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Employment effects of CAP payments in the UK non-farm economy

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This paper investigates the CAP payment effects on employment in the non-farm SMEs, which are central for job creation. It examines whether there are differences in the effect by business location, industry grouping, and CAP Pillars. A microeconomic approach is employed, based on firm data from FAME dataset combined with detailed subsidies information from DEFRA. System GMM is used to estimate the effect of CAP payments in both static and dynamic models of employment. Results suggest positive net spillovers of CAP payments to non-farm employment. Although the magnitude of the effect is small, it is economically significant.

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Employment effects of CAP payments in the UK non-farm economy

This paper investigates the effects of the CAP payments on the indirectly generated non-farm jobs in small and medium-sized enterprises (SMEs), which are central for job creation. It examines whether there are differences in the effect according to business location - rural or urban, the agricultural supply chain, and according to CAP Pillars. A microeconomic approach is employed, based on firm data from FAME dataset combined with detailed subsidies information from DEFRA. The generalised method of moments (system GMM) is used to estimate the effect of CAP payments in both static and dynamic models of employment. The results suggest positive net spillovers of CAP payments to non-farm employment. Although the magnitude of the effect is small, it is economically significant. In general Pillar 1 has a stronger employment effect relative to Pillar 2. However, in the rural areas and within agricultural supply chain, Pillar 2 payments have a stronger positive effect per Euro spent.

1 Introduction

This paper investigates the contribution, if any, of the EU's Common Agricultural Policy (CAP) payments to non-farm sector employment in both rural and urban areas in the UK through its direct and indirect effects on agriculture's up- and downstream industries, and the economic diversification of rural areas. In recent years, given the difficult recovery from the 2008 economic and financial crisis, the provision of employment is of primary interest to policy makers and to millions of UK citizens. Additionally, whatever the UK package for Brexit will be, it is almost certain that the UK will leave the CAP and the ways agriculture is supported will change. Naturally, majority of existing studies are concerned with the effects of the forthcoming changes on agriculture but it is also useful to have some indications of the wider possible benefits or losses beyond farming by investigating the inter-industry spillovers of the CAP payments on non-farm employment.

For decades, the CAP payments implicitly maintained the level of agricultural employment, or at least slowed down its decline under the pressures of technical and structural change. In the face of these forces, the CAP could hardly have further impact in the direction of job creation or even job maintenance in primary agriculture. However, the CAP payments may have had inter-industry spillovers on non-farm employment which are often not-accounted for.

Against this backdrop, the objective of this paper is to estimate the effect of the CAP payments on the indirectly generated non-farm jobs. In particular, the study focuses on three key questions: (i) whether CAP payments are positively associated with non-farm employment; (ii) whether there are differences in the effect according to business location - rural or urban, and within agricultural supply chain, and (iii) whether different CAP payments have different employment effects, i.e. Pillar 1 direct payments and Pillar 2 rural development payments.

Most previous CAP and employment research has focused on the CAP's impact on agricultural and rural jobs, often in an EU regionalised framework (for example, Petrick and Zier, 2011; 2012; Olper et al., 2014). Several studies have investigated the economy-wide effects either through Input-Output (I-O) analysis (Mattas et al., 2005; 2011) or regionalised social accounting matrices (Psatopoulos et al., 2004). Mattas et al. (2011) investigated the effect of rural development payments under Pillar 2 in five EU regions. The study revealed that the employment generating effects differed across sectors and depended on the economic structure of the regions. The evaluation of the effect of €507.8 million rural development funding in the period 2007-2013 on the two Greek case study regions (Anatoliki Makedonia and Thraki) revealed the creation of 11,741 jobs or 5.3% of the baseline employment, with the strongest employment effect observed in the secondary sector. A recent report for the European Parliament Committee on Agriculture and Rural Development (COMAGRI) concerning the role of CAP in creation of rural jobs has reviewed 53 studies. Concerning the direct effect of the CAP, 16 studies reported a negative effect on employment in agriculture; 9 studies – a positive one; 8 studies - a mixed effect, depending on farm structure and rural economy, and 6 studies - no effect. However, all of these studies were agri-centred - they were either focused on agriculture and rural jobs, or on labour migration out of agriculture (EP, 2016). One notable exception is the recent paper by Blomquist and Nordin (2017), who employed a regional macroeconomic approach and estimated the open-economy relative multiplier of agricultural subsidy reform in Sweden, thus capturing the CAP's impact on regional employment beyond agriculture. They estimated the costs per job as equal to USD 26,000. An earlier paper by Petrick and Zier (2012) using a different methodology (a dynamic labour adjustment model) applied to East Germany estimated higher costs - €50,000 per job.

The present paper attempts to fill the gap in the literature and to stimulate a broader debate about the wider, rural-urban and inter-industry employment effects of the CAP. The paper employs a micro approach, based on firm data extracted from the Financial Analysis Made Easy (FAME) dataset of Bureau van Dijk combined with detailed subsidies data extracted from Department of Environment, Food, and Rural Affairs (DEFRA) CAP Payments database. The effect on employment in small and medium-sized enterprises (SMEs) is the focus of analysis. SMEs are defined by the UK government and the EU as businesses with less than 250 employees. The rationale to focus on SMEs is based on two considerations. First, at the beginning of 2013, SMEs represented over 99 per cent of all private-sector businesses in the UK, accounting for 59.3 per cent of private-sector employment and for 48.1 per cent of private-sector turnover (Department for Business Innovation and Skills, 2013). They are also central to job creation as recognised by the UK government. Second, as mentioned above, one of the objectives of the study is to investigate whether there are different effects of CAP payments on employment in rural and urban non-farm businesses. Rural businesses are mainly SMEs, and comparisons with large companies (national and international) located in metropolitan areas would not make much sense.

The theoretical underpinning of the analysis is based on Smolny's (1998) monopolistic competition model with delays in adjustment in output price, employment, and capacity. The generalised method of moments (system GMM) is used to estimate the effect of the CAP payments in both static and dynamic models of employment. The results suggest positive net spillovers of CAP payments, although the magnitude of coefficients is rather small. Looking at different CAP Pillars, relative to Pillar 2, Pillar 1 direct payments have a stronger statistically significant effect on the level of employment in both static and dynamic models. However, when the cross-effects with rural location and agricultural supply chain are investigated, the effect of Pillar 2 payments is stronger per Euro spent.

The rest of the paper is structured as follows. The next section presents a short overview of the CAP subsidies in the UK and their distribution by constituent country. Section 3 details the theoretical framework, and section 4 presents the data and the estimation strategy. Section 5 presents the results, while section 6 concludes with a brief discussion of policy implications.

2 The evolution of CAP subsidies and the implications for employment

The period covered in the empirical analysis ranges from 2008, the year of the CAP Health Check by the European Commission, to 2014 - the first transitional year of the 'new' CAP for the period 2014-2020. The presentation of the implementation of different CAP measures in the UK is limited to the period analysed, since a wider general discussion of the CAP is beyond the scope of the present paper.

The Health Check of 2008 introduced the main policy changes before implementation of the most recent CAP reform for the period 2014-2020 (Allen et al., 2014). It did not change the fundamental decisions taken in the 2003 CAP reform, i.e. the introduction of a decoupled (from production) Single Farm Payment (SFP) to farmers, conditional on environmental and other cross-compliance requirements, and keeping the land in Good

Agricultural and Environmental Conditions (GAEC), as the main feature of Pillar 1. The Health Check moved slightly further in the direction mapped by the 2003 CAP reform, i.e. it decreased the remaining coupled payments, increased modulation of funds from Pillar 1 to Pillar 2, and removed arable land set-aside. It also provided the EU Member States (MSs) with flexible possibilities to assist sub-sectors of agriculture with special problems, the so-called Article 68 measures.

