Impact of the Agri-Environmental Scheme of the Common Agricultural Policy on Agricultural Employment

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Disclaimer: This conference paper summarizes specific results of a more elaborate paper on the impact of various types of CAP subsidies on EU agricultural employment. We refer to this paper for more details, robustness tests, more discussion and implications.[1]

Abstract

This paper investigates the relationship between EU agricultural subsidies, including agri-environmental subsidies, and the outflow of labor from agriculture. We use more representative subsidy indicators and a wider coverage (panel data from 210 EU regions over the period 2004-2014) than has been used before. The data allow to better correct for sample selection bias than previous empirical studies. We find that, on average, CAP subsidies reduce the outflow of labor from agriculture, but the effect is almost entirely due to decoupled Pillar I payments. Coupled Pillar I payments have no impact on reducing labor outflow from agriculture, i.e. on preserving jobs in agriculture. The impact of overall Pillar II is mixed, but agri-environmental payments strongly reduce the outflow of labor from agriculture. Our estimates predict that an increase of 10 percent of the CAP budget would prevent an extra 16,000 people from leaving the EU agriculture sector each year. A 10 percent decoupling would save 13,000 agricultural jobs each year. However, the budgetary costs are large. The estimated cost exceeds € 300,000 per year (or € 25,000 per month) per job saved in agriculture.

Keywords: Common Agricultural Policy, agricultural employment, panel data analysis.

JEL classifications: Q12, Q18, O13, J21, J43, J60.

[1] Garrone, M., Emmers, D., Olper, A., and J. Swinnen. (2019). "Jobs and Agricultural Policy: Impact of the Common Agricultural Policy on EU Agricultural Employment." *Food Policy*, forthcoming.

1. Introduction

It is well known (a) that agriculture's share in employment decreases when an economy develops; and (b) that government support to agriculture increases as economies grow (Anderson et al., 2013). Agricultural subsidies have been criticized for distorting agricultural markets and labor allocation in the economy by constraining or preventing structural change that is essential for economic growth and development (Johnson, 1973; Gardner, 1992; OECD, 2008). At the same time, proponents of agricultural subsidies have argued that such policies are crucial to support incomes of farmers and to sustain rural communities by creating jobs and preventing out-migration from rural areas (European Commission, 2010). Adverse economic conditions caused by the global economic crisis have reinforced the arguments for job creation. For example, the European Commission's recent "*Communication on the Future of the Common Agricultural Policy (CAP)*" identified fostering jobs in rural areas and attracting new people into the agricultural sector as key policy priorities (European Commission, 2017).

Interestingly, while the arguments of opponents and supporters of agricultural subsidies are used to support different policy conclusions, they both assume that subsidies increase agricultural employment, i.e. lead to more jobs in agriculture than would be the case without (or with less) subsidies. However, empirical evidence on this assumption is actually quite mixed. Some studies do indeed find a positive impact of subsidies on agricultural employment (Breustedt and Glauben, 2007; Olper et al., 2014), but others find no or mixed impacts (Barkley, 1990; Petrick and Zier, 2012) and yet others find a negative impact (Berlinschi et al., 2014).[2]

The different empirical findings may be due to various reasons. Conceptual studies have pointed out that the simple logic behind a positive subsidy-employment relationship ignores potentially important additional effects. Subsidies may affect employment through other channels than income, and cause indirect effects because of interactions with capital, land, education and insurance

[2] Some recent studies focus on the impact of agricultural subsidies on non-farm employment. Blomquist and Nordin (2017) estimate a positive employment effect of agricultural subsidies in Sweden at a cost of about $26,000 per job. Rizov et al. (2018) report a strong positive employment effect on employment in small and medium enterprises in the UK's manufacturing sector. M'Barek et al. (2017) find a positive effect of CAP subsidies on employment in the food industry.

markets.[3] For example, subsidies may cause capital–labor substitution (replacing labor by e.g. machinery) or lead to a reduction in credit constraints, thus allowing farmers to purchase other farmers' land, inducing those to leave agriculture (Goetz and Debertin, 1996, 2001). The labor substitution effect may be reinforced by land capitalization of subsidies, depending on the land ownership structure (Barkley, 1990; Ciaian et al., 2010). Subsidy-induced increases in farm income or reductions in credit constraints may also result in a reduction of agricultural employment if they allow investments in education and human capital, thereby enhancing farmers' off-farm employment opportunities (Berlinschi et al., 2014). Hence, (an increase in) subsidies may have an indirect negative impact on agricultural employment because of these indirect effects. The net effect will likely depend on a variety of factors, such as factor market imperfections, which may differ among countries and over time.

Another reason for the different findings may be empirical, i.e. differences in geographic and regional coverage of the analysis and differences in data and/or empirical models used.

In this paper we attempt to contribute to the empirical literature on the impact of subsidies on agricultural employment generally and on the impact of the CAP on agricultural employment in the EU more specifically by (a) having a broader coverage of EU regions; (b) using more precise CAP subsidy data and (c) disaggregating subsidies into specific subsidy instruments. First, we use data for the 210 regions from the entire EU-27 (compared to EU-15 in earlier studies). This allows to disentangle the effect for sub-groups of countries and in particular whether there are differences between old member states (OMS) and new member states (NMS). Second, we cover the post-NMS accession period (2004-2014) which has not yet been covered in previous studies. Third, we are the first to use the *Clearance Audit Trail System* (CATS) dataset from the European Commission as indicators of subsidies for the study of government support and agricultural employment. The CATS data are very detailed, covering all payments made to all farmers for each individual budget component of the CAP funds. Using this CATS dataset represents a fundamental improvement. Previous studies mainly used data from the *Farm Accountancy Data Network* (FADN) to construct EU agricultural

[3] During the transition process in Central and Eastern Europe in the 1990s the impact of subsidies on labor allocation to agriculture was even more complex since it was interacting with institutional reforms and major farm restructuring (Dries and Swinnen, 2004; Swinnen et al., 2005).

subsidy indicators. FADN data cover only agricultural holdings whose size exceeds a minimum threshold, which unavoidably creates sample selection bias. Fourth, we distinguish in the impact analysis (a) between Pillar I and Pillar II payments; (b) within Pillar I support between decoupled and coupled payments; and (c) between different types of payments within Pillar II. This allows to test whether these various types of payments have different effects on agricultural employment. Recent studies on the impact of CAP subsidies on productivity indicate that the impact depends on the type of subsidy instruments (Mary, 2013; Rizov et al., 2013; Kazukauskas et al., 2014). In this paper we test whether this also affects agricultural employment differently.

