The Swedish 1990 Agricultural Reform – Adjustments of the Use of Land

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Abstract: This paper provides an empirical analysis of adjustments of land use as a result of the conversion programme in the Swedish agricultural reform of 1990. The determinants of farmers' choice to voluntarily convert arable land to other uses and the share of land converted are analysed with the Heckman selection model. The results suggest that the decision to convert is significantly affected by a farmer's age, the size and location of the farm, the type of farming, and the macroeconomic situation in the region. Farm operators on farms highly specialised in grazing livestock and farmers on large farms were found to be more prone to convert.

Keywords: Sample selection, Agricultural reform, Sweden, Set aside, MTR; *JEL*: Q15, Q18

Introduction

The mid-term-review (MTR) in 2003 resulted in a reform of the common agricultural policy (CAP) with the aim to replace earlier agricultural support with more decoupled support. Previous direct payments, acreage and headage support, to the agricultural sector will be replaced by a single farm payment. Farmers will receive payments regardless of their production as long as they maintain the land in good agricultural condition. The decoupled payments are intended to have no or minimal distorting effects on the level of production. However, even though the policy is further decoupled with lower distortions on the production level, the fact that the policy is changed towards more decoupling can trigger changes in the use of land and the type of farming (see e.g. OECD, 1999 and Andersson, 2004). According to several studies (e.g. European Commission, 2003 and Bäckstrand, 2003) production and land use is expected to change. Moreover, predicting the future after a radical policy is difficult. Additional insights can be attained by looking at past experiences.

In 1990 the Swedish agricultural policy was reformed and deregulated. In the present paper we will provide an empirical analysis of this reform. The results can be valuable when analysing the effects of other reforms, such as the MTR. The Swedish reform did not include decoupled payments, but was aimed at buying out production by converting arable land to e.g. forest or wetlands, but also to the production of energy crops and pasture. Since the participation in the conversion programme was voluntary, an analysis can provide insights to where the largest changes in the traditional agricultural business can be expected due to the MTR.

The Swedish reform has been described as radical, compared to the reforms in the EU and other western countries by Daugbjerg (1998). In the EU, the question was how to subsidise the agricultural sector, not whether or not to do it. In Sweden, the subject was deregulation. The reform included grants to farmers who converted arable land on a voluntary basis to other use than food production.

The most important policy instrument in Sweden prior to 1990 was the administered price on a number of crops (see appendix). Domestic prices were set in negotiations between the Federation of Swedish Farmers and the Consumer Delegation under the supervision of the Government. Farmers were compensated for increasing costs of production. The domestic prices were supported by the use of import levies and export subsidies. Export subsidies were used to compensate the farmers when quantities that could not be sold domestically at the administered prices were sold at lower prices on the world market. Structural policies played a minor role, and direct payments were introduced as late as 1989 with headage payments. Producers in the north however have received special support via the producer cooperatives.

In 1990 Sweden decided on a reform of the agricultural policy. According to the Government Bill (prop. 1989:146) the agricultural sector should act under the same conditions as the rest of the business sector. Farmers should be compensated only for demanded goods, and hence the consumer choice should be focus of the production. The internal market regulations were abolished while the border measures were kept awaiting a possible agreement within the GATT. As the Swedish agricultural sector was more supported than the average in the OECD, the abolishment of export subsidies was expected to have a negative impact on commodities produced at a surplus at domestic prices. Calculations by Jonasson (1993) show that the grain prices were expected to fall by 20 percent, while the impact on meat and milk prices were expected to be considerably lower. According to the Government Bill, the transition to a deregulated agricultural sector should be eased during a five year period from July 1, 1991 to June 30, 1996.

To reduce the over-production and to prevent prices from falling too much, one major part of the reform was to encourage a reduced production of the price regulated crops. To accomplish this, a conversion grant was created that could be applied for by farmers who voluntarily ceased with production of price regulated crops. Furthermore, for a permanent conversion of arable land to e.g. deciduous forest or wetland, an investment grant was created. Moreover funds were granted for special education and counselling to farmers in order to ease the transition in the agricultural sector. It was also stated the regional support to the northern parts of Sweden prevail (prop. 1989/90:146).

Sweden applied for a membership in the EC in July 1991 and joined the union in January 1995. The application to and the membership negotiations with the EC had a large effect on the reform. One major effect was that farmers who had joined the conversion programme were allowed to exit before the end of the conversion period, with the only obligation to repay the funds for the rest of the period. The planned conversion action was not required to be fulfilled.

Previous studies of the 1990 reform have focused on the implementation and the effects of the reform (OECD, 1995), as well as the political economy of establishing the reform package (Rabinowicz, 2004). The Swedish Board of Agriculture followed up the reform with reports in each year during the period 1991 to 1994. In 1994 a governmental study (SOU 1994:119) in addition analysed the impact of the reform from a consumer point of view.

The primary focus in this study is the impact of the reform on land use. We analyse two aspects; first, which factors that influenced the farmers' choice to join the conversion programme, and second, which factors influenced the share of arable land converted. We also focus on an early stage of the reform since the EU membership application heavily affected the decisions and expectations of the farmers.

The paper is organised as follows. In the following sections the legal framework of the conversion programme is described, and a theoretical framework for a farmer's decision making is presented. This section presents hypotheses about the likely impact of factors such as age, fertility of land, and size on the decision to participate. Thereafter, an empirical analysis is conducted. The last section provides conclusions and offers a discussion of whether any lessons about the likely impact of the MTR can be learned from the Swedish experience.

