INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS
IGAE
29th | Milan Italy 2015
UNIVERSITÀ DEGLI STUDI DI MILANO AUGUST 8 - 14
AGRICULTURE IN AN INTERCONNECTED WORLD

Capitalization of the SPS into Agricultural Land Rental Prices under Harmonization of Payments

Allen Klaiber[1], Klaus Salhofer[2] and Stan Thompson[1],

[1]Department of Agricultural, Environmental, and Development Economics, The Ohio State University

[2]Institute for Sustainable Economic Development, University of Natural Resources and Life Sciences, Vienna, klaus.salhofer@boku.ac.at

This paper provides estimates of the capitalization of the Single Payment Scheme (SPS) payment of the Common Agricultural Policy (CAP) on agricultural land rental rates. In so doing we address problems of unobserved heterogeneity and sample selection. As the 2013 CAP Reform calls for the harmonization of SPS payments, we estimate the implications of this mandate on agricultural land rental rates over time as Germany began introducing their Hybrid payment system in 2011. Using Bavarian farm level panel data we find strong capitalization effects that increase substantially in the most recent years of 2011 and 2012 after the introduction of the hybrid model. On average, the marginal effect on rental rates of an additional SPS euro is 38 cents, growing over time to 57 cents as regionalization of payments develops.

JEL Classification codes: C33; Q15; Q18

Keywords: CAP Reform, Capitalization Effect, Sample Selection; Panel Data, German Farms

1. Introduction

Since the 1990s the Common Agricultural Policy (CAP) of the European Union (EU) has transitioned through a series of reforms aimed at moving away from coupled price supports to decoupled direct payments. In 2003 the Fischler Reforms continued this transition to a more fully decoupled policy with the introduction of the Single Payment Scheme (SPS) in 2005. Farmers now own a specific number of tradable entitlements, which can be activated every year, if the farmer owns or has rented at least the same amount of eligible hectares of agricultural land. To receive payments farmers are no longer obliged to plant anything on these eligible hectares, but rather just have to maintain the area in "good agricultural and environmental condition" (EU 2003). Hence, payments under the SPS are clearly decoupled from production decisions, but since land is necessary to activate entitlements, they are not decoupled from land.

The different theoretical models Ciaian et al. (2008), Courleux et al. (2008) and Kilian and Salhofer (2008) all conclude that SPS payments will at least partly be capitalized into land rental prices. Empirically, the effect of the SPS on land rental prices are investigated by Kilian et al. (2012) for Bavaria, O'Neill and Hanrahan (2013) for Ireland, Moro et al. (2013) for Italy, Guastella et al. (2014) for all EU Member States and Michalek et al. (2014) for all EU-15 Member States. While Kilian et al. (2012), O'Neill and Hanrahan (2013) and Gustella et al. (2014) find clear evidence that a considerable share of the payments is capitalized into land rental prices, Michalek et al. (2014) find much lower evidence and Moro et al. (2013) reject the hypothesis of a significant capitalization of CAP payments before and after the Fischler Reform.

In explicitly modelling the policy change from coupled area and animal payments before the Fischler Reform to SPS payments afterwards, Kilian et al. (2012) conclude that one can expect the degree of capitalization to increase with the reform. This is mainly the case, because animal payments were only loosely linked to land before the reform, e.g. through stocking limits, but are now integrated in the much closer linked SPS payments. Kilian et al. (2012) also provide some empirical evidence for this additional capitalization for Bavaria.

EU Member States were also given different choices on how to implement the SPS. They could choose a historical model (initially distributed entitlement values were based on the farm's payment history), a regional model (all entitlements have the same value which is based on the regional payment history), or a hybrid model (a combination of the historical and the regional model). The hybrid model exists in a static and a dynamic form. The latter proceeded in a stepwise fashion to the regional model. The historical SPS implementation model was chosen by Austria, Belgium, France, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Wales and Scotland. Malta and Slovenia chose the regional model. The static hybrid model was chosen by Luxemburg, Sweden and Northern Ireland, while Denmark, Finland, England and Germany chose the dynamic hybrid model.[1] Ciaian et al. (2008, 2014), Kilian and Salhofer (2008) and Kilian et al. (2012) show that the capitalization effect will be stronger in case of the regional model, as compared to the historical model. The main argument is that rental prices are determined at the margin. If high and low entitlement values exist and owners of these entitlements compete for the same eligible hectares, the maximum willingness to pay of the low entitlement owner will determine the rental price in the market (Kilian et al. 2013, p. 792; Michalek et al, 2014, p. 265). Another argument why the capitalization is smaller with the historical model is the asymmetric information structure. In the case of the regional model, entitlement values are perfectly known to landowners, while this is not the case with the regional model. This may weaken the bargaining position of the landowner and decrease the rental price (Ciaian et al., 2014, p. 654). Now, the 2013 CAP reform mandates the harmonization of SPS payments within each country so all Member States achieve a regional model by 2019 (EU 2013). This is where our analysis starts. Our primary hypothesis is that as the implementation model moves from a historical to regional payment scheme the capitalization effect increases. Since Germany chose the dynamic hybrid model we have already a natural experiment for this transition from a historical to regional model available. In particular, we use a rich farm level panel data set from the State of Bavaria for the years 2006 through 2012. To our knowledge, no one has empirically investigated how the SPS impacts rental prices as the regionalization of payments evolves. Our results confirm existing theoretical results and show that capitalization rates become larger as the transition to a regional model evolves.

[1] All New Member States except Slovenia and Malta have a Single Area Payment Scheme (SAPS) that we do not discuss here. Like in the regional model payments are the same for each hectare. However, farmers do not own tradable entitlements.

