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Jobs and Agricultural Policy: Impact of the Common Agricultural Policy on EU Agricultural Employment

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Jobs and Agricultural Policy

Impact of the Common Agricultural Policy

on EU Agricultural Employment

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Abstract

This paper investigates the relationship between EU agricultural 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 and the impact of Pillar II is mixed. Coupled Pillar I payments have no impact on reducing labor outflow from agriculture, i.e. on preserving jobs in agriculture. The impact of Pillar II is mixed. Our estimates predicts that a decline of 10 percent of the CAP budget would cause an extra 16,000 people to leave EU agriculture each year. A 10 percent decoupling would save 13,000 agricultural jobs each year.

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Jobs and Agricultural Policy

Impact of the Common Agricultural Policy on EU Agricultural Employment

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 (e.g. Johnson, 1973; 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 (e.g. 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 use basic economic models of labor allocation that predict that agricultural employment is responsive to changes in returns to agricultural labor. In other words, agricultural subsidy programs are expected to have a positive impact on agricultural employment because they increase agricultural incomes.

However, empirical evidence on this assumption is actually quite mixed. Some studies do indeed find a positive impact of subsidies on agricultural employment (e.g. Breustedt and

Glauben, 2007; Olper et al., 2014), but others find no or mixed impacts (e.g. Barkley, 1990; Petrick and Zier, 2012) and yet others find a negative impact (e.g. Berlinschi et al., 2014).[1]

The different empirical findings may be due to various reasons. Conceptual studies have pointed out that the simple logic behind the subsidy-employment relationship is too simplistic because subsidies may affect employment through other channels than income, and cause indirect effects because of interaction with capital or land markets.[2] Subsidies may cause capital–labor substitution 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). Hence, (an increase in) subsidies may have an indirect negative impact on agricultural employment because of capital or land substitution, which can (depending on the country and/or time period) dominate the direct positive impact (the direct income effect). Berlinschi et al. (2014) propose a related explanation based on education and longer-term adjustments. By increasing farmers' income, subsidies allow credit constrained farmers to invest more in their children's education and thereby their employment choices in the next generation. If children with higher educational levels have access to more attractive job opportunities in non-agricultural sectors, then in the long term a subsidy-induced increase in farm income may result in a reduction of agricultural employment, instead of an increase. Their empirical findings are consistent with these hypotheses.

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

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

[2] 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 (see e.g. Dries and Swinnen, 2004 and Swinnen et al., 2005).

In this paper we attempt to contribute to the literature by using more detailed and more complete CAP subsidy data and a broader coverage of EU regions than have been used in previous analyses of the impact of agricultural subsidies on agricultural employment in the EU. First, we use data for the 210 regions from the entire EU-27 (compared to EU-15). 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. 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 used data from the *Farm Accountancy Data Network* (FADN) to construct EU agricultural subsidy indicators. FADN data cover only agricultural holdings whose size exceeds a minimum threshold, which unavoidably creates sample selection bias.

The CATS data allow to distinguish (a) between Pillar I and Pillar II payments; (b) within Pillar I support between decoupled and coupled payments; and (c) within Pillar II payments in five classes of payments (for which we follow the categorization of Boulanger and Philippidis (2015)). This allows to test whether these various types of payments have different effects on agricultural employment.

2. Data and Econometric Model

Our dataset covers 27 EU member states[3] and 210 regions over the period 2004-2014. The choice of the period of analysis (2004-2014) is due to data availability. The subsidy (CATS)

[3] 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 since 2004. Croatia, which joined the EU most recently, is not included as CATS data are not available for the period of analysis covered in our paper.

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)[4] at NUTS2 level with the exception of Denmark, Germany, Slovenia and the United Kingdom, for which NUTS1 level of aggregation was applied.[5] We had to drop some regional observations due to the lack of data for some variables employed in our econometric analysis, and a few outliers.[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 βs are the parameters to be estimated. X 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.

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[4] The Nomenclature of Territorial Units for Statistics (NUTS) is a geographical nomenclature subdividing the economic territory of EU into regions at three different levels: NUTS 1, 2 and 3 respectively, moving from larger to smaller territorial units. (Eurostat, 2013).