Details of the conversion programme

The regulation of the reform were formulated in the law SFS 1990:941. More specific details were outlined by the Swedish Agricultural Board in SJVFS 1991:5. The effects of the deregulation of the markets were supposed to be limited by the provision of support to the agricultural sector during a *conversion period.* This transition period ranged from July 1, 1991 to June 30, 1996. Three types of grants were created: an area based *income support*, a *conversion grant* for land taken out of production, and an *investment grant* to stimulate long-term investment on converted land. The base for participating in the reform was an *entitlement area*. This was defined as arable land that was farmed in 1990 with crops that were included in the price regulation system. The farmer needed more than 2 hectares of arable land to qualify for support.

The *income support* was paid annually based on the entitlement area. All farmers with such an area received the income support. The level of support diminished in the period from 1990 to 1993.

The *conversion grants* were supposed to cover the conversion period and to be paid out after the approval of an application from the farmer. The application to the conversion programme could be made for the years 1991 to 1994 for participation after the application date, i.e. no grants could be applied for ex post. The size of the grants depended on the location of the farm and was based upon the fertility of land in that area. The grant was given as a loan where the entire amount was paid in the beginning of the period, and then the loan was successively written off yearly during the conversion period. The primary objective of the conversion was to remove arable land from production of the price regulated crops. The alternatives for conversion were (SFS 1990:941, 4§)

- other permanent use than food production
- growing food crops not competing with present production
- permanent conversion to pasture
- contracted cereal production for ethanol production

The farmer was not obliged to specify in the application what the land should be converted to. The purpose was to give the farmer time to find the best alternative for conversion (Swedish Board of

Agriculture, 1991:4). Consequently, the farmer was also allowed to keep the land on hold until it was converted. During this period the land could only be used as a pasture for game (SJVFS 1991:5 19§).

The *investment grants* could be applied for during 1991 to 1995. The grant could be approved for planting bio-energy forests, deciduous forest, and for the establishment of wetlands. The grant was to be paid out when the investment was finished and approved.

Besides these three types of support, indebted farmers could apply for special support in the form of interest grants, liquidation grants, and redemption grants (Swedish Board of Agriculture, 1994:16). The use and the need for this type of support was however limited.

Impacts of the conversion programme

The total amount of land which was both eligible for income support and possible to convert within the conversion programme was about 1 906 000 hectare. About 72 000 farmers out of a total of 96 600 farmers were affected by the reform (Swedish Board of Agriculture, 1992:5). Table 1 shows the number of farmers that joined the conversion programme and the amount of arable land in conversion. As seen in table 1, about 93 percent of the converted land was put in conversion the first year of the reform. The share of the eligible area converted amounted 19 percent.

Table 1. Statistics on the conversion of arable land

	1991/92	**1992/93**	**1993/94**	**total**
Number of farmers with support from year:	19 657	1 989	541	21 056
Converted area (hectare)	337 466	20 661	4 697	362 824
Outstanding Loans (million SEK)	2 981	120	18	3 119

Source: Swedish Board of Agriculture (1994:16)

As a consequence of the Swedish EU membership, the reform was left unfinished and the farmers were allowed to leave the programme without fulfilling unfinished conversion activities. Table 2 shows how the area enrolled in the conversion programme were used in 1994.

Table 2. The use of converted land as of June 1994

Land permanently converted	55%
Converted land in store	45%
Use of areas permanently converted:	
Pasture	68%
Forest, bio-energy forest, wetland	16%
Niche crops (industrial crops)	15%

Source: Swedish Board of Agriculture (1994:16)

Table 2 shows that there were a limited permanent conversion and that the majority of the permanently converted land was turned into pasture. As a consequence, the investment grants were of limited use. In 1993, the Swedish Board of Agriculture followed up the use of the investment grant as approved amounts were not used fully, and among farmers waiting for approval numerous withdrew or changed the applications to cover less area (Swedish Board of Agriculture, 1993:23). Based on a questionnaire among farmers who had not yet used approved grants or who had waited for an approval, the Swedish Board of Agriculture made the following conclusions. First, the dominant cause, at least among farmers with investments covering at least 25 hectares, seemed to be an uncertainty about the Swedish agricultural policy as a result of the membership application to the EC. Second, cultivation was viewed to be more profitable. Third, the grant had not been used with reference to environmental considerations. It should, however, be noted that for farmers with investments covering less than 25 hectares, no such dominating alternative existed.

Land area under conversion was not eligible for compensatory payment in the EU or environmental payments. During 1995 and 1996, as a consequence, it was possible to leave the conversion and join the EU compensatory payment scheme. About 19 000 farms with a total of 330 000 hectares of arable land did leave the conversion programme. The farmers had to re-pay what remained of their loans, corresponding to the remainder of the conversion period. At the end of the conversion period, 30 June 1996, a total of 18 607 hectares (i.e. less than 1 percent of the eligible area) on 1 919 farms were approved as being converted. Thus the permanent effect on the area of arable land after the conversion reform was limited (Statistics Sweden, 2000).

