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Regional employment impacts of Common Agricultural Policy measures in Eastern Germany: A difference-in-differences approach

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Regional employment impacts of Common Agricultural Policy measures in Eastern Germany: A difference-in-differences approach

Regionale Beschäftigungseffekte der Gemeinsamen Agrarpolitik in Ostdeutschland: Ein „Difference-in-differences“-Ansatz

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Abstract

Politicians and farm lobbyists frequently use the argument that agricultural policy is necessary to safeguard jobs in agriculture. We explore whether this is true by conducting an econometric ex-post evaluation of the European Union’s Common Agricultural Policy (CAP) in the three East German States Brandenburg, Saxony, and Saxony-Anhalt. Whereas previous studies have employed descriptive statistics or qualitative methods and have looked at single policy instruments in isolation, we apply a difference-in-differences estimator to analyse the employment effects of the entire portfolio of CAP measures simultaneously. Based on panel data at the county level, we find that investment aids and transfers to less favoured areas had a zero marginal employment effect. We present evidence that full decoupling of direct payments in 2005 led to labour shedding, as it made transfer payments independent of factor allocation. Spending on modern technologies in processing and marketing and measures

aimed at the development of rural areas led to job losses in agriculture. Agri-environmental measures, on the other hand, kept labour intensive technologies in production or induced them. This analysis calls into question whether an expansion of existing second pillar measures is a reasonable way to use funds modulated away from the first pillar.

Keywords: Impact analysis, Agricultural employment, Common Agricultural Policy, Decoupling

JEL codes: Q18, J43, R58

Zusammenfassung

Dass die Agrarpolitik notwendig ist, um Arbeitsplätze in der Landwirtschaft zu sichern, ist ein häufig von Politikern und Interessensvertretern gebrauchtes Argument. In diesem Artikel untersuchen wir seine Stichhaltigkeit mithilfe einer ex-post Evaluierung der Gemeinsamen Agrarpolitk (GAP) der Europäischen Union in Brandenburg, Sachsen und Sachsen-Anhalt. Bisherige Studien verwendeten hierzu vorwiegend beschreibende Statistiken oder qualitative Methoden und konzentrierten sich auf einzelne Politikmaßnahmen. Wir verwenden stattdessen einen sog. „Difference-in-differences"-Schätzer, um die Beschäftigungswirkungen des gesamten Maßnahmenbündels der GAP simultan abzubilden. Auf der Basis von Paneldaten auf Landkreisebene legen die Ergebnisse nahe, dass Investitionsbeihilfen und die Ausgleichszulage für benachteiligte Gebiete keinerlei Beschäftigungseffekte zur Folge hatten. Weiterhin stützen die Ergebnisse die Vermutung, dass die Entkopplung der Direktzahlungen im Jahre 2005 zu Arbeitsplatzverlusten führte, da sie die Zahlungen von den Produktionsergebnissen und vom Faktoreinsatz unabhängig machte. Auch erhöhte Mittel für Verarbeitung und Vermarktung sowie die Dorferneuerung gingen teilweise mit einer Verringerung der Beschäftigung in der Landwirtschaft einher. Agrarumweltmaßnahmen hingegen schienen arbeitsintensive Technologien in der Produktion zu halten oder sie zu induzieren. Die vorgestellte Analyse stellt daher in Frage, ob die aus der „ersten Säule" der GAP modulierten Mittel für eine Ausweitung der vorhandenen Maßnahmen der „zweiten Säule" verwendet werden sollten.

Schlüsselwörter: Wirkungsanalyse, Beschäftigung in der Landwirtschaft, Gemeinsame Agrarpolitik, Entkopplung

Inhaltsverzeichnis

Tabellenverzeichnis

Abbildungsverzeichnis

1. Introduction

Many European citizens expect that the European Union's (EU) Common Agricultural Policy (CAP) safeguards or even creates jobs in rural areas (EC 2008: 7). In times of low economic growth and persistent unemployment in European regions, politicians and farm lobbyists extensively use this argument to justify towards the general public the enduring necessity of the CAP. But is it true?

It is commonly claimed that the financial support through direct payments, which has been occupying the lion's share of the CAP budget since their inception in the mid-1990s, is indispensable for keeping jobs in agriculture. Furthermore, it is argued that European agriculture has much potential, in addition to its conventional role of producing food and fibre, to also provide environmental services, contribute to quality of life in rural areas, and supply raw material for energy production. The more recent "second pillar" instruments of the CAP, such as investment aid, agri-environmental payments, and a broad range of rural development measures, are supposed to boost these additional functions. The European Commission insists that they focus on exactly the aim of maintaining existing or even creating new types of jobs in agriculture, despite their otherwise varying goals (EC 2006).

Such expectations are contrasting with a persistent decline in the agricultural labour force observed across most industrialized countries for decades (Tracy 1993). According to this trend, technological progress and rising off-farm wages have led to a process in which agricultural labour is increasingly substituted by capital. Given the envisioned new roles for farmers, the question thus arises whether the CAP can stop or even reverse this trend.

