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CAP REFORM AND THE EFFECTS OF DIRECT PAYMENTS  
ON HETEROGENEOUS FARM STRUCTURES IN EAST GERMANY

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2010

*Vortrag anlässlich der 50. Jahrestagung der GEWISOLA  
„Möglichkeiten und Grenzen der wissenschaftlichen Politikanalyse“  
Braunschweig, 29.09. – 01.10.2010*

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# CAP REFORM AND THE EFFECTS OF DIRECT PAYMENTS ON HETEROGENEOUS FARM STRUCTURES IN EAST GERMANY

## Abstract

In this article we explore the hypothesis that recent reforms of the Common Agricultural Policy's (CAP) direct payment regime affect farms of different size differently. Contrary to the view of a structure conserving effect of direct payments, these will have a distinct impact on structural change in agriculture if farms are heterogeneous. In the context of East Germany, we postulate that large farms benefit more from increases in direct payments than small farms if they are more tightly liquidity constrained. Their competitiveness on the land market hence relatively improved during recent reforms. Furthermore, the recently introduced degressive modulation for bigger farms provides incentives for strategic farm creation. Econometric evidence in favor of these propositions is presented. We estimate a dynamic model of structural adjustment in agriculture, based on a unique regional panel dataset of three East German *Bundesländer* for the period 1995 to 2007. We give results for the impact of direct payments on the total number of farms for two groups of different size classes. Our results suggest that large farms benefit most from CAP first pillar payments at the cost of smaller farms. Furthermore, we find evidence for strategic farm creation in connection with the 2003 reform of the CAP.

## Keywords

Structural change, Dynamic panel data models, Common Agricultural Policy, East Germany

## 1 Introduction

Many politicians and farm lobbyists claim that the first pillar of the Common Agricultural Policy (CAP) is crucial to maintain a reliable framework for farmers in the European Union (EU) and Germany accordingly. Recently, Tassos Haniotis, Head of the Agricultural Trade Policy Analysis in the Directorate General for Agriculture of the European Commission, endorsed that direct payments are indispensable for farm survival under the given EU regulations for farming (AGE, 2009). The future of the CAP first pillar funds is, however, discussed controversially. It is particularly questioned whether direct payments have the potential to raise farm incomes and thus increase the probability of farm survival. CIAIAN and SWINNEN (2009) argue, for instance, that in theory decoupled payments tend to increase land rents and thus decrease farm income. LEATHERS (1992), however, showed that the impact of governmental programs on farm structure cannot be predicted by theory alone and thus calls for empirical evaluation.

There are two patterns of direct payments' impacts on farm structure discussed in the literature. Many studies analyzing the North American agricultural sector give empirical evidence that subsidies tend to accelerate structural change (GOETZ and DEBERTIN, 2001; AHEARN et al., 2005; KEY and ROBERTS, 2006 and 2007; ROBERTS and KEY, 2008). They come to the conclusions that those farms participating in farm programs grow at the cost of the non-participants as the latter face disadvantages on the land market, a fact that would not have happened or proceed slower without the existence of government payments. On the other hand studies focusing on Western Europe support the hypothesis that agricultural subsidies tend to conserve farm structures by increasing the survival probabilities of farms (MANN, 2003a and b; BREUSTEDT and GLAUBEN, 2007). Compared to the North American agricultural sector, any farmer in the EU benefits from the support under the CAP. Accordingly, direct payments smooth farm incomes across all types of farms. Whether or not

farms are affected *heterogeneously* by direct payments thus seems to be of central importance for judging the effects of these payments.

It is, however, difficult to transfer the previous findings off hand to the East German agricultural sector (cf. MANN, 2003b; HUETTEL and MARGARIAN, 2009). Although farm structures, with regard to the average farm size, might be comparable to North America, the legal framework of farm support is quite different under the CAP. Moreover, all of these studies refer almost exclusively to agricultural structures dominated by family farms. East German farms predominantly operated by hired managers may be more flexible in terms of factor allocation than family operators owning most of the production factors, and may face a significant risk of bankruptcy. Little is known about the effects of policy reforms in such an agricultural setting. In this article, we address the existing research gap in two ways. First we empirically analyze the impact of the CAP first pillar payments on regional farm numbers applying a unique data set of disbursed payments at the level of the German *Landkreise* (NUTS-3 regions). Secondly, special attention is given to the impact of the 2003 reform of the CAP. In this regard, we will test whether regulations affecting particularly large farms led to strategic farm creation in East German agriculture to circumvent payment caps and minimize the risk of penalties from cross-compliance offenses.

