

Nordin, Martin

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Martin Nordin

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Martin Nordin¹
Department of Economic, Lund University
Agrifood, Lund University

Abstract

This study uses aggregated municipality data, for the years 2001 to 2009, to explore whether direct payments to farmers affect agricultural employment in Swedish municipalities. The decoupling reform in 2005 included a new grassland support payment accompanied by management obligations that had unexpectedly high redistributive consequences as it greatly increased CAP payments to municipalities with large areas of grassland. In some municipalities, total payments more than doubled. Thus, since the reform seems exogenous to the behavior of farmers and the regional economy, the reform can be used to identify a subsidy effect. We find that a permanent increase in agricultural employment can be attributed to the new grassland support. Our results indicate that the grassland support generates an additional job at a cost of SEK 250,000, relative to the average agricultural wage of SEK 333,000. However, the subsidy effect is largely keeping jobs in agriculture, i.e. the grassland support may be slowing down the process of structural change in grassland regions.

JEL classification: H5, J18, J21, Q1

Key words: agriculture, subsidies, employment effect, single farm payment, Common Agricultural Policy, EU

Correspondence to:
Martin Nordin
martin.nordin@nek.lu.se
AgriFood Economics Centre
Box 730 – Scheelevägen 15 D
220 07 Lund
Sweden

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1. Introduction

The *Common Agricultural Policy* (CAP) is supposed to protect jobs in agriculture and maintain sustainable development in the EU's rural regions (see for example EC, 2006). However, despite a long-standing debate about the CAP, there is little evidence of a positive relationship between the CAP subsidies and agricultural employment.

Decoupled subsidies are often assumed to have no impact on labour use (Petrick and Zier, 2012, Ahearn et al., 2006) and, when invested in labour-shedding technology, rather than protect jobs in agriculture they might well decrease employment (Petrick and Zier, 2011). The subsidies may also help some farmers to capitalize and buy out farmers willing to exit the sector (Goetz and Debertin, 1996). Another concern is that the protection of farmers' incomes results in an inefficient labour allocation (Gardner, 2002), which might have long-lasting consequences for rural development. On the other hand, if payments are conditioned (coupled), or if there are wealth or insurance effects (Hennessy, 1998), subsidies may increase labour use.

With the decoupling reform in 2003, implemented in Sweden in 2005, the direct payment scheme (Pillar I) was dramatically changed. The reform was decided at the European level and it implied that the coupled Pillar I payments (the arable land support and animal support) was decoupled and turned into a Single Farm Payment (SFP). Since the reform covered all agricultural land (EU, 2003), Sweden even made permanent grassland eligible for support, which basically meant that decoupled animal support was replaced with the eligibility of grassland for receiving SFP. Because the main share of the direct payments is based on historical production, the decoupling itself was not designed to foster a substantial redistribution of direct payments to farmers; on the contrary it was important to minimize redistribution. Nevertheless, farmers with large areas of grassland, in the end, received a large increase in their support, in some cases finding their direct payments had doubled (in Sweden the average share of grassland at the municipality level is 57% of total farmland). Therefore, even if the reform did not have redistributive intentions, redistribution was a consequence of including permanent grassland in the direct payments (i.e., SFP).

This study aims to explore whether the regional redistribution of the direct payment in 2005, caused by the decoupling reform and the grassland support, affects agricultural employment in Sweden. However, the focus is on the grassland support, and not on decoupling per se, because the redistribution of the direct payments relates to grassland shares and the subsidy effect is mainly related to grassland use and less to decoupling effects. Thus,

with aggregated municipality data for the years 2001 to 2009 the unexpected change of the Pillar I subsidies is used to identify a subsidy effect.

To analyse the effect of policies on economic outcomes, the policy variation has to be exogenous (Besley and Case, 2000). In the case of the introduction of the eligibility of grassland, it was originally decided at the European level, and subsequently appeared as a side effect of the decoupling reform. Additionally, in retrospect, the implications of the grassland support seem to be a surprise. The government memoranda (Ds, 2004) stated that the proposed hybrid model did not redistribute the direct payments between regions in Sweden, and a Swedish CAPRI-evaluation² of the decoupling reform (Ekman, 2005) did not even discuss the grassland support. However, a last minute change to the reform may have caused the redistribution of payments. The implication of this particular policy change seems exogenous to the behavior of the farmers and the regional economy,³ and at the same time rather unique in its large redistributive consequences.

The decoupling reform required that the farmers were responsible for keeping the farmland in good condition, i.e. cross-compliance requirements were introduced. In contrast to arable land use, where the production primarily involves crops, grassland production becomes a matter of sustaining the farmland's eligibility for support (besides the production of animal fodder), which implies that the grassland support is partly coupled (Courleux et al., 2008; Femenia et al., 2010; Bhaskar and Beghin, 2008). In this scenario, introducing a grassland support which increases the direct payments may imply a positive substitution effect on farm labour (Ahearn et al., 2006). Hence, since meeting the cross-compliance requirements for grassland is particularly costly (Swedish Board of Agriculture, 2011), the eligibility of grassland might decrease farm intensification, and thereby increase agricultural employment.

We find that the grassland support affects agricultural employment positively, with every SEK 100,000 (about €11,000) in subsidies generating 0.4 jobs. Because of a general decrease in agricultural employment during years under review, the grassland support is in part helping to sustain jobs in agriculture. Compared to Nordin and Manevska-Tasevska (2013), who explore the reform with farm data, our analysis here concerns the net and redistributive effects of the grassland support. The results of the studies are similar and complementary, together providing strong evidence for a causal effect.

² CAPRI is an economic model for the agricultural sector developed by European Commission research funds.

³ This paper has been presented at the Swedish Board of Agriculture and at a joint seminar with the Minister for Rural Affairs and, so far, the redistributive consequence of the decoupling reform is a surprise to all. A Policy Brief (2013) has also been published and no one has yet criticized the 'exogeneity' assumption.

The paper is structured in the following way. It starts with a literature review. Section 3 describes the CAP and the decoupling reform. Section 4 reports the data and descriptive statistics, followed by a description of the empirical specification in section 5. The results are presented in section 6. Section 7 concludes the paper.

2. Literature review

Few studies have explored the impact of subsidies on agricultural employment, in the main due to limited access to relevant regional data. Most of the research on this topic is descriptive or qualitative, and is typically restricted to describing a single policy of the CAP (Petrick and Zier, 2011). The use of modern evaluation techniques is sparse (Petrick and Zier, 2013) and to date there are (to our knowledge) no accounts that focus on a change in the CAP payments that can be described as exogenous.

The study that most resembles ours is Petrick and Zier (2011), who use German panel data to investigate whether the CAP subsidies affect agricultural employment. They use 69 of 255 landkreise regions (NUTS 3 level), for the years 1999 to 2006, and find that direct payments have a negative effect on agricultural employment. Moreover, the full decoupling of the direct payment in 2005 seems to have had an additional negative impact on agricultural employment. They conclude that the direct payments encouraged investments in labour shedding technology and that the decoupled payments changed factor allocation on farms. In the US, coupled direct payments also seemed to decrease agricultural labor in the 80s, because of a capital-labour substitution (Goetz and Debertin, 1996). However, the decoupling of the direct payments in 1996 does not seem to matter for off-farm labour participation in the US (Ahearn et al., 2006).