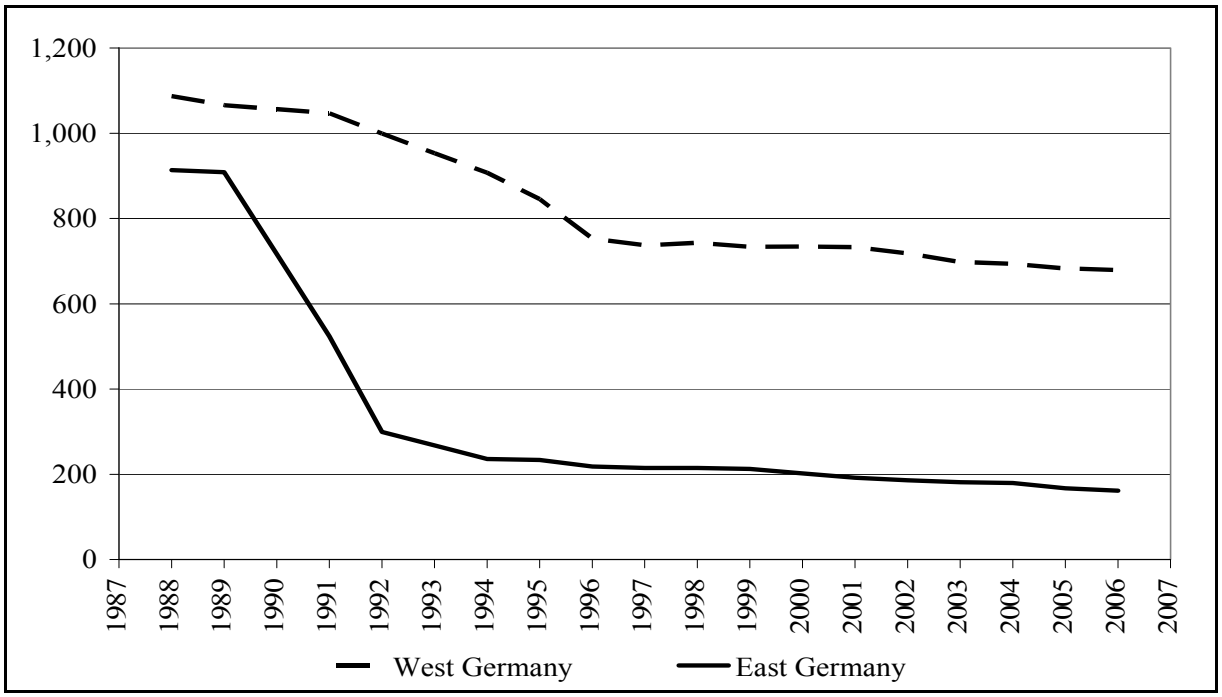
The existing evidence on this issue is inconclusive. European-wide studies are hampered by a lack of relevant disaggregate data (Shucksmith et al. 2005: 203). Furthermore, finding accurate employment indicators in agriculture is plagued by measurement problems, as many farmers work partly off-farm. Research at national levels is often limited to case studies and plausibility arguments (see the overview in Fasterding and Rixen 2006). We go beyond this literature by conducting an econometric ex-post evaluation of the CAP in the three East German States (*Länder*) Brandenburg, Saxony, and Saxony-Anhalt. Our dataset includes information on agricultural employment, disaggregate policy expenses, and a set of controls on 69 counties (*Landkreise*) over seven years. Whereas previous studies have usually employed descriptive statistics or qualitative methods and have looked at single policy instruments in isolation, we apply a difference-in-differences panel data estimator to analyse the employment effects of the entire portfolio of CAP measures simultaneously. The territorial approach allows us to include policies not directly related to individual farms, such as support to processing and marketing or development of rural areas. Controlling for latent regional and time effects, we identify net policy impacts by exploiting the variation within counties across years. An advantage of the study region is that the bulk of agricultural labour is hired farm workers. We expect that this increases the accuracy of employment figures, as information about working hours of hired workers is formally recorded by employers.

The following section explains the current state of agricultural employment in Eastern Germany and which agricultural policy measures have been used. Section 3 summarises the recent literature on employment effects of agricultural policies. Section 4 gives an overview of the methodological issues involved in impact assessment and explains the approach used in this study. Section 5 specifies the model and the data, section 6 presents the results, while section 7 concludes.

2. Employment in East German agriculture and the regional CAP portfolio

Situated on the territory of the former German Democratic Republic, the five East German Länder Mecklenburg-West Pomerania, Brandenburg, Saxony-Anhalt, Saxony, and Thuringia are characterized by large scale agricultural structures primarily based on hired labour. Many of the former collective farms were transformed into agricultural cooperatives or other corporate business entities (Forstner and Isermeyer 2000). Agriculture in Eastern Germany thus resembles structures in those New Member States of the EU which predominantly kept their large scale farms, such as the Czech and Slovak Republics, Hungary, or parts of Poland. While the immediate shock of transition had led to widespread labour shedding (Koester and Brooks 1997), recent downward adjustments of agricultural employment were more modest and followed the patterns of the family farm model in West Germany (Figure 1).

Figure 1. Labour force in German agriculture (1000 persons)



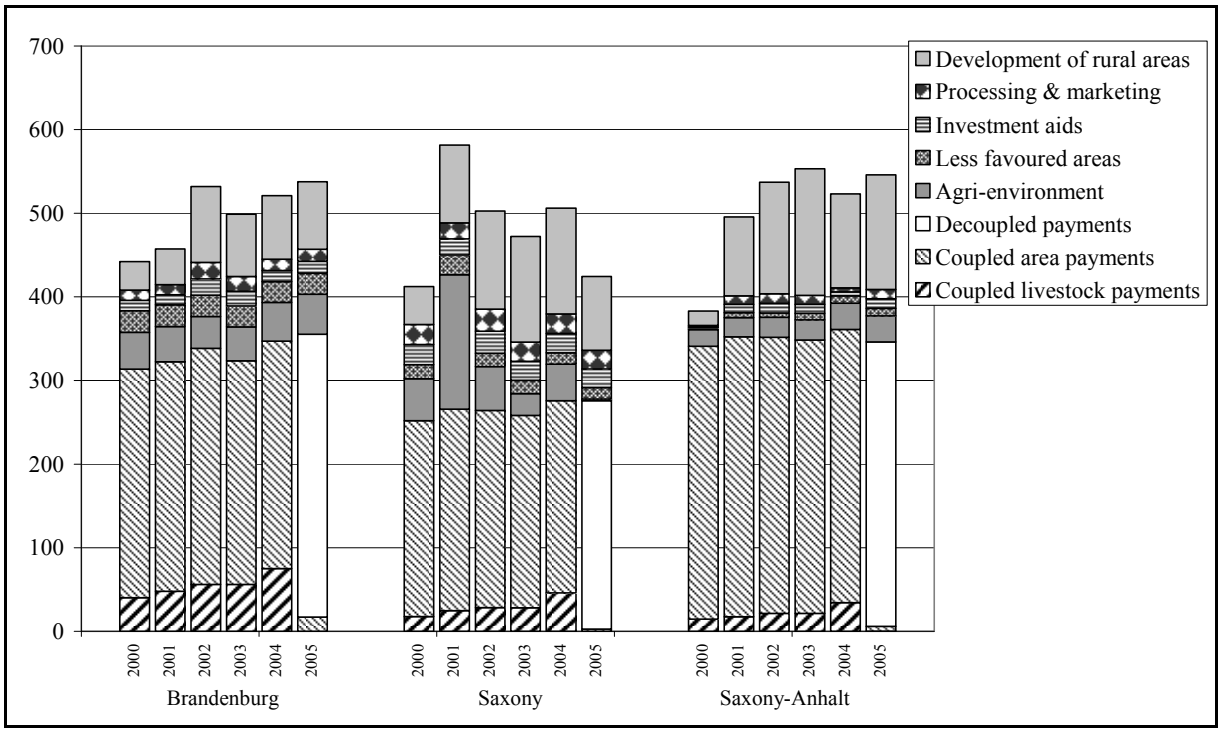
Note: Labour use for East Germany in 1988 and 1989 represents stock on September 30, other figures are annual averages. Labour use figures for East and West Germany in 1990 and 1993 were interpolated.