From theoretical viewpoint, given existing legislation, the CAP payments can affect non-farm employment both through a *production* and a *consumption* effect. In the 2003 Council Regulations establishing the rules for direct support schemes, the SFP scheme was treated as income support (OJ, 21/10/2003). The SFP is paid to farmers, the latter defined as natural or legal persons, or groups of such persons. Although in theory decoupled, the SFP may be invested in farm production and thus increase or maintain the employment in agriculture and up- and downstream industries. Bhaskar and Beghin (2007) reviewed a number of studies on the coupling mechanisms of decoupled payments. Some of these mechanisms include wealth and insurance effects that might increase the use of inputs and affect the increase in output. There can also be an effect on investment decisions as farmers could save and invest more, as well as increased liquidity of credit-constrained households.

The decoupled income support to farmers can also have a complex impact on the income-leisure trade-off and labour allocation decisions to work on- or off-farm. Further, it might increase savings and/or the contemporaneous consumption of farm households of non-farm goods and services as SFP adds to the overall household purchasing power. For example, studies on the impact of agricultural support policy on the household consumption in the US show that the marginal consumption varies by income sources - farm income, off-farm income and government transfers (Carriker et al., 1993; Whitaker, 2009). Whitaker's results indicate that decoupled payments are consumed by agricultural households at a high marginal rate of 24%. The measure of consumption excludes expenditure related to farm production, thus it only encompasses non-farm products and services.

The effect in terms of farmers' household income/expenditure is generated mainly in rural areas but it may or may not correlate with increased employment in those areas, taking into account purchases at a distance and services provided from urban areas. Additionally, the increase of the overall purchasing power in rural areas depends on how much of the CAP payments remain with the farm households. Higher land rent, which is a well-known consequence of direct payments, leaks out to landowners who may not live in the locality. [1]

To conclude, there are two main channels through which CAP SFP may affect non-agricultural employment – through its effect on consumption as a really decoupled payment, and through its coupled effect on farm investments and output levels. Both these channels would lead to expansion in the demand that the non-farm sector firms face.

Concerning Rural Development (RD) measures in Pillar 2, there are a wide range of channels through which payments can affect non-farm employment. Rizov (2004; 2005) studied the effect of CAP on the organisation and performance of rural communities since the introduction of Pillar 2 in 1999. He developed a theoretical model of private provision of public goods where RD payments lead to diversification of the economic activities in rural areas which, in turn, enhances the sustainability of the local economy. While his focus is mainly on formally defining the conditions under which the CAP income transfers can improve, or otherwise, rural community development, he does not explicitly address the complementary employment effects. However, the RD measures may create employment both within the local rural community and beyond, in the urban areas, thus emphasising the general interdependency of rural and urban areas. The first order effects, similarly to Pillar 1, are due to the fact that there is a flow of funds into some rural households which increases their purchasing power. Additionally, e.g. RD measures for investments in physical assets - farm modernisation, infrastructure, energy-saving technologies - may influence employment in research and development, construction, technical services, etc. Business start-up aid for young farmers and for non-farm enterprises, as well as village renewal support, can have a direct effect on employment in rural and surrounding urban areas. Support to enhance biodiversity and the provision of higher-value ecosystem services may help to create non-farm jobs in rural tourism and associated services. Policy developments within the food system, e.g. short food chains, organic box trade, and traceability, can produce employment growth along the entire agri-food supply chain.

However, the form and the level of CAP payments vary across the UK. Table 1 presents some indicators that exemplify the striking differences in agricultural sectors across its four constituent countries.

[1] A consequence of the appropriation of a high share of payments by the landowners means that the *local* multiplier effect of CAP Pillar 1 payments is likely to appear lower in those areas where there is a high proportion of rented land, as higher rents leak out to landowners who do not always live in the same locality; thus, the true effect is likely to be larger. Furthermore, while the presence of leakages is an important consideration, which generally applies to farmers' purchasing power and expenditure, our analytical framework is built on the idea of economy-wide spillovers and our data capture the economy-wide effects.

- Table 1 here –

Less Favoured Areas (LFA) payments in England are less important than in the other three countries where 70 per cent and more of the agricultural area is designated as LFA. Around half of the land area in England is under crops, whilst in the other countries it is either predominantly grass land (Northern Ireland and Wales) or rough grazing (Scotland). These production patterns, together with farm size and productivity effects, has led to a different reliance on subsidies: the lowest in England at 52 per cent of the total income from farming, and highest in Wales at 142 per cent (Allen et al., 2014).[2]

Table 2 presents in more detail the CAP payments by Pillar in the UK and the constituent countries since 2010 – the first year available which falls within the period of analysis in this paper. The UK constituent countries took different implementation decisions on the decoupled direct payment (SFP) - Scotland and Wales introduced the SFP on a historical basis, England opted for a dynamic hybrid version, and Northern Ireland for a static hybrid one.

- Table 2 here –

3 Theoretical framework: a firm employment function

As mentioned, the aim of this paper is to empirically evaluate the CAP payments impact on employment in the non-farm economy. Therefore, the focus here is not on developing a fully-fledged theoretical model of all possible channels of impact but rather it is on outlining a theoretical framework to motivate an appropriate estimating specification and to aid the interpretation of results. The theoretical framework employed is based on Smolny's (1998) monopolistic competition model with delays in adjustment in output price, employment, and capacity.[3] The framework, compared to a perfect competition model, leads to a richer and more realistic firm employment (demand) function. The timing assumptions in the original model are as follows. In the short run, only output is endogenous. Employment and prices adjust in the medium run, with a delay with respect to demand and cost changes, thus under

[2] Total income from farming is the return on own labour, capital and management input of all those with an entrepreneurial involvement in farming, generally farmers and partners. It is measured at sectoral level and represents the net value added at factor cost minus the compensation of employees, rent and interest.

[3] Smolny's (1998) model is related to the family of so called putty-clay models which have a long history in the growth and business cycle literature with micro foundations (Johansen 1959; Solow 1962; Phelps 1963; Sheshinski 1967; Cass and Stiglitz 1969; Bresnahan and Ramey 1994; Cooper, Haltiwanger, and Power 1999; Gilchrist and Williams, 2000).

uncertainty about demand. Capacities and the production technology are predetermined for the price and employment adjustment process, and react only in the long run.

The assumption about delays in the reduction of employment can be justified by legal and contractual periods of notice; there often are also substantial severance costs. In addition, reputational losses for firms in the case of frequent dismissals tend to restrict the downward adjustment of the labour force to normal separations, i.e. resignations and retirements. Delays in the upward adjustment of the labour force involve search, screening and training time. A delayed adjustment of prices corresponds to the assumption of price tags and menu cost. Importantly, even a short delay between the decision to change employment, and/or the price, and the realisation of a demand shock can introduce considerable uncertainty in adjustment for the firm.

The dynamic decision problem of the firm can be reduced to a sequence of static decision models which are then solved stepwise. We start by specifying a log-linear demand function for the firm's product (ln*D*) that allows us to distinguish between the effects of price elasticity of demand, demand shifts, and demand uncertainty:

$$lnD = \eta lnp + lnZ + \varepsilon, \quad E(\varepsilon) = 0, \quad Var(\varepsilon) = \sigma^2. \tag{1}$$

In equation (1), firm demand D is negatively associated with price p, with constant elasticity η, Z is a vector of exogenous or predetermined demand characteristics, such as aggregate industry demand $\overline{D}$ and demand shifters induced by market factors or policies, and the error term ε (with zero expected mean) captures the realised value of the demand shock which is not known at the time of the price and employment decision. The time and firm indexes are omitted for notational convenience.