Factors Affecting the Land Allocation Decision

There is a wide range of theoretical and empirical studies analysing structural changes in the agricultural sector and farmers' decision making. In this literature, a number of important determinants of the decision to expand or exit the farming industry have been pointed out. Tweeten (1984) concluded in a review of the literature that the most important determinants of farm size were technology, economic growth and off-farm income. The importance of socio-economic characteristics, technology, and macroeconomic factors as determinants for farmers' choice have also been addressed in formal models, e.g. in Goetz and Debertin (2001).

The following section provides a discussion of factors that are likely to be determinants of the decision to convert arable land from production of the price regulated crops to some alternative use. We concentrate the discussion on factors that have shown to be important in other studies of farmers' decision making, rather than on the outcome of formal economic models. This discussion is intended to give an insight into the factors that should be included in the empirical analysis and the likely impact of these on the decision to convert. The choice of variables included in the empirical analysis in this paper is restricted by the availability of data in the Central Farm Register. Thus, factors like e.g. recent investments, the presence of off-farm employment, and successors to the farm, unfortunately cannot be included in this analysis even though they have been proven to be important in previous studies, e.g. Weiss (2001).

Life-cycle effects

The importance of life-cycle effects on farmers' decisions have been emphasized by several authors. Boehlje and Eidman (1984) argue that the life-cycle of the farmer coincides with the life-cycle of the farm. This means that as the farmer gets older, the opportunity cost of investing in the farm or in terms of retraining and get an off-farm employment increases. Furthermore, young farmers, who have recently made large investments in their farms, are likely to be the most financially constrained, and they are thus expected to have less possibility of converting the land. For further discussions on the life-cycle effect see e.g. Huffman (1996), Goetz and Debertin (2001).

The effect of off-farm income

Off-farm income has traditionally been argued to stabilise the farm household income, which makes it possible for some farmers to continue their 'way of life' and even to continue a non-profitable farming activity (see e.g. Tweeten, 1984, Zurek, 1986, and Olfert, 1992). In contrast, it has been argued that off-farm work may be a first step out of farming due to lower transaction costs to find full-time off-farm employment (Pfeffer, 1989, and Goertz and Debertin, 2001).

An important factor regarding the possibility to obtain off-farm income is the economic potential in the region. One effect of being located in an area with a high economic potential is that the possibility of getting an off-farm income is good and the farmer could thus be expected to convert arable land to increase the off-farm income. However, the opposite may also be true, i.e. farmers in economically prosperous regions may already have diversified and are thus less dependent on the profits from the farm activity. The farmer may then be less likely to convert.

Type of farming and specialisation

The type of farming, both with respect to whether livestock is present on the farm, and to what degree the farm is specialised may affect conversion decisions. Farms with livestock may not have the possibility of converting arable land unless they reduce the amount of livestock as well, in order not to have a too high amount of animals per hectare land. The decision to convert thus has consequences for other farm operations than growing crops. On the other hand, the fact that pasture was included in the programme as a permanent conversion alternative, leads to the expectation that farms with grazing livestock such as cattle and sheep may be more likely to convert than others. The formerly price regulated crops may, however, be needed in the crop rotation with arable grassland, which implies that farms with grazing livestock may be less likely to convert too.

The degree of specialisation can also be important for the conversion decision, as the opportunity costs of converting may increase with the degree of specialisation. The higher opportunity cost can emanate both from a higher efficiency on these farms, and from the fact that these farm operators may have other management skills and education than is the case on less specialised farms. This applies both to the degree of specialisation in breading livestock and in growing crops.

Farm location and size

The *location* of the farm is obviously important for the explanation of the allocation and the use of land. The location to some extent determines the *fertility* of land, but also the mix of arable land and grassland on the farm. The effect of the fertility of the land on the conversion decision is not obvious. On the one hand, the largest areas of price regulated crops were grown on the most fertile land. Thus, the more fertile the land the more farms in that area was eligible for the reform. On the other hand, profits in crop farming generally increases with land fertility.

The *size of the farm* might also be of importance. Studies of structural change in the agricultural sector have found that exit rates are higher in regions with smaller farms (Glauben et al. 2003). It has been argued that the growth of large scale farms to emanate from technological change. In this sense, large farms has an advantage as they typically have access to more information, and financing and also have the necessary management skills (Lu, 1985). It has been argued in the theoretical literature, however, that small farms can survive as a consequence of the opportunity to get off-farm income. This suggests two types of hypotheses. The first hypothesis states that if it is the case that farmers on small farms has a part-time or a full-time off-farm employment, then these farmers might be interested in joining the conversion programme, in order to collect the grant without doing anything else. Thus, the smaller the farm, the higher the probability of joining the programme. This also has implications for the effect on the conversion of the macroeconomic environment. The easier it is to get an employment outside the farm, the higher the propensity to join the programme. The second type of hypothesis claims the reversed effect. Conversion on a small farm may demand that the farming activity is replaced by an off-farm employment. The decision to convert then incurs higher transaction costs than it would do on a large farm. Moreover, even without searching off-farm employment, transaction costs are high in relation to the grant on small farms. Thus, small farms may be expected to convert to a lesser degree.