Source: 1988; 1989; 1991 Statistical Yearbooks of the GDR and FRG, var. years; 1992; 1994-2006: Destatis (2009).

As a result of recent reforms of the CAP, East German Länder have been spending substantial amounts of direct payments, of which 75 percent are co-financed by the EU. Essentially, these reforms meant a stepwise transformation of price- and product-related support measures to area-based farm payments that are increasingly decoupled from most factor allocation decisions. Hectare- and livestock-related payments had already been introduced with the MacSharry reform of 1992 and were further strengthened by the Agenda 2000. Implementation of the Mid-term review in 2005 brought a full decoupling of payments in the form of the Single Payment Scheme (SPS).[1]

Figure 2 shows that, in the three states studied here, about two thirds of the CAP budget is allocated to direct payments. Single farms receiving more than 300 thousand euro of direct payments annually are no exception.[2]

Figure 2. Aggregate annual CAP expenses in Brandenburg, Saxony, and Saxony-Anhalt according to main policy aggregates (million euro)



Source: Authors' calculations based on unpublished data of State paying agencies.

1 See Petrick (2008) and Stead (2008) for the larger picture of recent CAP reforms. Current reform steps are concisely presented in OECD (various issues).

2 This is the threshold above which farms are subject to additional modulation after the "health check" reforms of November 2008.

East German states also implemented a region-specific mix of second pillar measures. The emphasis is on instruments under the umbrella of "development of rural areas". These are mostly related to infrastructure investments, such as road construction and improvement, and are usually disbursed to local municipalities. The second largest portion of the second pillar measures goes to agri-environmental measures, which include payments for the maintenance of extensive grassland and the conversion to organic farming. In addition, some ten to twenty million euro are spent on compensatory allowances for less favoured areas (LFA), as well as on investment aids and processing and marketing support. While the former represents support for regions with below average soil conditions, the latter two are credit subsidies for a wide range of capital investments on farms and in the downstream sector. These programmes are regularly complemented by federal and state funding in the framework of the "Joint Task for the Improvement of Agricultural Structures and Coastal Protection" (Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes, GAK) (Rudolph 2005). The appendix of this paper details how individual policy instruments were composed into the aggregates shown in Figure 2 and used in the empirical analysis below.

The various measures reflect the partly incompatible policy goals described in the introduction. While direct payments and less favoured area transfers are primarily of a compensatory nature, they alleviate adjustment pressure and should thus lead to less pronounced labour shedding on farms. However, the move from coupled to decoupled payments should release labour, as production activities are no longer necessary to receive payments. To the extent that they promote labour intensive technologies, such as organic farming, agri-environmental measures will have a positive effect on employment. To the contrary, capital subsidies will commonly increase the capital intensity in the production process and thus substitute labour. The effects of "development of rural areas" are hard to predict, as these infrastructure measures only indirectly affect allocation decisions in the agricultural sector. They may increase the profitability of farms, but may also make off-farm employment more attractive, for example by allowing rural inhabitants to commute to urban centres more easily.

A sound evaluation of the employment effects of the CAP must therefore allow different impacts of the various instruments. At the same time, their effects should be analysed jointly to avoid that unexpected effects are driven by left-out political instruments.

In addition to the CAP, there are numerous policies by European, national or state governments that also have potential effects on agricultural employment. In Eastern Germany, the most important in terms of financial volume are labour market policies, federal investments in transport infrastructure, and EU structural funds (BBR 2005:287). Although these policies do not directly address economic activities that are specific to farms or rural areas, it is certainly possible that they have a regionally differentiated effect on farm employment. However, there is no regionally disaggregated database of these payments available. Their analysis is hence beyond the scope of this paper.

3. What we know about employment effects of the CAP

Fasterding and Rixen (2006) provide a review of policy impacts on agricultural employment in Germany. While they stress the inherent tendency of agriculture to shed labour in the process of economic development, they also assess the potential impact of individual measures or policy areas. Based on a number of primarily descriptive studies and case studies as well as plausibility arguments they suggest that organic farming may often display a higher labour intensity than conventional farming. Land consolidation and farm investment aid, on the other hand, lead to an increase in labour productivity, and thus have a negative employment effect. The authors argue that the support of production diversification is a reasonable way to develop additional jobs in agriculture.

Other recent studies make more systematic use of panel data sets, although only some of them look at agricultural employment. Schmitt et al. (2004) presented a regression analysis of the EU objective 5b programme, based on French regional data. They found positive employment effects in the service sector, while agriculture and manufacturing were negatively affected. Esposti (2007) investigated the impact of the CAP as well as the EU objective 1 programme at the NUTS-2 level by estimating a conditional growth convergence model. He confirmed a positive growth impact of the objective 1 programme, but did not refer explicitly to employment issues. Pufahl and Weiss (2009) applied non-parametric difference-in-differences propensity score matching to evaluate the effects of participation in the agri-environmental programmes in Germany.[3] Based on accountancy panel data, they found that farms participating in agri-environmental measures significantly used more on-farm labour. Henning and Michalek (2008) also implemented a matching approach to investigate the impact of the EU pre-accession aid SAPARD in Slovakia. They found that participation in the farm investment aid scheme had a positive effect on farm employment, but negatively influenced labour productivity. Both papers argue that a naïve mean value comparison overestimates the policy impact and conclude that considering this fact is crucial for an appropriate policy evaluation.