In this paper the information content of the *Z*-vector in the firm demand function is extended with the CAP expenditure indicators.[4] Following the discussion in the previous section and findings in the limited literature on the impact of CAP subsidies on regional development (Vatn, 2002; Peterson et al., 2002; Rizov, 2004; 2005), we argue that the inter-sectoral spillovers and the local economy diversification effects of subsidies are associated

[4] The extension of the demand equation (1) with CAP expenditure information partially addresses omitted variables concerns when specifying an estimating equation. To further deal with omitted variables concerns at the estimation stage we also use sets of location, industry, and time dummies. A similar approach to modelling the CAP impact on employment in a regional level framework is applied in a recent study by Blomquist and Nordin (2017).

with the expansion of aggregate demand that non-farm sector firms face.[5] This first-order, demand effect is likely to impact significantly on non-farm sector firm employment.[6]

According to equation (1), another effect of CAP subsidies on non-farm firm demand and employment could occur through the volatility of demand captured by the variance of demand σ^2; the subsidies would generally reduce volatility of demand, and thus smooth employment adjustments. Following this argument, while subsidies would not affect the mean of ε they may affect σ.

To complete the framework, we specify firm supply (S) function determined by a short-run production function with capital K and labour L as inputs:

$$S = \min(Y_K, Y_L) = \min(\pi_K K, \pi_L L), \qquad (2)$$

where Y_K is capacity, Y_L is the employment constraint, and π_K, π_L are the productivities of capital and labour respectively. In the short run, output Y is determined as the minimum of supply and demand:

$$Y = \min(S, D). \qquad (3)$$

The medium-run optimisation problem is

$$\max_{p,L} \quad pE(Y) - wL - cK, \qquad (4)$$

subject to equations (1) and (2), where E is the expectation operator. Wage w and user cost of capital c are treated as exogenous at the firm level.

There are two relevant optimisation scenarios where capacity is, or is not, binding on decisions.[7] In the case of capacity constraint, employment is determined from the capacity.

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[5] The diversification of the local economy driven by CAP payments can be seen as a sustainable development effect, associated with a higher average demand level, considering that a diversified local economy would be more resilient to economic shocks (Barkley, 1995; Stavins et al., 2003).

[6] There could also be a second-order, supply effect derived through different channels such as changes in competition and agglomeration in the upstream and/or downstream industries, but our focus here is on the first-order (dominant) demand effect. The second-order, supply effect is controlled for in the estimation stage by firm characteristics such as size, age, and cost-per-employee, which is also a measure of productivity (e.g., Barrios et al., 2011).

[7] For completeness, we point out to a third scenario in which labour supply is constrained, i.e., the firm does not have sufficient number of applicants. In this case, optimal employment is determined by the (exogenous) labour supply which in turn may depend on local market conditions, and regional and national policies including the CAP and movement of labour laws. Given the setup of our framework, the labour supply constraint is

No more workers will be hired than can be employed with the predetermined capital stock. Supply and employment result from:

$$S = Y_L = Y_K, \quad L(Y_K) = \frac{Y_K}{\pi_L}. \tag{5}$$

The optimal price depends on capacity, expected demand shifts, demand uncertainty and competition. In the capacity-constrained scenario, the adjustment of employment is inhibited, and the whole adjustment with respect to expected demand shifts falls on the price. The implication is that level of employment will remain unchanged.

In the case of unconstrained capacity, which is the most likely case in the UK market economy, optimal employment and price are jointly determined by setting marginal costs of employment, i.e. the wage rate w, equal to the marginal revenue. The latter is determined as the price, multiplied by the productivity of labour, and multiplied by the probability that the additional output can be sold, i.e. that demand exceeds supply:

$$p(w)prob(Y_L < D)\pi_L - w = 0. \tag{6}$$

The optimal price is determined by unit labour costs w/π_L, and the mark-up is equal to the probability of a supply constraint on the goods market. This probability is determined by the price elasticity of demand and demand uncertainty, i.e. the optimal price is independent of expected demand shifts as set out in equation (1).

Optimal supply and employment are derived from

$$S = Y_L(w) = \eta lnp(w) + lnZ + \bar{\varepsilon}(\eta, \sigma), \tag{7a}$$

$$L(w) = \frac{Y_L(w)}{\pi_L}, \tag{7b}$$

where $\bar{\varepsilon}(\eta, \sigma)$ is the value of the demand shock which distinguishes the supply-constrained regime from the demand-constrained regime.[8] Demand shifts induced by the expansion of demand due to the spillovers and diversification effect of CAP payments lead to growth in

predetermined in short and medium runs. Nevertheless, in our empirical analysis we use locational controls such as the rural-urban and supply chain dummies and clustering at constituent country level, as well as sets of time and industry dummies which proxy for possible exogenous labour supply constraints.

[8] Note that $\bar{\varepsilon} = lnS - lnD$ and its optimal value depends only on η and on the parameters of the probability density function (pdf) of $\bar{\varepsilon}$. A pdf of $\bar{\varepsilon}$ which is completely characterised by its expected value and variance can be written as $\bar{\varepsilon}(\eta, \sigma)$.

employment. An immediate adjustment of employment is contained as the limiting case with $\sigma \to 0$. Introducing uncertainty reduces the expected utilisation of employment, and has the same effect on price and employment as higher variable costs. Thus, uncertainty reduces optimal employment and increases the price through the costs of underutilisation of employment. However, as argued earlier, if CAP payments reduce uncertainty, then there will be less underutilisation of labour and employment would relatively rise.

Assuming log-normal distribution of ε which follows from equation (1), equation (7b) can be written in a log-linear form which together with equation (5) will form the basis of our estimating specification discussed in the next section:

$$lnL = -ln\pi_L + \eta lnp(w) + lnZ + \bar{\varepsilon}(\eta, \sigma). \tag{8}$$

The framework outlined above is useful for the analysis of employment adjustments, and price rigidities, during the business cycle in general, and of the implications of the CAP payments in particular. For example, suppose that the stochastic process generating demand shocks is auto-correlated, i.e. firms expect that demand shocks are persistent. Then, unexpected demand shocks affect the utilisation of labour and capital contemporaneously. If the actual utilisation differs from the optimum, employment and/or prices adjust as the adjustment depends on the availability of capacity. In the case of a capacity constraint (or in boom periods), employment would remain unchanged, and the firm would adjust the price. With a sufficient capacity (or in recession periods), the firm would adjust employment, and the price would remain unchanged.[9] CAP payments resulting in sustained higher demand and smoothing the demand fluctuations thus lead to larger firm capacities and more employment; in the long run they would also lower the probability of demand shocks hitting the capacity (supply) constraint. The above discussion demonstrates that we need to be agnostic of the contingencies, in terms of industry and business cycle conditions, that may influence the CAP employment effects.[10]

[9] The framework yields a further hypothesis about the effects of the price elasticity of demand on employment and price adjustment. In the case of demand shocks, a low price elasticity of demand $|\eta|$ should favour employment adjustments against price adjustments. Hypotheses for the analysis of effects of competition on employment and price adjustments could also be formulated but they are beyond the purposes of the analysis here.

[10] We note that our empirical analysis covers the period of economic downturn following the financial crisis from 2007 when firms were generally experiencing decline in demand and thus unconstrained (excess) capacity. It would have been interesting to include a period before the great recession but there is no available CAP payment data with the necessary detail.