Data

The empirical analysis in this paper is based on farm level data from 1990 and 1992 from the Swedish Central Farm Register. The data for 1992 cover 99 576 individual farms. From these farms we singled out those that were eligible for the reform. The eligibility depended on the farmers’ status in 1990. In total, this yields a sample of 66 657 farmers, which can be compared to the about 72 000 farmers who were eligible for the reform, according to the Swedish Board of Agriculture. We made some additional revision of the sample. Only farmers below the age of 65 have been included. This was made in order to exclude non profit oriented behaviour from groups that are at the very end of the life-cycle. Furthermore, farms organised in the form of stock companies were excluded, due to a lack of data on the age of farm operators. A sensitivity analysis with regard to this variable is discussed at the end of this paper. The final sample therefore consists of 54 303 farmers who were eligible for conversion. The years 1990 and 1992 were chosen since 1990 is the base year for eligibility for the reform, and 1992 since it is the first year when data was collected on converted arable land.

Table 3 shows the use of converted land in 1992 according to the Central Farm Register. This gives us an opportunity to see how well the data covers what actually happened during the reform.

Table 3. The use of converted land according to the Central Farm Register 1992.

Conversion activity:	Area (hectares)
Broad-leaf forest	2 128,6
Foliferous forest	3 469,6
Coniferous forest	4 995
Total forest	10 593,2
Pasture	124 089,5
Bio-energy forest	5 500,8
Industry and energy crops	10 970,2
Wetland	1 362,3

Other	10 348,1	
Total of permanently converted land	162 864,1	47% of totally converted land
Land in hold position	185 593	53% of totally converted land
Total of converted land	348 457,1	

First, already in 1992 as much as 53 percent of the converted land was put a in hold position. This can be compared to the register data from the Swedish Board of Agriculture, shown in tables 1 and 2, which state that as late as 1994 when farmers were offered to leave the conversion programme, the share of land put in a hold position had only diminished to 45 percent. Furthermore, as much as 89 percent of the area that was taken out of production of the price regulated crops were put in hold position or used as pasture. Thus, the most popular alternatives were those that were easy to reverse to arable land. Out of the permanently converted land 76 percent were pasture. The choice of the easily reversible alternatives was certainly affected by the expectation of the possible future membership in the EC.

Variables included in the analysis are shown in table 4, where some descriptive statistics are shown. Further descriptions of the variables are also shown in a list in appendix. In the following text some of the variables introduced in the analysis are briefly discussed.

To account for the economic potential of the region in which the farm is located, we have used a so called potential index (Spiekermann et al., 2002). The economic potential of the region, which is here represented by the municipality, is calculated from the economic mass in each region and the distance between the regions. The economic mass is the total income in the municipality and the distance is the fastest way between the main cities in two regions. Data used in calculating the potential index are official statistics on the municipality level from 1990 provided by Statistics Sweden. Unfortunately, in this study we have no available data on the relation between on-farm and off-farm income.

The labour input of the farm is measured by *standard hours* which is a variable available from the Central Farm register. The standardized labour input is calculated by Statistics Sweden on the basis of what the farmers have stated in terms of crop areas, number of livestock, dairy production etc. High numbers of standard hours indicate either large arable farms or labour intensive livestock farms such as diary farms.

Fertility of land is measured by the *norm yield* that was used by the Swedish Board of Agriculture to determine the income support and the conversion grants levels in the 1990 agricultural reform (SJVFS 1991:5). In 1990 Sweden was divided into 151 yield areas where norm yields, based on the yield in the specific area on different crops, was assigned by the Swedish Board of Agriculture.

To represent the intensity of farming the *degree of specialisation* in crops and in livestock is introduced in the model. Specialisation is calculated as a Herfindahl index (see appendix). We have also included a dummy variable for farms that were coded in the Central Farm Register as having their main operation in grazing livestock.

Regional differences that affect all farmers in the region in the same manner are accounted for by *dummy variables* for the eight official production areas used in the official statistics. These are listed in appendix.

Table 4. Definition of variables and descriptive statistics

Variable	Symbol	Eligible for conversion All Mean (stdv.)	Eligible for conversion Age<65 Mean (stdv.)	Converters All Age<65 [1] Mean (stdv.)	Converters Permanent Age<65 [2] Mean (stdv.)
Number of observations		66 657	54 303	13 506	9 217
Age of farmer	AGE	52.3158 (13.3909)	47.894 (10.447)	46.837 (9.883)	46.498 (9.921)
Potential index	POTIND	154.909 (57.8026)	155.243 (58.300)	160.951 (51.391)	159.719 (48.342)
Share of price regulated crops grown on the arable land 1990	RELPRCR	0.507 (0.306)	0.5190 (0.303)	0.630 (0.266)	0.602 (0.262)

Relation of the area of arable land between 1990 and 1992.	RELAR	1.0542 (0.363)	1.069 (0.388)	1.200 (0.545)	1.293 (0.607)
Degree of specialisation in livestock	SPECLS	0.332 (0.290)	0.333 (0.283)	0.307 (0.299)	0.345 (0.284)
Degree of specialisation in crop farming	SPECCR	0.436 (0.206)	0.424 (0.200)	0.371 (0.189)	0.352 (0.171)
SPECLS*DUMLS	DLS	0.187 (0.229)	0.192 (0.227)	0.145 (0.217)	0.176 (0.225)
SPECCR*DUMLS	DCR	0.179 (0,219)	0.184 (0.218)	0.120 (0.182)	0.147 (0.190)
Dummy variable for main operation in grazing livestock	DUMLS	0.4558 (0.498)	0.473 (0.499)	0.351 (0.477)	0.434 (0.496)
Standardised labour time needed for the stated type of farming	STANDARD	1631.7 (1701.78)	1788.23 (1756.74)	1982.42 (2071.06)	2178.98 (2158.05)
Area of arable land before conversion in hectares	AREA	34.585 (41.979)	37.83 (42.783)	63.420 (62.292)	69.119 (65.460)
Normalised yield in the region	NORMY	3924.66 (1059.78)	3954.22 (1056.24)	4354.37 (893.515)	4343.47 (871.784)
AREA* NORMY	NORMAREA	148420.9 (207426.4)	162634.4 (211561.4)	287675.1 (312283.2)	312230.7 (328380.0)