Referring to a different policy context, Ahearn et al. (2006) focused on the effect of decoupling on labour allocation decisions of US farm operators. They found that direct payments generally had a positive effect on on-farm labour use, contrary to theoretical predictions that decoupled payments are allocation neutral. Key and Roberts (2009) explained this finding by nonpecuniary benefits from farming.

Overall, the literature on employment effects of the CAP is rather incomplete as many important measures – such as direct payments or policies for the development of rural areas – have not been analysed at all. The evidence on other measures is inconclusive and suffers from the shortcoming that only single policies were analysed in isolation.

[3] A discussion of methods for evaluating policies is given in the following section.

4. Methods for quantitative ex-post policy evaluation of CAP measures

4.1 The basic treatment effect model

A simple way to evaluate the impact of policies is to compare the outcomes of units that have received policy treatment in varying intensities. Such a comparison requires observations from at least two groups of units with different treatment. However, the assumption that no other variable influences the outcome is crucial for isolating the policy effect, which is quite implausible outside of controlled experiments. It is therefore common to use multiple regression models to control for other covariates than the policy treatment, such as in the following treatment effect model (Greene 2008: 889):

(1) $y_i = \delta\theta_i + x_i^{'}\beta + \varepsilon_i$.

y_i is the outcome variable observed for a sample of $i = 1...n$ units of observation (regions). θ_i is a vector of binary or metric variables that indicate (potentially multiple) policy treatment in region i, x_i a vector of control variables, β a vector of coefficients that is to be estimated, and ε_i an identically and independently distributed (i.i.d.) error term. δ then contains the population average treatment effects (ATE). In the case of continuous (rather than binary) treatment, δ denotes the marginal impact of the policy measures on the outcome.

4.2 Selection on observables

In the standard treatment effect model, (1) is estimated for a pooled sample of regions with different policy treatments. Although (1) mimics an experimental setting by controlling for multiple factors influencing the outcome, identification is still based on a number of assumptions. An assumption that has been the key characteristic for classifying models in the recent programme evaluation literature is that units of observation differ only with regard to observable variables (Imbens and Wooldridge 2009).[4] This approach hence falls in the class of models based on *selection on observables*.[5] We denote this assumption with (i). In our context, several determinants of agricultural employment can be measured relatively easily, such as prices or factor stocks. However, unobserved climatic or soil conditions or the human capital in a region are important latent determinants of agricultural employment that are not controlled by an analysis based on (1). Further assumptions of this approach follow directly from (1), namely (ii) that treatment effects are linear, (iii) they are additively separable, and (iv), because δ is assumed constant across regions and time, they are homogenous for all units observed (the so-called common effects assumption). A core aim of the recent literature

[4] The typical application in this literature is the effects of employment programmes on labor market outcomes.

[5] Alternatively, in the programme evaluation literature, the characteristic assumption in this class of models has been called 'unconfoundedness' or 'exogeneity', see Imbens and Wooldridge (2009:7). Smith (2004) provides an accessible overview of the literature and links it to the analysis of regional policies.

has been to relax one or several of these assumptions (Blundell and Costa Dias 2009; Imbens and Wooldridge 2009).

Within the selection on observables paradigm, an increasingly popularised alternative to estimating (1) by conventional regression methods is propensity score matching, in which individual outcomes from a treated and a non-treated population are compared by using some distance metric (Rosenbaum and Rubin 1983; Smith 2004: 299).[6] Matching compares differentially treated units which are chosen to be as similar as possible, based on the distance metric. It thus imposes little structure on the process of treatment and relaxes assumptions (ii) to (iv). However, this advantage does not come without cost (see Heckman and Vytlacil 2007, section 4, for a critique). First, the method crucially hinges on finding appropriate units for comparison. Hence, datasets must be suitably rich to include the relevant characteristics on which observations are matched. The selection of variables on which to base the propensity score is often ad-hoc and still based on assumption (i).[7] Furthermore, it is unclear in which way findings can be generalised, as there is usually no explicit link to structural models of the treatment process based on economic theory. Finally, and most important in the present context, matching requires the formation of subsamples based on participation or non-participation in a policy treatment. There is hence no natural way to study the effects of several continuously measured policy measures simultaneously. Attempts to extend this method to multiple or continuous treatments are still in their infancy (Imbens and Wooldridge 2009) and seem difficult without imposing further structure on the treatment process.

4.3 Selection on unobservables

In the remainder of this article, we pursue another route of analysis based on panel data methods. These longitudinal methods relax the assumption of selection on observables (i), because they allow to observe the same unit in several periods. They can eliminate the effects due to latent characteristics that do not change over time. The following panel data model hence allows *selection on unobservables*, and thus falls in the second important group of treatment effect models. It includes a potentially latent, regional fixed effect α_i that may be correlated with elements in x (Blundell and MaCurdy 1999: 1608; Smith 2004: 304):

$$(2) \quad y_{it} = \delta\theta_{it} + x_{it}'\beta + \alpha_i + \mu_t + \varepsilon_{it}.$$

μ_t denotes an unobservable macro or time effect that affects all regions at time t in the same way. Differencing each observation from group means leads to:

$$(3) \quad y_{it} - \bar{y}_i = \delta\left(\theta_{it} - \bar{\theta}_i\right) + \left(x_{it} - \bar{x}_i\right)'\beta + \left(\mu_t - \bar{\mu}\right) + \varepsilon_{it} - \bar{\varepsilon}_i,$$

6 This metric is often based on a regression model for programme participation.

7 An exception are matching approaches based on first differences (Heckman et al. 1997; Pufahl and Weiss 2009).

which shows that the influence of latent characteristics of regions, as far as they are time invariant, as well as any other linear separable selection bias is 'swept out' of the equation. In this model, δ denotes a 'difference-in-differences' estimator of the treatment effect, because it compares relative differences in the coevolution of variables within one group over time.[8] Alternatively, it has been called a 'natural experiment' approach, as it exploits naturally occurring variation in treatment of observed groups. It hence represents a powerful method to deal with unobserved heterogeneity, as it replaces assumption (i) that there generally are no unobserved characteristics or shocks that affect outcomes by the much less restrictive assumption (denoted (i')) that these unobserved characteristics are not both group-specific and temporary (Blundell and MaCurdy 1999; Blundell and Costa Dias 2009). In other words, θ_{it} is assumed exogenous given the inclusion of fixed effects into the equation (Besley and Case 2000).