The next section below describes the econometric methods used to test our key hypothesis. This is followed with a discussion of our empirical findings. In the last section we provide some concluding remarks.

2. The Agricultural Land Rental Market and SPS Payments

In the typical farmland rental agreement in Germany the one who farms the land (tenant) pays the cash rent as well as some contract-specific expenses (von Witzke, *et al.*). The tenant receives the SPS payment (entitlement) plus market revenues. Opposed to many other EU countries, the land rental market in Germany is quite liberal with no regulations in regard to contract duration and rental prices. In fact, a contract can have any duration or be open-ended. In the latter case the contract can be terminated without a specific reason either by the landlord or the tenant after an appropriate notice period. In contrast, Ciaian et al. (2010) report that the minimum legal contract duration is nine years in Belgium and France, six years in the Netherlands and five years in Spain. Looking at data for the period 2006 to 2008 Salhofer et al. (2009, pp. 39-40) find that contract duration in Germany varies considerably. One third of the contracts is open-ended. For the rest they find several peaks in the distribution of contract duration: Short-term contracts with one year, medium-term contracts with five to six years, and long-term contracts with 9 to 12 years. For Southern Germany they find medium-term contracts to be typical, but not exclusively.

For the last 20 years average farmland rental shares, defined as the rented agricultural area in total utilized agricultural area, have been relatively stable and somewhat above 60% in Germany.[2] With approximately 1.5 million hectare in 2013 Bavaria is the federal state with the most rented agricultural area in absolute terms. While average rental shares in Bavaria are smaller than in most other federal states, they are still considerable and approximately as high on average in all EU Member States (Ciaian et al. 2010, Figure 31). As depicted in Figure 1 rental shares in Bavaria increased considerably from 16.5 percent at the beginning of the 70s to 49.3 percent in 2013. We observe a constant increase until the beginning of this century, a pretty stable phase for the first years of the 2003 Fischler Reform and an increase again in the last years. In contrast, average rental prices more than doubled between the beginning of the 70s and

[2] Please note that 1991 is the first year with available data after the unification in 1989. Therefore, we do not depict the rental shares for Germany before that time.

end of the 80s, remained pretty stable around 230 €/ha in the 90s and the first half of this century, but increased by 23 percent between 2007 and 2013. The rapid increase in rental prices in the last few years becomes even more obvious, if we look at average rental prices of newly established contracts in Figure 2. In the last eight years, rental prices of newly established contracts increased by 73 percent for cropland and 70 percent for grassland. Given this, farm expenditures for land rentals are considerable and add up to € 2.05 billion for Germany and 358 million for Bavaria in 2010. This is more than 30 percent of the net added value, defined as the production value minus input costs (not including rents) minus depreciation and direct payments.

The hybrid model of SPS was introduced in Germany in 2005. Entitlement values were based on a regional and a historical (farm specific) component. The latter was called “top-up” and was based foremost on former animal payments (special bull premium, calf slaughter premium, suckler cow premium, suckler sheep premium, 50 percent of extensification premium) a farm received between 2000 and 2002, the dairy premium as allocated in 2005 and some premiums for special products (25 percent of the decoupled part of the starch potatoes premium, decoupled part of the aid for dried fodder, decoupled part of tobacco premium) farms received on average between 2000 and 2002. For Bavaria the average values of these top-ups were 111 €/ha on cropland and 155 €/ha on grassland in 2005.

The regional part of the payments was different between cropland and grassland. It also varied between federal states, but not between farms in the same state. For Bavaria 299 €/ha were assigned to cropland. This value was defined by summing up historical payments (averages 2000 – 2002) mainly for arable area payments and some other minor support measures (75 percent of the decoupled part of the starch potatoes premium, seed production premium, hop premium, aid for protein crops) for Bavaria and dividing it by the number of eligible cropland in 2005. Similarily, a value of 89 €/ha was designed for grassland. This was derived by summing up the following payments in 2002: slaughter premium (not including veal calf), 50 percent of extensification payments, national Therefore, at the beginning each farmer received a certain number of entitlements, based on the average farmed area between 2000 and 2002 and (Something missing here)

Starting from 2010 all individual entitlement values were gradually transformed to a uniform value of € 354.55 in 2013. The transformation was progressive. For example, if a farmer owned

an entitlement with a value of € 500 in 2009, it was decreased by € 144.46 over the next 4 years. In 2010 the value was decreased by 10 percent (€ 14.45), in 2011 by 20 percent (€ 28.89), in 2012 by 30 percent (€ 43.34) and 2013 by 40 percent (€ 57.78). If the initial entitlement value was less than € 354.55 it was gradually increased.

3. The Data

We use farm level panel data from the State of Bavaria in Germany. Bavarian farm bookkeeping records is the source of the data, which serve as a basis for the EU's Farm Accountancy Data Network (FADN). The sample is stratified with respect to legal form, farm type (agriculture, viniculture, horticulture and forestry), farm size and geographical region. However, very small farms and part-time farms are underrepresented. The reporting period is the financial year which starts at 1st of July and ends at 30th of June. Hereinafter, we refer to the financial year 2005/06 as the year 2005 since CAP payments are usually transferred at the end. Therefore, direct payments for 2005 are included in the data of financial year 2005/06. Our panel consists of 2,663 farms observed annually for each year from 2005 to 2011, first seven years after the Fischler Reform. Of these farms, we observe 2,509 farms with rented land comprising a total of 17,261 individual farm-year observations. We exclude some observations with inexplicable values, e.g. rental prices greater than 3,000 €/ha. Descriptive statistics of the data are provided in Table 1. We observe rental prices in about 94 percent of the sample while rental rates for 6 percent we not observed. Those who did rent paid on average 263 €/ha.