Empirical Analysis and Results

To analyse which farmers that did join the conversion programme and the share of arable land they converted, we estimate a two-stage model as proposed by Heckman (1979). In the first stage, the probability of joining the conversion programme is estimated with a discrete choice model using a Probit estimator. This stage seeks to take into account the selection bias arising from the fact that some farmers decide not to participate in the conversion programme at all. From this first estimation the inverse Mills ratio is calculated for each observation. In the second stage, we estimate the determinants of the share of arable land converted by OLS. At this stage, we only use data for the farmers that decided to join the conversion programme. The selection bias is controlled for by the inclusion of the inverse Mills ratio as an explanatory variable. This two-stage approach allows us to make two types of analyses. First, the patterns determining whether or not a farmer decides to convert is analysed, and second, the determinants of the share of arable land converted is analysed. It could also be noted that the specifications of the stage 1 and stage 2 models differ with respect to the included variables. Following Vella (1998), in order to avoid problems of identification of the second stage, the OLS model, we include variables in the first stage not included in the second. We therefore include the potential index in the estimation of the probability to convert, but omit this variable in the second stage when estimating the share of arable land converted.

We estimate three different models with three different dependent variables. In all estimations, the independent variables are the same. In the first model [1] the dependent variable is conversion according to the legislation. In the second model [2] permanent conversion is analysed, and the dependent variable is conversion excluding land in hold position. Finally, in the third model [3] we also exclude conversion to pasture, since the permanence of such an activity can be questioned.

Empirical results

The following section discusses the estimation of model [1] where total conversion is explained. The alternative models [2] and [3] of permanent conversion are discussed later in a short chapter relating the results of these models to [1].

The results of the estimations are reported in table 5. In the first panel of the table, the marginal effects of the Probit estimation of the probability to convert are presented. The second panel shows the OLS estimates. Bold figures indicate parameter estimates significant at the 5 percent level while bold italics indicate significance at the 10 percent level. The t-ratios are reported within parentheses. All parameters, except one regional dummy variable (PA2), are significant at the 5 percent level in the Probit estimation of the conversion. At the second stage, the OLS estimation of the determinants of the share of arable land converted, three variables, the potential index (POTIND) and the norm yield

(NORMY), the dummy variable for production area 7 (PA7) the lower parts of Norrland, are not significantly different from zero. The share of price regulated crops grown in 1990 (RELPRCR) is significant at the 10 percent level, while the remaining variables are significant at the 5 percent level.

It also deserves to be mentioned that the coefficient of lambda, i.e. the inverse of Mills ratio, shows that the selection process is important for explaining the share of arable land converted.