4.4 How restrictive are the assumptions for CAP analysis?

Besley and Case (2000) emphasise the importance of regional political variables that may have a bearing on regional policy design. This determinant can be largely ruled out here, as the underlying political decisions are mostly made at a European level, with only some leverage left at the *Länder*, but not at the *Landkreis* level. Whereas the procedures for calculating and administrating direct payments are mostly settled at the European and national level, *Länder* have freedom to allocate funds within their Rural Development Plans and their Operational Programmes. State programmes are thus focusing on agri-environment and farm structures (see appendix for the states considered here), and state governments can decide how to use funds from the modulation of direct payments. However, there is practically no decision power related to the CAP at the *Landkreis* level, our unit of observation. (i') is therefore regarded a weak assumption in our context. Given these payment levels set by policymakers, the volume of actual payment streams depends on cropping decisions of farmers for the direct payments and their participation decisions in certain programmes, such as investment support or agri-environmental stewardship. We assume that these decisions are completely determined by the given natural resources and the human capital of a region in the sense of a time-invariant, average absorption capacity. This source of endogeneity can thus be differenced out. Transfers that are not paid on the basis of voluntary participation of farmers, such as public good investments or measures affecting the downstream sector, are exogenous to the model per se.

Assumptions (ii) and (iii) are restrictive in the sense that they impose much a-priori structure on the model. At the same time, these assumptions are the basis for relaxing assumption (i) in model (3), as complex interactions among variables or non-linear functional forms would

[8] The fixed effect estimator controls both observed and unobserved heterogeneity. This property is an advantage compared to other approaches that control only observed heterogeneity, for example by conditioning the covariates on size variables, such as land resources or number of farms, or by using growth rates. It also avoids the choice of an arbitrary conditioning variable.

preclude to difference out fixed effects. The linearity assumption is very common in the literature and there is no obvious alternative. We therefore kept it.[9]

Assumption (iv) has been debated widely in the labour market literature, where treatment effects are supposed to systematically differ between treated and untreated groups. However, the literature has focused on the case of binary treatment, whereas the continuous and multiple treatment case relevant here has only very recently been addressed in the framework of so-called correlated random coefficient models (e.g., Florens et al. 2008). There are no established methods available (yet) to study this case. We thus leave the question whether continuous group-specific treatment effects are empirically important in agriculture for future work.

5. Data and model specification

Data on CAP payments was collected from paying agencies of the Ministry of Rural Development, Environment and Consumer Protection in Brandenburg, the Saxon State Ministry of Environment and Agriculture as well as the Ministry of Agriculture and Environment in Saxony-Anhalt. This data is not publicly available and the access to it depended on the cooperation of the state ministries. The analysis is therefore limited to these three states.

As noted above, full decoupling of payments was introduced in Germany in 2005. Our data panel covers observations before and after decoupling, but it is slightly unbalanced. For Brandenburg and Saxony, we cover the years from 2000 to 2006, while 1999 to 2005 are included for Saxony-Anhalt. For each of the 69 *Landkreise*, seven years of observation are thus available $(T = 7)$, so that there are 483 observations in the dataset.

We distinguish coupled and decoupled direct payments of the CAP's first pillar. Naturally, the latter ones are particularly important in the years after 2005 and 2006. Coupled payments were split into area-based and headage-based payments. Furthermore, we included a dummy variable taking the value of one for the years 2005 and 2006 and zero otherwise. By this variable, we expect to isolate the structural effects of decoupling that cannot be captured by a mere increase of transfers alone as measured by the monetary value of decoupled direct payments. In line with the difference-in-differences approach outlined above, separate annual dummy variables for the years 2000 to 2004 were also included.

The second pillar instruments were aggregated according to the Rural Development Plans of the *Bundesländer* in the range of Guarantee and the respective Operational Programmes regarding the Guidance measures. We distinguish the single farm investment aid scheme, the

[9] One specific way to relax (iii) that still allows differencing is to assume log-linearity rather than linearity. We tested linearity vs. log-linearity using the procedure described in Davidson and MacKinnon (1981), which yielded inconclusive results. However, the predictions vs. residuals plot looked much more homogeneous for the linear model. As log-linear models also create difficulties in dealing with zero observations, which are of some relevance in our policy variables, we worked with the linear model.

support of processing and marketing of agricultural produce as well as measures for the adoption and development of rural areas, following regulation (EC) 1257/1999. Guarantee funds are aggregated as agri-environmental measures and the compensatory allowance for less favoured areas. A detailed overview of measures is given in the appendix.

Two sets of variables that plausibly do vary across regions and in time are the prices of land and labour as well as the local demographic structure. Land and labour markets are typically local because of the inherent immobility of these factors. We therefore attempted to include county data on land prices and wages into our regression analysis. Unfortunately, it was impossible to obtain land price data with sufficient coverage, so that we only present results for the wage variable. In addition, net migration out of rural areas has been particularly strong in the age class between 18 and 29 years and may have led to local shortages of labour (Uhlig 2008).[10] It also may have wider implications in terms of public goods provision by the government. We capture these trends by also including data on regional population density. All monetary values were transformed into 2000 prices by using the GDP deflator for Germany published by Eurostat.