4 Data and estimation strategy

In the empirical analysis of firm employment we use the FAME data set of Bureau van Dijk combined with detailed subsidies data extracted from the DEFRA CAP Payments database. FAME covers all firms filed at Companies House in the UK, and includes information on detailed unconsolidated financial statements, employment, location, by post code, and activity description. The data used in the analysis contains annual records on over 2 million firms over the period 2008–2014. The geographic distribution of the firms in the dataset which are available for analysis is presented in Figure 1. The coverage of the data compared with the aggregate statistics reported by the UK Office for National Statistics (ONS) is very good concerning sales (89 per cent) and employment (90 per cent).

- Figure 1 –

While partially available for all years from 2006 to 2014, the CAP subsidy data is not complete for some years. This is to a great extent a result of amendments to Commission Regulation (EC259/2008). Following a decision of the European Court of Justice, for some years after 2008 the Commission removed the requirement to publish subsidy payment data on farming individuals and partnerships, though MSs were still obliged to publish data on legal entities. In 2013, the Commission introduced new rules for transparency, including both individuals and all legal entities. The only exception was for very small beneficiaries who receive less than €1,250 in total subsidy (equivalent to £1,045 in 2014 and £972 in 2015); their names were withheld and replaced by a code number. Therefore, the workable dataset available for this study covers four years: 2008, 2010, 2012, and 2014. The CAP payment information comprises the amount of total subsidy and its three components: common market organisation (CMO) and direct payments (DP) or aka single farm payment (SFP) made under CAP's Pillar 1, and rural development (RD) payments made under Pillar 2. The geographic distribution of the average annual CAP payments in the dataset is presented in Figure 2

- Figure 2 –

Considering the nature of data available and the theoretical labour demand functions (5) and (8) we opt for estimating of the reduced form employment equation (9):

$$L^*_{jt} = \beta_1 D'_{jt} + \beta_2 X'_{jt} + \beta_3 S_{jt} + \beta_4 I' + \beta_5 R + \beta_6 T' + \epsilon_{jt}\,, \qquad (9)$$

where the optimal firm *j* employment L^* at time *t* is specified as a function of a vector of demand characteristics *D'* (aggregate industry demand and firm demand variance), a vector of firm-specific characteristics *X'* such as productivity (cost per employee), size (total assets), and age, as well as the CAP payments S at narrowly defined location units (postal districts). In the estimating equation, besides the identically and independently distributed error term ϵ also are included vectors of industry (including agricultural supply chain) *I'*, location (rural-urban) *R*, and time dummy controls *T'* capturing the heterogeneity in factor prices and price elasticity of demand, as well as the business cycle.[11, 12]

Equation (9) represents the optimal (desired) level of firm employment and thus the estimate of β_3 can be interpreted as the long run effect of CAP payments on employment.[13] However, as discussed in the previous section firms are likely to experience delays in adjusting their employment levels which can take the form of an iteration process leading to the formulation of a flexible accelerator or partial adjustment estimating model (Hamermesh, 1993; Bond and Van Reenen, 2007). Such model has been applied in a context similar to ours by Petrick and Zier (2012) in their analysis of CAP payment effects on agricultural employment. Equation (10) represents a discrete time version of the model:

$$L_{jt} - L_{jt-1} = \gamma(L^{*}_{jt} - L_{jt-1}), \qquad (10)$$

where γ is the speed of adjustment ($0 \leq \gamma \leq 1$) which is decreasing in the level of adjustment costs (Nickell, 1986).

Solving equation (10) for L_{jt} and substituting equation (9) for L^{*}_{jt} yields the partial adjustment estimating equation for firm employment:

$$L_{jt} = \lambda L_{jt-1} + \beta_1 D'_{jt} + \beta_2 X'_{jt} + \beta_3 S_{jt} + \beta_4 I' + \beta_5 R + \beta_6 T' + \epsilon_{jt}, \qquad (11)$$

[11] Ericson and Pakes (1995) model the firm profit maximisation problem as a function of firm's own state variables, factor prices, and a vector of the state variables of the other firms active in the market. Olley and Pakes (1996) specify a vector of firm specific state variables that consists of the age of the firm, firm's capital stock, and a measure of firm's efficiency. A market structure consists of a list of these triples for all firms active in the market. Thus, considering that our empirical analysis utilises large micro data representative of all industry sectors, urban and rural, in the UK, the specification employed is capable of recreating the firm interactions in the whole of the UK economy and capturing general equilibrium effects.

[12] Considering that CAP payments go to the farm sector which is located almost exclusively in rural areas due to proximity considerations in economic interactions one could expect a stronger CAP effect on rural firms as well as on firms that are close to agriculture in other dimensions such as being part of the agricultural supply chain. Furthermore, using different levels of geographies at which we aggregate when creating some of the control variables, e.g., the aggregate demand, rural-urban dummy and constituent country controls helps address, to some extent, the spatial dependency problems; such approach is in the spirit of multi-level modelling applied to regional analysis.

[13] In the previous section the theoretical framework used described the sequence and frequency of adjustments taking place in the firm's optimisation problem by referring to short, medium, and long run. In this section we consider the equilibrium outcome of the optimisation adjustments which equates to the formulation of a long run relationship. We note that the long run is simply the entire set of short/medium run optimisation solutions.

where the speed of adjustment $\gamma = (1 - \lambda)$. In this specification CAP payments may affect current labour demand immediately, as measured by β_3. However, there is also a long run effect via the dynamic adjustment process. Considering that in steady state $L_{jt} = L_{jt-1}$ the long run effect of CAP payments will be β_3/γ. The higher the speed of adjustment γ, the faster is the adjustment of employment to a new equilibrium and the smaller the effect of CAP that can be observed in the long run relative to the short run.

To implement the estimation strategy devised above we manipulate the FAME data in several ways. The industry sectors are identified on the basis of the 2007 UK Standard Industrial Classification (SIC) at the 4-digit level. Given the large number of 4-digit industries, on several occasions, for definition of specific variables the more aggregated 2-digit codes were used. All nominal monetary variables were converted into real values by deflating with the appropriate ONS industry deflators at 4-digit UK SIC level, when available, and at 2-digit level otherwise. The producer price index (PPI) was used to deflate sales, wages and CAP payments, and asset price deflators were used for deflating firm capital.

To account for inter-industry linkages, which are important for the transmission of the CAP expenditure effects from agriculture to non-agricultural sectors, the input-output (I-O) shares of the agriculture, forestry and fishing sector in all other sectors were used averaged over the 2005-2010 period. Data was obtained from OECD symmetric I-O tables which represent a complete picture of the sectoral interdependencies in the UK economy. Specifically, the Leontief matrix total technical coefficients were used as regression weights to account for the sectoral interdependence affecting the transmission of the CAP expenditure effects to the non-farm sector firms. It is reasonable to assume that CAP expenditure will have stronger effect on firms from sectors closely linked to the farm sector. Therefore, we are treating each firm-observation as more or less informative about the underlying relationship between agriculture and other industry sectors. Those sectors that are more closely linked to agriculture are given more weight, and those that are more remote are given less weight. To explicitly estimate the impact of CAP payments along the agricultural supply chain we also create an indicator variable equal to 1 if a 4-digit sector is part of the chain and 0 otherwise following definitions in van der Vorst et al. (2007). In the agricultural supply chain we have included the manufacturing of inputs to agriculture (e.g. fertilisers, pesticides and other agrochemical products; machinery for agriculture, forestry and for food processing; renting or leasing of agricultural machinery and equipment) and industries downstream encompassing food processing and wholesale of agricultural raw materials and live animals.