Table 5. Regression results

Specification:	Conversion	Permanent conversion	Permanent conversion exclusive pasture
Independent variables:	Coeff. (t-ratio) [1]	Coeff. (t-ratio) [2]	Coeff. (t-ratio) [3]
	Dependent variable: probability to convert		
Intercept	**-0.879** (-22.431)	**-0.669** (-21.057)	**-0.180** (-11.581)
AGE	**0.0128** (8.287)	**0.007** (5.459)	**0.001** (2.400)
AGESQ	**-0.00015** (-9.170)	**-0.872E-04** (-6.597)	**-0.162E-04** (-2.516)
POTIND	**-0.694E-04** (-2.018)	**-0.0001** (-3.528)	**-0.437E-04** (-3.004)
RELPRCR	**-0.035** (-3.795)	**-0.083** (-10.815)	**0.012** (3.207)
SPECLS	**-0.033** (-4.480)	**0.045** (7.495)	**-0.009** (-3.461)
SPECCR	**-0.060** (-4.749)	**-0.098** (-8.756)	**-0.034** (-6.780)
DLS	**0.123** (5.781)	-0.017 (-1.056)	**0.054** (6.171)
DCR	**-0.056** (-2.281)	**-0.048** (-2.363)	-0.015 (-1.318)
DUMLS	**-0.096** (-7.228)	**0.028** (2.559)	**-0.047** (-7.887)
STANDARD	**-0.523E-04** (-30.701)	**-0.386E-04** (-29.163)	**-0.161E-05** (-3.162)
AREA	**0.012** (42.747)	**0.008** (39.178)	**0.001** (13.613)
NORMY	**0.917E-04** (22.323)	**0.764E-04** (23.288)	**0.982E-05** (6.059)
NORMAREA	**-0.159E-05** (-28.674)	**-0.111E-05** (-27.282)	**-0.134E-06** (-8.398)
PA1	**-0.064** (-5.176)	-0.008 (-0.677)	**-0.022** (-6.911)
PA2	-0.001 (-0.110)	**0.037** (2.988)	**-0.015** (-4.067)
PA3	**0.074** (4.794)	**0.053** (3.843)	-0.007 (-1.504)
PA4	**0.149** (10.022)	**0.102** (7.339)	**0.014** (2.277)
PA5	**0.034** (2.956)	**0.051** (4.756)	**-0.013** (-3.257)
PA6	**0.076** (5.670)	**0.077** (5.778)	0.004 (0.704)
PA7	***-0.021*** (-1.899)	0.002 (0.222)	**-0.019** (-6.280)
McFadden	0.197	0.162	0.152
Correct predictions*	79.417%	84.073%	94.816%
	Dependent variable: share of arable land converted		
Intercept	**-0.121** (-2.427)	**-0.138** (-4.030)	**-0.320** (-2.847)
AGE	**0.006** (3.884)	**0.002** (2.358)	0.0005 (0.153)
AGESQ	**-6.874E-005** (-3.962)	**-2.890E-005** (-2.611)	-1.081E-006 (-0.048)
RELPRCR	***-0.017*** (-1.799)	**-0.079** (-12.332)	0.007 (0.536)
RELAR	**-0.019** (-5.469)	**0.053** (26.709)	**0.061** (11.503)
SPECLS	**-0.100** (-14.440)	0.006 (1.210)	**-0.047** (-5.108)
SPECCR	**0.393** (31.636)	**0.141** (14.705)	**0.101** (4.469)
DLS	**0.192** (8.865)	**0.028** (2.125)	**0.181** (4.883)
DCR	**-0.354** (-13.602)	**-0.129** (-7.987)	**-0.162** (-3.963)
DUMLS	**-0.060** (-4.531)	**0.020** (2.551)	**-0.115** (-4.431)
STANDARD	**-2.386E-005** (-14.585)	**-1.953E-005** (-17.234)	**-3.746E-006** (-2.696)
AREA	**0.002** (8.191)	**0.002** (8.516)	**0.002** (3.488)
NORMY	7.463E-006 (1.596)	**1.646E-005** (5.155)	2.974E-006 (0.448)
NORMAREA	**-3.590E-007** (-7.234)	**-2.358E-007** (-7.297)	**-1.896E-007** (-2.947)
PA1	**0.038** (2.390)	**0.049** (4.541)	***-0.045*** (-1.862)
PA2	**0.068** (4.736)	**0.072** (7.306)	-0.018 (-0.903)
PA3	**0.120** (7.929)	**0.069** (6.622)	-0.002 (-0.081)
PA4	**0.163** (11.551)	**0.076** (7.725)	**0.042** (2.309)
PA5	**0.098** (7.502)	**0.073** (7.908)	-0.020 (-1.161)
PA6	**0.112** (8.236)	**0.071** (7.361)	0.027 (1.590)
PA7	0.016 (1.072)	0.015 (1.521)	**-0.056** (-2.511)
LAMBDA	**0.101** (9.477)	**0.062** (8.292)	**0.158** (4.304)
No. of obs.	13 506	9 217	2 805
R^2	0.261	0.239	0.204
R^2 adj.	0.260	0.237	0.198

* Actual 1s and 0s correctly predicted.

Life-cycle effects

The effect of the farmer's age (AGE and AGESQ) is non-linear. The probability of a farmer to convert increases up to an age of 42 years, thereafter the effect of age is negative. Regarding the share of land converted, a farmer's age increase the share of conversion up to the age of 46 years. The results thus confirm the hypothesis of a life-cycle effect. This type of effect has also been found in previous studies, e.g. Weiss (1999) and Gale (1994).

Effects of off-farm employment possibilities and labour input

The economic potential of the region where the farm is located is captured by the potential index (POTIND). This variable has a significantly negative effect on the probability to join the conversion programme. This result contrasts the idea that the opportunity to get off-farm employment has a positive effect on the probability to convert. It seems that farms located in areas with a high economic potential are less likely to convert. An explanation of this finding could be that farmers in these regions are not as dependent on farm income as others, since the possibility to reach off-farm income is good. This interpretation thus seems to support previous results, e.g. Tweeten (1984) regarding the impact of off-farm income on the decision to exit farming. Goetz and Debertin (2001) conclude that the effect of off-farm employment is complicated. While it has been argued that off-farm income may be a way for small farms to survive, Goetz and Debertin (2001) find a potentially positive effect on the exit rate of off-farm employment in countries that experience a net loss of farmers.

The effect of the standardized labour input (STANDARD) needed on the farm is negative both on the probability to convert and on the share of arable land converted. Farm operators on farms with a high labour input are thus less likely to convert. The rationale of this effect could be that converting arable land has implications for changes in other operations on the farm. Given that the area of arable land has been controlled for, a high amount of standard hours implies a labour intensive livestock on the farm. On these farms the area of arable land might be needed for keeping the number of animals per hectare at a suitable level. This will have a negative impact on the share of land converted. In this case conversion thus implies more than just converting land since it also affects other operations on the farm.

Type of farming

The effect of *grazing livestock* is controlled for by the variable DUMLS and the interaction with the degree of specialisation in livestock (DLS) and in crops (DCR). The direct effect of grazing livestock is negative both on the probability to join the programme and on the share of land converted. The interaction effect of specialisation in crops is also negative, while the effect of a higher specialisation in livestock is positive. The total effect, measured at the mean level of specialisation remains negative for both estimations however. Interaction effects are shown in appendix.