Our dependent variable is number of employees in agriculture, forestry and fishery, taken from the regional database of the German Federal Statistical Office (Destatis 2009). From the same source we use regional population density and average yearly wages per employee. Table 1 displays some descriptive statistics.

Table 1. Descriptive statistics of the data (69 counties, 7 years)

		Mean	Std. Dev.	Min	Max
Employees 1st sector	Persons	1754.30	972.68	109.00	4962.00
Coupled area payments	Million €	9.43	9.22	0.00	39.88
Coupled livestock payments	Million €	1.12	1.60	0.00	10.52
Decoupled direct payments	Million €	3.30	7.79	0.00	46.85
Development of rural areas	Million €	3.91	3.24	0.00	22.30
Processing and marketing	Million €	0.33	1.52	-0.74[a]	23.19
Investment aids	Million €	0.67	0.72	0.00	4.05
Less favoured areas	Million €	0.66	0.81	0.00	3.35
Agri-environment	Million €	1.63	1.88	0.00	11.74
Population density	Persons/km²	288.18	380.90	41.36	1912.12
Average annual wage all sectors	Thousand €	24.62	1.40	21.21	29.15

Note: [a] There was occasional overpayment in some regions, which led to negative expenses in subsequent years. N=483. All monetary values expressed in real terms, using the GDP deflator for Germany.

Source: Authors' calculations.

[10] Migration and commuting behaviour of the rural population in East Germany thus counteracted the local fragmentation of labour markets. However, important differences in wage levels remain, as the further analysis shows.

A question that arises with regard to policy measures that are aiming at long-term changes in factor allocation, such as development of rural areas and investment subsidies, is whether their impact is temporary or permanent. Furthermore, because adjustment to long-term changes may take time, effects of these policies may occur not instantaneously but only with a time lag. This question is treated rather lightly in the evaluation literature focusing on labour market outcomes. However, it can relatively easily be addressed in the panel data model used here by including lags of θ_{it} into the model and testing their significance empirically. If a payment made at time t creates permanent employment effects in periods t, $t+1$, …, $t+s$, a significant effect should show up in each of the parameters of θ_{it} to θ_{it-s}.[11] An alternative way to model the dynamic properties of labour use is in the framework of a partial adjustment model (Hamermesh 1993). However, in this model, specific econometric issues arise due to the endogeneity of the lagged dependent variable, which is why we leave it for future research.

In the following, we report results for three models: a "naïve" regression model using pooled data (equation (1)), and two versions of the difference-in-differences model (equation (3)). We present a static version which only allows instantaneous policy effects (denoted model (3a)) and a dynamic version that also includes lags of the measures on the development of rural areas, processing and marketing support, as well as investment aids (denoted model (3b)). As each lag reduces the number of observations available for the estimation in our relatively short panel, we limited the number of lags to two.[12] All reported standard errors are robust to serial correlation within groups.

6. Estimation results

For illustrative purposes, we start with an analysis of the "naïve", pooled OLS model without fixed effects (1). In this model, coefficients are highly significant and positive for coupled area payments, decoupled direct payments, investment aids, payments for less favoured areas, and agri-environmental measures (Table 2). These results show that payments under the CAP mostly go into regions where many people are employed in agriculture. As such, these figures show interesting correlations. However, they are not useful for analysing policy impacts, as regional heterogeneity in the size and structure of the agricultural sector are not included in the model.

[11] We tested trend stationarity of the employment variable by using a test for heterogeneous panels with serially uncorrelated errors due to Im et al. (2003). It rejected the hypothesis that the panels were all non-stationary at the one percent significance level.

[12] Lagged values for the years 1997 and 1998 were available and thus included for the 24 counties in Saxony-Anhalt.

Table 2. Regression estimates: policy impacts on employment in agriculture

Explanatory variable	Pooled OLS model (1)		Difference-in-differences (3a)		Difference-in-differences with lagged effects (3b)	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Coupled area payments	51.26 ***	4.90	-33.26 **	13.29	-34.05 **	13.97
Coupled livestock payments	38.35	28.44	-43.44 *	22.37	-43.17 *	22.93
Decoupled direct payments	43.50 ***	5.11	-36.97 **	14.04	-37.79 **	15.28
Development of rural areas	7.64	10.33	2.39	3.80	5.12	4.77
lag 1	-		-		-7.64 *	4.40
lag 2	-		-		-7.72	5.69
Processing and marketing	10.00	14.28	-11.17 ***	3.99	-6.72 *	3.43
lag 1	-		-		-1.90	3.46
lag 2	-		-		-4.17 *	2.31
Investment aids	285.09 ***	38.20	13.60	11.22	15.24	15.43
lag 1	-		-		20.48	14.75
lag 2	-		-		15.84	15.12
Less favoured areas	279.67 ***	44.65	8.66	109.98	-38.86	148.55
Agri-environment	71.28 ***	16.13	13.72	8.41	14.45 *	8.60
Decoupling (2005/6=1)	-202.97	133.15	-280.84 ***	90.54	-229.05 **	114.03
Population density	0.02	0.08	-1.10	0.87	-0.46	1.00
Average annual wage all sectors	11.71	18.35	-96.45 ***	39.34	-95.27 **	46.87
Year = 2000	94.16	123.87	-12.18	60.83	10.42	54.49
Year = 2001	-209.15 *	122.96	-110.15 *	62.91	-75.06	55.62
Year = 2002	-190.98	116.72	-146.80 **	67.56	-137.57	90.76
Year = 2003	-152.36	116.45	-171.43 **	76.72	-136.86	100.33
Year = 2004	-181.33	121.39	-163.52 *	91.45	-119.27	114.03
R^2	0.774		0.464		0.430	
N	483		483		393	

Notes: *** (**,*): significant at the 1% (5%, 10%) level. All models also include a constant. Standard errors are robust to serial correlation within groups.

Source: Authors' calculations.

Model (3a) removes group means and thus controls observed and unobserved heterogeneity. As detailed in section 4, this model can much more credibly be used for policy impact analysis, and indeed the picture changes completely. The coefficients of all the direct payments as well as support of processing and marketing change into highly significant, negative effects. The impacts of compensatory allowance and investment aid disappear. The *p*-value of the agri-environmental measures rises to 0.11 (not shown in the table). We find an expected negative sign on the general wage level. At the same time, we observe a drop in R^2, which measures the explanatory power of the group deviations ("R^2 within") in models (3a) and (3b). As some variation is removed by groupwise demeaning, this is not surprising.