The environmental and rural programmes of the Pillar II are assumed to make agricultural production more extensive. The empirical evidence is however inclusive. Pufahl and Weiss (2009) use propensity score matching on German farm data to show a positive association between on-farm labour and participating in agroenvironmental programmes. On the other hand, Petrick and Zier (2011) finds that the farm investment aids and transfers to less developed areas have no impact on employment, and Schmitt et al. (2004) finds that a subsidy promoting “development and structural adjustment of rural areas” affects agricultural employment in France negatively. By analyzing the dynamic labour use, Petrick and Zier (2012) find that investment aids slow down job cuts Petrick and Zier (2011).

A different strand of literature focuses on the exit rate of farms. For the US, Key and Roberts (2006) use the variation in base acreage, between 1978 and 1997, as a source of

exogenous variation in the coupled direct payments. They find a negative effect of payments on the risk of farm closure. Moreover, in regions with a declining number of farms, the subsidies help the remaining farmers to consolidate their position by buying out other farmers who are willing to leave the agricultural sector (Goetz and Debertin, 2001), i.e. a capitalization effect of the subsidies, creating opportunities to increase the average farm size and guide the process of structural change in rural regions. Studying 110 regions (NUTS 1 and NUTS 2) in Western Europe, Breustedt and Glauben (2007) show that total CAP subsidies during the 90s (i.e. both the price supports and other subsidy programmes) negatively influence exit rates. On the other hand, by using US data for the 80s and 90s a positive effect of subsidies on the exit rate of farmers is reported in Goetz and Debertin (1996) and in Hoppe and Korb (2006).

Regarding regional economic performance in general, Esposito (2007) finds no influence of direct payments on growth. He uses regional EU (NUTS 2 level) data for the years 1989 to 2000 to estimate a conditional growth convergence model, finding that structural fund payments do have a positive impact on growth.

3. The CAP and the decoupling reform

In Sweden, the decoupling reform implemented in 2005 meant that direct payments were no longer coupled to production, but that farmers receiving the new SFP were responsible for keeping the land in good agricultural and environmental condition (the cross-compliance requirement). The member countries of the EU had several options regarding the model for calculating SFP (historical, regional or a hybrid model)⁴. Sweden decided on the hybrid model,⁵ a combination of the historical and the regional model, where direct payments are calculated according to the regional model, but vary between different geographical regions. Notably, because direct payments are based on historical production, they are much higher in the more productive regions in southern Sweden.

A special feature of the decoupling reform was that all farmland was eligible for support.⁶ Permanent pastures, consisting of semi-natural pastures and grassland on arable land, were made eligible for SFP, whereas arable crops were already eligible for area support. However, the animal support was not completely decoupled in 2005, and 75 percent of the

⁴ The historical model is a farm-specific model where payments are equal to the support the farm received in a "reference" period. In the regional model farmers receive identical payments per hectare within a region.

⁵ It has been shown that subsidies are partially capitalized into land values in a hybrid model, and for Sweden in 2005 and 2006 grassland prices increased faster than arable land prices (Ciaian et al., 2011).

⁶ Only permanent crops, fruit and vegetables and potatoes were excluded from the decoupled direct payments (EU, 2003).

special beef premium along with a milk subsidy were still coupled after 2005. The later gradually increased through 2006, and in 2007 was decoupled and included in the direct payments. The policy change implied that arable land became less supported (on average the arable land support decreased with 28% per hectare), whereas farmers with grassland received a large increase in their Pillar I support. Thus, by replacing the animal support with a grassland support it had large redistributive consequences that heretofore have not been discussed in the research literature.

What caused the redistribution is still somewhat unclear. The government memoranda (Ds, 2004) proposed a hybrid model without redistribution of the direct payments between regions in Sweden. However, in comparison to the proposed payment scheme the granted petition (Skr, 2003) included a last minute change to the reform. The petition was concerned that some farms in regions 4 and 5 may lose more than 20% of their support, and the granted payments to these regions were therefore higher than in the memorandum, i.e. in the petition money was moved from the grassland support in regions 1 to 3 to the arable and grassland support in regions 4 and 5. Thus, even if the intention was to reduce a potential redistribution of the payments, it may have caused the observed redistribution.

The absence of attention may well derive from a general confusion in taking for granted the definition of grassland. While it is generally taken that grassland includes grassland on arable land *and* semi-natural pastures, in Swedish official land-use statistics only semi-natural pastures (in Swedish betesmark) are classified as grassland as compared to arable land. However, the redistribution results from the eligibility of grassland on arable land, which constitutes about 40% of arable land in Sweden. Therefore, according to official statistics it seems as if only a third of the grassland area was made eligible because eligibility statistics are not reported; in practice the entire grassland area was made eligible for the SFP.

In 2005 the SFP for semi-natural pastures (€17 per hectare in 2005) was the same in all 5 regions, but in 2006 (when there was a general increase in the SFP due to the sugar policy reform) the support increased more in the most productive region (about 14% higher in region 1). The arable support (including arable land and grassland on arable land) was the same as the support for semi-natural pastures in region 5 (Northern Sweden and forest regions), and remain equivalent today. Compared to region 5, the arable support is about 25%, 60%, 90% and 120% higher in the other four regions.

The decoupling reform also included a modulation, i.e., a transfer of money from the Pillar I budget to the Pillar II budget. Pillar II consists of a wide range of programmes supporting environmental and rural development. Pillar II is far too complex to evaluate here,

but econometrically the Pillar II subsidies have to be taken into account, as they may affect the employment effect of the grassland support. One evaluation of the Swedish Pillar II found that many of the specific programmes were inefficient, and their impact on their respective objectives at best was very small (SLU, 2010).

4. Data and descriptive statistics

The panel dataset consists of annual data for 261 municipalities over the period 2001 to 2009. Sweden has 290 municipalities, and 24 of the 29 excluded municipalities are located in the metropolitan areas of Sweden (greater-Stockholm, Gothenburg and Malmö) where there is virtually no agricultural sector in comparison to the population at large, and the remaining 5 are either miniscule or were just created contemporaneously. The relatively long time period and the number of municipalities give us an ample sample of 2,349 observations to analyse.

Data on the CAP subsidies is from the Swedish Board of Agriculture. For the direct payments there is information on both the coupled (acre and animal subsidies) and the decoupled SFP, and for Pillar II we have information on every single type of subsidy.

Figure 1 illustrates the mean yearly direct payments to the municipalities, and to show that there has been a decrease in the direct payments since 2006, due to the modulation, the exchange rate adjusted payments (payments in SEK/exchange rate to the euro) are also represented. Because the support per hectare is in euro, but paid out in SEK, the payments vary with the exchange rate. Thus, given the depreciation of the SEK, it is clear that the payments to the Swedish farmers, which had steadily increased between 2001 and 2006, were as high in 2009 as in 2006.