Based on a literature review, we identify determinants of structural change in agriculture. The approach of path dependency (cf. BALMANN, 1997) serves as a starting point for our empirical model, assuming that past farm structures have an impact on future structural change. The model is further specified by economic and agro-political factors affecting the survival of farms at the regional level. These are disaggregated agricultural input and output prices as well as regionally disbursed first pillar payments of the CAP. The effects of the 2003 CAP reform on farm creation are explicitly modeled in our regression. Our analysis is applied at the level of 69 *Landkreise* of the three characteristic East German *Bundesländer* of Brandenburg, Saxony, and Saxony-Anhalt. The data set covers biannual figures on regional first pillar payments and farm structure for the time period from 1995 to 2007. We use a bias-corrected least square dummy variable (LSDVC) model that has recently been developed by BRUNO (2005b) for unbalanced macro panels with a comparably short time dimension and a moderate number of regions.

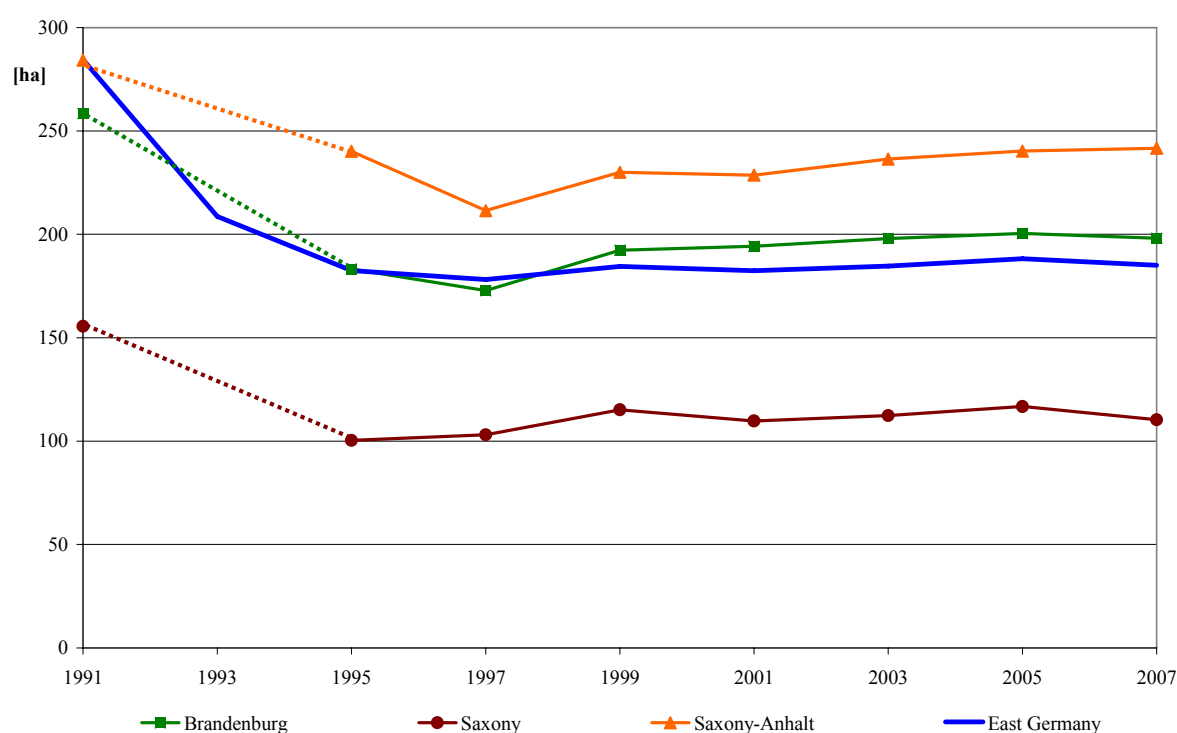
In the following section 2, we give some background information on the development of farm structures in East German agriculture after the reunification. Section 3 presents a literature review on structural change in agriculture with a particular focus on the impact of governmental support. In Section 4, we derive our empirical approach and the hypotheses to be tested. Section 5 gives an overview of the methodological issues involved in the estimation of dynamic panel models and explains the approach used in this study. Section 6 specifies the model and data. Section 7 presents the results, while section 8 concludes.

## **2 Structural change in East German agriculture after 1989**

Due to the de-collectivization of the large collective farms after the German reunification in 1990 farm numbers significantly increased in East German agriculture at the beginning of the 1990s. The data, however, gives evidence that this transition process was finished between 1995 and 1997 when average farm sizes stabilized at a still comparably high level of about 180 hectares (see Figure 1). Given their substantial land and animal stocks per farm, East German farm managers regularly obtain levels of direct payments per farm that are far beyond the amount received by an average family farm in the EU. In Brandenburg, Saxony, and Saxony-Anhalt, for instance, the disbursed first pillar funds per farm averaged 53,243 € in 2005 whereas the EU-25 average ranged from 7,500 € in 2004 to 8,780 € in 2006 (EC, 2008a). On the other hand, farm numbers modestly, but steadily declined in East German