A further interesting result is that subsidies for investment in processing and marketing now have a significantly negative effect on employment. These subsidies primarily increased the capital intensity in the downstream sector, for example by supporting investment in egg and fruit handling and processing. It seems plausible that these investments were mainly made in labour saving technologies and thus led to employment losses.

Model (3b) allows the analysis of lagged effects due to the measures that aim at long-term structural changes. With regard to processing and marketing aids, the effect seems indeed to be of a lasting nature, as the two-years lag turns out to be significant. According to these estimates, a million euro spent in processing and marketing aids costs about seven jobs in the short run and an additional five jobs in the longer run. Furthermore, in contrast to the zero contemporaneous effect, measures aimed at the development of rural areas also reduced agricultural employment if a one-year lag is allowed. Better infrastructure in rural areas hence appears to accelerate labour cuts in agriculture. No effects could be isolated for the investment aids directly geared to farms. Given the significance of these lagged parameters, model (3b) seems the most appropriate specification for our analysis.

In addition, agri-environmental measures again have a positive sign which is significant at the ten percent level. The share of this measure in the total CAP budget of the states varies between 5 and 15 percent. Agri-environmental payments in the states studied here were particularly increasing in the support of conversion to organic farming. Our result is consistent with the view that labour intensity increased in regions where payments stimulated organic farming. This result is also in line with the findings of Pufahl and Weiss (2009). According to our estimate in model (3b), transfers of on average 69 thousand euro annually are necessary to create one full-time job by agri-environmental support.[13] This magnitude is considerably higher than the average wage of 25 thousand euro (Table 1).

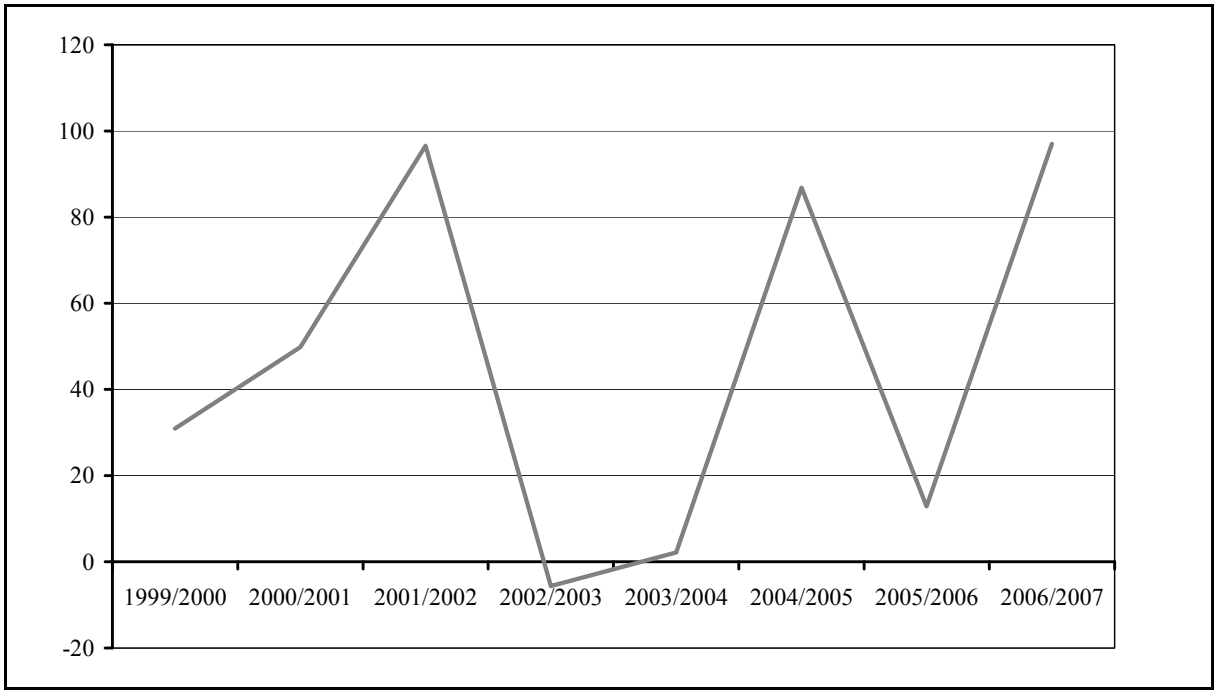
Both models (3a) and (3b) provide evidence in favour of a significantly negative effect of decoupling on farm employment. A plausible explanation is as follows: while the stepwise decoupling led to higher area payments, it also induced shedding of excess labour, as payments were made increasingly independent of the level of production. This applies to both

[13] One additional million euro create 14.45 jobs, so that 69.2 = 1000/14.45 thousand euro are necessary for one additional job.

crop and livestock production. Farms could reduce labour input (and hence output) without risking the loss of transfer payments.

The results suggest there are two effects of this policy reform. One is a general effect occurring in the years after SPS introduction, as measured by the indicator variable "decoupling". This variable allows a shift in employment for observations in 2005 and 2006. The other is tied to the increase of payments, which occurred simultaneously. To what extent the effect of the former can indeed be linked to decoupling depends on the potential relevance of other macro shocks that occurred in the same period. Figure 3 shows the profit situation of farms operated as corporate entities in Eastern Germany based on farm accountancy data, hence the situation of typical large farms in this region. Generally, profits were quite volatile, so that no obvious relationship to the constant decrease in labour use as shown in Figure 1 can be established. According to Figure 3, there was a downward spike in 2005, whereas profits recovered notably in 2006. It hence cannot be ruled out that labour releases in 2005 were partly fuelled by worsening economic conditions. However, splitting the "decoupling" variable into two year dummies also produces two highly significant, negative parameters. These are -223.96 for 2005, significant at ten percent, and -250.59 for 2006, significant at five percent in model (3b). Note that no significant annual macro effects are present in model (3b) for any other year. It seems therefore likely that decoupling as such had an important effect.