[5] The choice of employing NUTS1 level data for Germany and the UK is because (a) these countries adopted a regional approach to the implementation of both CAP and Structural Fund (SF) policies at NUTS1 level; and (b) of the necessity to match data from different sources to include all control variables used in our econometric model expressed in equation (1) (in particular FADN data on family labor are only available at NUTS1 level for these two countries). As for Denmark and Slovenia, the choice of employing NUTS 1 level is due to the fact that agricultural subsidy data are not available at NUTS 2 level for the entire period of analysis.

[6] Following Olper et al. (2014), we dropped the Greater London (UK) region as we consider it an urban region (with a population density 20 times the mean density of all other regions and employment 15 times the rest of EU regions). We dropped also a few observations based on a number of diagnostic tests to detect potential outliers. Partial-regression plots and the DFBETA test in STATA clearly identifies the values of CAP subsidies for Wales in 2006 and Border, Midland and Western in 2012 as 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

The subsidy variables as well as the other covariates enter the equation lagged by 1 year. 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 the level of CAP payments at time t-1. To control for potential endogeneity bias due to omitted variables, we include regional level and time fixed effects, α_i and γ_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 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]

(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).

[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).

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 set for subsidy measures. As is well known, this biases the sample towards larger farms. Unlike the FADN dataset, the CATS dataset covers all transfers paid to all EU farmers. Table 1 and Figure 1 compare the CATS subsidy rates and the FADN subsidy rates. The average ratio of CAP payments per value added is 57 percent higher with FADN data than with CATS data (53 percent in OMS and 69 percent in NMS), which confirms that FADN-based subsidy indicators are higher compared to those constructed from the CATS data because of the bias towards larger farms.

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] Some also argue that regardless of the reforms implemented, the cross-country and cross-commodity distribution of CAP spending remained largely unaffected (Ackrill, 2008).

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 this, all the CAP variables are lagged by 1 year, which would reduce a

[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).

potential bias caused by a spurious correlation due to shocks simultaneously affecting CAP payments and farmers' exit.

In our robustness tests (section 5) 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. A residual component of coupled subsidies, linked to inputs (e.g. land) and/or production, still represented a small fraction of the overall support.

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]

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

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

expenditures of the European Regional Development Fund (ERDF), the Cohesion Fund (CF), and the European Social Fund (ESF)[13] at the NUTS2 level of regional aggregation per unit of regional GDP.[14] 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 intersectoral 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 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 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.

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

[14] Data from the DG REGIO website https://cohesiondata.ec.europa.eu/EU-Level/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv.

3. Hypotheses on the Impact of CAP Subsidies

The CATS disaggregation of CAP payments allows to test whether the impact of the subsidies differs between CAP payments. Coupled subsidies have traditionally been identified as the main source of distortions of agricultural markets – and therefore also as a key factor in distortions of input use, including keeping labor employed in less productive agricultural activities (which are more likely to receive subsidies).[15]

However, there are some caveats to this argument. Since coupled subsidies tend to be targeted to sectors which do not have a comparative advantage, coupled subsidies may be correlated with more, rather than less, labor outflow. While they may still prevent labor outflow at the margin, the size of the impact may be lower than expected because the revenue-increasing effect may not be sufficient to cover the difference in income compared to sectors with more comparative advantage. In addition, as already explained in the introduction, studies have indicated that subsidies may stimulate capital-labor substitution and stimulate reallocation with reduced credit constraints (Berlinschi et al., 2014; Goetz and Debertin, 1996, 2001).

Decoupled payments may still stimulate capital-labor substitution and reduced credit constraint indirect effects, but since they are not coupled to specific farming activities they do give farmers more options in choosing for more productive farming activities. This argument suggests that decoupled direct payment could have a more positive effect on agricultural employment than coupled subsidies (Dewbre and Mishra, 2007; Hennessy and Rehaman, 2008). This argument is consistent with empirical evidence showing that agricultural productivity on farms in the EU increased with the shift from "coupled" to "decoupled" subsidies, allowing farmers to increase specialization in farming activities with higher value added (Kazukauskas et al., 2014; Rizov et al., 2013).

[15] Political economy studies show that support to agriculture and to specific sectors is inversely related to these sectors' comparative advantage (Anderson 1995; Anderson et al., 2013; Olper, 1998; Swinnen, 1994, 2018).