agriculture since the mid 1990s which led to continuous increases in average farm sizes. This trend, however, seemed to reverse with the implementation of the 2003 CAP reform in 2005 (see Figure 1). The reform was characterized by the transfer of direct payments into the single area payment scheme (SAPS) as well as a gradual modulation of first pillar funds to the second pillar of the CAP and the implementation of cross-compliance regulations. Within the obligatory modulation farms receiving more than 5,000 € of direct payments per year suffer from a cut in the respective funds of 5%. From 2009 on this share will gradually increase up to 10% in 2012 along with an additional cut of 4% for farms that receive more than 300,000 € of pillar one funds per year (DBV, 2010). In conjunction with the implementation of the 2003 CAP reforms a general increase in direct payments received per farm on average by 16.9 % could be observed in the EU-25 between 2004 and 2006, due to raising subsidies for milk production and a level increase of the SAPS (EC, 2008a). In this regard, the three considered East German *Bundesländer* reveal a more modest increase by 5.1 % between 2004 and 2006. But does this trend cause the creation of new farms in East German agriculture after 2005? Another reasonable explanation could be that existing farms opt for splitting their farm to avoid adverse effects of a maximum acreage eligible for direct payments to be expected in the future or create separate units without land which provide agricultural services subject to cross-compliance regulations of good agricultural practice.

**Figure 1 Average Farm Size [ha] in East Germany, Brandenburg, Saxony, and Saxony-Anhalt (1991–2007)**



Note: Biannual figures. No data available for 1993 at the level of the Bundesländer.

Source: BMELV (various years), DESTATIS (2009). Authors' calculation.

### 3 The impact of direct payments on structural change in agriculture

Regarding the empirical literature on the impact of governmental support on structural change, generally, two different patterns can be observed. On the one hand, authors analyzing the North American agricultural sector argue that agricultural subsidies accelerate structural

change. AHEARN et al. (2005) applied a three-stage least squares model to a panel data set of 48 states in the U.S. They find that increasing commodity payments lead to higher farm exit rates in US agriculture, particularly with regard to small farms. The authors conclude that those farms receiving direct payments buy out farms that do not. This effect emerges from the specific design of governmental support to agriculture in the U.S. since participation in farm programs is facultative. Direct payments have historically been aimed at cash grain and cotton farms based on production volume. Accordingly, larger farms who participate in programs have higher average payments. Analyzing the concentration rate of farms in North America at the zip code level by means of a semi-parametric generalized additive model, ROBERTS and KEY (2008) argue that from a third up to more than a half of the concentration growth can be tracked back to government payments. Prior studies of these authors (KEY and ROBERTS, 2006 and 2007) conducted at the farm level support the hypothesis of an accelerating effect of farm programs on structural change. Similar to AHEARN et al. (2005), they propose that larger farms (> 1,000 acres) participating in farm programs grow at the cost of those who do not, which are mainly smaller farms operating less than 50 acres.

Despite the fact of an unbalanced distribution of government payments to farms of varying size classes, differences with regard to the farms' credit constraints may lead to differing impacts of direct payments on farm performance. ROBERTS and KEY (2008) argue that agricultural subsidies have the potential to relieve borrowing constraints and thus allow some farms to grow more quickly than they would have without governmental support. In their theoretical evaluation of credit market imperfections on the distribution of policy rents CIAIAN and SWINNEN (2009) are more precise with regard to this issue. In a setting of heterogeneous farms, the authors find that a credit constrained farm benefits more from the introduction of area payments than one which is not. The reduction in its credit constraint leads to higher marginal land productivity gains and thus boosts land demand compared to an unconstrained farm.

Given that it is not uncommon among large East German cooperatives to operate their farm with debt to asset ratios above 80%, a certain restriction to take up additional leverage is very likely. Accordingly, increasing amounts of direct payments paid to large farms relieve existing budget constraints and improve the economic position of large farms when they bid for production resources.

In contrast to the previously mentioned studies, authors analyzing the impact of direct payments on farm structure in Western Europe indicate a definite structure preserving effect. Investigating the Swiss agricultural sector by means of a cohort analysis, MANN (2003a) finds that higher direct payments slow down structural change. He observes the same trend if the price and income ratio between farm and non-farm business changes in favor of agricultural activities due to governmental price support. Applying an exit-entry model to 110 regions in 12 Western European states, BREUSTEDT and GLAUBEN (2007) indicate lower farm exit rates between 1993 and 1997 in connection with higher subsidy payments and increasing long-term output prices. These contrary results compared to the studies conducted in the U.S. may be driven by the specific agricultural policy design in the EU<sup>1</sup> as any farm benefits from government support.