The rationale of the total negative effect of grazing livestock could be that these farms need the area for the crop rotation with arable grass land. The need to keep up the area of arable land per livestock could be solved by converting to pasture, where manure can be spread. Thus the former explanation seems more probable. The positive effect of the interactive term DLS, i.e. the degree of specialisation in livestock given that the farm is raising grazing livestock, could be given the interpretation that these farms specialise further in grazing livestock, which requires further grazing land.

The *degree of specialisation* is included here as highly specialised farms may be more efficient than others, and as a consequence may incur higher opportunity costs. The effect of the degree of specialisation on the probability to join the conversion programme is negative, which supports the idea of opportunity costs. One exception appears however. Given that a farm is operating mainly grazing livestock, the probability to convert is higher, i.e. the interaction effect with variable DLS. The rationale of this result is the conversion alternative pasture. These farms have an advantage of converting as they already have the livestock, and thus the short run investment incurred by the conversion is probably limited to fencing. Thus such farms incur lower opportunity costs to join the programme.

A first effect regarding the share of land converted is that specialisation in crops (SPECCR) increases the share of conversion. Thus, there is an effect of *all or nothing* among highly specialised arable farms. Those who join convert more than the less specialised farms.

The effect of specialisation in livestock is dependent on whether the livestock is grazing. Again, a grazing livestock implies higher conversion shares, i.e. the joint effect of SPECLS and DLS. Again, the explanation is probably the pasture. For other farms, specialisation in livestock (SPECLS) affects the share of converted land negatively. As before this effect could be explained by the need to keep the amount of livestock per hectare at a suitable level.

Overall, the effect of specialisation seems to be that these farms are less likely to join the conversion programme. One exception concerns farms with a grazing livestock, which seem to use the alternative pasture and thus seem to increase the pasture land while, at the same time, collecting the conversion grant during the conversion period. Thus, specialised farms which, generally, are more efficient, and which thus have higher opportunity costs to convert, choose to continue to farm the land in a larger scale than others.

To account for the fact that farmers were not able to convert more land than was previously devoted to price regulated crops, we included a variable (RELPRCR) to control for the share of price regulated crops on the farm in 1990. The estimated parameter implies that the higher share of price regulated crops 1990, the lower is the probability to join the conversion programme, and the lower is the share of arable land converted. The effect of this variable was not as expected. One explanation could be that this variable catch a lock-in effect in growing price regulated crops. Despite the expected fall in prices, farmers that were more dependent on these crops had too high opportunity costs to convert.

Farm size and regional location

The size effect (AREA) shows that larger farms are more likely to join the conversion programme, and they also convert a larger share of the arable land. However, the effect is smaller the more fertile is the land. This follows from economic theory since the opportunity cost to convert increases with fertility. The effect remains positive however. The rationale of this effect could be that a conversion implies different decisions for large and small farms. For a small farm, a conversion might practically imply exiting the farm activities, while on a large farm, conversion could imply a mere scale down, and perhaps complemented by a part-time off-farm employment.

The effect of the fertility of land (NORMY) on the probability to join the conversion programme depends on the size of the farm. The effect is positive for farms smaller than 58 hectares and negative for larger farms. The negative impact of fertility on large farms suggests that economies of scale negatively affect the decision to convert. The share of arable land converted is negatively affected by the fertility of the land independent of the farm size, which follows from the discussion of opportunity cost.

The effect of an increase in the area of arable land between 1990 and 1992 (RELAR) was studied in the analysis of the share of arable land converted. The effect is negative and thus expanding farmers seem to have had a more positive view of the future of farming than others.

The effect of the *regional location* is captured by the dummy variables which show that farmers in the south of Sweden, i.e. PA1 and PA2, and in the north, i.e. PA7 and PA8, were less interested to convert than others. Consequently, in the regions with the most fertile arable land in the south and the least fertile land in the north farmers were less likely to join the conversion programme and converted lower shares of their arable land. One possible explanation of this result, apart from all other region specific differences catched by these variables, could be found in the expectations of the future of farming. It is not unlikely that the expected profitability of farming in relation to other regions was relatively good in the north and south. If profitable farms are to be found at all it is likely that they are located in the most fertile region in the south. In the northern regions special subsidies were provided as a regional support.

Explaining permanent conversion with and without pasture

This section describes the differences between the results of the estimation of model [1] and models [2] and [3]. In model [2], permanent conversion is the dependent variable and in [3] permanent conversion without pasture is used. The discussion will focus on main differences.

The estimations with permanent conversion without pasture [3] contain more insignificant variables than the other two models. Age, the economic potential in the region and the share of price regulated crops grown in 1990 are all insignificant. It should be noted that fewer farmers converted permanently, and even fewer did so if pasture is excluded.

The major difference when comparing the estimations of conversion [1] and the two cases of permanent conversion is the effect of specialisation and grazing livestock. When permanent conversion [2] is analysed, the effect on the probability to join the conversion programme of a *grazing livestock* switched to positive in contrast to the estimation in the analysis of the all conversion alternative [1]. The effect however remains negative when permanent conversion exclusive pasture [3] is analysed. This result supports the discussions earlier that farms with a grazing livestock as their major operation, did convert to permanent pasture. The effect on the share of arable land converted remains negative for both specifications of permanent conversion. It thus seems that farmers with a grazing livestock did convert to pasture. However, *ceteris paribus*, the presence of a grazing livestock reduced the share of land converted.

