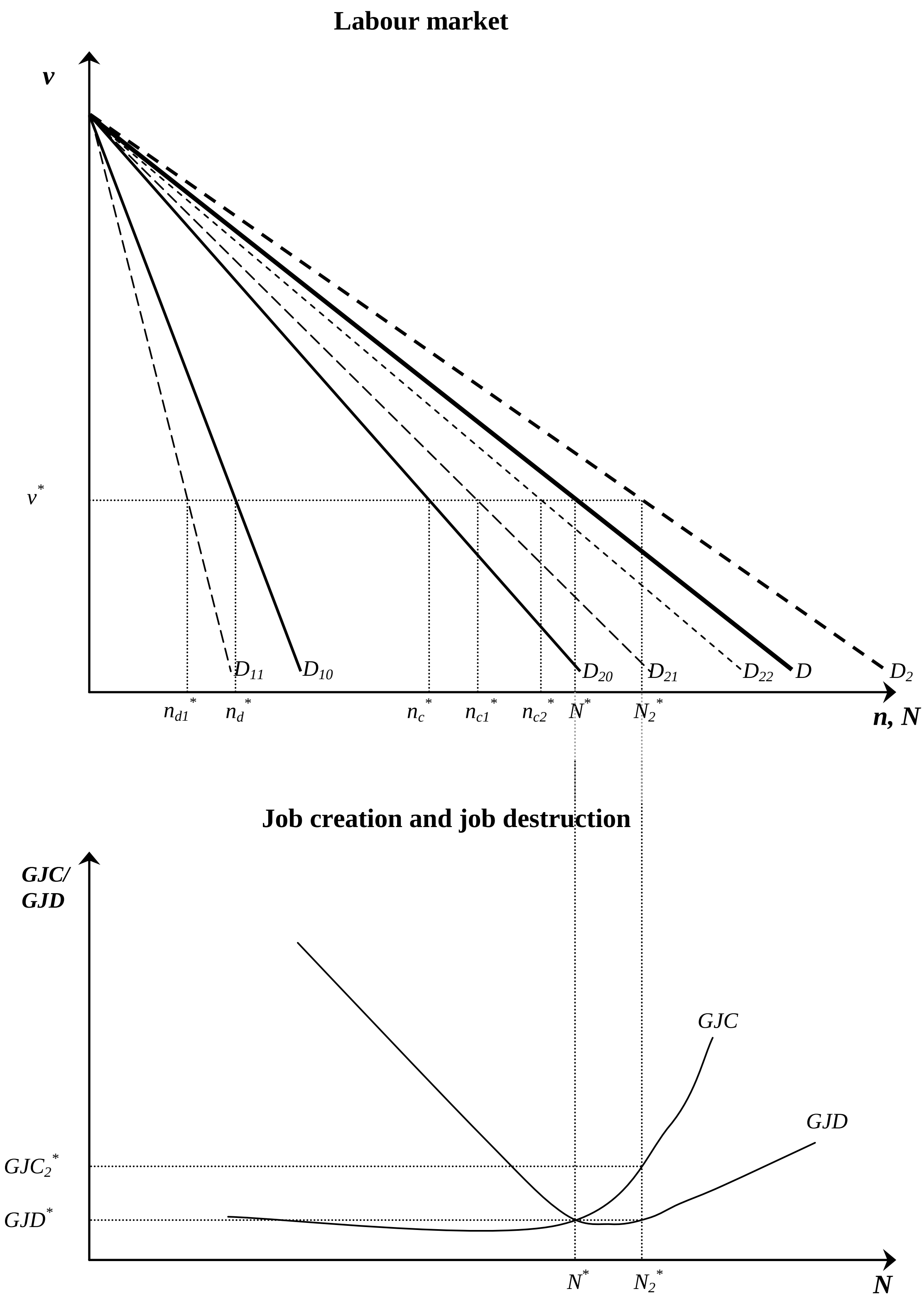
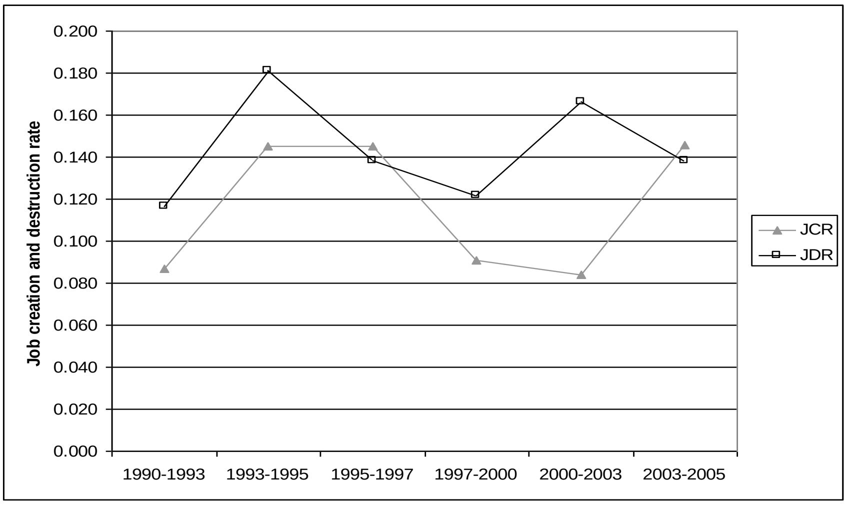