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<sup>1</sup> The first pillar of the CAP is characterized by an obligatory support to all farms depending on farm size. Prior to 2005 the amount of direct payments received per farm were mainly determined by the agricultural area allocated to eligible crops as well as animal, slaughter and milk premiums. Those payments were partly decoupled from production, varying from member country to member country (EC 2008b), and transferred into the SAPS with the implementation of the 2003 reform of the CAP in 2005. In Germany, direct payments were fully decoupled despite some exceptions, i.e. tobacco and hop.

#### 4 Empirical approach and testable hypotheses

Based on the literature review we pursue a dynamic regression approach to estimate the impact of regionally disbursed direct payments on the development of farm numbers in total as well as two distinct size classes in selected East German *Landkreise*. In addition to data on the first pillar of the CAP, the model includes regional land rents, and national agricultural input and output price indices to control for market mechanisms affecting the survival probability of farms. The following hypothesis will be empirically tested:

- 1) Given that the first pillar of the CAP serves as a direct income support increasing the profitability of agricultural production, direct payments are generally expected to preserve farm structures. We, however, assume that the heterogeneous farm structure in East Germany will lead to differing impacts of governmental support. Large cooperatives characterized by a high debt to equity ratio are supposed to gain more from CAP first pillar payments than small farms, due to a relaxed budget constraint. Their competitive power on the land market hence increases. If this holds true, we expect the coefficient for the impact of first pillar funds on the number of small farms to be negative, i.e. increasing direct payments lead to a reduction of small farms. On the other hand, direct payments are assumed to have no significant effect on the number of larger farms as they do not grow in numbers, but in size.
- 2) Impairing business conditions, characterized by decreasing agricultural output prices as well as increasing input prices and land rents, decrease farm income and thus result in higher exit rates from agricultural production and shrinking farm numbers (cf. SHEPARD and COLLINS, 1982). The other way around, favorable business conditions will lead to an uptake of new farms. Particularly, low land rental values are expected to attract potential farmers to establish a new farm.
- 3) There is at least anecdotic evidence that the implementation of the 2003 reform of the CAP in 2005 led to strategic farm creation in East German agriculture. Accordingly, farm numbers are assumed to increase after 2005.

Furthermore, past regional farm structures will be included in our empirical model as we expect structural adjustment to be sluggish and highly determined by the initial structure of the agricultural sector in a region (cf. HUETTEL and MARGARIAN, 2009). Methodological issues in estimating such dynamic panel data models are discussed in the following section.

#### 5 Estimation Methods for Dynamic Panel Data Models

We consider the dynamic fixed effects model

$$(1) \quad y_{i,t} = \gamma y_{i,t-1} + x'_{i,t} \beta + \eta_i + \varepsilon_{i,t}; i = 1, \dots, N \text{ and } t = 1, \dots, T$$

where  $y_{i,t}$  is the dependent variable,  $x_{i,t}$  is a  $(K-1) \times 1$  vector of exogenous regressors,  $\eta_i$  is an unobserved individual effect and  $\varepsilon_{i,t}$  is an identically and independently distributed error term. The lagged dependent variable captures the idea that farm adjustment is sluggish and thus follows a path dependent process.

It is well known that the Least Square Dummy Variable estimator (LSDV) for model (1) is not consistent for finite  $T$  even if  $N$  is considered to be large (NICKELL, 1981). Thus, LSDV only performs well when the time dimension of the panel tends to infinity. Regarding the fact that our dataset consists of 69 regions observed from 1995 to 2007 the LSDV estimates would be seriously biased. GREENE (2008: 340f) argues that for  $T$  values from 5 to 15, the relative bias in estimation of  $\gamma$  could reach up to 60 percent. JUDSON and OWEN (1999) find that even

with a quite large time dimension of 30 observations the bias accounts for 20 percent of the true value of the coefficients.

A number of consistent instrumental variable (IV) and Generalized Method of Moments (GMM) estimators have been proposed to estimate equation (1) when  $T$  is moderate. ANDERSON and HSIAO (1981) (AH) suggest an approach based on first-differences to eliminate the unobserved individual heterogeneity. They apply two IV estimators that use the second lags of the dependent variable, either differenced or in levels, as an instrument for the differenced one-time lagged dependent variable. ARELLANO and BOND (1991) (AB<sub>1</sub>) extended the AH approach in terms of efficiency by allowing for a greater number of internal instruments leading them to a GMM estimator for the first-differenced model. The AB<sub>1</sub> estimator can be applied as a one-step or two-step procedure depending on whether the error terms are homoskedastic or not (BOND, 2002). ARELLANO and BOVER (1995) (AB<sub>2</sub>) as well as BLUNDELL and BOND (1998) (BB) report Monte Carlo evidence of a downward bias in the AH estimator when the true dynamic coefficient is equal to or greater than 0.8. As a solution, they propose a system GMM estimator using additional moment restrictions, supported by the structure of panel data, as superior alternatives.