Pillar II payments include various measures, which target different activities and hence may have different effects on employment. Investments in physical and human capital may enhance productivity and reduce costs (Dudu and Kristkova, 2017). This may increase or reduce agricultural demand depending on whether it enhances agricultural labor productivity more or less than other activities; and to what extent it may create complementary opportunities which can be combined with farm work. For example, investments in human capital is likely to enhance farm productivity but at the same time may enhance farmers' opportunities in being hired for better paying off-farm jobs. Agri-environmental payments are linked to specific production activities, which are often more labor-intensive than the traditional ones, so they can increase the demand of labor (Petrick and Zier, 2012). LFA payments are linked to land and may thus have an ambiguous effect similar to that of coupled payments (Olper et al., 2014). Finally, wider rural development payments are generally assumed to have no effects on the 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 lead to a loss or continuation of agricultural employment depending on whether they are substitutes or complements (Schuh et al., 2016; Boulanger and Philippidis, 2015; Dudu and Kristkova, 2017).

In summary, the impact of CAP payments on agricultural employment is likely to differ by the type of payment, but it is more complex than often argued. The expected net impact is not always clear *ex ante*, since it is likely to depend on the relative size of the different sub-effects.

4. 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 4 present regression results with disaggregated CAP spending into Pillar I and Pillar II subsidies (column 2); and the Pillar I subsidies into "coupled Pillar I subsidies" and "decoupled Pillar I subsidies" (column 3); and the Pillar II subsidies in its five components (column 4). 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 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 association of coupled Pillar I payments with 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 in the EU-27 as a whole, and in the OMS or NMS separately. The effect is strongest in the NMS, with a coefficient (-0.25 to -0.29) that is 4 to 5 times as large as in the OMS (-0.06), but even in the OMS it is strongly significant.

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 the coefficient 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, but the effect is not significant in the NMS. The size of the effect of agri-environmental payments is large (the coefficient is 5 times as large as that of decoupled Pillar I payments) in OMS. The strong effect in OMS drives the significant effect for the EU-27 as a whole. In NMS other Pillar II payments have a significant negative effect: investment in physical capital (PK) and LFA payments. However, the effect of these payments is not significant in the OMS, nor for the EU-27 as a whole.

Sixth, in the NMS other Pillar II investment in human capital (HK) have a significant positive effect (meaning that HK investment subsidies stimulate the outflow of labor from agriculture in the OMS), and the effect is so strong that it drives the overall positive effect of HK for the EU-27 (with no effect in the OMS). The positive HK estimates are consistent with the argument that while investments in human capital increase farm productivity, they also enhance off-farm labor opportunities, and apparently the second effect is stronger in NMS.

Finally, the estimated coefficients of the control variables (such as relative income, sectoral employment, unemployment rate, population density and farm family work, which might affect migration costs) 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 rates and (4) population density have the expected (and significant) sign.[16]

5. Robustness checks

The estimated relationship between off-farm migration and CAP payments may be affected by endogeneity bias.[17] In Section 2 we explained that there are arguments that suggest that this

[16] *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 in the static fixed effects specification, 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)

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

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).[18] 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 for all specifications (especially in the specifications for the EU-27 and NMS), making the IV estimates unreliable.[19] Although for OMS the Cragg-Donald Wald statistic (28.37) exceeds the Stock and Yogo critical value,[20] 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.

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[18] Agricultural area data at NUTS2 level were collected from EUROSTAT.

[19] 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.

[20] 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.

For a second robustness test, we estimate a SYS-GMM[21] 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. [22]

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.

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 system 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).

Overall, these additional robustness checks are consistent with the conclusion that coupled payments had no significant impact on agricultural employment. The conclusion that

[21] 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.

[22] 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.

decoupled Pillar I payments reduce labor outflow from agriculture is supported by the SYS-GMM model results. The IV estimation is only partially consistent with this (only for OMS) but has problems with weak instruments.

6. Economic Size of the Effects of CAP Subsidies and Decoupling

We can now use our regression results to estimate the magnitude of the policy coefficients. The estimated coefficients represent marginal effects. According to the estimated coefficient in column 1 of table 2, 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. [23] At the average level of the CAP subsidy rate (32.4 percent, see table 1) and off-farm migration (1.50 percent) in the EU-27, a 10 percent decrease in the subsidy rate would lead to an increase in off-farm migration by 8.86 percent, [24] meaning that the annual off-farm migration rate would increase to 1.63 percent. In terms of agricultural jobs, this means 16,048 more people would leave agriculture per year, compared to an average annual outflow of 181.21 thousand people and an average agricultural employment of 12.12 million in the EU-27 in the period of analysis.