Figure 1 about here

The implementation of the new grassland support in 2005 (with the decoupling reform) implied a large increase in the direct payments to regions with a large share of grassland. Figure 2 illustrates the change in the payments for regions with different shares of grassland. The groups correspond with the deciles of the share of grassland (ratio between grassland and total farmland),⁷ i.e. the first group contains municipalities with less than a 10% share of grassland, the second contains municipalities with between a 10 to 20% share of grassland, etc. Since there are no municipalities with more than 90% grassland, we have 9 groups. The figure shows that the increase in payments is large for regions with a large share of grassland, and the size of the increase varies directly with the grassland share. The relatively small

⁷ Data on the hectares of grassland (vall på åkermark och bete- och slåttervall) and total hectares of farmland are from the Swedish Board of Agriculture. We calculate an average share of grassland for the entire time period.

decrease in payments for regions with small shares of grassland is because the support per hectare is generally much higher in these regions. This redistribution of direct payments occurred for two reasons: i) a decrease in support for regions with the least grassland after 2004, and ii) an increase in the payments in 2005 for regions with more than 40% grassland. Additional descriptive statistics for the municipality groups are reported in Table 1.

Table 1 and Figure 2 about here

The figure also shows that there was a relationship between the share of grassland and the payments in 2002 and 2004, i.e. for these years there was a change in the payments that increased with the grassland share. These variations were related to prior changes in the animal support. In 2002 the animal payments had increased (due to a general increase in all animal subsidies), and in 2004 a milk subsidy was implemented. However, the animal payments did not increase more in the regions with significant grassland. In general, since the share of direct payments that came from animal support was much larger in the grassland regions it implied that the relative change in the direct payments became larger in those regions. For example, in the regions with the most grassland (more than 50% grassland), the animal payments represented about 50% of the total direct payments before the decoupling reform, whereas in the regions with the least grassland (less than 30%) the animal payments represented only 10% of the total direct payments. This pattern, of relatively greater inflation of the milk subsidy in grassland regions needs to be taken into account in specifying our empirical model. Moreover, the increase in the payments at the end of the period was due to the depreciation of the SEK. Why the depreciation of the SEK does not increase payments in regions with 30 to 40% grassland, is probably because the average farm size is large in these regions. A large farm size implies a large modulation of the payments.

The employment data at the municipality level has been collected from Statistics Sweden. They report the number of people employed in each sector of every municipality based on register data (RAMS). To be classified as employed an individual has to work on average at least one hour per week in November. The sectoral classification is based on the firms SNI2007 code. People are categorized in terms of their main employment, i.e. where they receive most of their income from work. In this framework it is important to emphasize that part-time workers who work mainly outside the agricultural sector are thereby excluded from the measure and are essentially invisible. Moreover, seasonal variations in employment are not captured. However, since the results in our study are similar to those of Nordin and Manevska-Tasevska (2013), where annual hours are used, the results appear to be unrelated to seasonal changes.

Figure 3 reports the mean number of employed in the municipalities between 2001 and 2009. Prior to 2004 employment decreased in the agricultural sector, and for the period 2004 to 2009 employment varied around a mean of 290. Figure 3 also illustrates a large increase in the number of employed in 2004, which was mainly due to an altered method of calculating employment in one-person businesses.

Prior to 2004 one-person businesses with a negative income from business were classified as inactive, but from 2004 onwards the owners of such firms (given that it is their main employment) are included in the employment measure. In the econometric specification, the time fixed effects remove the average employment increase of this change. However, the results in this study might be affected if the increase in the employment measure varies between municipalities, and is related to the share of grassland. To make the employment variable comparable over the entire time period, we assume that employment in 2004 followed the trend set from 2001 to 2003, i.e. that local agricultural employment continues to decrease at the same rate as in the preceding years.⁸ In Figure 3 we see the effect of the transformation on the mean number of employed. In section 5.1 we explore the transformation and find that it biases the grassland support effect downward rather than upward. Moreover, farm level data confirms that our results are not artefacts of the measurement change (Nordin and Manevska-Tasevska, 2013).

Figure 3 about here

Moreover, due to the decoupling and the grassland eligibility, some landowners may have entered farming just to obtain the subsidy. Insofar as this is the case, the effect of the reform on agricultural employment might well be illusory. Because the Swedish Board of Agriculture classifies every farm that receives some subsidy as a farm, the decoupling reform increased the number of small farms in their data. Nonetheless, due to the “main income” restriction, a similar change is not found in sectoral employment data from Statistics Sweden (Swedish Board of Agriculture, 2008).

5. Empirical specification and covariates

With a fixed effect model, the overall association between CAP subsidies and employment is estimated as follows:

$$Number\ Emp_{it} = \alpha_i + \gamma_t + \beta DP_{it} + \delta PillarII_{it} + \rho X_{it} + \varepsilon_{it} \quad (1)$$

⁸ That is, we calculate the average yearly change in municipality employment between 2001 and 2003, and subtract this number from the employment measure for the rest of the period.

In this model, α_i represents the unobservable municipality characteristics that are constant over time, and γ_t reflects time-fixed effects. DP is the total per municipality direct payments (in 2008 prices) to the farmers. A vector of covariates, X , and Pillar II subsidies are included as controls.

The drawback of this model is that it uses the total variation in the DP to estimate the subsidy effect, and not the change in the DP caused by the eligibility of grassland. Because the grassland support is hypothesised to have a specific effect on employment, we need to capture the specific change in the DP caused by the grassland support. Total DP captures other redistributive aspects of the decoupling reform as well, and there is plausibly some redistribution between municipalities within regions. In order to specifically evaluate the decoupling reform and the new grassland support we relate the change in the DP after 2004 to the share of grassland,⁹ and use this variation to estimate the grassland support effect on agricultural employment. Thus, by using the grassland share as an instrument, the fixed effect instrumental variable (IV) estimator uses the fact that the increase in the direct payments after 2004 is directly related to the share of grassland in the municipality.¹⁰ For the years before the introduction of the grassland support, the instrument takes the value zero, and for the years 2005 to 2009 the instrument equals the share of grassland in the municipality. Accordingly, the first stage in the IV-analysis is:

$$DP_{it} = \alpha_i + \gamma_t + \sigma \text{Grassland share}_{it} + \rho X_{it} + \varepsilon_{it} \quad (2)$$

where X refers to all of the covariates used in equation 1, and α_i are γ_t the municipality- and time-fixed effects, respectively. Our instrument is the share of grassland in the municipality. Once the first-stage results are obtained, the predicted value of DP will replace the observed DP in the second stage, namely, equation 1.

For non-experimental policy evaluation where a policy change is not exogenously assigned, IV estimation is a standard approach (see Angrist, Imbens and Rubin, 1996, Heckman, LaLonde and Smith, 1999, for surveys). By exploiting an instrument that causally determines the policy change, but is unrelated to the specific outcome at issue, causal inference is achieved. We argue that in our complex setting the change in the DP payments is exogenously distributed, and the regional differences in grassland shares can be reliably used to identify the marginal effect of the grassland support on agricultural employment. However,

⁹ Because the change in DP depends on the hectares of grassland relative to the hectares of arable land, the share of grassland is a much better predictor than the actual grassland hectares.