However, a considerable shortcoming of IV and GMM estimators is that their properties depend on large  $N$ . Thus, their application can lead to severely biased coefficients in panel datasets with a moderate number of cross-sectional units (BRUNO, 2005b). Recently, alternative approaches based upon the bias-correction of LSDV have become popular in the econometric literature. JUDSON and OWEN (1999) compared the performance of pooled Ordinary Least Squares (OLS), LSDV, AH, AB<sub>1</sub> (one-step and two-step estimator), and a LSDVC estimator derived in KIVIET (1995) regarding the coefficients of  $\gamma$  and  $\beta$  by means of a Monte Carlo experiment with  $T$  values between 5 and 30. They found evidence that the LSDVC approach consistently outperforms the other estimators. BUDELMEYER et al. (2008) analyzed the performance of the same range of estimators on a more complex indicator that summarizes the properties of a vector of fixed effects coefficients in a similar Monte Carlo simulation. They confirm the findings of JUDSON and OWEN (1999) that when  $N$  ( $=20$ ) and  $T$  ( $=5$ ) are small the LSDVC estimator outperforms all other estimators<sup>2</sup>.

Given the fact of some missing values in our panel data set, we follow the approach of BRUNO (2005a) who extends the literature<sup>3</sup> on corrected LSDV estimators for samples with small or moderate  $T$  to unbalanced panels. BRUNO (2005a) augments model (1) to a more general version that allows for missing observations in the interval  $[0, T]$  for some regions. The author defines a dynamic selection rule  $s(r_{i,t}, r_{i,t-1})$  to identify those observations that are usable for the dynamic model

$$(2) \quad s_{i,t} = \begin{cases} 1 & \text{if } (r_{i,t}, r_{i,t-1}) = (1,1) \\ 0 & \text{otherwise} \end{cases} \quad ; i = 1, \dots, N \text{ and } t = 1, \dots, T$$

where  $r_{i,t}$  is the selection indicator such that  $r_{i,t} = 1$  if  $(y_{i,t}, x_{i,t})$  is observed and  $r_{i,t} = 0$  otherwise. Following BRUNO (2005a), the unbalanced dynamic panel model can be written as

$$(3) \quad s_{i,t} y_{i,t} = s_{i,t} (\gamma y_{i,t-1} + x'_{i,t} \beta + \eta_i + \varepsilon_{i,t}) \quad ; i = 1, \dots, N \text{ and } t = 1, \dots, T.$$

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<sup>2</sup> The only exception is the case, when the true value of the dynamic parameter  $\gamma$  is equal to 0.8. Than OLS reveals the best performance.

<sup>3</sup> Cf. Kiviet (1995, 1999), and Bun and Kiviet (2003).



According to BUN and KIVIET (2003) three possible bias approximations emerge. They reveal an increasing accuracy from the leading term of the LSDV bias  $B_1$  of order  $O(T^{-1})$  to the successive higher-order terms  $B_2$   $O(N^{-1}T^{-1})$  and  $B_3$   $O(N^{-1}T^{-2})$ . However, BUN and KIVIET (2003) showed that the leading term  $B_1$  already comprises 90 percent or more of the true bias and the higher-order terms only lead to minor improvements. BRUNO (2005a) could prove that the bias approximations derived in BUN and KIVIET (2003) can be applied to unbalanced panels with a strictly exogenous selection rule as well. Thus, LSDVC could theoretically be obtained by subtracting any of the above mentioned bias approximation terms from LSDV.

In practice, however, those approximations are unfeasible to calculate, given the unknown parameters for the actual bias of the error terms and the real coefficients for  $y_{i,t-1}$ . BRUNO (2005a) circumvents this issue by identifying estimators for a consistent estimation of these parameters, namely the AH, AB<sub>1</sub> and BB. This leads him to an individually corrected estimator for each order of bias approximation and choice of initial estimator:

$$(4) \quad LSDVC_i^j = LSDV - \hat{B}_i^j ; i = 1, 2, 3 \text{ and } j = \text{AH, AB}_1, \text{BB.}$$

## 6 Data and Specification of the Empirical Model

Data from three different sources are combined to estimate the regional dynamic panel data model of structural change in East German agriculture. Biannual figures on CAP first pillar payments were collected from the paying agencies of the state agricultural ministries for the period from 1997 to 2007<sup>4</sup>. Price indices on agricultural inputs and outputs for the respective years were taken from the *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* (BMELV various years). The year 2000 serves as the base year indicated by a value of 100. Biannual figures on the number of farms per *Landkreis* as well as the regional land rents<sup>5</sup> between 1995 and 2007 were collected from the statistical offices of the federal states. The slightly unbalanced panel comprises 69 *Landkreise* of the three *Bundesländer* Brandenburg, Saxony, and Saxony-Anhalt covering biannual data from 1995 to 2007. First pillar payments of the CAP steadily increased over the considered time period. The same trend can be observed for agricultural input prices. Agricultural output prices rather fluctuate with two peaks in 2001 and 2007. As Figure 2 shows, the share of farms smaller than 50 ha in our sample reveals a decreasing trend comprising 63% of the total number of farms in 2007. As a matter of fact, the share of farms equal to or larger than 50 ha increased until 2007. The share of agricultural area allocated by the farms of the two size classes, however, remains unchanged over the considered time period with 4% operated by small farms and 96% by larger farms. Further descriptive statistics are given in Table 1.