The last part of the paper will interpret the econometric results and discuss the policy implications. We provide an estimate on the number of jobs created or saved by the CAP subsidies and we relate these job numbers to the costs of the subsidies. We also relate these findings to the policy discussions on the impact of different types of policy instruments.

2. Data and Econometric Model

Our dataset covers 27 EU member states (MS)[4] over the period 2004-2014. The choice of the period of analysis (2004-2014) is due to data availability. The subsidy (CATS) data were available only from 2004; and the employment data coming from the *Cambridge Econometrics Regional Database* (CERD) was available only until 2014.

The data were aggregated based on the *Nomenclature of Territorial Units for Statistics* (NUTS). For most MS (23) the NUTS2 level was used. In 4 MS (Denmark, Germany, Slovenia and the UK) the NUTS1 level of aggregation was applied because some key data were not available at NUTS2 level for these MS[5] and these MS adopted a regional approach to the implementation of both CAP and Structural Fund (SF) policies at NUTS1 level. We also had to drop a few NUTS2 regions as

[4] Today there are 28 EU member states. The 15 "old" member states (OMS, also often referred to as "EU-15") joined the EU before 2004; the 13 "new" member states (NMS) joined after 2004. More specifically, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia joined in 2004, Bulgaria and Romania in 2007. Croatia, which joined the EU most recently in 2013, is not included as CATS data are not available for the period of analysis covered in our analysis.

[5] Agricultural subsidy (CATS) data are not available at NUTS2 level for Denmark and Slovenia for the entire period of analysis and FADN data on family labor are only available at NUTS1 level for Germany and the UK.

extreme outliers and because of lack of regional data for some variables employed in our econometric analysis.[6] This resulted in a final sample consisting of 210 regions and 1,745 observations.

We estimate the following model:

$$m_{i,t} = \beta_0 + \beta_2 s_{i,t-1} + \beta_3\, SF_{i,t-1} + \beta_n X_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{i,t,} \qquad (1)$$

where $m_{i,t}$ is the outflow of labor from agriculture, $s_{i,t-1}$ is the agricultural subsidy rate at time t-1 and β_s are the parameters to be estimated. $X_{i,t-1}$ is a vector including all control variables such as relative income, sectoral employment, population density, family farm work, and unemployment rates. To control for other EU regional support, we include a variable, $SF_{i,t-1}$, for the additional regional expenditures of the *EU Structural and Investment Funds* (ESIF),[7] which have as a key goal to promote regional economic growth and job creation.

The subsidy variables and the other covariates are used in lags. This reflects the assumption that farmers need time to adjust to a new situation, e.g. a farmer's choice to leave at time t is affected by CAP payments in previous years. In the basic model (equation 1) the lag is t-1 (one year). Afterwards, we also estimate models with longer lag periods to test longer time effects of subsidies. To control for potential endogeneity bias due to omitted variables, we include regional level and time fixed effects, $\alpha_i \text{ and } \gamma_t$, respectively.[8]

2.1. Agricultural Employment (Dependent Variable)

To measure the change in agricultural employment, we used regional data coming from the CERD. In particular, we use regional agricultural employment, corrected

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[6] The 27 MS had 279 NUTS2 regions in 2014 and 219 regions when using NUTS 1 regions for Denmark, Germany, the UK and Slovenia, and NUTS2 regions for the other 23 MS (European Commission, 2018). We dropped 9 regions (out of 219) from our analysis due to lacking data or because of extreme values. Specifically, data were missing for the regions of Åland, Berlin, Bremen, Brussels, Ceuta, Guyane, Mayotte and Melilla. As Olper et al. (2014), we dropped the Greater London (UK) region because it was a clear outlier. However, regression results for decoupled and the different components of Pillar II payments are robust to the inclusion of Greater London (*available* from the *authors upon request*). These 9 regions were not included. Partial-regression plots and the DFBETA test in STATA clearly identified a few specific observations (in particular CAP subsidies for Wales in 2006 and Border, Midland and Western in 2012) as outliers. These were also excluded (see appendix A for the inclusion of these outliers).

[7] Most EU funding is delivered through the five European structural and investment funds (ESIF): European regional development fund (ERDF), Cohesion Fund (CF), European agricultural fund for rural development (EAFRD/old EAGGF), European Social Fund (ESF) and European maritime and fisheries fund (EMFF). They are jointly managed by the European Commission and the EU countries. They are designed to invest in job creation and growth. As explained in section 2.4, our variable covers all funds, except for the EAFRD –to avoid double counting with our CAP payment data- and the EMFF –for which data are not available.

[8] The application of fixed-effects controls for (time invariant) observable and unobservable differences in the unit of analysis that can influence the farmer's decision to migrate, but that change quite slowly over time. These include for example the stock of human capital, the age structure of the farm population, or the share of land under property (Olper et al., 2014).

for the growth rate of the total labor force, following Larson and Mundlak (1997), and define the outflow of labor from agriculture as:

$$m_{i,t} = \left[L_{i,t-1}^{A} \frac{L_{i,t}^{T}}{L_{i,t-1}^{T}} - L_{i,t}^{A}\right] / L_{i,t-1}^{A} \qquad (2)$$

where $L_{i,t}^{A}$ is the labor force employed in the agricultural sector of region *i* at time *t* and $L_{i,t}^{T}$ is the total labor force in the region's economy at time t.