The hybrid model of the SPS was introduced in Germany on Januray 1st 2005. Entitlement values were based on a regional and a historical (farm specific) component (BMVEL, 2005). The latter was called top-ups and was based on different animal payments (special bull premium, calves slaughter premium, suckler cow premium, ewe premium, 50 percent of extensification premium) a farm received between 2000 and 2002, the dairy premium as allocated in 2005 and some payments for special products (25 percent of the decoupled part of the starch potatoes premium, decoupled part of dried fodder production aid, decoupled part of tobacco aid, sugar compensation payments) farms received on average between 2000 and 2002. The regional part of the payments was different between cropland and grassland. It also varied between federal states, but not between farms in the same state. For Bavaria 299 €/ha were assigned to cropland. This

value was defined by summing up average payments between 2000 and 2002 mainly for arable area and some other support schemes (75 percent of the decoupled part of the potato starch potatoes premium, seed production aid, hop premium, payments for protein crops) for Bavaria and dividing it by the number of eligible cropland in 2005. Similarly, a value of 89 €/ha was designed for grassland by summing up the following payments in 2002: slaughter premium for bovine (other than calves), 50 percent of extensification payments, national, complementary national bovine premium. Therefore, in 2005 each active farmer received as many entitlements as hectares farmed at that time. Entitlement values were determined by the land type (299 €/ha for cropland, 89 €/ha for grassland) and by the proportionate farm-specific payments (all attributable payments divided by the hectares farmed). Therefore, entitlement values considerably varied between farmers but each farmer's entitlements had the same value for each type of land. Average entitlement values in Bavaria in 2005 were around € 400 for cropland and € 244 for grassland (Salhofer et al., 2009).

Starting from 2010 all individual entitlement values were gradually transformed to a uniform value of € 354.55 in 2013. The transformation was progressive. For example, if a farmer owned an entitlement with a value of € 500 in 2009, it was decreased by € 144.46 over the next 4 years. In 2010 the value was decreased by 10 percent (€ 14.45), in 2011 by 20 percent (€ 28.89), in 2012 by 30 percent (€ 43.34) and 2013 by 40 percent (€ 57.78). If the initial entitlement value was less than € 354.55 it was gradually increased.

In our sample the average SPS payments are 351 €/ha on average over all years. In addition to the decoupled direct payments (renting) farmers received on average 60.84 (61.58) €/ha agr-environmental payments and 38.55 (39.47) €/ha disadvantaged area payments. To account to for the effect of the quality of land in rental prices we include returns to land per hectare, defined as revenues minus variable costs. In addition, land quality and profitability is correlated with what is grown. Therefore, we include the ratio of crops in total utilized agricultural area of a farm as well as the ratio of some cash-crops (wheat, corn, rapeseed, potatoes, sugar beet) in crop area. Other farm specific characteristics include milk density, farm size in hectares and the percentage of rented farmland. We also include some socio-economic attributes of the farmer and his family, in particular, percentage of family labor employed, level of employment, age, gender and education level of farmer as dummies.

4. The Analytical Framework

We model the rental price as a reduced-form equation

$$r_{it1} = \boldsymbol{x}_{it1}\boldsymbol{\beta}_1 + c_{i1} + u_{it1}, \quad t \quad 1 \ldots T \qquad (1)$$

where, r_{it1} is the observed rental price of farm *i* in time *t*, $\boldsymbol{x_{it1}}$ is a vector of explanatory variables including payments and other relevant covariates, c_{i1} accounts for unobserved farm heterogeneity, u_{it1} is an idiosyncratic error term and $\boldsymbol{\beta}_1$ is a vector of coefficients to be estimated. To estimate equation (1) we can use only those farms in the sample which actually rent land. Hence, we face an incidental truncation problem which may lead to a sample selection bias if the decision to rent is related to unobserved factors (c_{i1}) of the rental price equation. To account for the nonrandom nature of the sample, we need to understand why some farms chose to not rent. This decision may be due to things other than those which determine rental prices. Likely factors include family structure characteristics such as, age, gender, and educational level of the farmer. In our rental price model, unless the decision to rent is fully explained by the observable variables or the inclusion of fixed effects we need the nature of this decision to aid correction for potential bias.

4.1. Heckman selection model

To ensure consistent estimates when sample selection is potentially present, Heckman (1976, 1979) suggests a two-step procedure. In the first step the entire sample is used to estimate the decision to rent as a binary probit selection equation

$$s_{it2} = 1[\boldsymbol{x}_{it}\boldsymbol{\beta}_2 + c_{i2} + u_{it2} > 0] \qquad u_{it2} \mid \boldsymbol{x}_i \sim N(0,1) \qquad (2)$$

where, s_{it2} is an indicator variable taking value one if farm *i* is renting land in time *t* and zero otherwise, $\boldsymbol{x}_{it}$ is a vector of exogenous explanatory variables observed every period and including all variables in $\boldsymbol{x_{it1}}$ plus at least one more; hence $\boldsymbol{x}_{it1}$ is a strict subset of $\boldsymbol{x}_{it}$, c_{i2} accounts for unobserved farm heterogeneity, u_{it2} is a standard normal distributed error term and $\boldsymbol{\beta}_2$ is a vector of coefficients to be estimated. The rental price r_{it1} is only observed if $s_{it2} = 1$. Sample selection bias can occur if the error terms of the rental price equation (u_1) and of the rental decision (u_2). Hence, to get unbiased estimates of $\boldsymbol{\beta}_2$ we have to estimate the rental equation (1) conditional on $\boldsymbol{x}_{it}$ and u_{it2}. Though, we do not observe u_{it2}, given that it is standard

normal distributed, it is equal to the inverse Mills ratio evaluated at $\boldsymbol{\beta}_2\boldsymbol{x}_{it}$. Hence, using the estimates of the probit equation $\widehat{\boldsymbol{\beta}}_{\boldsymbol{2}}$ we can compute the inverse Mills ratio $\hat{\lambda}_{it} = \left(\boldsymbol{x}_{\boldsymbol{it1}}\widehat{\boldsymbol{\beta}}_{\boldsymbol{2}}\right)$ for each observation $s_{it2} = 1$ and use it as an additional regressor in equation (1). This gives a consistent and approximately normally distributed $\widehat{\boldsymbol{\beta}}_{\boldsymbol{1}}$. In addition, we can use the usual *t* statistic on the estimated coefficient of the inverse Mills ratio to test if a selection bias is present (Wooldridge, 2003, 589).