According to equation (1) we specify the following dynamic fixed effects model to estimate the impact of CAP first pillar payments on regional farm numbers:

$$(5) \quad y_{i,t} = \gamma y_{i,t-1} + x'_{i,t} \beta + \delta d_{i,t} + \pi_t + \eta_i + \varepsilon_{i,t} ; i = 1, \dots, N \text{ and } t = 1, \dots, T$$

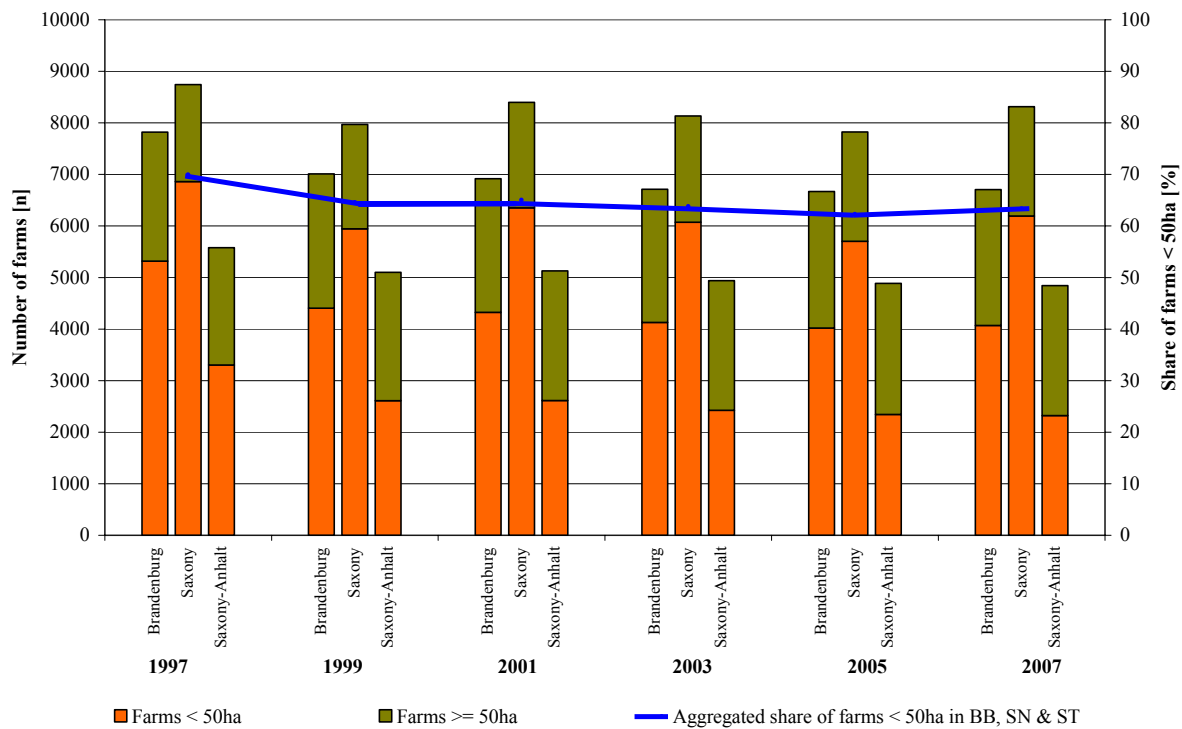
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<sup>4</sup> Data on government payments is available on a yearly basis, but summed up to biannual figures as the statistics on regional farm structure determine the bottleneck of our analysis. Figures on CAP first pillar payments in Brandenburg and Saxony-Anhalt are only available until 2005.

<sup>5</sup> Only the statistical office of Saxony was able to provide us with a data set of land rents from 1997 to 2007 at the level of the *Landkreise*. In Brandenburg and Saxony-Anhalt data at this level was only available for 1999. Accordingly, we derived figures for the missing years by interpolating the state averages in the respective years with data from 1999.

where  $y_{i,t}$  is the number of farms in region  $i$  at time  $t$ .  $x_{i,t}$  is a vector of exogenous regressors controlling for market mechanisms with:  $x_{1i,t}$  land rental value,  $x_{2i,t}$  agricultural output price index, and  $x_{3i,t}$  agricultural input price index.  $d_{i,t}$  depicts the regionally disbursed direct payments, thus,  $\delta$  denotes the policy impact.  $r_t$  is a dummy variable for the 2003 reform of the CAP accounting for 0 until 2003 and 1 afterwards. Accordingly,  $\pi$  indicates the reform effect.  $\eta_i$  is an unobserved, time invariant regional effect and  $\varepsilon_{i,t}$  is a random disturbance.