2.2. Agricultural Subsidy Rate (Independent Variable)

The key variable in the regression equation, $s_{i,t-1}$, is the agricultural subsidy rate, which, as in previous analysis, is calculated as the ratio of agricultural subsidies over agricultural value added at regional level.[9]

What is different in our study is that we calculate the regional CAP payments with data from the CATS database[10] aggregated at NUTS2 regional level. The CATS database includes information on payments of each individual budget component of the CAP funds to all farms that receive payments. Previous studies used FADN data for subsidy measures. As is well known, this biases the sample towards larger farms. Unlike FADN data, CATS data cover all transfers paid to all EU farmers.

A key assumption of our identification strategy is that our (lagged) CAP subsidy rate variable $s_{i,t-1}$ is predetermined with respect to the outflow of agricultural labor. For Pillar I payments, this assumption can be justified on the ground that these policy instruments are decided by EU authorities rather than by regional authorities.[11]

The assumption of the exogeneity of Pillar II payments might be more open to critique. Regional institutions do have a say in the allocation of Pillar II payments. In a previous study, Olper et al. (2014) justified this exogeneity assumption arguing that the regional allocation of Pillar II payments is mostly the result of negotiations between EU and national authorities. To further control for

[9] See e.g. previous studies on government support and out-migration of farm labor in the US (Barkley, 1990; D'Antoni and Mishra, 2010) and in the EU (Olper et al., 2014).

[10] CATS was created to assist the European Commission in implementing audits on agricultural expenditures. It collects the digitalized files that each Member State forwards to the European Commission concerning details of all individual payments (in euro) made to CAP recipients.

[11] More specifically, the CAP is financed by two funds: the EAGF (European Agricultural Guarantee Fund) and EAFRD (European Agricultural Fund for Rural Development), and up until financial year 2006 the EAGGF (European Agricultural Guarantee and Guidance Fund).

this, all the CAP variables are lagged by one year, which would reduce a potential bias caused by a spurious correlation due to shocks simultaneously affecting CAP payments and farmers' exit.

In our robustness tests (section 4) we also try to test for potential endogeneity using different methods.

2.3. Different Types of Agricultural Subsidies

The CATS database allows to disaggregate total CAP payments into several components to test whether the impact on agricultural employment differs among types of agricultural subsidies. As already indicated above, we distinguish between Pillar I and Pillar II payments. Moreover, within each pillar we further distinguish between different types of payments.

First, within Pillar I support we distinguish between decoupled and coupled payments. Coupled Pillar I policies, such as tariffs and price support, were the main form of EU agricultural support in the 1970s and 1980s. These support measures have been reformed and most of the Pillar I payments are now decoupled from production.

Second, within Pillar II payments we distinguish between five categories, following Boulanger and Philippidis (2015): (a) investment in human capital (HK); (b) investment in physical capital (PK); (c) agri-environmental payments; (d) least favored areas (LFA); and (e) wider rural development (RD) instruments.[12]

Third, given our focus on employment impacts, we further disaggregate Pillar II investment in human capital (HK) into: (a) subsidies targeted to farm employment and management, such as training, setting-up of young farmers, use of advisory services and supporting management relief and advisory services; (b)

[12] The wider rural development measures include diversification into non-agricultural activities; encouragement of rural tourism; village renewal and development, etc.

early retirement support; (c) investment support for quality[13] and (d) NMS transitional measures.[14]

2.4. Control Variables

To control for other types of (non-agricultural) EU support to the region, we include a variable covering the EU regional structural and investment funds (ESIF). We use annual EU expenditures of the European Regional Development Fund (ERDF), the Cohesion Fund (CF), and the European Social Fund (ESF)[15] at the NUTS2 level of regional aggregation per unit of regional GDP.[16] Few previous studies have controlled for these payments, but these payments could influence the results if they are correlated with CAP subsidies (due to omitted variable bias).

Other control variables include relative income, unemployment, population density, family labor involved in farm work, and sectoral employment. Data for these variables stem from several sources, such as CERD, Eurostat and FADN. To account for inter-sectoral income differentials as a driving force behind migration we include a relative income indicator, which is calculated as the ratio of per worker gross value added (GVA) in non-agriculture over per worker GVA in agriculture, measured at constant prices. The local rate of unemployment is an indicator of employment opportunities outside of agriculture. Population density, calculated as the total population over regional area in km^2, is an indicator of the distance (and thus transfer costs) to alternative employment opportunities. The population density variable can also account for time-varying regional differences in off-farm migration (in addition to the time-fixed regional effects included in regression specification) because during the 2004-2014 period, population density grew at different rates across the EU-27 regions (Eurostat, 2014). The number of family farm workers is an indicator that captures the effect that hired labor is more likely (or less constrained) in reallocating than family labor. A final control variable is sectoral employment, which is calculated as the ratio of non-agricultural

[13] This category includes the following measures: adaptation to new standards based on Community legislation; participation of farmers in food quality schemes; information and promotion activities; holdings undergoing restructuring;

[14] This category includes the following measures: support for semi-subsistence farming; producer groups; and farm advisory and extension services in Bulgaria and Romania.

[15] Together with the EAFRD, these funds account for almost 95 percent of total EU funds remitted. EMFF data are not available in this dataset.

[16] ESIF data were extracted from the DG REGIO website: https://cohesiondata.ec.europa.eu/EU-Level/Historic-EU-paymentsregionalised-and-modelled/tc55-7ysv.

employment to that in agriculture. A higher share of agriculture means that more people are affected (and thus may want to leave or stay) with changes in subsidies. At the same time, a higher share of agriculture in employment means that the relative size of the employment in the rest of the economy is smaller, making it more difficult to find alternative jobs.

3. Results

Tables 2 to 4 present the fixed effect regression results for the EU-27, OMS and NMS, respectively. Column 1 presents regressions for total CAP subsidies. Columns 2 to 5 present regression results with disaggregated CAP spending: disaggregating Pillar I and Pillar II subsidies (column 2); disaggregating Pillar I subsidies into "coupled Pillar I subsidies" and "decoupled Pillar I subsidies" (column 3); disaggregating Pillar II subsidies in its five components (column 4); and disaggregating Pillar II human capital (HK) subsidies in four components (column 5). Key results are the following.