The exogenous variables of the selection equation $\boldsymbol{x}_{it}$ are all as described in Table 1, except the rental price. In addition, given the panel nature of the date we include six time dummies to account for year-to-year changes that are constant over individuals, e.g. expectations about output prices. To account regional differences not explained by our exogenous variables we include 11 dummies to account for 12 different agricultural production area as defined by Wittmann (1983) and LfB (1984). The subset of exogenous variables of the rental price equation $\boldsymbol{x}_{it1}$ does not include socio-economic factors: age, percentage of family labor, dummy for part-time farming, gender and education level. Assuming the coefficients are constant over time equation (2) is estimated as a pooled probit. To control for cross section unobserved heterogeneity we use the suggestion of Mundlak (1978) and substitute $c_{i1}$with $\overline{\boldsymbol{x}}_{\boldsymbol{i1}}$ and c_{i2} with $\overline{\boldsymbol{x}}_{\boldsymbol{it}}$ at time *t*.

4.2. A panel data model with sample selection

Wooldridge (1995) argues that the Heckman two-step procedure does not lead to consistent estimates. As an alternative, W(95) requires using the entire sample to estimate probit regressions for each time period. He calculates an IMR for each time period and interacts the IMRs ($\hat{\boldsymbol{\lambda}}_{\boldsymbol{it2}}$) with each time dummy ($d_t$) and adds these terms to the primary equation. Following this logic, we then use our selected sample to estimate our final regression

$$r_{it1} = \boldsymbol{x}_{it1}\boldsymbol{\beta}_1 + d_2\hat{\boldsymbol{\lambda}}_{it2} + \cdots + d_T\hat{\boldsymbol{\lambda}}_{it2} + u_{it1}, \quad t = 1, 2 \ldots T \qquad (3)$$

We can test the null that selection is not important by simply using the standard t-test on $\hat{\boldsymbol{\lambda}}_{\text{it2}}$ computed with clustered bootstrapped standard errors. A significant lambda implies sample selection is important.

Empirically, we compare two sample selection approaches. The first is the traditional cross-sectional Heckman model and the second as an extension to this model elaborated by Wooldridge (1995), hereafter W(95). The latter explicitly accounts for farm specific unobservables and allows for selection to occur separately in each time period. Next we briefly discuss both approaches.

5. The Results

Before presenting our primary sets of results, we first report estimates from a naïve fixed effects OLS estimation of equation (1) using only data on rented farms. These results are shown in Table 2. From these results, we see that single payments capitalize into rents at approximately 37 cents per dollar while disadvantaged payments and environmental payments capitalize at 76 cents and 8 cents, respectively. The estimation results for our cross section Heckman selection model from equation (1) and (2) are shown in Table 3. Using clustered, by farm, bootstrapped standard errors we find little evidence of selection with an IMR ratio highly insignificant. As a result, it is perhaps no surprise that our primary variable of interest, the coefficient on single payments is nearly identical indicating a 37 cent capitalization to rental rates.

Turning to the W (95) results reported in table 4, we continue to find very little evidence of selection bias. A significant coefficient single payments suggests that policy support is an important determinant of rental prices. In Table 4 the estimated coefficient .38 is highly significant (p-value < 0.000). It can be interpreted as the marginal impact on rental price resulting from an additional euro of SFP. In this case, rental prices will increase 0.38 cents for an additional euro of payment. The larger this coefficient the more the tenant pays and more the payment captured by the landlord. Roughly 38 cents of the marginal single payment euro accrues to the landlord and 62 cents to the one who farms the land. However, it is likely that only a portion of the landlord's additional 38 cents of income capitalized into land values. This is gross income, not net of taxes and other costs. To estimate the portion the rental income that is capitalized into land sales values is beyond the scope of this paper, but we can say that it clearly is an opportunity cost to the landlord.

We further test the hypothesis that the capitalization effect becomes larger as the transition proceeds to a fully harmonized regional model. Our test is based on the single payment*time

interaction terms. In Tables 2, 3, and 4 we see a gradual progression of positive interaction effects from 2006 to 2012 OLS fixed effects, a Heckman cross-section model and the W (95) panel model specification. While all coefficients are positive only those for 2011 and 2012 are statistically significant. Clearly, a stronger capitalization effect has occurred during the first two years of the transition toward the regional model. Specifically, as harmonization of the SPS occurs and the regional model takes-hold, the capitalization effect grows to 0.57 (0.36 + 0.21) in W (95) . This result is strong empirical support for the hypothesis postulated by Ciaian, *et al*., and Kilian, *et al*. that the capitalization effects are stronger under the regional model than the historical model. In the long-run landowners could capture more than half of the SPS!

