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AgriFood economics centre

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Abstract

By evaluating the employment effects of the grassland subsidy, introduced in Sweden in 2005, this study provides empirical evidence of the importance of taking land use practices into account. The subsidy was included as a part of the decoupled direct payments to the farmers. Using farm-level data (FADN) for the period 1998 to 2008, this study finds that the grassland subsidy had a large positive effect on annual work hours, but that the production and investments were not affected. Thus, more rigorous eligibility requirements altered land use practices and induced farmers to produce environmental benefits.

Key words: grassland, farm employment, direct payments, Common Agricultural Policy, Sweden

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1. Introduction

Although the main trend in agriculture is a process of structural change that decreases the need for labour (e.g. Olper, Raimondi, Cavicchioli and Vigani, 2012; Berlinschi, Van Herck and Swinnen, 2011), there is no consensus on whether the Common Agricultural Policy (CAP) increases or decreases farm employment (Woldehanna, Lansink and Peerlings, 2000; Mattas, Arfini, Midmore, Schmitz and Surry, 2011; Petrick and Zier, 2011; Olper, Raimondi, Cavicchioli and Vigani, 2012); in fact, findings on the influence of the CAP on agricultural employment are rather contradictory. Pillar I subsidies (direct payments) are mainly explained as capital subsidies which increase the capital intensity, and therefore decrease the need for labour (Petrick and Zier, 2011; Goodwin and Mishra, 2005; Van Herck, 2009). Pillar II subsidies make agricultural production more extensive, and thus are generators of on-farm labour (Petrick and Zier, 2011).

The empirical literature makes an important distinction between the effects of coupled/decoupled Pillar I subsidies (Goodwin and Mishra, 2005; Petrick and Zier, 2011) and various Pillar II subsidies (Petrick and Zier, 2011), but the specifics of different land use practices have never been considered. CAP is a major factor affecting agricultural land use in the European Union (Trubins, 2013), and as the agricultural land use practices and the policies for land use are changing (Nitsch, Osterburg, Roggendorf and Laggner, 2012), the need for labour can also be expected to adjust to the new conditions.[2]

By evaluating the employment effects of the grassland subsidy, introduced in Sweden in 2005[3], this study provides empirical evidence of the importance of taking land use practices into account. The subsidy was included as a part of the decoupled direct payments to the farmers but, in comparison to the arable land subsidy, the grassland subsidy is relatively labour intensive due to the cross-compliance requirements (The Swedish Board of Agriculture, 2011). Approximately 1 million hectares grassland was made eligible for support in 2005, which implied a 75 percentage increase in eligible hectares.

Theoretically, a decoupled subsidy is a non-labour market improvement of farm income, which has a negative income effect on farm labour. On the other hand, the subsidy in a coupled system can be considered a wage, and when the wage increases the opportunity cost of leisure also increases (Ahearn, El-Osta and Dewbre, 2006). Thus, when the subsidy is coupled to the production, subsidies may increase labour due to a positive substitution effect. In contrast to the decoupled direct payment (Pillar I after 2004), the Pillar II subsidies come

[2] See Nordin (2013) for a detailed description of the Pillar I payments in Sweden.
[3] The subsidy is not specific for Sweden, but is relatively high compared to many other countries.

with conditions, and are therefore assumed to affect labour positively. Since the support for grassland use is highly subjected to cross-compliance requirements for improving the environmental and the agricultural conditions, it is unresolved if the grassland subsidy has mainly a negative income effect on labour (as the Pillar I arable support), or a positive substitution effect (as the Pillar II subsidies).

Hence, a feature few acknowledge is that a cross-compliance requirement is a “weak” type of coupling which might have an impact on farm labour. It has been discussed (Courleux, Guyomard, Levert and Piet, 2008; Femenia, Gohin and Carpentier, 2010; Bhaskar and Beghin, 2008), but empirically it has not been investigated. In the case of arable land use, the production is primarily related to crops, but in the case of grassland use it is to some extent a matter of keeping the grassland eligible for support (besides the production of animal fodder), and farmers in Sweden report that meeting the cross-compliance requirements of grassland takes the most time and incurs the highest costs (Swedish Board of Agriculture, 2011). For grassland use, it may therefore be more valid to view the subsidy as a “wage-increasing” subsidy, and since the grassland subsidy and the Pillar II have much in common in that they both aim at improving the environmental and agricultural conditions, their influence on farm labour may be similar; that is, they may decrease farm intensification, and increase the need for labour.