First, the overall CAP subsidy rate (column 1) has a negative coefficient for all three regressions (EU-27, OMS and NMS), but the effect on the outflow of labor is only significant at the 10 percent level for the EU-27. Hence, on average, CAP subsidies as a whole have reduced the outflow of labor from EU agriculture, but the estimated effect is weak.

Second, there is no significant effect of coupled Pillar I payments on agricultural employment in the EU-27 as a whole, nor in the OMS or NMS separately.

Third, decoupled Pillar I payments have a strongly significant negative effect on the outflow of labor from agriculture. This result holds for the EU-27 as a whole, and for the OMS or NMS separately.

Fourth, Pillar II payments on aggregate have no significant effect in the EU-27 and in NMS. The effect of Pillar II payments is significant for OMS and the size of the coefficient is similar to that of decoupled Pillar I payments, indicating that the marginal effect of both types of payments are similar in OMS.

Fifth, the estimated effects of the different components of Pillar II payments varies quite strongly between OMS and NMS. In OMS, the only type of Pillar II payments with a significant (negative) coefficient is agri-environmental payments.

The size of the effect of agri-environmental payments is large and is the only reason for the significant effect of Pillar II payments as a whole in OMS (column 3 of Table 3). The strong effect in OMS also drives the significant effect for the EU-27 as a whole. In NMS agri-environmental payments have no significant effect. There is some negative effect of LFA payments and investment in physical capital (PK), though they are only statistical significant at the 10% level. Neither of these have a significant effect in the OMS.

Sixth, in the NMS Pillar II investment in human capital (HK) has a strongly significant, and positive, estimated effect. This means that these HK investment subsidies have stimulate the outflow of labor from agriculture in the NMS, and the effect is so strong that it drives the overall positive effect of HK for the EU-27 (with no significant effect in the OMS).

To further analyze this effect, we then distinguish between different components within the Pillar II subsidies for "investment in human capital (HK)". The results in column 5 show that the different components have quite different effects. Somewhat surprising, the first component of investment in HK, which are subsidies targeting farm employment and management, for example by supporting the start-up of young farmers,[17] have no effect on employment, nor in NMS nor in OMS. The second component, payments for early retirement schemes,[18] have significant increased the outflow of labor in NMS but had no significant effect in OMS. The third component, which includes investments aimed at improving the quality of agricultural production, has a significant negative effect on the outflow of labor from agriculture in OMS, but not in NMS. The last component, transitional measures for NMS, significantly increased the outflow of labor from agriculture in NMS. (These measures were only applied in NMS).

In summary, the aggregated effect that HK investments significantly increased the outflow of labor from agriculture for EU-27 (positive coefficient in column 4 in Table 2) is due to the strong effect of two specific components in NMS: early retirement schemes and "transitional measures". The effects are different

[17] Setting-up of young farmers is a payment targeting farmers of no more than 40 years of age who are setting up for the first time an agricultural holding as head of the holding (ENRD, 2014).

[18] Early retirement schemes are designed to incentivize older farmers and farm workers to leave the farm earlier than planned by offering them annual payments. The retiring farmer's land is released and can be transferred to another farmer, who may be able to increase the size and economic viability of his/her farm or can be assigned to non-agricultural use (Davis, Caskie and Wallace, 2009).

in OMS where there was no effect of early retirement schemes, and "quality measures" reduced the outflow of labor.

Finally, the estimated coefficients of the control variables (such as relative income, sectoral employment, unemployment rate, population density and farm family work) are in line with our expectations. As expected: (1) in all specifications (tables 2-4) relative income between agriculture and non-agricultural sectors has a positive and strongly significant effect on off-farm migration; (2) the outflow of hired labor is higher than the outflow of family labor; (3) unemployment rate and (4) population density have the expected (and significant) sign;[19] and the coefficient for ESIF spending is not significant in most regression specifications.

4. Robustness Checks

The estimated relationship between off-farm migration and CAP payments may be affected by endogeneity bias.[20] In Section 2 we explained that there are arguments that suggest that this bias will be small in our estimates. Still, we perform two robustness checks to test potential endogeneity of these variables.

First, we estimate an alternative regression specification where decoupled Pillar I payments are instrumented with two variables: regional arable land and permanent grass land - following the strategy of Blomquist and Nordin (2017).[21] In this test, the instrumental variables (IVs) only work for decoupled Pillar I payments, not for Pillar II payments. Hence, we can only focus on Pillar I payments. However even for Pillar I payments, standard tests indicate that these instruments are weak in our analysis (see the bottom part of the table 5). Test results indicate that the equations are under-identified due to weak instruments

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[19] *Augmented Dickey Fuller* (ADF) tests were performed to test the stationarity of the variables. Fisher test and the Im, Pesaran, and Shin (2003) test for unbalanced panel allowed us to reject the hypothesis that the variables were non-stationary (p-value, 0.01), with the exception of sectoral employment and unemployment rate. However, these variables become stationary in first difference. Thus, they were introduced in first difference and, as such, they capture short-run effects. In one specification of the Im, Pesaran, and Shin (2003) test, population density also appeared to be unit root in level and stationary in first difference. We have run the same regressions entering population density in first difference (see Appendix tables B.1 to B.3). The main results for the employment effect of non-distortionary Pillar I decoupled are robust to this specification. As for the components of Pillar II, wider rural development spending turns to be positive and significant (the effect is exclusively driven by OMS). This is consistent with the argument that wider rural development payments are generally assumed to have no effects on agricultural sector as such, but to support other sectors such as construction or tourism. In this sense, these payments may be effective in creating new rural jobs, which can also lead to a loss of agricultural employment (Schuh et al., 2016; Boulanger and Philippidis, 2015; Dudu and Kristkova, 2017) .

[20] For a discussion on the potential endogeneity and reverse causality associated to agricultural support, see Blomquist and Nordin (2017).

[21] Agricultural area data at NUTS2 level were collected from Eurostat.

for all specifications (especially in the specifications for the EU-27 and NMS), making the IV estimates unreliable.[22] Although for OMS the Cragg-Donald Wald statistic (28.37) exceeds the Stock and Yogo critical value,[23] the F-statistic (9.86) and Kleibergen-Paap rk Wald F-statistic (2.19) are quite low, suggesting relatively weak instruments for this group of countries as well.