There are only a few comparable empirical studies that provide a perspective for our SPS capitalization estimates. However, none considered the time-varying effects of the SPS within a sample selection framework. Feichtinger *et al*. (2014) found the of post-Fischler SPS capitalization effect in Germany to be 0.47 cents of the marginal Euro of payment. On the other hand, Moro *et al.* (2013) used Italian data and found little or no effect of subsidies on rental rates. These authors also applied the W(95) procedure and found no evidence of sample selection bias, similar to our own findings. It is quite possible their differences are due to the Italian implementation model. Italy chose the historical model and Germany the hybrid model. Note also in Italy that the ratio of entitlements to UAA for Italy ranged from 0.56 to 0.66 (2007-2011), see Ciaian, *et al.* (2014). These authors and others (Kilian, et al.) provide theoretical justification for the capitalization effect to be smaller when there is a scarcity of entitlements to eligible hectares *ceteris paribus*. Finally, Ciaian and Kancs (2012) found the area-based Single Area Payment Scheme (SAPS) in the New EU Member States to have a significantly positive influence on land rental prices, capturing 0.19 of the SAPS Euro[3].

6. Concluding Remarks

We bring micro-level evidence of Bavarian farms to test the research hypothesis that the harmonization of SPS payments increases the capitalization into farm rental rates. Our data covered the period during which Germany implemented its dynamic hybrid model. This enabled

[3] SAPS in the New EU Member States differs from the SFP. For a comprehensive description of SAPS, see Ciaian and Krancs (2012), pp. 520-521.

us to estimate of the time-related capitalization effects as Germany transitioned from a historical to regional model of SPS implementation. Based on both static and dynamic panel data models of sample selection we found weak evidence of sample selection but strong SPS capitalization effects. On average, we found the marginal SPS payment to increase rental rates from about 0.37 cents but increased to 0.57 as Germany transitioned to the harmonized payment result of the regional model. As EU Member States move toward harmonized payments, the owner of the land can be expected to capture a greater portion of the SPS.

References

Agrarmanager (2014). Bodenmarkt 7. Deutscher Landwirtschaftsverlag. München.

BMVEL (Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft) (2005). Meilensteine der Agrarpolitik: Umsetzung der europäischen Agrarpolitik in Deutschland. Berlin

Chamberlain, G. (1982). Multivariate regression Models for Panel Data. *Journal of Econometrics* 18:5-46.

Ciaian, P. and D. Kancs (2012). The Capitalization of Area Payments into Farmland Rents: Micro Evidence from New EU Member States. *Canadian Journal of Agricultural Economics* 60:517-540.

Ciaian, P., D. Kancs and J. Swinnen (2010). EU Land Markets and the Common Agricultural Policy. Center for European Policy and Studies, Brussels.

Ciaian, P., D. Kancs and J. Swinnen (2014). The Impact of the 2013 CAP Reform on Land Capitalization. *Applied Economic Perspectives and Policy*, doi:10.1093/aepp/ppu016.

EC (2003). Council Regulation No. 1782/2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers and amending Regulations (EEC) No 2019/93, (EC) No 1452/2001, (EC) No 1453/2001, (EC) No 1454/2001, (EC) 1868/94, (EC) No 1251/1999, (EC) No 1254/1999, (EC) No 1673/2000, (EEC) No 2358/71 and (EC) No 2529/2001. *Official Journal of the European Union* L 270/1.

EU (2013). Regulation No. 1307/2013 of the European Parliament and the Council Establishing Rules for Direct Payments to Farmers under Support Schemes within the Framework of Common Agricultural Policy and Repealing Council Regulation (EC) No. 637/2008 and

Council Regulation (EC) No. 73/2009. *Official Journal of the European Union* L 347/608.

Feichtinger, P., Salhofer, S., Sinabell, F. and S. Thompson (2014). This Land is Your Land- Who Benefits from Agricultural Subsidies? *The Common Agricultural Policy in the 21st Century*. Facultas.wuv. universtätsverlag, Wien, Austria: 67-82.

Guastella, G., Moro, D., Sckokai, P. and M. Veneziani (2014). The Capitalisation of Fixed per hectare Payment into Land Rental Prices: a Spatial Econometric Analysis of Regions in EU. Paper presented at the AIEAA Conference "Feeding the Planet and Greening Agriculture: Challenges and opportunities for the bio-economy". 25-27 June, Alghero, Italy.

Kilian, S. and K. Salhofer (2008). Single Payments of the CAP: Where Do the Rents Go? *Agricultural Economics Review* 9: 96–106..

Kilian, S., Anton, J., Salhofer, K. and N. Röder (2012). Impacts of 2003 CAP Reform Land Rental Prices and Capitalization. *Land Use Policy* 29:789-797.

LfB (Landesanstalt für Betriebswirtschaft und Agrarstruktur) (1984). Die Einteilung Bayerns in Landwirtschaftliche Standorte, Landwirtschaftliche Erzeugungsgebiete und Agrargebiete. Landesanstalt für Betriebswirtschaft und Agrarstruktur. Bayerisches Landwirtschaftliches Jahrbuch: Heft 3-4, Munich, Germany.

Michalek, J., P. Ciaian and D. Kancs (2014): Capitalization of the Single Payment Scheme into Land Value: Generalized Propensity Score Evidence from the European Union. *Land Economics* 90 (2): 260–289.

Moro, D., G. Gaustella, P. Sckokai and M. Veneziani (2013). The Capitalization of Area Payment into Land Rental Prices: Micro-Evidence from Italy. Paper presented at the AIEAA Conference "Between Crisis and Development: Which Role for the Bio-Economy". 6-7 June, Parma, Italy.

Mundlak, Y. (1978). On the Pooling of Time Series and Cross Section Data. *Econometrica* 46: 69-85.

O'Neill, S. and K. Hanrahan (2013): An Analysis of the Capitalisation of CAP Payments into Land Rental Rates in Ireland. Factor Markets Working Paper no. 68, (http://www.factormarkets.eu/content/analysis-capitalisation-cap-payments-land-rental-rates-ireland).