As explained earlier, the empirical analysis is based only on data for SMEs, i.e. enterprises with less than 250 employees, in FAME. Definition of variables and descriptive statistics calculated from the estimated sample of SMEs are reported in Table 3. Average SME characteristics are presented by rural and urban locations in Table 4. Generally, there are no important differences in summary statistics between rural and urban firms, but rural SMEs are slightly larger as measured by employment and smaller in assets, and they face smaller local market demand. The cost of employees (and wage) also is lower in rural SMEs. In rural areas, more CAP payments are received than in the urban areas as exemplified by the total subsidy and the higher share of direct payments. It is noteworthy that our location-based (at postal district) CAP payments measure confounds the amount of payments received by individual farms with the size of the farm sector at the location considered; nevertheless, such measure, of intensity of the CAP payments suffices our analytical purpose.

- Tables 3 and 4 here –

For comparison and as a robustness check, we estimate both the static, equation (9) and dynamic, equation (11) versions of the labour demand function, derived in the previous section using the system GMM (generalised method of moments) estimator (Blundell and Bond, 1998). While the system GMM is best suited to deal with dynamic panel data models, Roodman (2009, pp. 99, 127), Aguirregabiria (2009), and Alonso-Borrego (2010), amongst others, demonstrate its possible applications also to static models with endogenous regressors. The system GMM estimator exploits moment conditions constructed out of equation (9) (or equation (11) respectively) and its first-differenced version, and yields consistent estimates when the cross-sectional number of observations (N) is large and the number of time periods (T) small as in our case (e.g., Hayashi, 2000). The system GMM controls for unobserved firm heterogeneity and for potential endogeneity of the firm-level explanatory variables (Baum et al., 2003). For the estimations we use Stata's xtabond2 command. Given the firm-level dependent variable, the firm-level explanatory variables are treated as endogenous while the sector-level, regional-level, and the time dummy explanatory variables are treated as predetermined or exogenous in alternative specifications.

The explanatory variable of main interest – the CAP payments - which is available at postal district level is unlikely to suffer from endogeneity as the location units at which it is calculated do not systematically correlate with the spatial patterns of economic activity and thus are unlikely to affect the individual firm employment decisions; within each postal district there is sufficient independent variation across firms. Furthermore, the decision on subsidy allocation is made and known to recipient farms at least one period prior to actual disbursement; this is certainly true in the historic allocation model, and to a large degree in the hybrid models of subsidy allocation. This timing of information process makes the reverse causality of the non-farm firms' employment decisions on farmers' behaviour, as a mediator of CAP payment effects, very unlikely.[14]

5 Results

The estimation results from the SME sample, for the static, and dynamic models, based on equations (9) and (11) respectively are presented in Tables 5 and 6.[15] As previously mentioned, in the estimations, the I-O shares were used to weight each firm-level observation, while the observations were also (multiway) clustered at panel identifier and constituent-country level to account for policy environment and structural factors in each country.[16]

There could be a potential problem with the system GMM related to 'instrument proliferation', which may bias the coefficient estimates of endogenous variables, due to overfitting and weakening test procedures of instrument validity, as well as produce downward-biased standard errors. Therefore, we estimate our models with and without applying the Roodman's (2009) collapsed instrument matrix procedure, reducing the instrument count.[17] The two sets of estimated results turned out to be very similar and we report the set of results without collapsing. The estimated coefficients of all theoretically motivated control variables are significant and have the expected signs. Considering the

[14] Petrick and Zier (2012) argue that practically there is no decision power regarding CAP payments at sub-national, local economic units such as county or local authority and that, in fact, CAP policies are settled at the EU and national level ruling out concerns of CAP payment endogeneity in the case of micro data analysis.

[15] We have run the same set of estimations on the full sample of firms (large and SMEs), and the results obtained are qualitatively similar in terms of coefficient magnitudes to the ones reported.

[16] Multiway clustering of observations allows for correlation of observations at panel identifier and constituent country which in turn results in robust standard errors estimation. The four constituent countries differ in their implementation and administration of the CAP payments as well as there are structural differences in terms of agricultural land rental arrangements and proportions. It is noteworthy that the rental patterns are quite homogeneous within a constituent country and stable over time; thus, the country controls do capture important information on the CAP payments utilisation.

[17] In the differences equation, for endogenous variables, lags 2 and earlier are valid instrument. For predetermined variables (not strictly exogenous), lag 1 is also valid. For the lagged dependent variable, which is predetermined, realizations of lags 2 and earlier are valid instruments. For the levels equation, for endogenous variables, lags 1 and earlier of the first differences of the same variables are valid instruments, while for predetermined variables the contemporaneous first differences of the same variables are also valid. The Roodman's collapse procedure creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance. However, in large samples, such as ours, collapsing the instrument matrix reduces statistical efficiency.

AR(2) and Hansen-J tests respectively, there is no evidence of second-order autocorrelation or weak instruments (or correlation of instruments with the unobservable error process).

- Tables 5 and 6 here –

The variable in the focus of the analysis – the CAP payments – has a statistically significant effect in both the static and dynamic models. While the magnitudes of the coefficients, representing elasticity, appear small, they are of economic significance. The impact of total CAP payments on employment levels is 0.014 (Table 5, column (1)), which means that completely removing the CAP payments in the UK would result in 1.4 per cent drop in employment in non-farm SMEs from the current level, *ceteris paribus* (no alternative amount spent in the UK by new national agricultural policy).[18] Given our framework and considering that according to ONS (2015) SMEs employed 15.6 million people in 2015, a drop of 1.4 per cent is equivalent to about 220,000 jobs. In Table 5, column (2) we decompose total CAP payments into Pillar 1 and Pillar 2, which show differential magnitude of the effects. The contribution of Pillar 1 to non-farm employment is 0.9% or 140,000 jobs and Pillar 2 contributes 0.5% or around 80,000 non-farm jobs.[19]

In Table 6 we present the results of the dynamic models where we can distinguish between short and long run effects. The total short run effect of CAP payments (column (1)) is 0.9% while the long run effect is about 1.4% (0.9/(1-0.350)), similar to the estimate from the static model. In column (2) the effects of Pillar 1 and Pillar 2 are estimated separately; the short run effects are 0.6% and 0.3% respectively generally preserving the relative importance of the two pillars from the static model analysis. Importantly, the static and dynamic analyses seem to produce comparable and consistent results.

Even though in the previous section we argued that the CAP payments are unlikely to cause endogeneity problems in our set up of analysis, as a robustness check, we estimate a specification where CAP payments are treated as endogenous and instrumented with a measure of the total agricultural land at local authority level following ideas in Blomquist and Nordin (2017). We present in column (3) of Tables 5 and 6 the estimation results where we use the predicted value of CAP payments. The results obtained are similar to the ones discussed previously. Furthermore, we perform a C (difference in Hansen J-statistic) test for exogeneity of CAP payments which is a χ^2 distributed test of the associated set of validity of

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[18] The *ceteris paribus* condition here also implies that the amount of CAP payments would be relocated in a tax neutral way.

[19] These estimated (direct) effects are likely to be the lower bound of the total effects, considering that the aggregate market demand variable may be already capturing some of the CAP spillovers in a dynamic sense, i.e., some of the employment increase due to higher demand is in fact indirectly driven by the past CAP expenditure contribution to the shift in demand.

orthogonality conditions. We could not reject the C test null hypothesis that the CAP payments are a proper instrument and therefore in the rest of the analysis and discussion we treat CAP payments as exogenous.

The finding that Pilar 1 has a stronger impact on employment than Pillar 2 is interesting and suggests that, although in theory decoupled from farm output, Pillar 1 payments do in fact affect the supply and demand linkages between farms and firms. Furthermore, the Pillar 1 and Pillar 2 payments appear to have heterogeneous effects on non-farm employment that deserves a further investigation.