We can also use our estimates 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

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[23]As both our dependent and independent variables are expressed in ratio, we can approximate marginal changes to percentage changes, i.e. 1 percent decrease in CAP subsidy rates corresponds to an increase of migration rate by 0.041 percent (see column 1 of table 2).

[24] 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) 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 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.

7. 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 circles. 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. The effect is strongest in the NMS, but also in the OMS it is strongly significant.

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). The size of the effect of agri-environmental payments is similar to that of decoupled Pillar I payments in OMS. In NMS agri-environmental payments have no significant effect. Instead, investment in physical capital (PK) and LFA payments reduce outflow of labor from agriculture in NMS.

Interestingly, we find that Pillar II expenditures on investments in human capital (HK) have a significant positive effect (meaning that HK investment subsidies stimulate the outflow of labor from agriculture in the NMS), and the effect is so strong that it drives an overall positive effect of HK for the EU-27 (with no effect in the OMS). The positive HK estimates are consistent with the argument that while investments in human capital increase farm productivity, they also enhance off-farm labor opportunities, and apparently the second effect is stronger in NMS.

We performed a series of additional robustness tests to address the issue of endogeneity and reverse causality related to agricultural subsidies. We apply an instrumental variable approach following Blomquist and Nordin (2017) as well as a SYS-GMM specification along the line of Petrick and Zier (2012). These additional checks support the conclusion that in the OMS decoupled Pillar I payments contributes to reduce labor outflow from agriculture, meaning a positive impact on agricultural jobs. The results are fairly robust to alternative specifications, in particular to the SYS-GMM specification. The IV strategy turns out to be weak, generating not reliable estimates. Thus, further work is needed in order to find a stronger IV, which can properly address the potential endogeneity issue between CAP payments and off-farm migration.

These findings have important policy implications. They indicate that non-distortionary payments, especially decoupled Pillar I payments, sustain agricultural employment. The CAP reduced the reduction in farm employment by increasing agricultural productivity through decoupled payments. This is in line with previous research documenting a higher efficiency loss associated with coupled payments (e.g. Kazukauskas et al., 2014; Rizov et al., 2013).

Using our estimated coefficients, we estimate that a 10 percent decline in the CAP subsidy rate increases off-farm migration by 0.13 percentage points. With an average of 12.1 million people employed in agriculture in the EU-27 between 2004-2014, this implies that this would cause around16,000 people extra to leave agriculture every year. However, a shift of 10 percent of coupled payments to decoupled payments would save around 13,000 agricultural jobs, at the same total CAP subsidies.

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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	0.696	1,357	0.617	388	0.973
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
Total CAP payments/VA – (FADN)	Subsidy Rates FADN	1,475	0.511	1,357	0.485	388	0.602
Pillar I payments/VA - (FADN)		1,475	0.355	1,357	0.349	388	0.376
Pillar I coupled payments/VA -(FADN)		1,475	0.112	1,357	0.117	388	0.092
Pillar I decoupled payments/VA -(FADN)		1,475	0.244	1,357	0.232	388	0.283
Pillar II payments/VA – (FADN)		1,475	0.156	1,357	0.135	388	0.226

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
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
			(0.33)	(0.34)
Pillar I decoupled (t-1)			-0.075***	-0.070***
			(4.90)	(4.67)
Pillar II (t-1)		-0.050	-0.045	
		(1.58)	(1.50)	
Pillar II HK (t-1)				0.405*
				(1.78)
Pillar II PK (t-1)				-0.013
				(0.26)
Pillar II agri-env. (t-1)				-0.314***
				(3.51)
Pillar II LFA (t-1)				-0.073
				(0.58)
Pillar II RD (t-1)				-0.010
				(0.15)
Relative income (t-1)	0.082***	0.083***	0.095***	0.098***
	(5.50)	(5.73)	(6.65)	(6.79)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(4.81)	(4.81)	(4.83)	(4.85)
Population density (t-1)	0.545**	0.555**	0.453**	0.417*
	(2.34)	(2.47)	(1.97)	(1.73)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***
	(4.42)	(4.38)	(4.30)	(4.47)
Family work (t-1)	-0.033***	-0.034***	-0.034***	-0.033***
	(2.87)	(2.92)	(2.94)	(2.83)
Structural and Investment Funds (t-1)	0.238	0.255	0.207	0.248
	(0.89)	(1.15)	(1.11)	(1.28)
Observations	1,745	1,745	1,745	1,745
R-squared	0.431	0.431	0.437	0.444
Number of regions	210	210	210	210
Region FE	YES	YES	YES	YES
Year FE	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. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