Furthermore, whereas farm subsidies, in general, are found to be used for investments in labour-saving technology (Goodwin and Mishra, 2005; Petrick and Zier, 2011; Van Herck, 2009; Goetz and Debertin, 1996), environmental subsidies promoting labour-intensive technology may increase farm labour (Petrick and Zier, 2011). Farm subsidies may also be used for land-investments, which increase farm labour (Goetz and Debertin, 2001), and there is evidence that subsidies can stimulate farm employment and make the subsidized farmers less inclined to seek employment in other industries (Ahearn, El-Osta and Dewbre, 2006; D'Antoni and Mishra, 2010; Mishra and El-Osta, 2008; Van Herck, 2009), which increases the likelihood of farm survival (Key and Roberts, 2006). In addition to CAP, changes in the farm employment are said to originate from structural changes, such as farm intensification (Ahearn, El-Osta and Dewbre, 2006; Ahearn, Yee and Korb, 2005; Alasia, Weersink, Bollman and Cranfield, 2009; El-Osta, Mishra and Ahearn, 2004; Woldehanna, Lansink and Peerlings, 2000; D'Antoni and Mishra, 2010) or different motivations, regional specifics, farm and farmers’ characteristics etc. (Alasia, Weersink, Bollman and Cranfield, 2009; Mishra and El-Osta, 2008; Key and Roberts, 2006; Van Herck, 2009). Hence, a comprehensive assessment of the employment effect of CAP should preferably be analysed in a within-farm specification (i.e. in a fixed effect model), otherwise between-farm characteristics might bias the subsidy effects.

This study is complementary to the analysis in Nordin (2013), which uses aggregate municipality data to evaluate the impact of the CAP reform of 2005 on agricultural employment. Nordin (2013) found that the grassland subsidy (primarily) saved jobs in agriculture, but was not able to explain the change in farm behaviour; so, to understand the mechanism of the positive employment effect, a farm-level analysis is needed.

This study uses a panel from the Swedish Farm Accounting Data Network (FADN) for the period 1998-2008. To illustrate that the grassland subsidy and the direct payments (in general) have differential effects on labour, a comparative analysis based on a fixed effects model and an instrumental variable (IV) model is provided. We use the farm's share of grassland to identify the grassland effect on farm labour and, to broaden the analysis, include the subsidy effect on total production and investments, besides annual hours of work.

Explaining the influence of the CAP on farm employment is the main contribution of this study to the literature. The specific contribution concerns grassland utilization, which, to the best of our knowledge, has only been assessed by Nordin (2013). The land use practice is lifted as a key factor that influences the effect of the implemented policy.

The paper is structured in the following way. The next section presents the data and descriptive statistics. After describing and discussing the specification of the econometric model, the following section reports the results. The final section contains the conclusions.

3. Method

3.1 Data

This study uses the Farm Accounting Data Network (FADN) provided by Statistics Sweden (SCB). The Swedish JEU (Jordbruksekonomiska undersökningen) is a stratified sample of about 30,000 farms, out of which 1,000 farms are selected every year (based on geographical location, size and production characteristics) to be included in FADN. Farms with a farm size value of at least eight European Size Units (ESU), where one ESU corresponds to 1200€, are included. FADN is considered the most comprehensive and standardized survey-based data set for the EU member states, and is used for both scientific and decision making purposes, but since small farms are not included, it is often criticised as not representative of the entire population of farms.

Much of the information in FADN comes from the farms' book-keeping (e.g. the incomes and expenses), and farm characteristics are collected from the LBR (Lantbruksregistret). The subsidy payment comes from the administrative records of The Swedish Board of Agriculture, and additional information is collected through interviews.

Our analysis uses an unbalanced panel consisting of 10,327 observations (and 1,612 farms) for the period 1998-2008. 236 farms (observations) are lost because they only appear once, which is not possible in a fixed effect framework. We also restrict the sample to those with direct payments above SEK 1,000 (about 100€), and annual work hours above 400. By excluding these small farms, we lose another 393 observations.

Thus, the data set provides detailed information of farm labour characteristics, farm production value, investments, grassland and total area, livestock units, received direct payments, payments for environmental subsidies, other rural subsidies, employment subsidies[4], and regional location. A detailed presentation of the outputs and covariates can be found in the empirical specification and descriptive statistics in Table A1.

3.2 Grassland subsidy and the direct payments in Sweden, 1998-2008

Since 2005, Swedish farmers utilizing grassland have received direct payments based on the area of grassland and the regional characteristics (hybrid model of decoupling).[5] Permanent pastures, consisting of semi-natural pastures and grassland on arable land, were made eligible for single farm payments, whereas arable crops and permanent crops were already eligible for area support. The most important change was to make grassland on arable land eligible, because there is almost as much grassland on arable land in Sweden as there is arable land used for crop production (about a million hectares). Semi-natural pastures cover about half as much land. Eligibility statistics do not exist, however, so the exact numbers of eligible hectares of arable land and grassland land are not available.