- Table 7 here –

In Table 7, the static and dynamic specifications from column (2) in Tables 5 and 6 respectively are estimated while augmented with interaction terms between the CAP payments (separate for Pillar 1 and Pillar 2) and the rural area indicator - in columns (1) and (3) - and the agricultural supply chain indicator - in columns (2) and (4) - to identify location and industry-linkage specific impacts on employment. The estimated coefficients of the interaction terms in both the static and dynamic models are statistically significant, alongside the significant main effects, and their magnitudes suggest that the (long-run) impact of CAP payments on employment is relatively concentrated in the rural SMEs and within the agricultural supply chain. Furthermore, the rural dummy coefficient loses significance, suggesting that only the CAP payments bring extra employment in rural areas relative to urban areas. Regarding the agricultural supply chain employment, the interaction term leads to reduction in the dummy coefficient which in the static model also loses significance suggesting that again CAP payments play a very important role for job creation in the industries up- and downstream of agriculture. It is interesting that the effect of Pillar 1 remains slightly larger than Pillar 2.

Considering that rural SMEs employed over 2 million people in 2015 (ONS, 2015) completely removing the CAP payments *ceteris paribus* would lead to losing around 65,000 rural jobs as the negative impact on the rural labour market would be significant. Interestingly, the contribution of Pillar 2 to rural employment is relatively higher (1.5%) compared to the contribution of Pillar 1 (1.7%) per Euro spent, considering that the Pillar 2 payments are less than half the Pillar 1 payments.

The contributions to employment in the agricultural supply chain of Pillar 1 is about 17% and of Pillar 2 about 15% (the static model). Again the relative contribution of Pillar 2 is higher than Pillar 1, per Euro spent. The fact that CAP payments show higher overall employment creation in the agricultural supply chain compared to the rest of the economy suggests farmers' spending on production activities generates spillovers and is important for non-farm employment in spite of subsidy decoupling. In other words, although in theory decoupled, Pillar 1 single farm payments have pronounced coupled effects.

6 Conclusions

This paper aims at filling the gap in the literature concerned with the effects of CAP payments on employment in the non-farm economy. Whilst most previous studies have focused on the effect of the CAP on employment in agriculture and/or in rural areas only, this paper investigates explicitly the inter-sectoral spillovers without limiting itself to the boundaries of 'rural'. The theoretically founded estimation framework developed in this study leads to a firm employment function which is estimated with the FAME dataset containing rich firm level information. The estimated sample comprises about 200,000 firm-year observations and covers all industries in the UK economy. Both static and dynamic models of the employment function were estimated with a sample of SMEs only as these represent the majority of employing private businesses in the UK, particularly in rural areas. A distinctive feature of the study is the micro-data approach and the wide coverage of all sectors in the economy which allows capturing the net equilibrium employment effects of the CAP payments.

The CAP has been subject to many criticisms by economists due to its market-distorting effects, even after the decoupling of direct payments from farm production, and due to the blanket income support to farmers, which attenuates their incentives to stay competitive and profitable without substantial public transfers. However, this study has found a net positive effect of the CAP payments on non-farm employment, with relatively stronger effect of Pillar 2 (RD) compared to Pillar 1 (SFP) per Euro spent in rural areas and within the agricultural supply chain. The magnitude of the overall estimated effect is 1.4% which is relatively small but of economic significance as it is associated with the creation of about 220,000 jobs. The effect is indeed smaller than the estimate of 5.3% by Mattas et al. (2011) for the CAP impact on regional employment levels in two regions in Greece. In a recent study on Sweden Blomquist and Nordin (2017) estimate an effect of the CAP direct payments on the private (non-farm) economy of around 2.4%. Due to differences in methodology and data used this cross-country comparison is speculative but also informative – if we argue that the UK has one of the most flexible and efficient labour markets in Europe which was characterised by relatively low unemployment during the period of analysis our results are in line with other studies. The UK case could be considered as an example of the lower bound of the CAP employment effects on the non-farm economy.

Nevertheless, under an extreme policy scenario in which the CAP payments are completely removed without compensating/countervailing measures (and neutral tax policy), the impact on the UK employment would amount to about 220,000 jobs lost. Furthermore, the impact in rural areas will be almost three times stronger, in percentage terms, which equates to about 65,000 jobs. In the industries comprising the agricultural supply chain the effect, in percentage terms, is also substantial, at about 32%. The results suggest that the removal of CAP payments would likely have rural development implications beyond employment lost, e. g., contributing to the higher rural unemployment and a possible outflow of population from rural areas. Furthermore, if the extra jobs at firm level supported by the CAP were removed, there could also be a negative efficiency effect, due to reduction of the scale of operation below the minimum efficient scale for some SMEs; such firms may become unviable and exit in the long run.

A caveat to these results and discussion is that they are based on a partial equilibrium *ceteris paribus* analysis. This suggests that the findings should be interpreted as relevant to the question on the impact of CAP subsidy on jobs in the UK within the EU membership context and the CAP administrative framework, rather than Brexit, which would clearly be associated, besides withdrawal from CAP, with important changes in the UK's trade regime and the overall functioning of the economy.

Furthermore, the results should not be interpreted as an attempt to justify the role of CAP subsidies as a job creation policy across the EU because there might be other non-agricultural, labour market policies which could be more efficient in increasing or sustaining employment opportunities in non-farm enterprises. Nevertheless, this study sends the message that a broader approach is necessary in analysing the implications of the CAP, as its impact is felt well beyond agriculture.

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Table 1: Indicators of UK farming by constituent country, 2013

Indicators	England	Northern Ireland	Scotland	Wales
Total agricultural area (million ha)	9.5	1.0	6.2	1.7
Number of farms ('000)	101	24.5	52.7	42.3
Average farm size (ha)	90	41	106	37
Crops/grass/ rough grazing (% of total agric. area)	40/44/10	5/78/17	10/24/66	5/68/27
Less favoured area (%)	17	70	85	81
Gross output per farm (£'000)	189.3	78.4	59.6	26.1
Gross output per ha (£)	2016	1925	507	879
Net Farm Income (average all farm types, £'000)	34	13	21	17

Source: Allen et al. (2014).

Table 2: CAP payments by funding stream and constituent country, € million *

	2010	2011	2012	2013	2014
UK Total	*4337*	*4327*	*4433*	*4417*	*4299*
Pillar 1	3424	3309	3348	3326	3234
of which DP	3325	3304	3290	3285	3195
CMO	99	5	58	41	39
Pillar 2 **	913	1018	1085	1091	1065
of which EAFRD	512	653	742	752	798
England Total	*2761*	*2696*	*2777*	*2792*	*2714*
Pillar 1	2199	2099	2146	2126	2048
of which DP	2100	2094	2088	2085	2009
CMO	99	5	58	41	39
Pillar 2 **	562	597	631	666	666
of which EAFRD	348	448	470	532	563
Wales Total	*413*	*417*	*426*	*406*	*413*
Pillar 1 DP	316	312	309	309	301
Pillar 2 **	97	105	117	97	112
of which EAFRD	38	45	54	48	54
Scotland Total	*779*	*826*	*840*	*819*	*757*
Pillar 1 DP	589	583	584	583	566
Pillar 2 **	190	243	256	236	191
of which EAFRD	92	123	167	113	119
Northern Ireland Total	*384*	*388*	*390*	*400*	*415*
Pillar 1 DP	320	315	309	308	319
Pillar 2 **	64	73	81	92	96
of which EAFRD	34	37	51	59	62

Source: Agriculture in the United Kingdom (2014).

Notes: DP – Direct Payments; CMO – Common Market Organisation; EAFRD – European Agricultural Fund for Rural Development. * Annual data is for the EU financial year 16th October – 15th October. ** The difference between the total Pillar 2 and the amount received from EAFRD indicates the national co-financing.