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

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) 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
			(0.25)	(0.34)
Pillar I decoupled (t-1)			-0.063***	-0.058***
			(4.49)	(4.24)
Pillar II (t-1)		-0.079**	-0.063*	
		(2.19)	(1.75)	
Pillar II HK (t-1)				-0.528
				(1.54)
Pillar II PK (t-1)				0.008
				(0.07)
Pillar II agri-env. (t-1)				-0.295***
				(2.73)
Pillar II LFA (t-1)				-0.114
				(0.73)
Pillar II RD (t-1)				0.107
				(1.54)
Relative income (t-1)	0.054***	0.056***	0.071***	0.076***
	(3.43)	(3.90)	(4.48)	(4.48)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(3.72)	(3.73)	(3.71)	(3.76)
Population density (t-1)	0.333***	0.401***	0.273**	0.018
	(2.95)	(3.35)	(2.08)	(0.10)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***
	(4.67)	(4.59)	(4.39)	(4.26)
Family work (t-1)	-0.033**	-0.035**	-0.033**	-0.026
	(2.08)	(2.21)	(2.07)	(1.65)
Structural and Investment Funds (t-1)	0.309	0.331	0.311	0.238
	(1.06)	(1.11)	(1.10)	(0.86)
Observations	1,357	1,357	1,357	1,357
R-squared	0.432	0.432	0.441	0.447
Number of regions	155	155	155	155
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

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

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) 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
			(0.31)	(1.11)
Pillar I decoupled (t-1)			-0.249***	-0.294***
			(3.13)	(3.84)
Pillar II (t-1)		0.047	0.049	
		(0.52)	(0.52)	
Pillar II HK (t-1)				0.771***
				(3.48)
Pillar II PK (t-1)				-0.063*
				(1.94)
Pillar II agri-env. (t-1)				-0.153
				(0.61)
Pillar II LFA (t-1)				-0.478*
				(1.86)
Pillar II RD (t-1)				0.006
				(0.04)
Relative income (t-1)	0.146***	0.154***	0.161***	0.176***
	(4.82)	(4.90)	(5.04)	(5.31)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(3.81)	(3.84)	(3.81)	(4.01)
Population density (t-1)	0.845	0.721	0.688	0.554
	(0.99)	(0.88)	(0.82)	(0.82)
Unemployment (diff)	-0.003	-0.003	-0.004*	-0.004*
	(1.42)	(1.67)	(1.78)	(1.73)
Family work (t-1)	-0.047**	-0.031	-0.030	-0.030
	(2.20)	(1.38)	(1.28)	(1.33)
Structural and Investment Funds (t-1)	0.510	0.622	0.721*	0.801*
	(1.26)	(1.46)	(1.75)	(1.84)
Observations	388	388	388	388
R-squared	0.483	0.490	0.492	0.515
Number of regions	55	55	55	55
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