The total hectares of semi-natural pastures and grassland on arable land are specified in FADN, so the farm's share of grassland (of total farmland) can be used as a proxy for the grassland subsidy. A relationship between the grassland share and the increase in direct payments is evident after 2004. Figure 1 illustrates the percentage change in the direct payments (compared to 2001) for farms with different shares of grassland. As is shown, for farms with more than 60 per cent grassland the direct payments increased by more than 30 per

[4] The employment subsidies are national labour market subsidies, and not CAP subsidies.
[5] The support for grassland (€117 per hectare in 2005) is almost the same in the whole country. The arable support and the grassland support are the same in region 5 (northern and forest regions), whereas the arable support is about 25%, 60%, 90%, and 120% higher in the other four regions.

cent between 2004 and 2005. For those with less than 15 per cent grassland, the payments decreased by about 8 per cent between 2004 and 2005. Between 2005 and 2008 the direct payments kept increasing for all farms by around 20 to 35 per cent, but more for those with a larger share grassland. The increase in 2007 was due to the depreciation of the Swedish currency, and the relatively large increase in 2006 was partly due to a general increase in the direct payments, and partly to an increase in the grassland subsidy.

Figure 1 about here

3.3 Empirical specification and covariates

To show that the grassland subsidy has a specific impact on farm production, this study provides a comparative analysis of fixed effect (FE) estimates and instrumental variable (IV) estimates. The FE model uses the within-farm variation in the direct payments to the farmers to estimate the subsidy effect on the outcome y. That is, with:

$$lny_{ij} = \alpha_i + \gamma_t + \beta lnDP_{ij} + \rho X_{it} + \varepsilon_{it} \tag{1}$$

we obtain the subsidy effect on each of our outcome variables: logarithmic annual hours worked at farm, logarithmic total outcome and logarithmic farm investments (in buildings, machines and equipment). *DP* is the logarithm of the direct payments (in 2008 prices) to the farmer. Thus, because the size of the absolute changes in the output variables and the direct payments are strongly related to farm size, it is the relative changes that are important.[6] In this model, α_i and δ_t are fixed effects for farm and year, respectively. Additional covariates and other subsidies are included as controls and represented by *X*.

Because we lack a measure of the actual change in the *DP* due to the grassland subsidy, the shortcoming of the fixed effect model is that it uses the total variation in the *DP* to estimate the subsidy effect. For this to be correct, the average change in the *DP* has to have an effect on *y* equal to the change in the *DP* caused by our specific policy change. Such an assumption is probably incorrect, since farms' *DP* might change for many reasons (other changes in the payment scheme, investments in land, changes in the number of animals etc.), and each of the changes may have differential effects on the farm's production decision. Thus, because different treatments are assumed to have local average treatment effects (LATE), we need to capture the specific change in the *DP* caused by the grassland subsidy.

[6] For example, without a relative measure one can assume that a certain increase in the subsidies has an equally large effect on y at large farms (with large subsidy payments) as at small farms (with small subsidy payments). Also, when estimating individual labour supply, it is standard to use the logarithm of annual hours.

Since the grassland subsidy is based on the hectares of eligible grassland, we use the farm's grassland share[7] to explain the change in the *DP* after 2004. Moreover, if the farm's grassland share is exogenous, the IV approach is the accurate way of estimating the grassland effect, although the instrument is not conventional. Thus, the fixed effect IV estimator will use the fact that the increase in the direct payments after 2004 is directly related to the share of farm grassland.

A main concern is that farms with a large share of grassland experience a specific trend (different from the average trend) in their production, which implies that the grassland subsidy effect captures this trend as well. However, since the share of grassland is largely a regional characteristic, the trend is regional. So, to test if regional economic conditions, for example strong economic progress or structural change, covariates with the grassland subsidy, 42 regional-specific time trends at the NUTS3 level, T and T^2 (linear and quadratic), are included. With the inclusion of the regional-specific time trends (and the other covariates), we are confident that the share of grassland fulfils the exclusion restriction.

Over the time period studied here, there have been large price fluctuations in cereal, dairy and meat prices, and for cereals the price variations have been particularly large. Such price fluctuations have an impact on a farm's production, investments and employment, and therefore the prices have to be included in the model. However, since the prices paid to the farmers are not available, we use national producer prices (provided by the Swedish Board of Agriculture). To achieve farm level variations in the national prices, we weight the prices with the specialization rates of the farm. Besides introducing farm level variations in the prices, the weighting allows the price impact to increase with the specialization rate of the farm, which is plausible (e.g. an increase in milk prices has, of course, a larger impact on farms specialized in milk production). The specialization rate is the value of each production type (e.g. milk or cereals) to the value of the total farm production. Time period averages of the production are used, otherwise endogenous changes in specialization[8] affect the price controls. We include the four most important prices: milk, beef and pig prices, and the average price of cereals.