¹⁰ This is not a conventional use of the IV approach, but it resembles the case when using IV to correct for measurement errors in the independent variable. In fact, if we assume that DP is used as a proxy for the grassland support, we use IV to remove measurement errors that comes from other variations in the payments.

given the fact that different instruments answer different economic questions, external validity may be limited (Heckman and Vytlačil, 2005). We acknowledge with this methodological tension in mind that the grassland support was only one part of the decoupling reform in 2005; the marginal effect incorporates the impact of the cross-compliance requirements, the abolishing of most of the animal subsidies, and the decoupling of the *DP* as well.

In our investigation, we were concerned about the fact that the milk subsidy, introduced in 2004 and included in the decoupled direct payments in 2007, covaries with the grassland support. To capture the employment effect of the milk subsidy, we use the number of milk cows (per capita) in the municipality, and add three indicator variables (interacted with a milk reform dummy) to locate the quartile of milk cow distribution to which the municipality belongs. Hence, these indicator variables are assumed to proxy for the size of the milk subsidy. This is done separately for the coupled and decoupled milk subsidy regime. Production changes in the labour-intensive milk sector (located primarily in grassland regions) that affect employment should also be captured with these indicator variables.

We recognize that for most Pillar II subsidies the number of beneficiaries (and payments) in each municipality is very small, and thus found it useful to divide them into three different measures, *Environmental subsidies*,¹¹ *Firm subsidies* and *Other rural subsidies*. The objective of the *Firm subsidies* is to improve firms or develop new firms, whereas the *Other rural subsidies* generally have the broader aim of improving rural areas at large. A special compensation is made available in the northern parts of Sweden (*Northern subsidy*) because the growing season is shorter.

There exist large fluctuations in cereal, dairy and meat prices that normally can and do affect investments, technology and the labour intensity of farms. The common time-fixed effects remove the average price variation, but since the price impact may vary among regions that specialize in different production, it is a wise to control for the regional price impact. Unfortunately, a regional breakdown of cereal, dairy and meat prices is not available, but the Swedish Board of Agriculture does provide us with national prices. Accordingly, by interacting the prices with regional dummies for different grassland shares (i.e. the grassland groups in Figure 2),¹² regional variation is attained allowing us to control for price variations, including major commodities such as wheat, grain, beef and milk.

¹¹ The compensatory allowances, aimed at maintaining sustainable farming, are included in the environmental subsidies.

¹²The regional price estimates are not reported because they only capture the deviation to the average price impact, which is captured by the time fixed effects.

To assure validity and avoid biased estimates, we include a broad set of control variables. Some may seem endogenous, but by showing that the subsidy effect is robust to the inclusion of the controls, the result is strengthened. We divide the control variables into two sets, demographic variables and economic indicators, which are then separately added to the specification. The control variables are listed in Table A1, along with reports of the descriptive statistics.

The specification includes gender identification (*Share of men*) and demographic age structure in the municipality because older men are highly over-represented among farmers. The probability of being a farmer is low for individuals with a foreign background and therefore the *Share with a foreign background* (including both first and second generation immigrants) is added. To further differentiate types of municipality *Logarithmic population density* (inhabitants per km²) and *Total Population* are included. Youth tend to leave the rural areas, especially in the northern parts of Sweden, and this migration pattern may have implications for agricultural employment. A variable measuring the *In and outflow* (number of migrants in and out of the municipality divided by the population size) of people documents the trend. All of the variables above are the demographical controls.

Income, unemployment and education levels (*Share with high school education* and the *Share with university education*) are included to capture changes in the socioeconomic structure in the municipality. The income level is also seen as a proxy for changes in non-agricultural wages. The unemployment variable tries to capture changes in the supply of labour. We include the *Logarithm of income*, a measure of the mean per capita income (gross-income for individuals aged 20 or older) in the municipality deflated with the Consumer Price Index. In addition, to capture regional policy changes that might affect the regional labour market, *Logarithm of expenditures on education*, *Logarithm of expenditures on social aid* and *Logarithm of expenditures on culture and leisure activities* are included. Data on the expenditures is per capita and deflated with the Consumer Price Index.

6. Results

6.1 The second-stage IV-results

Table 2 shows the second-stage IV-results when using the grassland share as an instrument for *DP*. Column (1) displays the results with the prices, the Pillar II subsidies and the milk cow dummies controlled. In column (2) the demographical municipality characteristics and in column (3) the economic municipality characteristics are added. In column (4), both

characteristics are added. The main findings are: the grassland support effect is large and significant in every model and the effect is almost the same, irrespective of the set of controls.

The subsidy effect in Table 2 is about 0.4, which can be translated as each additional SEK 100,000 (about 11,000 €) provides 0.4 jobs, i.e. that each additional job costs SEK 250,000. In Sweden, the total yearly wage cost of one person in agriculture is about SEK 333,000,¹³ which means that the subsidy creates jobs at a lower cost than the average wage cost. It may seem that finding an impact that is larger than the government expenditure is unrealistic, exaggerating the effect. On the other hand, some of the new jobs might just be part-time, and part of the effect could simply be an increase in hours worked by farm employees where it becomes their main employment (and therefore registered in official statistics). Moreover, in section 6.4 we show that it is partly an effect of maintaining jobs in the sector.

Regarding the other CAP subsidies, we find that the environmental subsidy has a negative effect on agricultural employment, and that the *Northern subsidy* has a positive effect. It is uncertain whether these effects are causal,¹⁴ though, and the model specification has a large impact on both their sign and significance. For example, with logarithmic environmental subsidies the environmental subsidy effect becomes positive. In both the coupled and decoupled milk subsidy regime more milk cows per capita is negatively related to agricultural employment. However, since the introduction of the milk subsidy is not exogenous, the association is not likely to be caused by the milk subsidy. The inclusion of the milk subsidy and Pillar II subsidies to the specification has a small impact on the grassland support effect. Yet without the prices included, it is noteworthy that the subsidy effect is almost twice as large (not reported, but found when adding the covariates stepwise to the model).

6.2 First-stage IV-results and the performance of the instrument

Table 3 shows the estimates of the first- stage regressions, together with the F-statistics of the weak IV-test (Kleibergen Paap F-statistics). Weak instruments are problematic as they give biased estimates and underestimated standard errors (Murray, 2006; Stock and Yogo, 2005). The columns in Table 3 correspond to the same columns in Table 2, and each model contains

¹³ In 2008 the monthly salary in agriculture was SEK 18,500. To obtain the total labour cost a payroll tax and a pension insurance fee should be added (they sum to about 50%).