The results, which should be interpreted with care given the problems with the IV specification, indicate that for all specifications the Pillar I coupled payments have no significant effect. The estimated coefficients of the decoupled Pillar I payments are considerably larger than for the coupled payments for all specifications but only significant (at the 10 percent confidence level) for OMS.

For a second robustness test, we estimate a SYS-GMM[24] model, which regresses observed agricultural employment (in logarithms) on a set of regional characteristics and decoupled and coupled Pillar I payments, as in Petrick and Zier (2012), for OMS.[25]

Standard tests to check for the consistency of the SYS-GMM estimators are reported at the bottom of table 6**.** The Arellano-Bond AR (1) and AR (2) tests indicate the presence of first-order serial correlation but no second-order autocorrelation, suggesting that the dynamic model is correctly specified. Moreover, the Hansen test confirms the joint validity of our instruments. In column 1 of table 6, the lagged dependent variable is instrumented with its *t-2* and longer lags levels while CAP payments are treated as strictly exogenous. In column 2 of table 6, CAP payments are treated as endogenous as well and instrumented with its *t–2* and longer lag levels.

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[22] As pointed out by Bound, Jaeger, and Baker (1993, 1995), the "cure can be worse than the disease" when the excluded instruments are only weakly correlated with the endogenous variables. With weak instruments IV estimates are biased in same direction as OLS, and Weak IV estimates may not be consistent.

[23] The Cragg-Donald Wald test can be used to test for weak instruments under the assumption of conditionally homoscedastic, serially uncorrelated model errors. Meanwhile, the Kleibergen-Paap rk test allows for heteroscedasticity, autocorrelation, and clustering. The null hypothesis for both tests is that the maximum relative bias of the 2SLS estimator due to weak instruments is at least b% larger as the OLS estimator. Stock and Yogo (2005) provided the following critical values: 19.13, 11.59, 9.75 and 7.25 for values of b =10 percent, 15 percent, 20 percent and 25 percent, respectively.

[24] This approach is an extension of DIFF-GMM estimator of Arellano and Bond (1991) and applies the GMM estimators to the equations in first differences and in levels. By adding the second equation additional instruments can be obtained. As empathized by Petrick and Zier (2012), the empirical literature suggest that the adopted estimator should be robust to high autoregressive parameters, as labor adjustment in agricultural labor tends to adjust slowly. We found that a dynamic panel specification (DIFF-GMM) is not correctly specified for this analysis, as AR (1) test systematically turn to be not significant. These results are available from the authors upon request.

[25] We also run SYS-GMM regressions for the EU27 and NMS samples, but in most of these regressions the standard Hansen test of over-identifying restrictions suggests that the model is not well specified. We therefore did not include these additional regressions, but they are available from the authors upon request.

The coefficient of the lagged dependent variable is significant and positive. This positive correlation indicates that if agricultural employment at time *t-1* is high, then it will be slightly higher at time t, a result consistent with previous findings showing that labor adjustment is sluggish (Petrick and Zier, 2012).

The SYS-GMM regression results indicate a positive employment effect of decoupled Pillar I payments and no effect of coupled Pillar I subsidies in the OMS. This effect is significant at the 1 percent confidence level in both specifications (see columns 1 and 2 of table 6) and fully consistent with the results in the main model (columns 3 and 4 of table 3).

5. A Simple Cost-Benefit Estimation of the Employment Effects of CAP Subsidies

To get a better perspective on the effectiveness of the CAP subsidies on maintaining/creating agricultural jobs, we will (1) use our regression results to estimate the magnitude of the policy effects, and (2) compare these "gross effects" with the cost of the policies.

The estimated coefficients in Tables 2-6 represent marginal effects. The estimated coefficient in column 1 of table 2 implies that a marginal increase of 1 percentage point in the "overall CAP subsidy rate" variable leads to a decrease in the dependent variable of 0.041 percentage point. At the average levels of the CAP subsidy rate (32.4 percent, see table 1) and off-farm migration rate (1.50 percent) in the EU-27, a 10 percent increase[26] in the subsidy rate would lead to a decrease in off-farm migration by 8.8 percent,[27] meaning that the annual off-farm migration rate would decrease from 1.50 to 1.37 percent. In terms of agricultural jobs, these results imply that around 16,000 farmers (or farm workers) would stay in agriculture each year if total CAP payments would increase by 10 percent,

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[26] In this simple calculation we (implicitly) assume that a 10 percent increase in the CAP payments increases the "subsidy rate" by 10 percent -- thus assuming that agricultural valued added (the denominator of the CAP subsidy rate) remains unchanged. If anything, this leads to an overestimation of the calculated employment effect because if we would incorporate the impact of the subsidy on value added the impact of a 10 percent increase in the payments would increase the subsidy rate by less than 10 percent.

[27] The elasticities are computed at the sample mean using the following formula:

$$\varepsilon_{y/s} = \frac{dy/y}{ds/s} = \frac{d\ln(y)}{d\ln(s)} = \beta\frac{\bar{s}}{\bar{y}}$$

where $\bar{s}$ refers to the estimated sample mean of each specific CAP payment variables; $\bar{y}$ refers to our sample mean of off-farm migration (see table 1); β is the estimated marginal effect of the CAP payments on our dependent variables (see table 2).

compared to an average of 12.1 million people working in agriculture of which on average around 181,000 people left agriculture each year over the period of analysis in the EU-27.[28]

We can also use our estimates in a similar way to quantify the effect of decoupling in terms of agricultural jobs saved per year. According to the regression coefficients reported in column 3 of table 2, a 1 percentage point shift of CAP subsidies from Pillar I coupled subsidies to Pillar I decoupled subsidies, would result in a net marginal decrease of 0.067 (=0.075-0.008) percentage point in the off-farm migration rate. At the average level of the Pillar I decoupled subsidy rate (16.0 percent, see table 1) and the off-farm migration rate in our sample, a 10 percent increase in the Pillar I decoupled subsidy rate would reduce the average off-farm migration rate by 7.15 percent, meaning that the annual off-farm migration rate would reduce from 1.50 to 1.39 percent. This means that a 10 percent shift of the CAP budget from Pillar I coupled payments to Pillar I decoupled payments would save 12,950 jobs in agriculture per year.