Payments received from environmental subsidies, other rural subsidies and employment subsidies are included. Because there is a large share of zeros for these subsidies, logarithmic

[7] Because we use the logarithm of the *DP*, the share is a much better predictor than the actual grassland hectares. Using the yearly grassland shares or the average grassland share (after 2004) gives more or less the same result, i.e. it is not endogenous change in the grassland share after 2004 that drives the result.

[8] Because the grassland subsidy may affect the specialization of a farm (for example, cattle are required to keep the grassland eligible), the specialization rate is a left-hand variable and therefore endogenous.

subsidies are not used.[9] To control for farm size we add total farmland, as well as a variable explaining whether the farm is an organic producer. Table A1 lists the control variables and reports the descriptive statistics.

In 2007 the milk subsidy was decoupled and included in the direct payments to the farmers. Consequently, there is an increase in the direct payments in 2007, which might interfere with the grassland subsidy. That is, since the milk subsidy goes to grassland regions with many milk farms, direct payments increase in the same regions due to both the grassland subsidy and the milk premium. However, the milk premium after 2006 should equal the subsidy received in 2006, and we can therefore just remove, from the direct payments, the same amount in the following years as the farm received in 2006 (which we know).

4. Results

First, we estimate the grassland subsidy effect, and compare the IV results to the FE results. Second, we analyse whether the instrument is valid and, finally, sensitivity tests and an exploration of the labour measure provide further understanding.

4.1 Estimating the grassland subsidy effect and comparing the IV results to FE results

Table 2 presents the fixed effect and IV estimation results for each dependent variable, separately. The table displays large differences in subsidy effect for the fixed effect and IV models, which clearly confirms that the average *DP* subsidy effect is different from the grassland subsidy effect. In the IV model, annual hours increases significantly with the grassland subsidy (a 0.1 log point increase in the subsidies increases annual hours with 2.4 per cent),[10] whereas the FE-effect on annual hours is small and insignificant. For farm investments and total production, the grassland subsidy is insignificant, whereas the FE-estimate is significantly positive.

Thus, the average increase in the *DP* seems to increase investments and total production, but the annual hours are unchanged. Few studies have analysed the relationship between direct payments and production, and the main finding is a weak relationship between the two (Femenia, Gohin and Carpentier, 2010). However, even in a decoupled system the existence of wealth and insurance effects could imply a positive relationship between

[9] We have also tried using logarithmic subsidies, but where we add a dummy variable indicating zero subsidies. Since this specification gives the same result as the chosen specification, it seems adequate to use the absolute values of the subsidies.

[10] The effect is exactly the same for farms affected by the grassland subsidy, i.e. for the sample of farms that are in the data both before and after the reform. We prefer to include the farms not affected by the reform because they increase the model fit, in general.

subsidies and total production. For example, higher wealth is assumed to increase the incentive to invest and produce for risk-averse farmers (Femenia, Gohin and Carpentier, 2010; Hennessy, 1998; Sckokai and Moro, 2006) and, because technical efficiency seems to have increased in Sweden (Zhu and Lansink, 2010), the positive impact on production may be due to the increase in investments.

On the other hand, the introduction of the grassland subsidy offers a different story. Receiving means for keeping the grassland in good condition (cross-compliance requirements), increases annual hours. However, the farm's labour increase does not result in an increase in production or investments. Furthermore, the grassland subsidy increases the subsidy dependence (calculated as the ratio of total subsidy amount to total farm revenue) by 12 percent (not reported).

Table 1 about here

So far, the difference in result between the FE model and the IV model is supposed to be a matter of treatment effects (average versus local), but the differences could, of course, also be related to biases in the estimates. However, since we are confident that the instrument is strong and exogenous, which is to be shown, it is only the FE effects that might be biased. Further research is required for establishing that the positive impact of subsidies on total production and investments is a causal effect; in the rest of the analysis we focus on the grassland effect on annual hours. Some significant associations are also found for the other CAP subsidies; then again, these may be biased, and reversed causation is a genuine problem for the Pillar II subsidies.

4.2 Exploring whether the instrument is valid

Therefore, we continue the analysis by first showing the instrument, the farm's share of grassland, to be strong (and relevant), and then providing evidence indicating that the instrument is truly exogenous. Table 2 displays the first-stage results when using farm's share of grassland (after 2004) as an instrument for the *DP*. As expected, after 2004 the farm's share of grassland has a large impact on the *DP*, a ten per cent increase in the grassland share increases *DP* by 0.047 log points. The weak IV-test statistic is 277.636, which indicates a very strong and relevant instrument (a rule of thumb is that the test-statistic should be above 10). A weak instrument gives biased estimates and underestimated standard errors (Murray, 2006; Stock, Wright and Yogo, 2002).