¹⁴ For the Pillar II subsidies, reversed causation, for example, is a problem. If the economic conditions in the regional agricultural sector affect the probability of applying for subsidies, an estimated association might run from the employment level to the subsidy payments.

the same respective fixed effects and control variables at both stages. The first-stage result indicates the instrument seems to perform well, and in this model a 10% higher grassland share implies a SEK 1,200,000 increase in the direct payments after 2004. A rule of thumb is that the test-statistic should be above 10,¹⁵ and here the F-statistic is about 45.

The instrument has to fulfill the exclusion restriction as well, which means that the instrument should not affect the dependent variable after controlling for relevant covariates. While this is untestable, the fact that the IV-estimate is robust to the inclusion of covariates indicates an exogenous instrument. We are confident that the introduction of the grassland support redistributes the *DP* exogenously because the subsidy effect in Table 2 is relatively unaffected by the inclusion of the demographic and the economic indicators.

When grassland is suddenly turned into a major asset, farmers are strongly incentivized to turn arable land into grassland, making area of grassland endogenous. However, in a decoupled system, where arable land is subsidized as well, these incentives should be relatively weak. Still, to overcome this problem we have used the average grassland share (after 2004) as our instrument, noting that yearly grassland shares give similar results. We also tried adding hectares of grassland to the specification (as an additional covariate at both stages of the IV-estimation), but this inclusion did not affect the grassland support effect.

6.3 Sensitivity tests

Because share of grassland is a relative measure, the first-stage regression is more correctly modeled with a relative measure for the payments as well. To test if the subsidy effect is affected by the choice of specification, we estimate a relative model where the logarithm of payments is regressed on the share employed in agriculture. Utilizing the sectoral employment measure, we construct the relative agricultural employment rate in the municipality by dividing the number of people employed in the sector by the total population in the age group 20 to 64. We note that in column (1) in Table 4 that the subsidy effect remains large and significant in the relative specification (the same model as in column (4) in Table 2). The weak F-statistic increases to 99.6, indicating a better modeling of the relationship between the grassland share and the receipt of direct payments. Moreover, when recalculating the effect into the same unit as in Table 2, we obtain a subsidy effect of 0.64 (calculated at the average *DP* and the average employment level). We compare this number (and the other sensitivity

¹⁵ The Kleibergen Paap statistic is to be used when the standard errors are clustered (which is a heteroskedasticity robust generalization of the Cragg–Donald F-statistic). Since critical values have not yet been generated for the Kleibergen Paap statistic, it is customary to use the critical values for the Cragg–Donald F-statistic, available in Stock and Yogo (2005).

results) with the estimate, 0.4, from Table 2. Thus, the relative model produces a subsidy effect relatively similar to the absolute model. Consequently, we prefer the absolute model because the modeling of the second stage is more standard and straightforward.

Table 4 here

Column (2) in Table 4 reports the subsidy effect for the non-adjusted employment variable. In this model, we see that the subsidy effect, 0.58, is somewhat larger than in the adjusted model. Since agricultural employment in 2004 is assumed on average to decrease in the adjusted model, an implicit assumption in the adjusted model is that the grassland reform has had no effect prior to the reform. However, to be eligible for the grassland support, the grassland must be maintained in good condition (cross-compliance requirement), and the introduction of the grassland support in Sweden may require the farmers to make some basic investments in the grassland. An increase in employment in November 2004 (when employment is measured) is therefore plausible. Thus, while the impact of the grassland support in the non-adjusted model is likely to be overstated, the result in the adjusted model is likely to be underestimated.¹⁶

On the other hand, even if the grassland support effect may be understated in the adjusted model, due to the removal of an early eligibility investment effect in 2004, the effect of the grassland support might, for the same reason, be of limited duration. That is, the effect may be related to an eligibility investment in 2005, which increased employment only temporarily. In column (3) we analyse whether the effect is permanent by isolating the year 2005 from the model, i.e. the temporal impact in 2005 is excluded. In column (3) we find that when the year 2005 is withdrawn from the model, the subsidy effect is roughly the same, 0.51. We can therefore conclude that the employment effect of the grassland support is probably long lasting.

If there is a regional trend that affects both the subsidies *and* employment, for example a strong economic improvement or structural change, the subsidy effect may well be biased. For example, it is possible that the rate of structural change in agriculture is different in grassland regions. So to test if the economic conditions in the municipality covariates with the subsidies, municipality-specific time trends are purposively included (261 linear time trends). In column (4) of Table 4, with the time trends included, the subsidy effect decreases to 0.27. However, in an IV-approach municipality-specific time trends are an inherently very

¹⁶ Because the share of small farms increases with the share of grassland in the municipality, we have tried to incorporate a variable that describes the share of small farms (for the years 2001 to 2003 the variable takes the value zero) in the specification, i.e. the group affected by the calculation change. Even with this transformation, which largely decreases employment in grassland regions after 2003, the subsidy effect remains large.

restrictive specification, eliminating much of the variation at the first stage. It is reasonable to argue that the effect is underestimated in this specification. However, from this exercise we can conclude that different time trends in grassland regions do not cause the main part of the subsidy effect.

6.4 Is the grassland support saving or creating jobs?

To what extent is the grassland support keeping the number of jobs stable instead of creating new jobs? This question is analysed by studying the time trend in employment for regions with different shares of grassland. Given that this is a purely descriptive analysis, the findings should not be over-interpreted, even if the exercise provides a nice illustration of the grassland impact on employment. Figure 4 shows the true employment numbers along with those with the employment impact of the grassland support subtracted (calculated at mean grassland share of each group). The subsidy-adjusted employment trends are marked with a dotted line. We divide the regions into three groups, i.e. those with less than 30%, 30 to 60% and more than 60% grassland. For regions with less than 30% grassland employment keeps decreasing throughout the period, while for the regions with 30 to 60% grassland the grassland support stabilizes employment on average around 280. In contrast, for regions with more than 60% grassland the subsidy increases employment after 2004, although a large part of the effect is through job retention. This pattern, given the general underlying decrease in agricultural employment, suggests the grassland support is at least partly effective in keeping jobs, possibly because of a reduction in the rate of structural change in the sector. In general, in grassland regions the subsidy may function to dampen the failure rate of small farms. Hence, since the grassland support is partly keeping jobs in agriculture, the relatively large impact might be reliable. For a farmer who wants to stay in farming the grassland support might have a vital impact on the survival rate.

Figure 4 about here

7. Conclusions

The redistributive grassland support, introduced in 2005, had a large impact on agricultural employment in Sweden. Because employment increased with the share of grassland, there is strong evidence pointing to a causal effect. In an IV-setting we find that every SEK 100,000 (about 11,000 €) in subsidies generates 0.4 jobs, each costing about SEK 250,000, which is low. The results indicate that effect of supporting grassland is partly an effect of keeping the number of jobs in agriculture stable, i.e. the grassland support may restrain the exit rates of

small farms and reduce the rate of structural change in grassland regions. Nordin and Manevska-Tasevska (2013), using farm data, find a similar effect.