The analysis so far only measures the "gross effect" of the CAP. It measures how much jobs have been affected without considering the costs of the policies. According to the CATS data, overall annual CAP payments in the period 2004-2014 amounted to € 52 billion. A simple calculation indicates that this implies that the cost of saving jobs in agriculture through the CAP was approximately € 324,000 per job annually -- or € 27,000 per month. Even if we take a 95% confidence interval for our estimations, the lowest boundary is € 179,000 (and the upper boundary over € 2 million).[29]

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[28] This estimated effect is larger than the impact estimated by Olper et al. (2014). In this study, a 10 percent increase in total CAP payments would increase agricultural employment between 1.7 and 2.5 percent in the OMS. There are several possible explanations for this difference: our analysis includes the NMS, covers a shorter and recent period, and the subsidy data also cover small-scale agricultural holdings that do not meet the FADN minimum size threshold. (Olper et al. (2014) cover the period 1990-2009 and 150 regions in OMS and use data on subsidy payments based on the FADN survey.) The estimated outflow coefficient of overall CAP subsidies is indeed much higher for NMS than for OMS (column 1 in tables 2-4): 0.030 for OMS, half the coefficient (0.062) for NMS with the coefficient for the EU-27 in between (0.041).

[29] If we take a 95% confidence interval, the boundaries of the estimated number of jobs saved in agriculture and the associated costs are as follows. A marginal increase of 1 percentage point in the "overall CAP subsidy rate" variable leads to a decrease in the dependent variable of 0.041 [95% CI -0.007 – 0.089] percentage point. At the average levels of the CAP subsidy rate (32.4 percent) and off-farm migration (1.50 percent) in the EU-27, a 10 percent increase in the subsidy rate would lead to a decrease in off-farm migration by 8.8 (=0.041* (0.324/0.015) *10%) [95% CI -1.5 – 19.2] percent, meaning that the annual off-farm migration rate would decrease from 1.50 to 1.37 [95% CI 1.26 – 1.52] percent. In terms of agricultural jobs, these results imply that around 16,000 [95% CI -2,420 – 29,040] farmers (or farm workers) would stay in agriculture each year if total CAP payments would increase by 10 percent. This means that the 95% confidence interval of the costs per job saved is between € 179,063 (lower boundary) and € 2,148,760 (upper boundary) per job annually.

This is a large amount compared to average incomes in the EU, in agriculture or outside. It does highlight the huge costs of the CAP as a job creating or saving policy mechanism. It is most likely much more efficient to use other policy instruments to support sustainable employment in rural areas or in the economy as a whole.

6. Conclusions

Following the global financial crisis, job creation is at the top of the political agenda in numerous countries. The relationship between agricultural employment and government support has gained increasing attention both in academic and policy debates. While policy arguments that agricultural subsidies increase farm profits and therefore jobs are used commonly, empirical evidence in support of this argument is much weaker than assumed and argued. There are good conceptual arguments for this relationship to be more complex than often assumed. There are also problems in measuring the effect empirically.

In this paper we contribute to the literature by estimating the relationship by using more complete data and a broader coverage than in earlier empirical studies. We use an EU-wide panel dataset of 210 regions over the period (2004–2014), and our analysis is the first to use CATS data with detailed payments for each NUTS2 region in the EU.

We find that CAP payments as a whole reduce the outflow of labor from agriculture, but the effect is weak. There is no significant association of coupled Pillar I payments with agricultural employment in the EU-27 as a whole, nor in the OMS or NMS separately. In contrast, decoupled Pillar I payments have a strongly significant negative effect on the outflow of labor from agriculture in both OMS and NMS – and thus obviously in the EU-27 as a whole. Different implementation models do not seem to have a significant impact on the decoupling effects.

The effect of Pillar II payments varies significantly between OMS and NMS. The effect of Pillar II payments as a whole is significant for OMS only and all the effect comes from agri-environmental payments (the other components are not significant). In NMS agri-environmental payments have no significant effect.

In NMS the total effect of Pillar II payments was zero (not significant) because different components had opposing effects. Both Pillar II investments in physical capital (PK) and LFA payments have reduced the outflow of labor, but early retirement schemes and "transitional measures for NMS" significantly increased the outflow of labor from agriculture in NMS.

We performed a series of extensions and additional robustness tests, e.g. to address the issue of endogeneity and reverse causality related to agricultural subsidies. We applied an instrumental variable approach as well as a SYS-GMM specification. These additional checks show that our results are fairly robust to alternative specifications.

In the debate on the future of the CAP**,** there is pressure to re-introduce a significant amount of recoupling. Our analysis suggests that, in terms of job creation or maintenance in agriculture, this is the wrong choice because it would lead to fewer jobs in agriculture.

That said, it is important to emphasize that, when interpreting our findings, our results do not imply that decoupled payments are an efficient policy instrument to target job creation. The budgetary costs required to maintain one job in agriculture per year is very high. Hence, for creating sustainable jobs, even decoupled payments are a costly instrument and most likely not the most efficient policy.