Table 2 about here

The instrument must also be exogenous; that is, not related to the dependent variable after controlling for relevant covariates. Whether the exclusion restriction is satisfied is always controversial and, in the end, untestable. Yet, what is indicative of an exogenous instrument is that the IV-estimate is robust to the inclusion of covariates. Thus, if the grassland subsidy effect is unaffected by the controlling of relevant covariates, a relationship between the instrument and the dependent variable caused by the omission of some less relevant covariate, is unlikely. Table 3 presents the results without covariates (only controlling for time and farm fixed effects). Because the subsidy effect on annual hours is 0.28 without covariates, and 0.24 with covariates, the effect is shown to be stable (irrespective of the combination of covariates). Moreover, by including 42 regional-specific (linear and quadratic) time trends, at the NUTS3 level, to the specification, the issue is further analysed. With such time trends the grassland effects on hours worked at the farm remain large, 0.20 (see Table 3). Therefore, regional trends in agricultural employment are not causing the grassland effect on annual hours.

Table 3 about here

4.3 Analysing the generalizability of the grassland effect

Another concern is that the increase in hours is related to a certain change happening within, for example, the sample of beef farms that have, on average, a large share of grassland. Thus, by restricting the sample to farms without a main specialization (where less than half of the total production comes from milk, cereals, beet or milk production), we explore whether the grassland effect is general, or if it is related to a certain farm specialization (which accordingly questions the causality of the effect).[11] Column one in Table 4 reports the IV result for this sample. Because the grassland effect on annual hours is actually larger, 0.39, for the 362 farms without a specialization, this concern can be ruled out. Additionally, when restricting the sample to farms with grassland (9,973 observations) or those with either cattle or milk cows (6,977 observations), the result remains (see columns two and three in Table 4). Hence, the result is not driven by differences between farms with grassland or animals, and farms without grassland or animals.

Table 4 about here

4.4 Is the grassland effect related to the number of animals?

[11] We have also tried using time trends (linear and quadratic) for the farm specializations, but it does not affect the results.

To understand the background to the positive subsidy effect on annual hours, the production has to be further explored. A plausible argument for the effect relates to the cross-compliance requirements and production intensification. To fulfil the cross-compliance requirements, the farmer has to keep the grassland in good condition, and yearly grazing of the land is mandatory. Thus, keeping cattle on pastures makes the production more extensive, meaning more labour is needed. Based on this argumentation, we estimate the change in animals due to the grassland subsidy (same model as before, but here we use the livestock of cattle, milk cows and pigs as the dependent variable). Table 4 shows that the grassland subsidy increases cattle, but decreases pigs and milk cows at farms. We have also estimated the grassland effect for semi-natural pastures and grassland on arable land, by using each of the shares as our instrument, separately. This analysis shows that the semi-natural pasture subsidy has a larger effect on annual hours of work, 0.32, than the grassland on arable land subsidy, 0.18, but both are significant. Hence, finding that the preservation of semi-natural pastures is more labour intensive, is an expected result that supports the argument.

4.5 Is the increase in hours affecting job-sharing and new employment?

An important question to answer is whether the increased hours represent an increase in the hours of employees, or mainly an increase in the hours of farm managers and/or their family members. To answer this question, we compute the share of hours done by the i) employees, ii) farm manager, and iii) unpaid family members and relatives. Another way of doing this would be to analyse the changes in the actual hours of the different labour groups, but since we use logarithmic hours we end up with lots of zeros, particularly for the employees, which complicates the analysis. Also, since we already know that the grassland subsidy increases annual hours, the changes in the shares provide us with information that is new. Table 5 shows that the employees increase their share of hours at the expense of the farm manager's hours. However, all groups increase their hours (not reported). Because the data do not describe the number of employees (only the hours provided by different types of labour), we cannot directly estimate whether the number of employees has increased. However, one way of testing if there is new employment at the farm is to construct a variable explaining whether there are any employees at the farm, at all. Thus, we can analyse whether the grassland subsidy affects the decision to get a first employee (or lay-off the employee(s)). In column four of Table 5 we find that the grassland subsidy influences the probability of having a first employee. The table also shows that there has been a significant increase in annual working-units (AWU) by 0.21 units.

Table 5 about here

5. Conclusion

This study has shown that the introduction of the grassland subsidy in Sweden implied a large increase in the annual working hours for farms with grassland. The empirical approach, the way the subsidy was introduced (suddenly and decided at the EU-level), and the finding of a similar effect in aggregate data (Nordin, 2013), make us certain it is a causal effect.

The labour increase is primarily represented by an increase in employees' hours, and sometimes the subsidy leads to new employment. In addition, the farm production and investments are not affected by the grassland subsidy. Apart from the grassland subsidy, direct payments have no impact on labour, which is the general finding in the literature.