**Figure 2. Job creation and job destruction rate in agriculture, EU-12, 1990-2005**




Source: Own calculations based on FADN data

**Table 1. Job creation and job destruction rate in agriculture, EU-12, 1990-2005**

| | JCR | JDR | NET |
|---|---|---|---|
| **1990-1993** | 0.087 | -0.117 | -0.030 |
| **1993-1995** | 0.145 | -0.181 | -0.036 |
| **1995-1997** | 0.145 | -0.138 | 0.007 |
| **1997-2000** | 0.091 | -0.121 | -0.031 |
| **2000-2003** | 0.084 | -0.166 | -0.082 |
| **2003-2005** | 0.146 | -0.139 | 0.007 |

Source: Own calculations based on FADN data

**Table 2. Average annual job creation and job destruction rate per size class, 1990-2005**

| | JCR | JDR | NET |
|---|---|---|---|
| **< 2 ESU** | 0.104 | -0.191 | -0.087 |
| **2 - < 4 ESU** | 0.088 | -0.305 | -0.217 |
| **4 - < 6 ESU** | 0.173 | -0.172 | 0.001 |
| **6 - < 8 ESU** | 0.174 | -0.141 | 0.032 |
| **8 - < 12 ESU** | 0.144 | -0.126 | 0.018 |
| **12 - < 16 ESU** | 0.129 | -0.136 | -0.007 |
| **16 - < 40 ESU** | 0.095 | -0.102 | -0.007 |
| **40 - < 100 ESU** | 0.089 | -0.086 | 0.003 |
| **100 - < 250 ESU** | 0.092 | -0.082 | 0.010 |
| **>= 250 ESU** | 0.074 | -0.102 | -0.029 |

Source: Own calculations based on FADN data

**Table 3. Annual job creation and job destruction rate in different Member States in relation to average farm size, EU-12, 1990-2005**

| | JCR | JDR | NET | Farm size* |
|---|---|---|---|---|
| **Portugal** | 0.131 | -0.196 | -0.065 | 8 |
| **Greece** | 0.108 | -0.147 | -0.039 | 9 |
| **Spain** | 0.172 | -0.144 | 0.027 | 16 |
| **Italy** | 0.132 | -0.203 | -0.071 | 18 |
| **Ireland** | 0.054 | -0.066 | -0.012 | 21 |
| **Luxemburg** | 0.060 | -0.086 | -0.026 | 52 |
| **France** | 0.073 | -0.090 | -0.017 | 58 |
| **Germany** | 0.080 | -0.101 | -0.021 | 59 |
| **Belgium** | 0.047 | -0.068 | -0.021 | 72 |
| **Denmark** | 0.056 | -0.082 | -0.026 | 72 |
| **UK** | 0.067 | -0.110 | -0.043 | 83 |
| **The Netherlands** | 0.058 | -0.079 | -0.021 | 111 |