Table 3 Definition of variables and summary statistics

Variable	Definition	Mean (S.D.)
Employment	Number of full-time equivalent firm workers, log	3.07 (1.50)
Market demand	Annual 2-digit SIC by TTWA aggregated demand in thousands GBP, log	13.83 (3.41)
Demand variance	Firm revenue deviation from 2-digit SIC geometric mean	0.99 (2.11)
Cost per employee	Annual firm wage bill per FTE worker in thousands GBP, log	2.99 (1.24)
Firm size	Value of firm total assets in thousands GBP, log	7.18 (2.60)
Firm age	Firm age in years	17.98 (17.93)
Total subsidy	Value of total CAP subsidies (Pillars 1 and 2) at 4-digit postcode district in thousands GBP, log	8.78 (1.79)
CMO share	Share of common market organisation (CMO) subsidy, Pillar 1	0.04 (0.11)
DP share	Share of direct payments (DP) aka SFP, Pillar 1	0.67 (0.41)
Pillar 1 share	Share of Pillar 1 (CMO+DP)	0.71 (0.39)
Pillar 2share	Share of rural development payments (RD)	0.29 (0.39)
Manufacturing	Dummy for aggregate manufacturing industries	0.12 (0.33)
Construction	Dummy for construction and utilities industries	0.09 (0.28)
Services	Dummy for aggregate service industries	0.79 (0.41)
Rural area	Dummy for rural areas according to the DEFRA (wider) definition of rurality	0.17 (0.38)
Ag. supply chain	Dummy for 4-digit SIC industries comprising the agricultural supply chain	0.02 (0.12)

Notes: Total number of observations: 190,348 for 2008, 2010, 2012 and 2014.

Table 4 Summary statistics for rural and urban samples of SMEs

Variable	Rural mean (S.D.)	Urban mean (S.D.)
Employment	3.09 (1.55)	3.06 (1.49)
Employment growth	0.01 (0.20)	0.01 (0.23)
Market demand	11.84 (3.40)	14.24 (3.26)
Demand variance	0.81 (2.06)	1.03 (2.12)
Cost per employee	2.82 (1.21)	3.03 (1.24)
Firm size	7.12 (2.61)	7.19 (2.59)
Firm age	18.65 (17.97)	17.85 (17.92)
Total subsidy	9.08 (1.79)	8.71 (1.78)
CMO share	0.02 (0.09)	0.04 (0.12)
DP share	0.76 (0.34)	0.66 (0.42)
Pillar 1 share	0.78 (0.33)	0.70 (0.40)
RD share	0.22 (0.33)	0.30 (0.40)
Manufacturing	0.16 (0.36)	0.12 (0.32)
Construction	0.10 (0.30)	0.08 (0.28)
Services	0.74 (0.44)	0.80 (0.40)
Ag. supply chain	0.03 (0.17)	0.01 (0.11)
Number of observations	32,788	157,560

Table 5 Regression results for the full SMEs sample, static specifications

Dependent variable	Log of employment, ln(empl)		
Explanatory variables	(1)	(2)	(3)
Total subsidy	**0.014 ** (0.002)**	**-**	**-**
Total subsidy (instrumented)	-	-	**0.018 ** (0.004)**
Pillar 1 share	**0.023 ** (0.006)**	**-**	**0.024 ** (0.006)**
Pillar 1 subsidy	-	**0.009 ** (0.001)**	-
Pillar 2 subsidy	-	**0.005 ** (0.001)**	-
Market demand	0.105 ** (0.007)	0.105 ** (0.007)	0.105 ** (0.007)
Demand variance	-0.183 ** (0.032)	-0.183 ** (0.033)	-0.184 ** (0.033)
Cost per employee	-0.226 ** (0.085)	-0.228 ** (0.088)	-0.221 ** (0.090)
Firm size	0.088 ** (0.014)	0.087 ** (0.014)	0.087 ** (0.015)
Firm age	0.017 ** (0.002)	0.017 ** (0.002)	0.017 ** (0.002)
Rural area	0.114 ** (0.014)	0.111 ** (0.013)	0.110 ** (0.014)
Ag. supply chain	0.248 ** (0.067)	0.248 ** (0.067)	0.248 ** (0.067)
2010	-0.111 ** (0.007)	-0.110 ** (0.008)	-0.110 ** (0.007)
2012	-0.151 ** (0.010)	-0.154 ** (0.009)	-0.164 ** (0.009)
2014	-0.171 ** (0.012)	-0.170 ** (0.012)	-0.169 ** (0.012)
Number of observations	190,348	190,348	190,348
Number of instruments	45	45	45
AR(1), p-value	0.01	0.01	0.02
AR(2), p-value	0.63	0.52	0.43
Hansen J, p-value	0.36	0.30	0.28

Notes: Robust standard errors are reported in parentheses; level of significance ** 1%, * 5%. A set of 1-digit SIC industry dummies with reference category food processing is included in all regressions.

Table 6 Regression results for the full SMEs sample, dynamic specifications

Dependent variable	Log of employment, ln(empl)		
Explanatory variables	(1)	(2)	(3)
Lagged ln(empl)	0.350 **	0.351 **	0.350 **
	(0.013)	(0.013)	(0.013)
Total subsidy	**0.009 ****	**-**	**-**
	(0.001)		
Total subsidy (instrumented)	-	**-**	**0.012 ****
			(0.002)
Pillar 1 share	**0.020 ****	**-**	**0.022 ****
	(0.003)		**(0.003)**
Pillar 1 subsidy	-	**0.006 ****	-
		(0.000)	
Pillar 2 subsidy	-	**0.003 ****	-
		(0.000)	
Market demand	0.084 **	0.085 **	0.085 **
	(0.006)	(0.007)	(0.006)
Demand variance	-0.277 **	-0.281 **	-0.289 **
	(0.017)	(0.018)	(0.017)
Cost per employee	-0.180 **	-0.180 **	-0.179 **
	(0.051)	(0.050)	(0.050)
Firm size	0.216 **	0.215 **	0.217 **
	(0.026)	(0.027)	(0.027)
Firm age	0.019 **	0.019 **	0.018 **
	(0.005)	(0.005)	(0.005)
Rural area	0.051 **	0.050 **	0.048 **
	(0.011)	(0.012)	(0.012)
Ag. supply chain	0.031	0.029	0.028
	(0.017)	(0.017)	(0.016)
2010	-0.069 **	-0.068 **	-0.068 **
	(0.006)	(0.006)	(0.006)
2012	-0.068 **	-0.074 **	-0.076 **
	(0.012)	(0.011)	(0.012)
2014	-0.076 **	-0.074 **	-0.074 **
	(0.013)	(0.013)	(0.013)
Number of observations	174,731	174,731	174,731
Number of instruments	48	48	48
AR(1), p-value	0.00	0.00	0.00
AR(2), p-value	0.15	0.14	0.13
Hansen J, p-value	0.45	0.46	0.45

Notes: Robust standard errors are reported in parentheses; level of significance ** 1%, * 5%. A set of 1-digit SIC industry dummies with reference category food processing is included in all regressions.