On the other hand, the farmers are constrained by the fact the grassland is only eligible for support if it is maintained in good agricultural and environmental condition and meets cross-compliance requirements, which takes a time and effort, and incurs costs (The Swedish Board of Agriculture, 2011). An increase (or a reduced decrease) in farm working hours is therefore expected, associated with changes in land use practices. Thus a clear pattern emerges. Since the grassland support does not normally increase farm output (Nordin and Manevska-Tasevska, 2013), it is subsidy eligibility (improving the environmental benefits) that is produced.

However, since the grassland support was introduced in a decoupled system, and the decoupling reform may have negatively impacted employment in general (as in Germany (Petrick and Zier, 2011)), it is uncertain whether the eligibility of grassland would have had the same effect if the coupled arable support had remained (i.e. where the grassland support had been added to the former payment scheme). That is, since the variation in employment in grassland regions is estimated in relation to the variation in employment in arable regions, the effect may partly be an effect of a decrease in employment in arable regions.

This study's findings are policy relevant, because there is an ongoing debate about whether to green the CAP further. For example, if as suggested a larger share of the semi-natural pastures are made eligible for payments, it may increase agricultural employment further. For example, EU-wide rules prohibit semi-natural pastures with more than 50 trees per hectare to be eligible for support. In addition, the subsidy is not specific for Sweden, so the results may be relevant for other European countries as well. What is specific for Sweden is that the grassland support is relatively high in relation to the arable support, and that the grassland share of total farmland is large. Moreover, because the grassland support redistributes Pillar I payments to regions with a relatively high unemployment level, it may be positive from an overall labour market perspective. In further research, we will analyse whether the change in the direct payments in 2005 had an impact on employment outside agriculture.

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Tables and figures

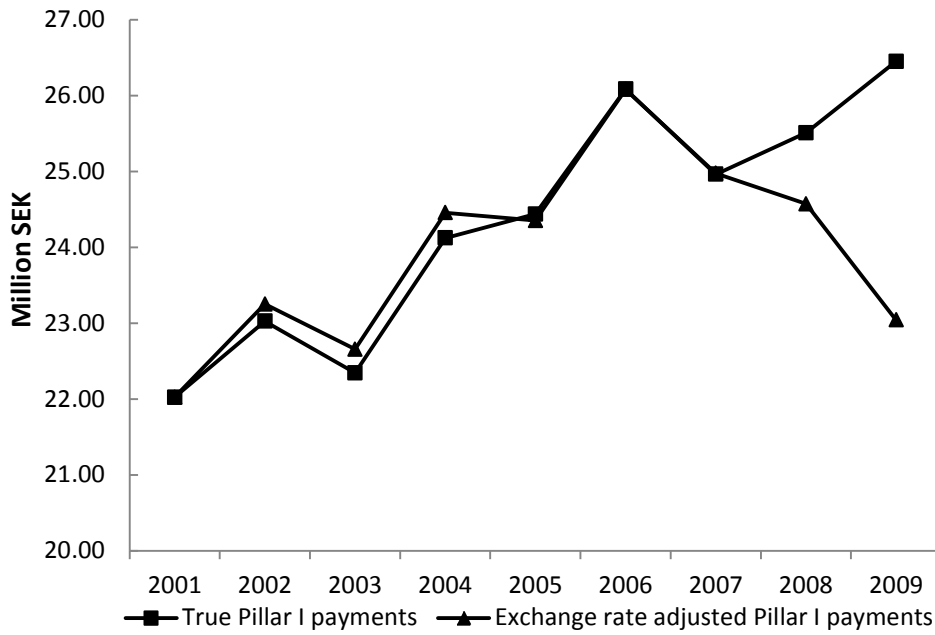


Figure 1. The mean direct payments to the Swedish municipalities (in millions). 2001-2009

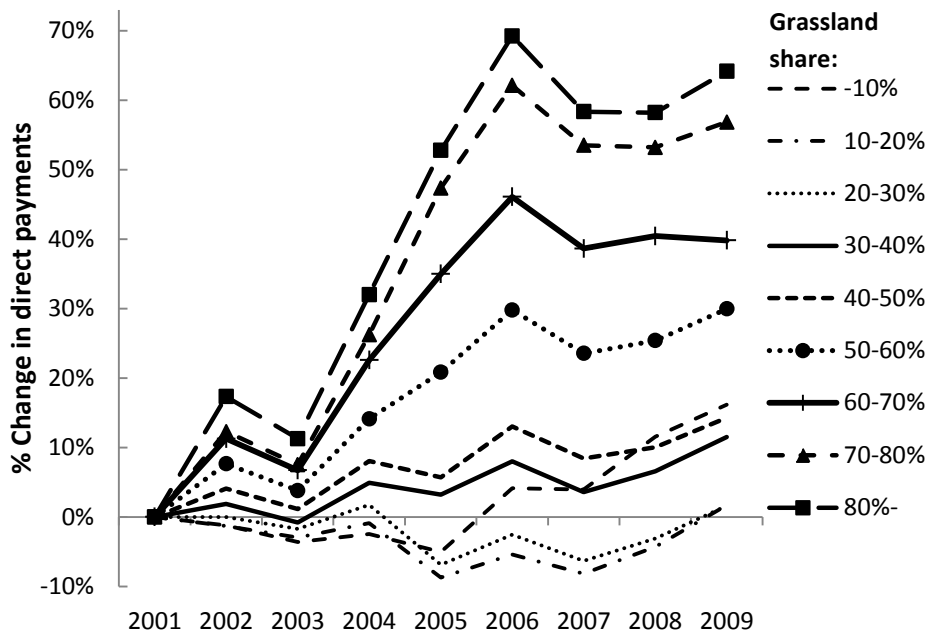


Figure 2. The change in the direct payments for regions with different grassland shares. 2001-2009

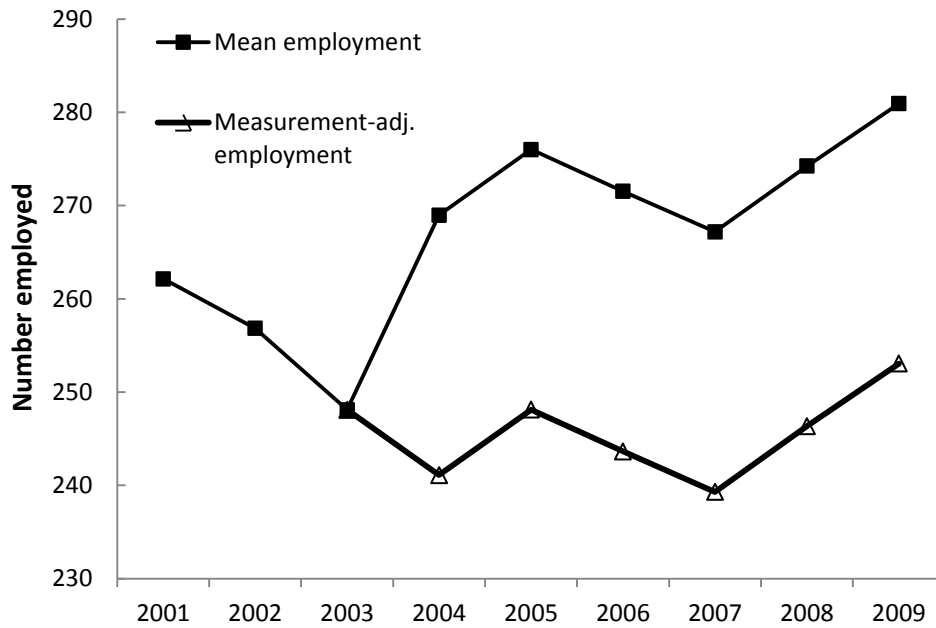


Figure 3. Mean and measurement-adjusted agricultural employment in the Swedish municipalities. 2001-2009