Salhofer, K., Röder, N., Kilian, S., Henter, S. and M. Zirnbauer (2009): Märkte für Zahlungsansprüche. Endbericht zum Forschungsauftrag 05HS041 des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz, Bonn.

StMELF (Bayersiches Staatsminísterium für Ernährung, Landwirtschaft und Forsten) (2014). Agrarbericht 2014, http://www.agrarbericht-2014.bayern.de/politik-strategien/index.html.

von Witzke, H., P.L. Kennedy and S. Noleppa (2007). „Effects of the EU Common Agricultural Policy and U.S. Farm Policy on Agricultural Land Markets.“ Report to the German Marshall Fund of the United States, Washington, D.C.

Wittmann, O.(1983). Standortkundliche Landschaftsgliederung von Bayern. Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen. Materialien: Heft 21. Munich, Germany.

Wooldridge, JM. (1995). Selection Corrections for Panel Data Models under Conditional Mean Independence Assumptions. *J. of Econometrics* 68: 115-132.

Table 1. Summary statistics

	All Farms (N=18,641; Farms=2,663)				Rented Farms (N=17,261; Farms=2,509)			
	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Rent					262.65	185.43	0.57	2983.86
Single Pay	351.05	96.04	0.00	997.31	351.17	95.14	0.00	997.31
Disadvantaged Pay	38.55	43.36	0.00	228.93	39.47	43.50	0.00	228.93
Environmental Pay	60.84	83.40	0.00	1683.66	61.58	82.36	0.00	1169.96
Return (HA)	1366.45	921.75	-2069.30	8879.39	1351.98	873.50	-2069.30	8298.62
Ratio - Corn	0.0378	0.1034	0.00	1.01	0.0372	0.1027	0.00	0.96
Ratio - Sugar	0.0216	0.0580	0.00	0.85	0.0203	0.0546	0.00	0.49
Ratio - Potato	0.0108	0.0500	0.00	0.57	0.0107	0.0493	0.00	0.57
Ratio - Crop	0.6538	0.3274	0.00	1.00	0.6520	0.3246	0.00	1.00
Ratio - Wheat	0.1571	0.1528	0.00	2.10	0.1547	0.1487	0.00	0.94
Ratio - Rapseed	0.0463	0.0795	0.00	0.90	0.0463	0.0781	0.00	0.90
Area (ln)	3.8282	0.6163	1.63	6.08	3.8838	0.5909	2.03	6.08
Milk Density	28.9789	33.2065	0.00	204.63	29.6826	33.1052	0.00	204.63
Rental Ratio	0.4132	0.1902	-1.54	0.91	0.4178	0.1914	-1.54	0.91
Age (ln)	3.9768	0.1831	2.83	4.52	3.9741	0.1839	2.83	4.52
Family Labor	0.9630	0.1036	0.18	1.00	0.9636	0.1019	0.21	1.00
Part Time	0.1069	0.3090	0	1	0.0933	0.2908	0	1
Female	0.0337	0.1804	0	1	0.0330	0.1785	0	1
Education - level 1	0.5830	0.4931	0	1	0.5835	0.4930	0	1
Education - Level 2	0.3234	0.4678	0	1	0.3284	0.4697	0	1

Table 2. Fixed effects OLS

Variable	(1)	(2)	Variable	(1)	(2)
Single Farm Pay	0.3688***	0.3645***	Area (ln)	-125.4692***	-116.6205***
	(0.042)	(0.046)		(24.426)	(24.307)
Disadvantaged Pay	0.7572***	0.7240***	Milk Density	-0.2638	-0.3106
	(0.129)	(0.129)		(0.212)	(0.213)
Environmental Pay	0.0827***	0.0857***	Rental Ratio	-4.8533	-5.6764
	(0.027)	(0.027)		(7.148)	(7.134)
Sing Pay - 2007	---	0.0355	Age (ln)	-39.3097*	-40.5697*
		(0.029)		(22.673)	(22.736)
Sing Pay - 2008	---	0.0019	Family Labor	-59.2591***	-59.7395***
		(0.029)		(20.538)	(20.646)
Sing Pay - 2009	---	0.0307	Part Time	10.7307	10.9914
		(0.033)		(22.374)	(22.184)
Sing Pay - 2010	---	0.0317	Female	31.2444	31.9750
		(0.035)		(25.105)	(25.154)
Sing Pay - 2011	---	0.0767**	Education - level 1	12.5134	12.6807
		(0.034)		(20.270)	(20.345)
Sing Pay - 2012	---	0.1658***	Education - Level 2	41.0364	40.1698
		(0.055)		(28.762)	(28.778)
Return (HA)	0.0137***	0.0131***	Year = 2007 (0/1)	-11.3892***	-23.9425**
	(0.003)	(0.003)		(3.065)	(9.891)
Ratio - Corn	118.5981***	114.7797***	Year = 2008 (0/1)	-2.5642	-3.2835
	(29.960)	(30.015)		(4.001)	(10.092)
Ratio - Sugar	432.5231***	423.1593***	Year = 2009 (0/1)	3.1832	-7.9088
	(112.469)	(112.526)		(4.419)	(11.975)
Ratio - Potato	125.7058	120.0334	Year = 20010 (0/1)	5.3167	-6.3507
	(133.038)	(133.179)		(4.545)	(12.309)
Ratio - Crop	227.4021***	224.6593***	Year = 20011 (0/1)	6.5171	-21.3520*
	(58.258)	(57.066)		(4.327)	(12.495)
Ratio - Wheat	112.3341***	108.5470***	Year = 2012 (0/1)	15.8270***	-43.3224**
	(24.038)	(24.161)		(4.573)	(19.688)
Ratio - Rapseed	117.2475***	114.5679***	Constant	579.2864***	558.7571***
	(25.628)	(25.603)		(136.658)	(137.730)