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

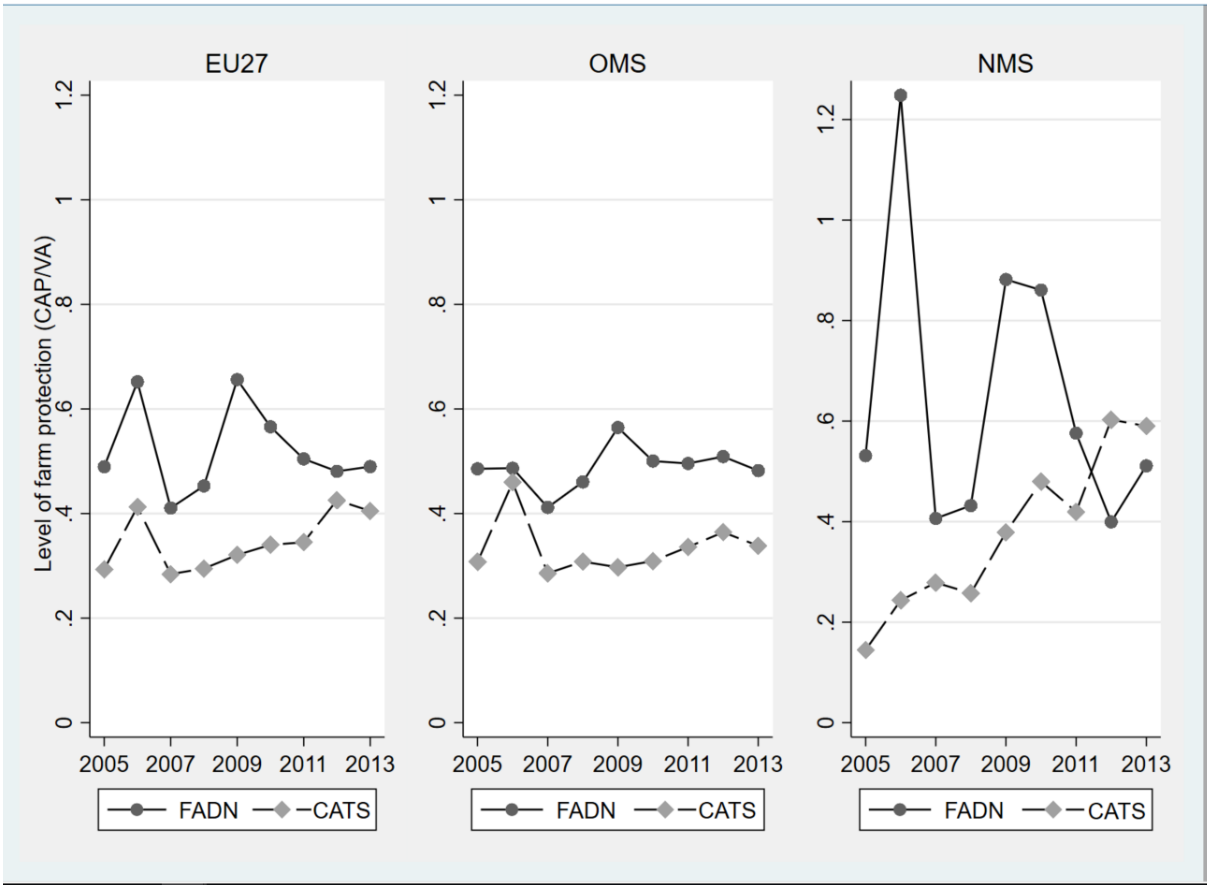
Note: each regression includes both region and time fixed effects. T-statistics based on standard errors clustered by region are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

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. * p<0.10, ** p<0.05, *** p<0.01. 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.

Figure 1: Evolution of CAP protection by regional specification



Source: CATS database provided by the European Commission and FADN.

Appendix A: Robustness check with the inclusion of the outliers

Table A.1: Off-farm migration regressions for EU-27 regions (210 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD
Overall CAP subsidy rate (t-1)	-0.013***			
	(3.93)			
Pillar I (t-1)		-0.009**		
		(2.16)		
Pillar I coupled (t-1)			0.017	0.018
			(1.29)	(1.37)
Pillar I decoupled (t-1)			-0.012***	-0.001
			(2.64)	(0.22)
Pillar II (t-1)		-0.067	-0.064	
		(1.59)	(1.54)	
Pillar II HK (t-1)				0.412*
				(1.78)
Pillar II PK (t-1)				-0.034
				(0.73)
Pillar II agri-env. (t-1)				-0.153
				(1.33)
Pillar II LFA (t-1)				-0.342
				(1.41)
Pillar II RD (t-1)				-0.043
				(0.69)
Relative income (t-1)	0.073***	0.075***	0.078***	0.080***
	(4.90)	(5.39)	(5.48)	(5.81)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(4.82)	(4.83)	(4.82)	(4.83)
Population density (t-1)	0.511**	0.572**	0.519**	0.495**
	(2.13)	(2.55)	(2.22)	(2.05)
Unemployment (diff)	-0.003***	-0.003***	-0.003***	-0.003***
	(3.73)	(3.56)	(3.45)	(3.42)
Family work	-0.037***	-0.038***	-0.039***	-0.041***
	(3.07)	(3.18)	(3.24)	(3.38)
Structural and Investment Funds (t-1)	0.022	0.156	0.060	-0.005
	(0.13)	(0.78)	(0.29)	(0.03)
Observations	1,747	1,747	1,747	1,747
R-squared	0.422	0.423	0.425	0.431
Number of regions	210	210	210	210
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