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Tables

Table 1: Descriptive statistics

Variables - (SOURCE)	Description	EU27		OMS		NMS	
		Obs.	Mean	Obs.	Mean	Obs.	Mean
Off-farm migration rate	Growth rate	1,475	0.015	1,357	0.012	388	0.027
Relative income	Non-Agr. GVA p.w./Agr. GVA p.w.	1,475	2.427	1,357	2.162	388	3.335
Sectoral employment	Non-Agr.Employment/Agr.Employment	1,475	45.337	1,357	52.262	388	21.118
Population density	1,000 person/km2	1,475	0.222	1,357	0.230	388	0.195
Unemployment rate	Percentage	1,475	9.450	1,357	9.528	388	9.175
Family farm labor force	Annual work unit	1,475	1.273	1,357	1.278	388	1.256
European Structural and Investment Funds	ESIF payments/regional GDP	1,475	0.010	1,357	0.006	388	0.026
Total CAP payments/VA – (CATS)	Subsidy Rates CATS	1,475	0.324	1,357	0.315	388	0.356
Pillar I payments/VA – (CATS)		1,475	0.249	1,357	0.261	388	0.207
Pillar I coupled payments/VA - (CATS)		1,475	0.089	1,357	0.108	388	0.020
Pillar I decoupled payments/VA – (CATS)		1,475	0.160	1,357	0.152	388	0.188
Pillar II payments/VA – (CATS)		1,475	0.075	1,357	0.054	388	0.150
Pillar II human capital/VA – (CATS)		1,475	0.007	1,357	0.004	388	0.018
Pillar II physical capital/VA – (CATS)		1,475	0.012	1,357	0.007	388	0.029
Pillar II agri-environment/VA – (CATS)		1,475	0.024	1,357	0.022	388	0.031
Pillar II LFA/VA – (CATS)		1,475	0.014	1,357	0.012	388	0.022
Pillar II RD/VA – (CATS)		1,475	0.013	1,357	0.008	388	0.032

Note: European Structural and Investment Funds (ESIF) include: European regional development fund (ERDF), Cohesion Fund (CF) and European Social Fund (ESF). Source: CATS database provided by the European Commission, CERD, DG REGIO, FADN, Eurostat.

Table 2: Off-farm migration regressions for EU-27 regions (210 regions)

Dependent variable: *Off-farm migration*	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD	(5) LSVD
Overall CAP subsidy rate (t-1)	-0.041*				
	(1.68)				
Pillar I (t-1)		-0.039			
		(1.35)			
Pillar I coupled (t-1)			-0.008	-0.008	-0.005
			(0.33)	(0.34)	(0.22)
Pillar I decoupled (t-1)			-0.075***	-0.070***	-0.069***
			(4.90)	(4.67)	(4.78)
Pillar II (t-1)		-0.050	-0.045		
		(1.58)	(1.50)		
Pillar II HK (t-1)				0.405*	
				(1.78)	
Pillar II HK with job obj. (t-1)					0.190
					(0.34)
Pillar II HK early retirement (t-1)					0.309
					(1.44)
Pillar II HK quality (t-1)					-0.500
					(1.05)
Pillar II HK NMS trans. measures (t-1)					1.032***
					(2.85)
Pillar II PK (t-1)				-0.013	-0.021
				(0.26)	(0.44)
Pillar II agri-env. (t-1)				-0.314***	-0.305***
				(3.51)	(3.41)
Pillar II LFA (t-1)				-0.073	-0.099
				(0.58)	(0.78)
Pillar II RD (t-1)				-0.010	0.015
				(0.15)	(0.20)
Relative income (t-1)	0.082***	0.083***	0.095***	0.098***	0.098***
	(5.50)	(5.73)	(6.65)	(6.79)	(6.89)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***	0.004***
	(4.81)	(4.81)	(4.83)	(4.85)	(4.87)
Population density (t-1)	0.545**	0.555**	0.453**	0.417*	0.355
	(2.34)	(2.47)	(1.97)	(1.73)	(1.45)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***	-0.003***
	(4.42)	(4.38)	(4.30)	(4.47)	(4.04)
Family work (t-1)	-0.033***	-0.034***	-0.034***	-0.033***	-0.030**
	(2.87)	(2.92)	(2.94)	(2.83)	(2.48)
Structural and Investment Funds (t-1)	0.238	0.255	0.207	0.248	0.408**
	(0.89)	(1.15)	(1.11)	(1.28)	(2.31)
Observations	1,745	1,745	1,745	1,745	1,745
R-squared	0.431	0.431	0.437	0.444	0.446
Number of regions	210	210	210	210	210
Region FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Note: each Least Square Dummy Variable (LSDV) regression includes both region and time fixed effects. T-statistics based on standard errors clustered by region are in parentheses. ***, ** and * denote significance at 1, 5 and 10% levels respectively.

Table 3: Off-farm migration regressions for OMS regions (155 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD	(5) LSVD
Overall CAP subsidy rate (t-1)	-0.030				
	(1.27)				
Pillar I (t-1)		-0.026			
		(1.08)			
Pillar I coupled (t-1)			0.004	0.006	0.006
			(0.25)	(0.34)	(0.36)
Pillar I decoupled (t-1)			-0.063***	-0.058***	-0.057***
			(4.49)	(4.24)	(4.15)
Pillar II (t-1)		-0.079**	-0.063*		
		(2.19)	(1.75)		
Pillar II HK (t-1)				-0.528	
				(1.54)	
Pillar II HK with job obj. (t-1)					-0.476
					(0.82)
Pillar II HK early retirement (t-1)					0.021
					(0.04)
Pillar II HK quality (t-1)					-1.253**
					(2.01)
Pillar II PK (t-1)				0.008	0.020
				(0.07)	(0.16)
Pillar II agri-env. (t-1)				-0.295***	-0.292***
				(2.73)	(2.78)
Pillar II LFA (t-1)				-0.114	-0.122
				(0.73)	(0.79)
Pillar II RD (t-1)				0.107	0.131
				(1.54)	(1.59)
Relative income (t-1)	0.054***	0.056***	0.071***	0.076***	0.075***
	(3.43)	(3.90)	(4.48)	(4.48)	(4.47)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***	0.004***
	(3.72)	(3.73)	(3.71)	(3.76)	(3.79)
Population density (t-1)	0.333***	0.401***	0.273**	0.018	-0.063
	(2.95)	(3.35)	(2.08)	(0.10)	(0.29)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(4.67)	(4.59)	(4.39)	(4.26)	(3.98)
Family work (t-1)	-0.033**	-0.035**	-0.033**	-0.026	-0.028*
	(2.08)	(2.21)	(2.07)	(1.65)	(1.74)
Structural and Investment Funds (t-1)	0.309	0.331	0.311	0.238	0.336
	(1.06)	(1.11)	(1.10)	(0.86)	(1.18)
Observations	1,357	1,357	1,357	1,357	1,357
R-squared	0.432	0.432	0.441	0.447	0.448
Number of regions	155	155	155	155	155
Region FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Note: each Least Square Dummy Variable (LSDV) regression includes both region and time fixed effects. T-statistics based on standard errors clustered by region are in parentheses. ***, ** and * denote significance at 1, 5 and 10% levels respectively.