* average ESU per farm

Source: Own calculations based on FADN data

**Table 4. Cell-regression results**

| | Job Creation Rate | | | Job Destruction Rate | | |
|---|---|---|---|---|---|---|
| | Coefficient | Std. error | | Coefficient | Std. error | |
| Output/ha | 0.000 | 0.000 | | 0.000 | 0.000 | |
| Input/ha | 0.003 | 0.005 | | -0.014 | 0.006 | * |
| Subs/ha | 0.000 | 0.000 | | 0.000 | 0.000 | |
| Asset/ha | 0.000 | 0.000 | | 0.000 | 0.000 | |
| FamL/totL | 0.032 | 0.025 | | 0.036 | 0.031 | |
| Liab./asset | 0.006 | 0.021 | | 0.053 | 0.026 | * |
| 1993 | 0.055 | 0.008 | * | -0.046 | 0.010 | * |
| 1995 | 0.042 | 0.008 | * | -0.026 | 0.010 | * |
| 1997 | 0.006 | 0.008 | | 0.000 | 0.010 | |
| 2000 | -0.006 | 0.008 | | -0.023 | 0.010 | * |
| 2003 | 0.053 | 0.008 | * | -0.040 | 0.010 | * |
| Belgium | -0.138 | 0.016 | * | 0.012 | 0.019 | |
| Denmark | -0.132 | 0.016 | * | -0.039 | 0.019 | * |
| Germany | -0.086 | 0.012 | * | -0.008 | 0.015 | |
| Greece | -0.059 | 0.010 | * | 0.041 | 0.013 | * |
| France | -0.108 | 0.013 | * | -0.020 | 0.016 | |
| Ireland | -0.090 | 0.011 | * | 0.061 | 0.013 | * |
| Italy | -0.033 | 0.010 | * | -0.028 | 0.012 | * |
| Luxemburg | -0.117 | 0.014 | * | -0.020 | 0.017 | |
| Netherlands | -0.101 | 0.015 | * | -0.037 | 0.018 | * |
| Portugal | -0.027 | 0.010 | * | 0.016 | 0.013 | |
| United Kingdom | -0.091 | 0.011 | * | -0.001 | 0.014 | |
| < 6 ESU | -0.012 | 0.008 | | -0.121 | 0.010 | * |
| 6-12 ESU | 0.013 | 0.007 | | -0.036 | 0.008 | * |
| > 40 ESU | -0.002 | 0.007 | | 0.024 | 0.009 | * |
| Cereals | -0.021 | 0.009 | * | 0.009 | 0.012 | |
| Field crops | -0.021 | 0.009 | * | 0.004 | 0.012 | |
| Permanent crops | -0.003 | 0.011 | | 0.023 | 0.013 | |
| Milk | -0.038 | 0.009 | * | 0.019 | 0.011 | |
| Grazing livestock | -0.014 | 0.009 | | 0.029 | 0.011 | * |
| Sheep & goats | -0.024 | 0.009 | * | 0.011 | 0.012 | |
| Pigs & poultry | 0.016 | 0.010 | | -0.015 | 0.013 | |
| _cons | 0.138 | 0.025 | | -0.155 | 0.031 | |

* significant at 0.05

Omitted category: 1990; Spain; 12-40 ESU; mixed farms

**Table 5. Job reallocation rate (JRR) in the EU agriculture, 1990-2005**

| | JCR | JDR | JRR |
|---|---|---|---|
| **1990-1993** | 0.087 | -0.117 | 0.203 |
| **1993-1995** | 0.145 | -0.181 | 0.326 |
| **1995-1997** | 0.145 | -0.138 | 0.283 |
| **1997-2000** | 0.091 | -0.121 | 0.212 |
| **2000-2003** | 0.084 | -0.166 | 0.250 |
| **2003-2005** | 0.146 | -0.139 | 0.284 |

Source: Own calculations based on FADN data

**Table 6. Decomposition of inter-temporal variance of job reallocation, job creation and job destruction**

| | Total | Country | Sector | Sizeclass |
|---|---|---|---|---|
| **fraction of job reallocation (JRRt) variance accounted for by** | | | | |
| a. Sectoral / aggregate effects | 0.006 | 0.008 | 0.001 | 0.048 |
| b. Idiosyncratic effects | 1.007 | 0.950 | 1.007 | 0.898 |
| 2cov(a,b) | -0.012 | 0.042 | -0.008 | 0.054 |
| **fraction of job creation (JCRt) variance accounted for by** | | | | |
| a. Sectoral / aggregate effects | 1.092 | 0.124 | 0.226 | 1.251 |
| b. Idiosyncratic effects | 0.649 | 1.095 | 1.310 | 1.211 |
| 2cov(a,b) | -0.742 | -0.219 | -0.536 | -1.462 |
| **fraction of job destruction (JDRt) variance accounted for by** | | | | |
| a. Sectoral / aggregate effects | 1.536 | 0.077 | 0.141 | -0.825 |
| b. Idiosyncratic effects | 1.592 | 0.821 | 0.742 | 1.362 |
| 2cov(a,b) | -2.128 | 0.102 | 0.117 | 0.463 |

Source: Own calculations based on FADN data