Figure 3. Average annual profit of farms operated as corporate entities in East Germany (thousand euro per farm) between 1999/2000 and 2006/2007



Note: Mean profit in this period: 46.31 thousand €/farm. Accounting years run from July 1 to June 30.
Source: BMELV (2010).

Whether decoupling is also responsible for the negative signs on the level of payments cannot be ultimately resolved here. As can be seen from Figure 2, direct payments constantly increased over the observed period. At the same time, price support was reduced. This gradual decoupling effect may have led to the release of labour no longer necessary for maintaining production levels. However, liquidity injections due to direct payments may also have altered the input mix in other ways. One hypothesis is that increased direct payments allow more labour-saving investments on credit-constrained farms. Empirical analysis of this hypothesis is left for future research.

Finally, models (3a) and (3b) suggest that a rising overall wage level drives down agricultural employment. The reported marginal effects imply an elasticity of labour use with respect to the overall wage level of -1.35 and -1.34, respectively. The regional economic environment responsible for the general wage level is hence an additional important determinant of agricultural labour use.

7. Conclusions

Our regression analysis of CAP payments in three German States revealed that there were few desirable effects on job maintenance or job creation in agriculture. Based on a difference-in-differences model implemented at the county (*Landkreis*) level, we found that farm investment aids and transfers to less favoured areas had no marginal employment effect at all. Increases in direct area payments on average led to labour shedding. In 2005 and 2006, full decoupling made transfer payments largely independent of factor allocation. We show that in these years, there was a significant reduction in agricultural employment, holding constant other influences. Spending on modern technologies in processing and marketing also led to job losses in the first sector, some of which only occur with a delay of two years. Measures aiming at the development of rural areas reduced agricultural employment with a lag of one year. Agri-environmental measures, on the other hand, tended to keep labour intensive technologies in production or induced them.

We therefore conclude that, in the three East German States, the CAP mostly misses its target of safeguarding jobs. It seems likely that further decoupling steps will lead to more job losses. Existing bundles of measures on rural development have partly contradictory effects on employment. In light of the recent debates about additional modulation, this analysis calls into question whether an expansion of second pillar measures is a reasonable way to use the modulated funds. More generally, the relevant decision makers should reconsider whether the CAP in its post-Agenda 2000 form is a useful policy to promote job creation in agriculture.

We stress that the analysis here has focused on the goal of job creation in agriculture. With regard to other goals that may have been achieved by the CAP, such as environmental stewardship or the social goal of income redistribution, we can only conclude that their potential achievement at least has not made jobs in agriculture safer.

In our view, the analysis presented here is a useful complement to evaluation studies based on case studies and stakeholder interviews, including those mandated by the European Commission. We have discussed some of the methodological assumptions and limitations of our quantitative approach above. These assumptions notwithstanding, the approach has several clear advantages: First, it summarises the evaluation outcome in a small number of well-defined statistical figures (the estimated treatment effects). Second, it is based on statistical data measuring treatment and outcomes that can be regarded as quite objective in the sense of being unbiased by stakeholder interests. Finally, this type of policy evaluation is rather inexpensive, given relevant methodological expertise on the side of the evaluators and the availability of appropriate data. However, this last point often inhibits that more studies of this sort are being conducted. We recommend that more data on policy spending that is differentiated regionally and by policy instruments should be made public. This would allow an extension of the approach to other regional settings relatively easily.

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Appendix

Table A1 presents the components of the eight policy aggregates used in the analysis of this article. Note that the three states did not implement all measures offered within the CAP. Furthermore, in the period under investigation, Saxony offered a fully state-funded farm investment scheme that was included in the respective aggregates. Brandenburg and Saxony offered a state-funded agri-environmental programme for the extensive use of agricultural land (KULAP 2000). Direct payments under the CAP (EC 1254/1999, EC 1673/2000, EC 2529/2001, EC 1782/2003) were split into the three aggregates coupled area payments, coupled livestock payments, and decoupled payments. The single measures listed in regulation EC 1257/1999 were aggregated according to the Operational Programmes and Rural Development Plans of the states.

Table A1. CAP policy aggregates and their components

Aggregate policy measure	Components
First pillar	
Coupled area payments	1999 to 2004: Aid for peas and beans, rapeseed, sunflower seed, and soybean, grain (without maize), industrial maize, vetches; obligatory and facultative set-aside acreage; additional aid for industrial durum (EC 1251/1999); aid for flax and hemp (EC 1673/2000). 2005 and 2006: Additional amount of aid; protein crop premium; aid for energy crops; aid for starch potato (EC 1782/2003).
Coupled livestock payments	1999 to 2004: Special premium male cattle; suckler cow premium; slaughter premium; cattle premium; milk premium (EC 1254/1999); ewe premium (EC 2529/2001). 2005 and 2006: No payments.
Decoupled direct payments	2005 and 2006: Single payment scheme (EC 1782/2003).
Second pillar	
Development of rural areas	Aid for tourism; development of rural areas; village renewal; integrated rural development; improvement of rural infrastructure; land consolidation; environmental and nature protection (EC 1257/1999, Art. 33).
Improving processing and marketing of agricultural products	Improvement of market structure; aid for processing and marketing of agricultural products (EC 1257/1999, Art. 25).
Investment aid	Investment in agricultural holdings, aid for direct marketing, aid for horticulture, aid for livestock production (EC 1257/1999, Art. 4); setting up of young farmers (EC 1257/1999, Art. 8); state specific investment aid Saxony.
Less favoured areas	Aid for less favoured areas and areas with environmental restrictions (EC 1257/1999, Art. 13).
Agri-environmental measures	Organic farming; aid for extensive use of agricultural land and perennial crops; extensive use of grassland; provision of breed and gene reserves; contract nature protection scheme (EC 1257/1999 Art. 22); Natura 2000; KULAP 2000; cultivation under environmental protection; modulation measures for crop diversification, tillage and extensive use of grassland.

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