Accordingly, the obvious question is: if the hours are not used for production, what is the extra labour used for? The plausible answer is that rigorous eligibility requirements altered land use practices and made farmers produce environmental benefits. The empirical findings in this study are in line with this explanation, and it seems as if the eligibility requirements are partly fulfilled by letting cattle graze, and, since grazing cattle extensify production, more labour is needed. Moreover, the cross-compliance requirements may also have a positive effect on labour for the arable subsidy, although the net (income) effect of this subsidy may be negative.

From a policy point of view, this study is important, as it shows that direct payments can be constructed so that they both increase employment and have an environmental impact.

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Tables and figures

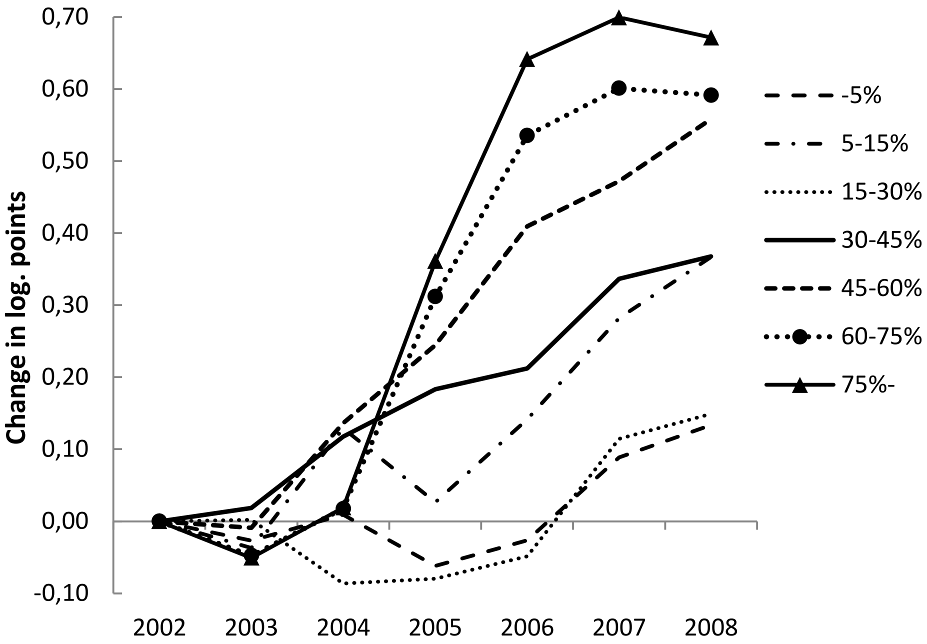

Figure 1. Average logarithmic change in the direct payments for farms with different shares of grassland. 2002-2008.

Table 1. Estimating the direct payment (DP) subsidy effect on hours, investments and output with a fixed effect (FE) and an instrumental variable (IV) model. 1998-2008.