Bootstrapped clustered (farm) standard errors in parenthesis

Table 3. Heckman selection

Variable	Rent	Selection		Rent	Selection
Single Pay	0.3711***	0.0004	Ratio - Rapseed	108.6833*	-0.1124
	(0.050)	(0.000)		(27.731)	(0.150)
Disadvantaged Pay	0.7720***	0.0015	Area (ln)	-90.6715*'	2.2695***
	(0.130)	(0.001)		(25.491)	(0.312)
Environmental Pay	0.0863***	0.0002	Milk Density	-0.3255	0.0011
	(0.028)	(0.000)		(0.212)	(0.001)
Return (HA)	0.0153***	0.0000	Rental Ratio	-4.5153	-0.0419
	(0.003)	(0.000)		(7.457)	(0.049)
Ratio - Corn	119.4229***	-0.1554	Age (ln)		0.0616
	(29.539)	(0.178)			(0.217)
Ratio - Sugar	304.5250*	-2.2214**	Family Labor		0.3927*
	(176.192)	(1.085)			(0.222)
Ratio - Potato	130.3356	0.4583	Part Time		0.0144
	(138.301)	(0.974)			(0.173)
Ratio - Crop	200.5056***	-0.6164	Female		0.1278
	(53.464)	(0.393)			(0.178)
Ratio - Wheat	106.6156***	0.0634	Education - level 1		-0.2243
	(27.365)	(0.200)			(0.175)
Constant	210.9052***	-4.0001***	Education - Level 2		-0.2985
	(37.388)	(1.375)			(0.324)
Inv Mills Ratio	-8.4777				
	(29.768)				
Panel Means	YES	YES			
Time Dummies (7)	YES	YES			
Area dummies (11)	YES	YES			

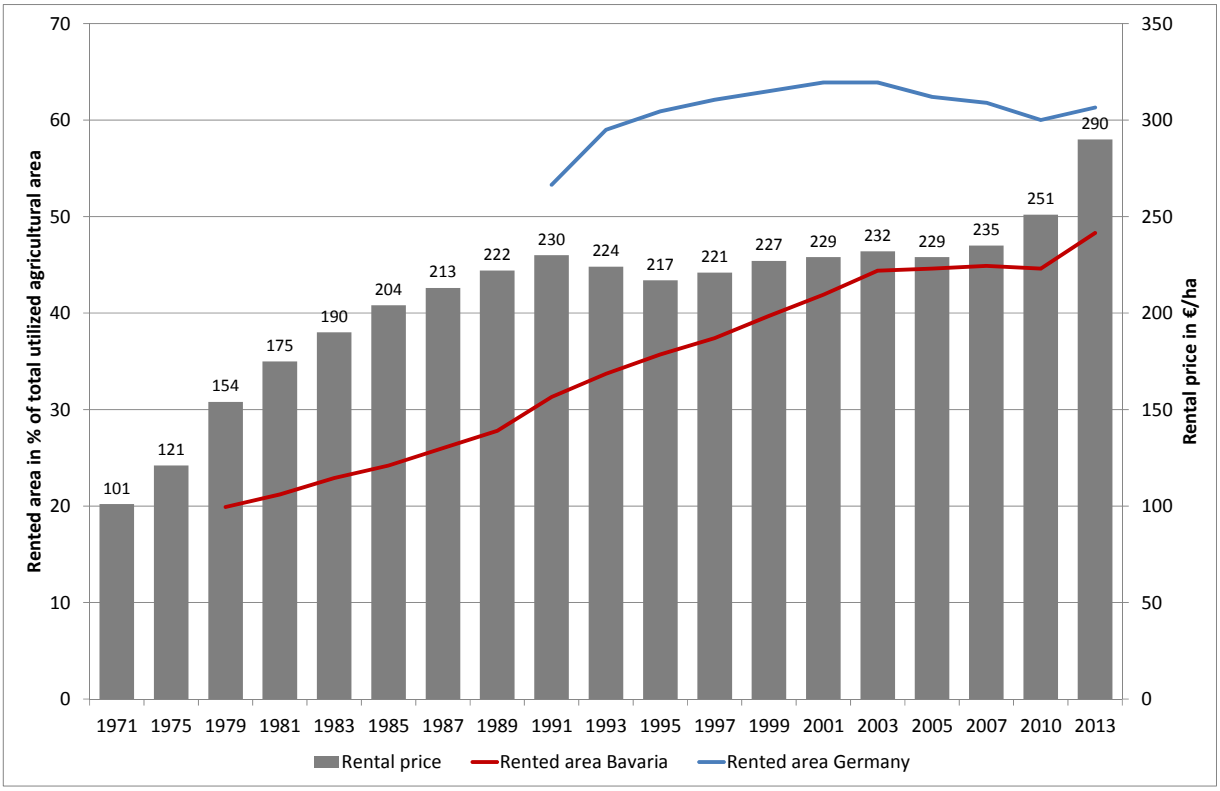
Bootstrapped clustered (farm) standard errors in parenthesis