Table 4: Off-farm migration regressions for NMS regions (55 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD	(5) LSVD
Overall CAP subsidy rate (t-1)	-0.062				
	(1.55)				
Pillar I (t-1)		-0.191***			
		(3.31)			
Pillar I coupled (t-1)			-0.029	-0.116	-0.111
			(0.31)	(1.11)	(1.02)
Pillar I decoupled (t-1)			-0.249***	-0.294***	-0.286***
			(3.13)	(3.84)	(3.67)
Pillar II (t-1)		0.047	0.049		
		(0.52)	(0.52)		
Pillar II HK (t-1)				0.771***	
				(3.48)	
Pillar II HK with job obj. (t-1)					0.574
					(1.19)
Pillar II HK early retirement (t-1)					0.753**
					(2.34)
Pillar II HK quality (t-1)					0.501
					(1.21)
Pillar II HK NMS trans. measures (t-1)					0.998**
					(2.10)
Pillar II PK (t-1)				-0.063*	-0.063*
				(1.94)	(1.97)
Pillar II agri-env. (t-1)				-0.153	-0.174
				(0.61)	(0.67)
Pillar II LFA (t-1)				-0.478*	-0.462*
				(1.86)	(1.71)
Pillar II RD (t-1)				0.006	0.023
				(0.04)	(0.16)
Relative income (t-1)	0.146***	0.154***	0.161***	0.176***	0.174***
	(4.82)	(4.90)	(5.04)	(5.31)	(5.09)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***	0.004***
	(3.81)	(3.84)	(3.81)	(4.01)	(3.98)
Population density (t-1)	0.845	0.721	0.688	0.554	0.581
	(0.99)	(0.88)	(0.82)	(0.82)	(0.85)
Unemployment (diff)	-0.003	-0.003	-0.004*	-0.004*	-0.004*
	(1.42)	(1.67)	(1.78)	(1.73)	(1.80)
Family work (t-1)	-0.047**	-0.031	-0.030	-0.030	-0.030
	(2.20)	(1.38)	(1.28)	(1.33)	(1.16)
Structural and Investment Funds (t-1)	0.510	0.622	0.721*	0.801*	0.845**
	(1.26)	(1.46)	(1.75)	(1.84)	(2.01)
Observations	388	388	388	388	388
R-squared	0.483	0.490	0.492	0.515	0.515
Number of regions	55	55	55	55	55
Region FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Note: each Least Square Dummy Variable (LSDV) regression includes both region and time fixed effects. T-statistics based on standard errors clustered by region are in parentheses***, ** and * denote significance at 1, 5 and 10% levels respectively.

Table 5: Off-farm migration regressions using agricultural land measures as instruments of CAP subsidies

Dependent variable: Off-farm migration	EU 27 (1) IV	OMS (2) IV	NMS (3) IV
Pillar I decoupled (t-1)	-0.054	-0.180*	-2.177
	(0.44)	(1.70)	(0.86)
Pillar I coupled (t-1)	-0.001	-0.034	0.277
	(0.03)	(0.57)	(0.59)
Relative income (t-1)	0.087**	0.110**	0.433
	(2.36)	(2.29)	(1.29)
Sectoral employment (diff)	0.004***	0.004***	0.003***
	(4.80)	(3.65)	(3.07)
Population density (t-1)	0.409	0.135	-0.663
	(1.56)	(0.97)	(0.30)
Unemployment (diff)	-0.004***	-0.004***	-0.005
	(4.42)	(4.49)	(1.13)
Family work (t-1)	-0.033***	-0.024	0.111
	(2.73)	(1.38)	(0.53)
Structural and Investment Funds (t-1)	-0.003	0.349	4.345
	(0.01)	(1.35)	(0.89)
Observations	1,731	1,352	379
R-squared	0.522	0.478	0.057
Region FE	YES	YES	YES
Year FE	YES	YES	YES
SW first-stage	0.916	2.188	1.162
F-stat	16.567	9.856	12.774
Cragg-Donald Statistic	18.527	28.366	1.864
Kleibergen-Paap rk Wald F-statistic	0.916	2.188	1.162
Kleibergen-Paap rk LM p-value	0.353	0.082	0.364
Anderson-Rubin Wald p-value	0.862	0.000	0.012
Hansen J-Stat. p-value	0.871	0.111	0.948

Note: each regression includes both region and time fixed effects. T-statistics based on standard errors clustered by region are in parentheses. ***, ** and * denote significance at 1, 5 and 10% levels respectively.

Table 6: Agricultural employment and CAP subsidies for OMS regions (156 regions) SYS-GMM regressions

Dependent variable: Agricultural employment	Exogenous (1)	Endogenous (2)
Pillar I coupled (t-1)	0.003	0.002
	(0.2)	(0.46)
Pillar I decoupled (t-1)	0.035***	0.044***
	(3.49)	(4.3)
Agricultural employment (t-1)	0.975***	0.981***
	(39.86)	(87.94)
Relative income (t-1)	-0.014**	-0.015***
	(2.25)	(2.7)
Unemployment (t-1)	0.001	0.001
	(1.39)	(1.03)
Population density (t-1)	-0.026	-0.022*
	(1.06)	(1.77)
Observations	1450	1450
No. of instruments	59	147
AR (1) p-value	0.000	0.000
AR (2) p-value	0.492	0.402
Hansen (p-value)	0.069	0.104

Note: Year fixed effects included in each regression. ***, ** and * denote significance at 1, 5 and 10% levels respectively.. SYS-GMM estimator, estimated in STATA using the *xtabond2* command with the orthogonal-deviations transform option; in regression (1) the lagged dependent variable is instrumented with its *t–2* and longer lags levels and CAP subsidies are treated as strictly exogenous; in regression (2) CAP subsidies are also treated as endogenous using the *t-2, t -3* and longer lags levels as instruments.