	Log. Annual hours worked		Log. investments		Log. total production	
	FE	IV	FE	IV	FE	IV
Log. direct payments (DP)	0.0123	0.240***	0.0825**	0.0491	0.148***	0.0848
	(0.0171)	(0.0728)	(0.0408)	(0.0851)	(0.0212)	(0.0561)
Total farmland	-6.89e-07	-2.85e-06***	3.47e-07	6.47e-07	4.00e-06***	4.59e-06***
	(9.00e-07)	(1.06e-06)	(2.88e-06)	(2.19e-06)	(1.03e-06)	(1.00e-06)
Environmental subsidies	1.74e-07	-5.52e-08	4.70e-07**	5.06e-07***	2.75e-07**	3.38e-07***
	(1.25e-07)	(1.30e-07)	(2.25e-07)	(1.54e-07)	(1.35e-07)	(1.06e-07)
Other rural subsidies	-1.67e-08	-2.05e-08	2.06e-07***	2.06e-07***	-1.11e-08	-1.01e-08
	(4.97e-08)	(4.49e-08)	(4.47e-08)	(4.50e-08)	(2.00e-08)	(2.05e-08)
Labour market subsidies	1.99e-07	6.24e-07**	1.22e-06***	1.14e-06***	2.03e-06***	1.91e-06***
	(2.85e-07)	(2.59e-07)	(4.12e-07)	(3.01e-07)	(3.17e-07)	(2.31e-07)
Milk subsidy	4.89e-08	-2.70e-07	1.14e-06***	1.19e-06***	3.73e-07**	4.61e-07***
	(2.23e-07)	(1.76e-07)	(3.70e-07)	(2.19e-07)	(1.80e-07)	(1.33e-07)
Special beef premia	4.67e-08	-3.20e-07**	4.69e-08	1.00e-07	-3.88e-07***	-2.86e-07**
	(1.59e-07)	(1.60e-07)	(3.04e-07)	(1.82e-07)	(8.50e-08)	(1.17e-07)
Cereals price	-0.000566	-0.000735	0.000881	0.000838	0.00134**	0.00139***
	(0.000813)	(0.000616)	(0.000978)	(0.000745)	(0.000643)	(0.000486)
Milk price	-0.00160*	-0.00169***	-4.96e-05	-7.64e-05	0.000276	0.000302
	(0.000838)	(0.000637)	(0.000726)	(0.000574)	(0.000713)	(0.000519)
Beef price	-0.00122	-0.00173*	-0.00328**	-0.00326***	0.000503	0.000644
	(0.00135)	(0.00101)	(0.00129)	(0.00105)	(0.00105)	(0.000788)
Pig price	-0.00115	-0.00117	-0.000988	-0.00109	0.00102	0.00103*
	(0.000936)	(0.000733)	(0.000844)	(0.000714)	(0.000729)	(0.000560)
Organic farmer	0.0497**	0.0429**	0.00743	0.00827	0.0752***	0.0771***
	(0.0248)	(0.0211)	(0.0516)	(0.0339)	(0.0265)	(0.0197)
1998	-0.0135	0.0414	0.0611	0.0476	0.0670	0.0518
	(0.0713)	(0.0578)	(0.0624)	(0.0546)	(0.0573)	(0.0461)
1999	-0.0831	-0.0120	0.0603	0.0445	0.0207	0.00103
	(0.0709)	(0.0588)	(0.0625)	(0.0562)	(0.0568)	(0.0463)
2000	-0.0491	-0.0493	0.0681	0.0627	-0.00781	-0.00772
	(0.0705)	(0.0538)	(0.0623)	(0.0499)	(0.0559)	(0.0432)
2001	-0.0535**	-0.0339	0.113***	0.111***	-0.0593***	-0.0647***
	(0.0269)	(0.0228)	(0.0241)	(0.0244)	(0.0196)	(0.0162)
2002	-0.0493**	-0.0285	0.0970***	0.0942***	-0.0440**	-0.0498***
	(0.0240)	(0.0222)	(0.0176)	(0.0178)	(0.0185)	(0.0158)
2003	-0.0744***	-0.0515**	0.0429*	0.0395	0.0689***	0.0625***
	(0.0220)	(0.0218)	(0.0228)	(0.0252)	(0.0159)	(0.0159)
2004	-0.0176	0.00890	0.0448***	0.0407**	0.0349***	0.0275*
	(0.0161)	(0.0210)	(0.0129)	(0.0185)	(0.0128)	(0.0151)
2006	0.0350**	0.0258	-0.0122	-0.0105	-0.0286**	-0.0261*
	(0.0158)	(0.0199)	(0.0117)	(0.0155)	(0.0116)	(0.0146)
2007	0.0765**	0.0786***	-0.405***	-0.397***	0.0692***	0.0686***
	(0.0328)	(0.0285)	(0.0394)	(0.0306)	(0.0241)	(0.0199)
2008	0.0546*	0.0378	-0.220***	-0.221***	0.173***	0.177***
	(0.0311)	(0.0283)	(0.0380)	(0.0337)	(0.0241)	(0.0212)
Observations	10,327	10,327	10,328	10,328	10,327	10,327
R-squared	0.014	-0.016	0.079	0.075	0.147	0.144
Number of farms	1,612	1,612	1,612	1,612	1,612	1,612

Notes: In the second-stage regressions the dependent variables are the logarithms of: annual hours worked at farm, farm investments and total production. In the first-stage regressions the dependent variable is the logarithm of the direct payments (when excluding the decoupled milk premium). Farm fixed effects are added in every specification. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 2. First-stage result when instrumenting the direct payments with the farm's share of grassland. 1998-2008.

	Estimate	Standard error
Farm's share of grassland	0.470***	(0.0423)
Total farmland (hectare)	1.13e-05***	(2.03e-06)
Environmental subsidies	9.15e-07***	(1.75e-07)
Other rural subsidies	7.56e-09	(3.18e-08)
Labour market subsidies	-2.12e-06***	(2.82e-07)
Milk subsidy	1.01e-06***	(1.55e-07)
Special beef premia	1.92e-06***	(2.04e-07)
Cereals price	0.00183***	(0.000580)
Milk price	0.000386	(0.000627)
Beef price	0.000663	(0.00103)
Pig price	0.000787	(0.000637)
Organic farmer	0.0175	(0.0226)
1998	-0.0218	(0.0536)
1999	-0.0987*	(0.0527)
2000	0.217***	(0.0516)
2001	0.107***	(0.0255)
2002	0.100***	(0.0246)
2003	0.0924***	(0.0233)
2004	0.0826***	(0.0227)
2006	0.0391***	(0.0111)
2007	-0.0342	(0.0271)
2008	0.0563**	(0.0251)
Weak IV-test	277.636	
Observations	10,327	
R-squared	0.248	
Number of farms	1,612	

Notes: The dependent variable is the logarithm of the direct payments (when excluding the decoupled milk premium). The instrument is the farm's share of grassland. Farm fixed effects are included. Robust standard errors in parentheses. *** p<0.01, **

Table 3. Estimating the direct payment (DP) subsidy effect on annual hours with an instrumental variable (IV) model. Excluding the covariates and including regional time trends. 1998-2008.