Table 7 Regression results for the full SMEs sample, cross effects

Dependent variable	Log of employment, ln(empl)			
Explanatory variables	(1)	(2)	(3)	(4)
Lagged ln(empl)	-	-	0.348 **	0.344 **
			(0.014)	(0.014)
Pillar 1 subsidy	**0.007 ****	**0.006 ****	**0.005 ****	**0.004 ****
	(0.002)	**(0.002)**	**(0.001)**	**(0.001)**
Pillar 2 subsidy	**0.003 ****	**0.003 ****	**0.002 ****	**0.002 ****
	(0.001)	**(0.001)**	**(0.001)**	**(0.001)**
Pillar 1 subsidy *Rural area	**0.010 ****	-	**0.007 ****	-
	(0.002)		**(0.002)**	
Pillar 2 subsidy *Rural area	**0.012 ****	-	**0.008 ****	-
	(0.003)		**(0.002)**	
Pillar 1 subsidy * Ag. supply chain	-	**0.167 ****	**-**	**0.109 ****
		(0.009)		**(0.007)**
Pillar 2 subsidy * Ag. supply chain	-	**0.145 ****	**-**	**0.096 ****
		(0.010)		**(0.009)**
Market demand	0.113 **	0.106 **	0.092 **	0.086 **
	(0.012)	(0.008)	(0.008)	(0.006)
Demand variance	-0.206 **	-0.177 **	-0.318 **	-0.268 **
	(0.037)	(0.031)	(0.020)	(0.018)
Cost per employee	-0.165 **	-0.181 **	-0.194 **	-0.197 **
	(0.054)	(0.053)	(0.051)	(0.052)
Firm size	0.070 **	0.065 **	0.230 **	0.214 **
	(0.022)	(0.015)	(0.034)	(0.030)
Firm age	0.014 **	0.018 **	0.011 **	0.013 **
	(0.003)	(0.002)	(0.002)	(0.001)
Rural area	0.112	0.112 **	0.129	0.073 **
	(0.083)	(0.014)	(0.109)	(0.014)
Ag. supply chain	0.213 **	0.169	0.247 **	0.069 *
	(0.070)	(0.130)	(0.031)	(0.033)
2010	-0.102 **	-0.109 **	-0.066 **	-0.070 **
	(0.007)	(0.009)	(0.006)	(0.006)
2012	-0.118 **	-0.120 **	-0.076 **	-0.077 **
	(0.006)	(0.008)	(0.010)	(0.011)
2014	-0.110 **	-0.116 **	-0.074 **	-0.074 **
	(0.010)	(0.012)	(0.014)	(0.014)
Number of observations	190,348	190,348	174,731	174,731
Number of instruments	45	45	48	48
AR(1), p-value	0.01	0.00	0.00	0.00
AR(2), p-value	0.43	0.64	0.20	0.36
Hansen J, p-value	0.37	0.42	0.46	0.49

Notes: Robust standard errors are reported in parentheses; level of significance ** 1%, * 5%. A set of 1-digit SIC industry dummies with reference category food processing is included in all regressions.

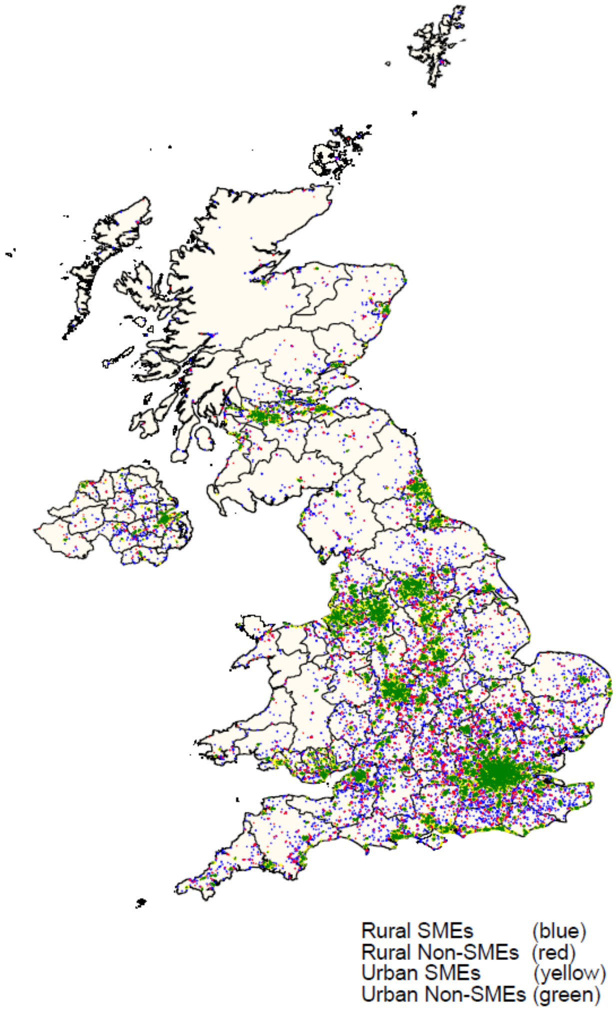

Figure 1 Geographic distribution of firms in the UK

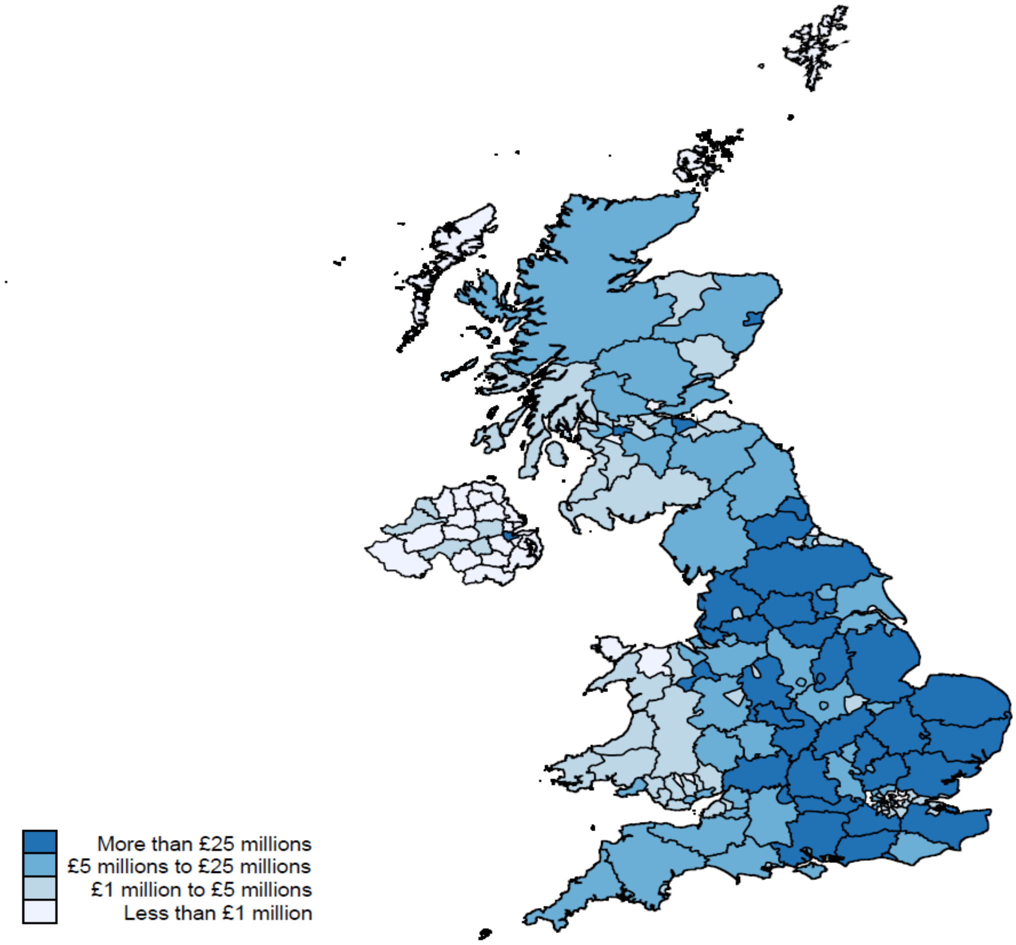

Figure 2 Geographic distribution of annual CAP payments