**Figure 2 Farm structure in Brandenburg, Saxony, and Saxony-Anhalt (1997-2007)**



Source: DESTATIS (2009). Authors' calculations.

**Table 1 Descriptive statistics**

|                              |          | Min    | Max        | Mean       | Std. Dev.  | N   |
|------------------------------|----------|--------|------------|------------|------------|-----|
| <b>Number of farms</b>       | n        | 14     | 1270       | 309        | 208        | 459 |
| <b>Farms &lt; 50 ha</b>      | n        | 9      | 689        | 199        | 132        | 457 |
| <b>Farms ≥ 50 ha</b>         | n        | 0      | 377        | 102        | 81         | 457 |
| <b>Direct payments</b>       | EUR      | 84,384 | 93,450,654 | 26,474,785 | 19,619,333 | 374 |
| <b>Land rental value</b>     | EUR/ha   | 9.92   | 317.00     | 109.52     | 57.85      | 483 |
| <b>AG output price index</b> | 2000=100 | 97.46  | 109.20     | 101.99     | 4.17       | 414 |
| <b>AG input price index</b>  | 2000=100 | 94.65  | 113.90     | 103.45     | 6.16       | 414 |
| <b>Reform dummy</b>          | 0/1      | 0      | 1          | 0          | 0          | 483 |

Source: Authors' calculations

## 7 Empirical Results

In this study, we initialize the bias correction underlying the LSDVC model with the AB estimator. According to JUDSON and OWEN (1999), and BUDELMEYER et al. (2008) this estimator showed the best performance for samples like the one considered here, except for

the LSDVC model. Bias approximation suggested by BUN and KIVIET (2003) is carried out by the first order leading term of the LSDV bias  $B_1$ . This approach already shows a sufficient accuracy that cannot be improved significantly by the higher order terms  $B_2$  and  $B_3$ . z-statistics are computed by means of bootstrapped standard errors running 50 iterations. The estimation results assessing the impact of CAP first pillar payments on regional farm structure are presented in Table 2<sup>6</sup>.

**Table 2 Regression estimates: policy impact on regional farm structure**

| <b>Explanatory variables</b>           | <b>LSDVC Model (1)</b> |         | <b>LSDVC Model (2)</b> |         | <b>LSDVC Model (3)</b>  |         |
|--|------------------------|---------|------------------------|---------|-------------------------|---------|
|  | Lhs: Number of farms   |         | Lhs: Farms < 50 ha     |         | Lhs: Farms $\geq$ 50 ha |         |
|  | Coefficient            | z-value | Coefficient            | z-value | Coefficient             | z-value |
| <b>Lagged dependent variable</b>       | 0,506 ***              | 0,000   | 0,519 ***              | 0,000   | 0,513 ***               | 0,000   |
| <b>Direct payments [mio. €]</b>        | -2,140 ***             | 0,000   | -2,200 ***             | 0,000   | 0,044                   | 0,734   |
| <b>Agricultural output price index</b> | 2,892 ***              | 0,000   | 3,074 ***              | 0,000   | -0,181 **               | 0,028   |
| <b>Agricultural input price index</b>  | 0,243                  | 0,460   | 0,427                  | 0,291   | -0,122                  | 0,269   |
| <b>Land rental value [€/ha]</b>        | -0,085                 | 0,110   | -0,083 **              | 0,032   | -0,006                  | 0,544   |
| <b>Reform Dummy</b>                    | 2,936                  | 0,371   | 0,133                  | 0,967   | 2,628 ***               | 0,004   |
| <b>Number of observations</b>          | 305                    |         | 303                    |         | 303                     |         |

Note: All models include 69 regional dummies. \*\*\* (\*\*, \*): significant at the 1% (5%, 10%) level

Source: Authors' calculations.

The first column of Table 2 shows the LSDVC model (1) estimated for the total number of farms per region as the lhs-variable. In this model, the impact of direct payments on farm numbers is highly significant and negative. The coefficients for the number of farms in the prior period and the agricultural output price index are highly significant and positive. Agricultural input prices, the regional land rent, and the implementation of the CAP reform reveal no effect on farm structures in model (1). Model (2) depicts the results of the LSDVC estimation if the number of farms per region operating less than 50 ha is considered as the lhs-variable. The coefficients indicate similar results compared to model (1) with regard to all explanatory variables except for the land rent, which changes into significant and negative. Moving to model (3), with the number of farms per region operating equal to or more than 50 ha as the lhs-variables, changes the picture completely. The coefficient for regionally disbursed CAP first pillar payments loses its significance. Agricultural input prices and regional land rents show no impact on the number of large scale farms. The effect of agricultural output prices changes into highly significant and negative. Except for the number of large scale farms in the prior period, model (3) also indicates a significant and positive effect for the 2003 reform of the CAP on the total number of farms equal to or larger than 50 ha within a region.