	Without covariates	Including regional time trends
Log. direct payments (DP)	0.282***	0.203***
	(0.105)	(0.0728)
Observations	10,327	10,327
R-squared	-0.033	0.004
Number of lopnr	1,612	1,612

Notes: In the second-stage regressions the dependent variable is the logarithm of annual hours worked at the farm. In the first-stage regression the dependent variable is the logarithm of the direct payments (when excluding the decoupled milk premium). Farm and time fixed effects are added, and when including time trends the covariates in Table A1 are also included. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Additional sensitivity tests and explorations of the grassland subsidy effect. 1998-2008.

	Mixed specialization	Grassland>0	Cattle or cows>0	Lifestocks of: Milk cows	Cattle	Pigs
Log. direct payments (DP)	0.393**	0.275***	0.436***	-14.80***	8.006**	-27.31***
	(0.165)	(0.0752)	(0.147)	(2.071)	(2.221)	(8.083)
Observations	2,177	9,973	6,977	10,327	10,327	10,327
R-squared	-0.113	-0.025	-0.071	0.142	0.128	-0.032
Number of farms	362	1,540	1,129	1,612	1,612	1,612

Notes: In columns one to three the dependent variable in the second-stage regression is the logarithm of annual hours worked. In columns four to six the second-stage dependent variable is the livestock of milk cows, cattle or pigs. In the first-stage regression the dependent variable is the logarithm of the direct payments (when excluding the decoupled milk premium). Farm and time fixed effects, and the other covariates reported in Table A1, are added in every specification. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Estimating the direct payment (DP) subsidy effect on different employment measures. 1998-2008.

	Family share	Employee share	Manager share	New employed	AWU
Log. direct payments (DP)	0.0245	0.0544**	-0.0788***	0.136**	0.213***
	(0.0219)	(0.0251)	(0.0279)	(0.0559)	(0.0648)
Observations	10,327	10,327	10,327	10,328	10,327
R-squared	0.005	0.004	-0.008	-0.003	-0.003
Number of lopnr	1,612	1,612	1,612	1,612	1,612

Notes: In columns one to three the dependent variables in the second-stage regression are the shares of employees of different types. In column four the second-stage dependent variable is the probability of having employees. In column five the second-stage dependent variable is the annual working units (AWU). In the first-stage regressions the dependent variable is the logarithm of the direct payments (when excluding the decoupled milk premium). Farm and time fixed effects and the other covariates reported in Table A1 are added in every specification. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix

Table A1. Descriptive statistics for outputs, land, CAP subsidies and other covariates used in the empirical models.

	Unit	Mean	Standard Deviation
Direct payments (DP)	Log. SEK	11.751	1.002
Annual hours worked at the farm	Log. hours	7.973	0.681
Farm investments	Log. SEK	13.297	1.797
Total production	Log. SEK	13.507	1.103
Total farmland	ha	109.254	129.384
Farm's share of grassland	per cent	0.414	0.337
Share of grassland on arable land	per cent	0.277	0.269
Share of semi-natural pastures	per cent	0.138	0.168
Family share	per cent	0.169	0.192
Employed share	per cent	0.133	0.234
Manager share	per cent	0.698	0.261
New employed	per cent	0.344	0.475
AWU	No	4.853	0.603
Mixed specialization	per cent	0.211	0.408
Grassland>0	per cent	0.871	0.335
Cattle or cows>0	per cent	0.677	0.468
Milk cows	LU	16.954	35.587
Cattle	LU	26.896	42.902
Pigs	LU	31.667	118.036
Subsidy dependence	per cent	0.239	0.150
Environmental subsidies	SEK	76,436	124,481
Other rural subsidies	SEK	17,501	42,995
Labour market subsidies	SEK	9,491	84,634
Milk subsidy	SEK	11,814	42,296
Special beef premia	SEK	25,508	74,446
Cereals price	SEK × per cent	28.416	32.508
Milk price	SEK × per cent	20.896	30.704
Beef price	SEK × per cent	9.230	15.106
Pig price	SEK × per cent	8.747	22.741
Organic farmer	per cent	0.198	0.399
1998	per cent	0.080	0.271
1999	per cent	0.089	0.285
2000	per cent	0.092	0.290
2001	per cent	0.093	0.290
2002	per cent	0.094	0.292
2003	per cent	0.095	0.293
2004	per cent	0.097	0.296
2005	per cent	0.093	0.290
2006	per cent	0.090	0.287
2007	per cent	0.086	0.281
2008	per cent	0.090	0.286