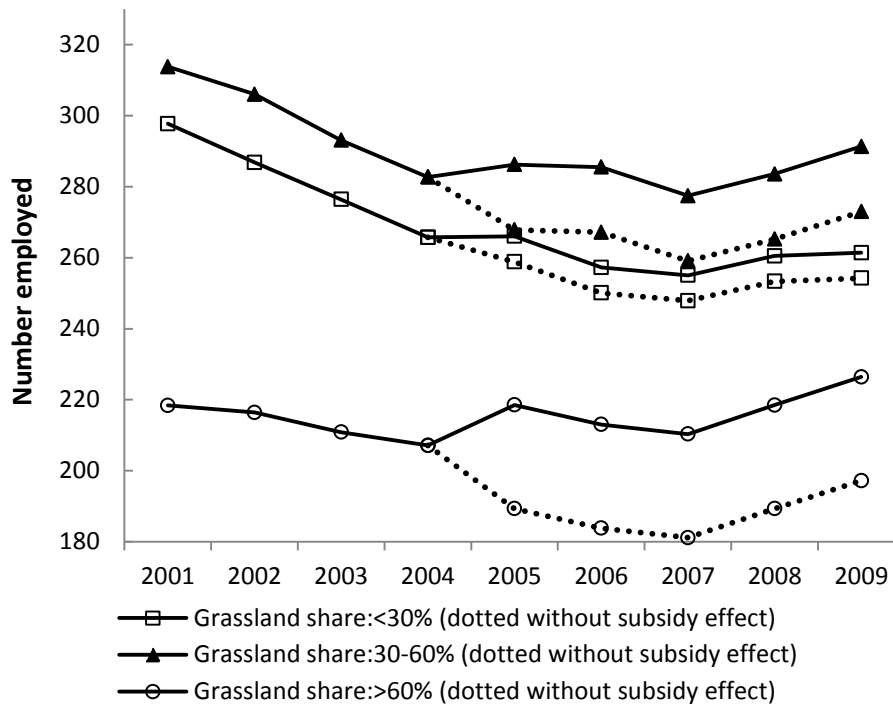


Figure 4. Presenting the yearly average employment numbers for regions with different shares of grassland. Dotted lines illustrate employment when the grassland support effect, is removed. 2001-2009

Table 1.
Descriptive Statistics for the different grassland regions. 2001-2009.

	Grassland region:								
	1	2	3	4	5	6	7	8	9
Municipalities	7	17	19	24	26	34	38	42	54
Share of grassland	6,1%	15,3%	24,9%	36,1%	45,0%	55,4%	65,8%	75,6%	84,7%
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
Agricultural employment (per 1,000 inhabitants)	8.54	13.86	14.88	10.71	15.1	14.33	14.26	18.73	17.51
	(0.74)	(0.63)	(0.68)	(0.56)	(0.57)	(0.44)	(0.40)	(0.57)	(0.42)
Direct payments (millions per 1,000 inhabitants)	1.58	2.33	2.19	1.22	1.67	1.24	0.94	0.94	0.60
	(0.23)	(0.14)	(0.10)	(0.07)	(0.08)	(0.05)	(0.05)	(0.06)	(0.03)

Note: Standard deviations in parenthesis.

Table 2.
Second-stage instrumental variable (IV) estimates on agricultural employment. 2001-2009.

	(1)	(2)	(3)	(4)
Direct payment to farmers	0.418*** (0.111)	0.413*** (0.104)	0.363*** (0.103)	0.393*** (0.105)
Environmental subsidies	-0.761*** (0.250)	-0.731*** (0.251)	-0.700*** (0.232)	-0.696*** (0.240)
Firm subsidies	0.105* (0.0633)	0.104* (0.0610)	0.0966 (0.0602)	0.104* (0.0605)
Other rural subsidies	-0.0568 (0.0642)	-0.0675 (0.0619)	-0.0532 (0.0552)	-0.0621 (0.0592)
Northern subsidy	0.359** (0.167)	0.306* (0.167)	0.274* (0.155)	0.288* (0.162)
Milk cow quartile 2 (coupled)	-10.74** (5.142)	-10.83** (5.166)	-11.84** (5.301)	-11.34** (5.311)
Milk cow quartile 3 (coupled)	-11.20** (5.315)	-10.68** (5.315)	-11.42** (5.133)	-10.96** (5.278)
Milk cow quartile 4 (coupled)	-26.13*** (6.792)	-26.05*** (6.352)	-25.19*** (6.172)	-26.46*** (6.203)
Milk cow quartile 2 (decoupled)	-9.448 (6.975)	-9.539 (7.274)	-11.70 (7.352)	-9.897 (7.374)
Milk cow quartile 3 (decoupled)	-17.90** (7.557)	-15.44** (7.666)	-18.50** (7.461)	-15.06** (7.658)
Milk cow quartile 4 (decoupled)	-32.74*** (8.825)	-31.16*** (8.123)	-31.12*** (8.036)	-30.77*** (7.957)
Demographical characteristics		yes		yes
Unemployment rate			-0.517 (1.120)	-0.885 (1.200)
Ln. of income			36.14 (93.97)	47.81 (106.2)
Share with university education			-10.47*** (3.580)	-8.614** (4.108)
Share with high school education			-3.641 (2.579)	0.256 (3.226)
Public expenditures			yes	yes
2001	16.95*** (4.339)	33.03*** (7.278)	1.024 (8.099)	21.63 (13.99)
2002	24.36*** (6.286)	33.49*** (7.710)	12.76* (7.188)	26.22** (10.66)
2003	17.97*** (6.014)	21.70*** (6.752)	10.48* (5.919)	17.40** (7.479)
2005	13.51** (6.365)	9.290 (6.281)	20.01*** (6.276)	14.15* (7.441)
2006	-11.25 (13.69)	-17.62 (14.60)	1.730 (12.18)	-9.443 (15.51)
2007	-17.74 (13.38)	-24.61 (16.47)	1.079 (13.28)	-15.17 (18.71)
2008	-22.44 (18.08)	-29.17 (22.77)	4.820 (16.98)	-16.12 (24.83)
2009	-38.91* (22.05)	-47.27* (26.38)	-6.089 (20.37)	-29.65 (29.89)
Observations	2,349	2,349	2,349	2,349
R-squared	0.985	0.986	0.987	0.987

Note: The dependent variable is the number employed in the agricultural sector at the municipality level. Municipality fixed effects and the prices are added in every specification. The dependent variable in the first-stage regression is the direct payments. The first-stage results (see Table 3) contain the same variables as the second-stage, but it also contains the instrument, share of grassland. The models are estimated in STATA with a least squares dummy variable (LSDV). Robust clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.
First-stage instrumental variable (IV) estimates on direct payments to farmers. 2001-2009.