Table A.2: Off-farm migration regressions for OMS regions (155 regions)

Dependent variable: *Off-farm migration*	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD
Overall CAP subsidy rate (t-1)	-0.008***			
	(3.18)			
Pillar I (t-1)		-0.002		
		(0.34)		
Pillar I coupled (t-1)			0.026*	0.029**
			(1.90)	(2.04)
Pillar I decoupled (t-1)			-0.006	0.002
			(1.02)	(0.44)
Pillar II (t-1)		-0.101*	-0.084	
		(1.69)	(1.36)	
Pillar II HK (t-1)				-0.495
				(1.47)
Pillar II PK (t-1)				-0.059
				(0.50)
Pillar II agri-env. (t-1)				-0.060
				(0.45)
Pillar II LFA (t-1)				-0.488*
				(1.76)
Pillar II RD (t-1)				0.107
				(1.53)
Relative income (t-1)	0.042***	0.047***	0.051***	0.053***
	(2.66)	(3.39)	(3.40)	(3.58)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(3.73)	(3.74)	(3.71)	(3.76)
Population density (t-1)	0.293***	0.421***	0.336**	0.035
	(2.89)	(3.11)	(2.15)	(0.20)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***
	(3.80)	(3.74)	(3.55)	(3.68)
Family work	-0.039**	-0.041**	-0.041**	-0.037**
	(2.28)	(2.43)	(2.40)	(2.25)
Structural and Investment Funds (t-1)	0.313	0.353	0.321	0.246
	(1.03)	(1.10)	(1.01)	(0.78)
Observations	1,359	1,359	1,359	1,359
R-squared	0.422	0.425	0.427	0.434
Number of regions	155	155	155	155
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

Table A.3: Off-farm migration regressions for NMS regions (55 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) 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
			(0.31)	(1.11)
Pillar I decoupled (t-1)			-0.249***	-0.294***
			(3.13)	(3.84)
Pillar II (t-1)		0.047	0.049	
		(0.52)	(0.52)	
Pillar II HK (t-1)				0.771***
				(3.48)
Pillar II PK (t-1)				-0.063*
				(1.94)
Pillar II agri-env. (t-1)				-0.153
				(0.61)
Pillar II LFA (t-1)				-0.478*
				(1.86)
Pillar II RD (t-1)				0.006
				(0.04)
Relative income (t-1)	0.146***	0.154***	0.161***	0.176***
	(4.82)	(4.90)	(5.04)	(5.31)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(3.81)	(3.84)	(3.81)	(4.01)
Population density (t-1)	0.845	0.721	0.688	0.554
	(0.99)	(0.88)	(0.82)	(0.82)
Unemployment (diff)	-0.003	-0.003	-0.004*	-0.004*
	(1.42)	(1.67)	(1.78)	(1.73)
Family work	-0.047**	-0.031	-0.030	-0.030
	(2.20)	(1.38)	(1.28)	(1.33)
Structural and Investment Funds (t-1)	0.510	0.622	0.721*	0.801*
	(1.26)	(1.46)	(1.75)	(1.84)
Observations	388	388	388	388
R-squared	0.483	0.490	0.492	0.515
Number of regions	55	55	55	55
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

Appendix B: Robustness check with population density in first differences

Table B.1: Off-farm migration regressions for EU-27 regions (210 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD
Overall CAP subsidy rate (t-1)	-0.031			
	(1.21)			
Pillar I (t-1)		-0.036		
		(1.10)		
Pillar I coupled (t-1)			-0.020	0.000
			(0.56)	(0.02)
Pillar I decoupled (t-1)			-0.092***	-0.070***
			(4.42)	(4.36)
Pillar II (t-1)		-0.006	-0.083	
		(0.11)	(1.46)	
Pillar II HK (t-1)				0.277
				(1.62)
Pillar II PK (t-1)				-0.044
				(0.91)
Pillar II agri-env. (t-1)				-0.314***
				(3.45)
Pillar II LFA (t-1)				-0.081
				(0.63)
Pillar II RD (t-1)				0.123**
				(2.05)
Relative income (t-1)	0.080***	0.080***	0.124***	0.097***
	(5.40)	(5.40)	(8.29)	(6.91)
Sectoral employment (diff)	0.004***	0.004***	0.004***	0.004***
	(4.80)	(4.82)	(4.95)	(4.91)
Population density (t-1)	-1.689	-1.718	-1.671	-2.011
	(1.18)	(1.20)	(1.17)	(1.55)
Unemployment (diff)	-0.004***	-0.004***	-0.004***	-0.004***
	(4.45)	(4.53)	(5.10)	(4.47)
Family work	-0.033***	-0.032***	-0.058***	-0.031***
	(2.61)	(2.61)	(4.05)	(2.61)
Structural and Investment Funds (t-1)	0.074	0.031	-0.226	0.131
	(0.28)	(0.12)	(0.84)	(0.72)
Observations	1,745	1,745	1,745	1,745
R-squared	0.430	0.431	0.496	0.448
Number of regions	210	210	210	210
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