<sup>6</sup> Due to space restriction only the results of the LSDVC regression under the conditions mentioned above are presented here. Further detailed estimation results are available upon request.

Our results give evidence that the first part of hypothesis (1) does not hold true, i.e. increasing direct payments do not preserve farm structures. According to model (1), higher first pillar payments result in fewer farms per region. A closer look on this issue by means of model (2) and (3) reveals that mainly farms smaller than 50 ha abandon farming. On the other hand, large scale farms consolidate. This is consistent with our earlier argument that credit constrained large farms benefit more from increases in direct payments than unconstrained small farms. That implies that larger East German farms grow at the costs of those farms smaller than 50 ha. This fact also explains the increase in average farm sizes across East German *Landkreise*.

With regard to the regional economic conditions for farming, we observe an ambiguous picture on the impact on farm structure. The results of model (2) support our hypothesis that a favorable business environment leads to an increase of farms. The coefficients indicate a significant and positive relation between increasing agricultural output prices and the number of small farms. Furthermore, low regional land rents attract potential farmers to start a business. On the other hand, our estimates for large scale farms in model (3) indicate an increase in farm numbers in conjunction with decreasing agricultural output prices. A reasonable explanation for this otherwise astonishing figure is that under decreasing output prices and thus economic stress some farms smaller than 50 ha merge. This action results in a new farm larger than 50 ha, so that the number of farms in this size class grows in connection with decreasing output prices. The variation of input prices does not affect farm structures. This may be due to the fact, that the effect of increasing prices for agricultural inputs can be somehow circumvented by a reduction of the input use. Accordingly, farm exit decisions are not immediately affected.

The results presented in Table 2 reveal interesting insights regarding our third hypothesis, i.e. whether the implementation of the 2003 reform of the CAP led to an increase in farm numbers. Unsurprisingly, the implemented dummy variable shows no significance in model (2), considering smaller farms. This trend is also transferred into model (1), including all farms in a region, as this figure is obviously dominated by the number of small farms. Model (3), however, provides evidence that the 2003 reform of the CAP leads to an increase in the number of larger farms. Furthermore, the results of model (2) and (3) point towards strategic farm creation in East German agriculture as a pattern of splitting the farm to avoid adverse effects of a maximum acreage eligible for direct payments rather than creating separate units without land which provide agricultural services subject to cross-compliance regulations. The latter would have led to an increase in the number of farms operating less than 50 ha.

The highly significant and positive coefficients for the lagged dependent variable across all three models provide evidence that structural adjustment is sluggish and crucially depends on past farm structures.

## **8 Conclusions**

Currently, there is a vivid debate on the future of CAP first pillar payments. Whereas some politicians and farm lobbyists claim that a strong first pillar is indispensable to maintain a reliable framework for farmers across the EU, the positive impact of direct payments on farm income is strongly questioned, otherwise. Empirical analyses are scarce with regard to this issue, particularly, concerning the agricultural sector of the EU. Given the fact that East German farms are among those receiving per farm payments far above the EU average their impact on farm structure is of special interest. Furthermore, large East German farms are strongly affected by the 2003 reform of the CAP implemented in 2005, due to additional cuts in direct payments. To our knowledge, this study is the first to examine the impact of CAP

first pillar payments on an EU region dominated by large scale farm structures, including an evaluation of the effect of the 2003 CAP reform on strategic farm creation.

Based on a dynamic fixed effects model implemented at the county level, we found that between 1997 and 2007 increasing direct payments led to a significant drop in farm numbers in East German agriculture. The story is, however, twofold. Whereas larger farms operating equal to or more than 50 ha consolidated, the number of smaller farms significantly decreased in connection with increasing direct payments. This implies that large farms increasingly profit from higher direct payments compared to smaller ones. Payment caps of government support are hence reasonable if policy makers wish to protect small-scale agricultural structures.

Our results, however, suggest that large East German cooperatives already reacted to the given threshold by a pattern we call “strategic farm creation”. A reform dummy, included in the regression analysis, points towards a significant increase of new farms equal to or larger than 50 ha after 2003. This supports the aforementioned anecdotic evidence that those farms being affected by additional cuts in CAP first pillar payments, split up in smaller units to circumvent existing and future losses in government support. However, more accurate data on the size distribution of farms within the counties would enable us to make more precise conclusions as the farm size affected by additional cuts in direct payments is far beyond 50 ha.

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