Table 4. W (95) panel selection

Variable	(1)	(2)		(1)	(2)
Single Pay	0.3765***	0.3613***	Ratio - Crop	197.4797***	202.2264***
	(0.046)	(0.060)		(57.298)	(54.765)
Disadvantaged Pay	0.7868***	0.7457***	Ratio - Wheat	104.5944***	101.0167***
	(0.129)	(0.121)		(27.209)	(27.345)
Environmental Pay	0.0880***	0.0905***	Ratio - Rapseed	103.9821***	100.3775***
	(0.025)	(0.029)		(27.902)	(26.446)
Sing Pay - 2007		0.0602	Area (ln)	-88.6095***	-82.4259***
		(0.048)		(23.026)	(22.367)
Sing Pay - 2008		0.0272	Milk Density	-0.3658	-0.4225*
		(0.042)		(0.227)	(0.225)
Sing Pay - 2009		0.0318	Rental Ratio	-4.6458	-5.6206
		(0.049)		(6.838)	(7.277)
Sing Pay - 2010		0.0404	Inv Mills	53.5359*	45.6992
		(0.049)		(30.958)	(28.106)
Sing Pay - 2011		0.1055**	Inv Mills - 2007	-14.8942	-18.2683
		(0.051)		(32.629)	(28.581)
Sing Pay - 2012		0.2119***	Inv Mills - 2008	-13.2445	-16.9489
		(0.067)		(35.753)	(32.884)
Return (HA)	0.0149***	0.0139***	Inv Mills - 2009	-50.8453	-53.8818
	(0.004)	(0.004)		(45.518)	(41.050)
Ratio - Corn	123.5503***	120.7670***	Inv Mills - 2010	-23.5794	-23.4705
	(30.736)	(29.454)		(45.080)	(42.141)
Ratio - Sugar	281.6837	284.5438*	Inv Mills - 2011	-49.9309	-49.1801
	(186.657)	(160.226)		(34.606)	(32.772)
Ratio - Potato	129.7238	125.3393	Inv Mills - 2012	-50.7920	-49.7944
	(144.353)	(162.881)		(36.584)	(36.562)
Constant	158.3147***	165.4805***			
	(34.668)	(38.306)			
Panel Means	YES	YES			
Time Dummies (6)	YES	YES			
Area dummies (11)	YES	YES			
Observations	17,261	17,261			
R-squared	0.316	0.319			

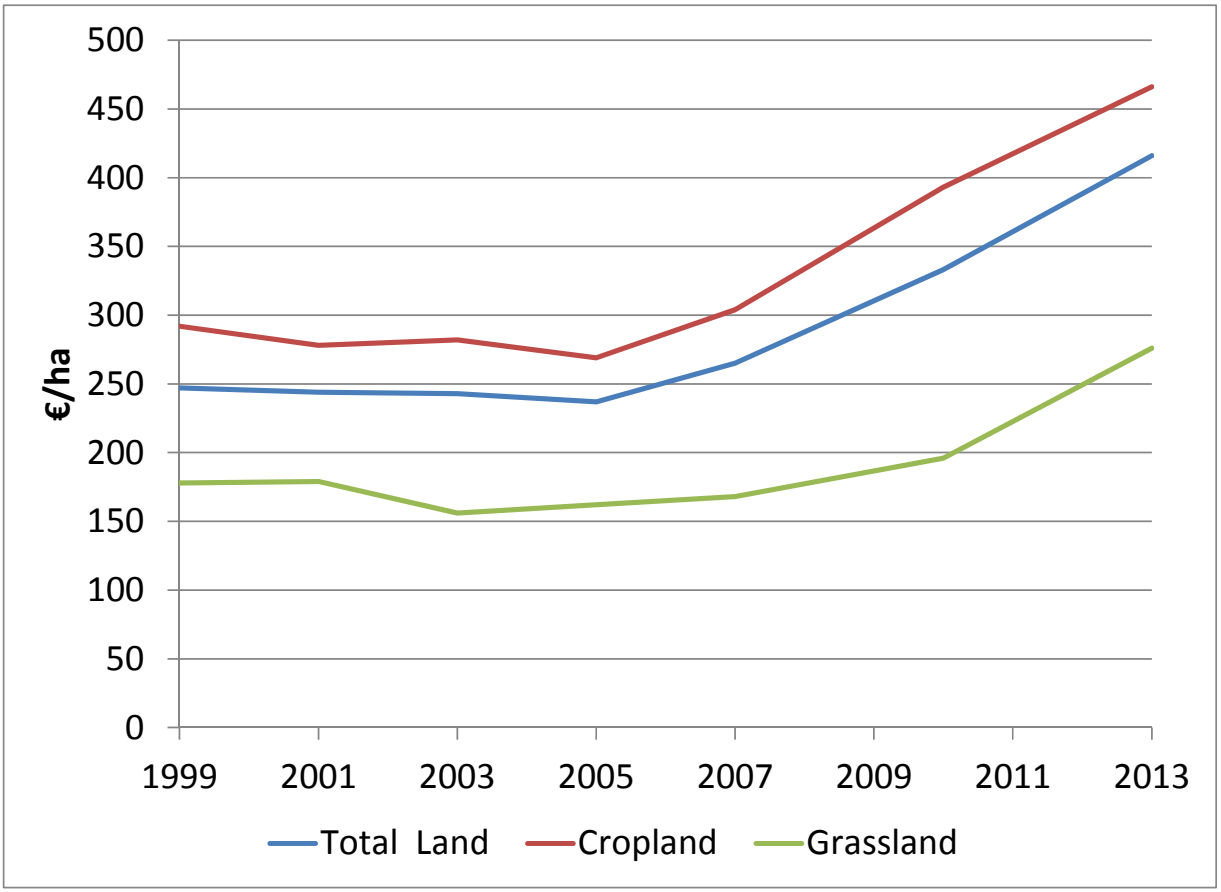
Bootstrapped clustered (farm) standard errors in parenthesis

Figure 1: Percentage of rental area in Germany and Bavaria and average rental prices in Bavaria



Sources: own illustration based on StMELF (2014) and Agrarmanager (2014)

Figure 2: Average rental prices of newly established contracts



Sources: own illustration based on Agrarmanager (2014)