Table B.2: Off-farm migration regressions for OMS regions (155 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD
Overall CAP subsidy rate (t-1)	-0.025			
	(1.04)			
Pillar I (t-1)		-0.024		
		(0.95)		
Pillar I coupled (t-1)			-0.003	0.008
			(0.16)	(0.49)
Pillar I decoupled (t-1)			-0.078***	-0.056***
			(4.74)	(3.98)
Pillar II (t-1)		-0.032	-0.063	
		(0.56)	(1.07)	
Pillar II HK (t-1)				-0.483
				(1.46)
Pillar II PK (t-1)				-0.023
				(0.20)
Pillar II agri-env.l (t-1)				-0.292***
				(2.69)
Pillar II LFA (t-1)				-0.119
				(0.76)
Pillar II RD (t-1)				0.155**
				(2.39)
Relative income (t-1)	0.052***	0.052***		0.075***
	(3.34)	(3.52)		(4.44)
Sectoral employment (diff)	0.004***	0.004***		0.004***
	(3.73)	(3.74)		(3.86)
Population density (t-1)	-0.534	-0.511		-1.162**
	(0.97)	(1.00)		(2.23)
Unemployment (diff)	-0.004***	-0.004***		-0.004***
	(4.69)	(4.67)		(4.31)
Family work	-0.031*	-0.031*		-0.025
	(1.92)	(1.94)		(1.59)
Structural and Investment Funds (t-1)	0.264	0.266		0.254
	(0.91)	(0.91)		(0.91)
Observations	1,357	1,357	1,357	1,357
R-squared	0.430	0.430	0.486	0.448
Number of regions	155	155	155	155
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.

Table B.3: Off-farm migration regressions for NMS regions (55 regions)

Dependent variable: Off-farm migration	(1) LSVD	(2) LSVD	(3) LSVD	(4) LSVD
Overall CAP subsidy rate (t-1)	-0.071*			
	(1.70)			
Pillar I (t-1)		-0.199***		
		(3.88)		
Pillar I coupled (t-1)			-0.178*	-0.087
			(1.74)	(0.98)
Pillar I decoupled (t-1)			-0.301***	-0.310***
			(5.05)	(4.74)
Pillar II (t-1)		0.041	-0.053	
		(0.46)	(0.83)	
Pillar II HK (t-1)				0.693***
				(3.54)
Pillar II PK (t-1)				-0.058
				(1.61)
Pillar II agri-env. (t-1)				-0.144
				(0.59)
Pillar II LFA (t-1)				-0.486*
				(1.91)
Pillar II RD (t-1)				0.023
				(0.15)
Relative income (t-1)	0.151***	0.157***	0.215***	0.179***
	(5.21)	(5.33)	(7.34)	(5.85)
Sectoral employment (diff)	0.003***	0.003***	0.003***	0.003***
	(4.11)	(4.20)	(4.85)	(4.38)
Population density (t-1)	-3.171*	-3.016*	-3.093*	-2.705*
	(1.82)	(1.79)	(1.80)	(1.78)
Unemployment (diff)	-0.003	-0.003	-0.007***	-0.004
	(1.39)	(1.64)	(3.90)	(1.65)
Family work	-0.061*	-0.045	-0.093**	-0.042
	(1.89)	(1.44)	(2.45)	(1.56)
Structural and Investment Funds (t-1)	0.276	0.432	0.321	0.689*
	(0.79)	(1.17)	(0.84)	(1.79)
Observations	388	388	388	388
R-squared	0.496	0.504	0.630	0.527
Number of regions	55	55	55	55
Region FE	YES	YES	YES	YES
Year FE	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. * p<0.10, ** p<0.05, *** p<0.01.