	(1)	(2)	(3)	(4)
Grassland share (zero before 2005)	107.1*** (16.24)	124.3*** (18.01)	118.3*** (16.66)	122.6*** (18.41)
Environmental subsidies	0.634* (0.370)	0.599 (0.377)	0.580 (0.380)	0.576 (0.380)
Firm subsidies	-0.229** (0.110)	-0.202* (0.107)	-0.230** (0.107)	-0.211** (0.107)
Other rural subsidies	0.164 (0.149)	0.177 (0.140)	0.172 (0.143)	0.175 (0.139)
Northern subsidy	-0.582*** (0.214)	-0.513** (0.220)	-0.479** (0.222)	-0.492** (0.222)
Milk cow quartile 2 (coupled)	1.975 (4.899)	4.597 (5.033)	5.239 (4.863)	4.794 (5.023)
Milk cow quartile 3 (coupled)	16.57*** (5.923)	20.05*** (5.948)	19.95*** (5.731)	19.80*** (5.743)
Milk cow quartile 4 (coupled)	38.71*** (6.537)	43.09*** (6.715)	42.39*** (6.515)	42.38*** (6.610)
Milk cow quartile 2 (decoupled)	3.071 (7.348)	9.309 (7.765)	9.655 (7.495)	9.819 (7.868)
Milk cow quartile 3 (decoupled)	26.50*** (8.985)	33.22*** (9.070)	33.32*** (8.925)	32.85*** (8.923)
Milk cow quartile 4 (decoupled)	52.30*** (8.817)	60.69*** (8.478)	58.12*** (8.564)	58.35*** (8.379)
Demographical characteristics		yes		yes
Unemployment rate			-0.134 (1.647)	0.0772 (1.751)
Share with university education			94.37 (121.8)	138.0 (131.7)
Share with high school education			17.93*** (5.028)	12.32** (5.890)
Ln, of income			-0.744 (3.149)	1.656 (3.908)
Public expenditures			yes	yes
2001	15.92* (8.244)	14.01 (11.86)	46.19*** (12.86)	48.75** (21.03)
2002	-4.652 (7.252)	-0.430 (9.894)	18.02* (10.05)	22.69 (15.18)
2003	-12.82* (7.160)	-7.441 (8.999)	1.347 (7.817)	4.145 (10.66)
2005	-35.35** (17.62)	-38.30** (18.16)	-50.83*** (18.21)	-51.96*** (19.13)
2006	16.53 (30.84)	15.30 (32.31)	-6.676 (31.75)	-8.979 (34.35)
2007	5.013 (28.41)	-1.968 (32.94)	-29.69 (30.80)	-35.66 (36.38)
2008	39.48 (37.26)	24.47 (45.63)	-4.095 (40.81)	-16.35 (50.21)
2009	51.33 (41.27)	33.42 (49.99)	1.785 (44.57)	-17.30 (56.73)
Weak F-statistic	43.493	47.698	50.441	44.397
Observations	2,349	2,349	2,349	2,349
R-squared	0.990	0.991	0.991	0.991

Note: The dependent variable is the direct payments (Pillar I) at the municipality level. Municipality fixed effects and the prices are added in every specification. The models are estimated in STATA with a least squares dummy variable (LSDV). Robust clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *

Table 4.
Sensitivity tests of the subsidy effect (second-stage IV estimates). 2001-2009.

	(1) Relative specification	(2) Non-adj. employment	(3) Excluding 2005	(4) Time trends included
Direct payment to farmers	0.850*** (0.230)	0.579*** (0.187)	0.509*** (0.098)	0.269*** (0.084)
Weak F-statistic	99.620	44.397	18.247	53.893
Observations	2,349	2,349	2,088	2,349

Note: In column (1) the dependent variable is the employment rate at the municipality level. In columns (2) to (4) the dependent variable is the number employed in the agricultural sector at the municipality level. In column (1) only, the payments are in logarithms. Municipality fixed effects, the prices and the covariates, in column (4) in Table 2, are included in every specification. The dependent variable in the first-stage regression is the direct payments. The first-stage results contain the same variables as the second-stage, but it also contains the instrument, share of grassland. The models are estimated in STATA with a least squares dummy variable (LSDV). Robust clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table A1. Descriptive Statistics

	Mean	Standard Deviation	Source
Agricultural employment (number)	267.332	198.168	Statistics Sweden
Measurement-adjusted employment	248.744	189.096	
Milk cow quartile 2 (coupled)	0.084	0.278	Swedish Board of Agriculture
Milk cow quartile 3 (coupled)	0.082	0.274	Swedish Board of Agriculture
Milk cow quartile 4 (coupled)	0.084	0.278	Swedish Board of Agriculture
Milk cow quartile 2 (decoupled)	0.084	0.278	Swedish Board of Agriculture
Milk cow quartile 3 (decoupled)	0.082	0.274	Swedish Board of Agriculture
Milk cow quartile 4 (decoupled)	0.084	0.278	Swedish Board of Agriculture
Enviromental subsidy	15.772	1.026	Swedish Board of Agriculture
Firm subsidies	11.029	5.468	Swedish Board of Agriculture
Other rural subsidies	8.834	6.172	Swedish Board of Agriculture
Northern subsidy	4.169	6.413	Swedish Board of Agriculture
Ln. of income	5.220	0.091	Swedish Board of Agriculture
Unemployment level	5.340	2.017	The National Labour Market Board in Sweden
Share with university education	10.15	3.836	Statistics Sweden
Share with high school education	19.039	2.108	Statistics Sweden
Ln. population size	9.726	0.845	Statistics Sweden
Ln. of exp. on education	9.476	0.102	Statistics Sweden
Ln. of exp. on social aid	7.599	0.326	Statistics Sweden
Ln. of exp. on culture and leisure	7.517	0.261	Statistics Sweden
In and outflow	93.163	19.9	Statistics Sweden
Ln. population density	43.032	70.086	Statistics Sweden
Share of men	50.212	0.727	Statistics Sweden
Share with a foreign background	10.705	5.998	Statistics Sweden
Share 00-14	17.035	1.858	Statistics Sweden
Share 15-19	6.954	0.643	Statistics Sweden
Share 20-24	4.985	1.087	Statistics Sweden
Share 25-34	10.097	1.692	Statistics Sweden
Share 35-44	13.226	1.176	Statistics Sweden
Share 45-54	13.433	0.747	Statistics Sweden
Share 55-64	14.142	1.28	Statistics Sweden
Share 65-74	10.008	1.528	Statistics Sweden
Share 75-84	7.288	1.432	Statistics Sweden
Share 85-94	2.660	0.616	Statistics Sweden