To further support the discussion on livestock, in the case of permanent conversion with pasture the effect of the *degree of specialisation* in livestock positively affects the probability of joining the conversion programme. Compared to model [1] this effect only appears on farms with grazing livestock.

The overall conclusion of the estimations of permanent conversion with [2] and without [3] pasture is that farms with grazing livestock used this alternative, which probably implied a further specialisation in the farming operations. This conversion alternative was thus not used as a partial exit or as a withdrawal from farming, but rather for an increased degree of specialisation.

Sensitivity analysis: including stock companies in the sample

No farms that are stock companies were included in the sample above as the age of the farm operator is lacking. A specification where the companies were given the average age, and a dummy variable indicating company were estimated. The result suggests that companies are significantly less probable to join a conversion programme, but given conversion, a higher share of arable land is converted. These effects correspond to the effect of the degree of specialisation in crops found in the models estimated without stock companies.

Concluding Discussion

The purpose of this paper was to investigate patterns of conversion activities as a consequence of the 1990 agricultural policy reform in Sweden. The reform included an income support in the form of area payments and conversion grants to farmers who converted arable land from production of the earlier price regulated crops. The payments and grants were temporary, and the intention was to provide them from 1991 to 1996. However, about the same time as the reform came into force, the Swedish Government applied for a membership of the EC. Naturally, this application had large effects on the farmers' expectations of the future of agricultural policy in Sweden. As a consequence of the EC accession in 1995 in combination with the fact that arable land in conversion did not qualify for area payments in the CAP, Swedish farmers were offered to leave the programme without fulfilling the planned conversion activities. The effect of the membership application and the early ending of the reform certainly affected the final outcome of the land conversion programme. Nevertheless, this is an example of a reform where farmers were offered payments that to some extent are similar to the single farm payment that is to be introduced in the CAP as a result of the MTR. Therefore, it is interesting to analyse the patterns of farmers' decisions to choose not to continue to farm parts of their arable land.

In the Swedish reform, conversion grants and investment grants to remove land out of production of price regulated crops were offered. Farmers who decided to convert arable land were obliged to immediately remove the arable land out of growing such crops. However, the conversion action needed not to be undertaken until the end of the conversion period. Thus, at the beginning of the reform, almost all land was put on hold, or converted into pasture. This means that the land was formally converted, but not necessarily in practice, and no non-reversible action had yet been taken. Much of this land was at the time of the EC accession removed back into farming.

The analysis shows that those most likely to participate in the conversion programme were farmers at the age around 40, farmers highly specialized in grazing livestock, and farmers with large farms. Those who were less likely to convert were young and old farmers, farmers located in a region with a high economic potential, highly specialized farms, farms with a grazing livestock, farms with more fertile land, or farms located in the northern part of Sweden where regional support were provided.

The analysis confirms the *life-cycle* patterns previously found in the literature. The highest probability of converting and the highest share of arable land converted is found among farmers between the ages of 38 and 46.

The effect of the *size* of the farms suggests that both the probability of converting and the share of the area converted are lower for small farms. Possible explanations of this finding are related to transaction costs and economies of scale in production. A large farm can convert a part of the land, presumably the least fertile plots, and still be able to farm remaining land with reasonable efficiency. This is difficult for a small farm. Moreover, transaction costs may be too high to make it worthwhile to convert a small plot. In combination with the fact that the economic potential of the region where the farm is located and the possibilities of reaching off-farm employment have a negative effect on the conversion decision, what would imply that there is no sign that farmers did convert in order to substitute farm income for *off-farm* income. Rather, the results can be interpreted in line with the arguments of Tweeten (1984); small farms could continue as a consequence of having an off-farm income. However, it should be mentioned that because of a lack of data, we have not directly included variables of off-farm employment or income, or of actual on-farm employment.

Overall the effect of *specialisation* seems to be that more specialised farms were less interested in joining the conversion programme. The exception is farms having their main operations in grazing livestock. The option to convert arable land into pasture gave them an opportunity to enlarge their area of pasture land and to receive a conversion grant during the conversion period. Specialised farms that probably have a high opportunity cost to convert, chose to continue farming the land in a larger scale than others. On the other hand, such farms tend to convert higher shares given that they have converted.

Livestock on the farm was also found to affect the decision to convert. The overall impression is that the presence of livestock has a negative effect both on the probability to join the conversion programme and on the share of arable land converted. However, the effect of *grazing livestock* on the probability of converting to pasture is positive.

The impact of *specialisation in crops* reveals differences between farms that joined the programme and those that did not. The degree of specialisation reduces the probability of joining the programme while the effect of specialisation on the share of arable land converted is positive amongst those who joined the programme. Thus, for these farms it seems to be *all or nothing*.

The effect of *fertility of land* is also ambiguous. The effect on the probability to join the conversion programme is dependent on the size of the farm. *Ceteris paribus*, the effect of the fertility of arable land is positive for farms with less than 58 hectares of arable land, but negative for larger farms. The effect on the share of arable land converted, however, is negative independent of the size of the farm, suggesting that the opportunity cost to convert increases with fertility.

We did find a significant effect of the location of the farm. *Regional effects* are captured by dummy variables for eight production areas. That regional differences exist is not unexpected, however, the pattern is interesting. Farmers in the north of Sweden (Norrland, PA7 and PA8) and in the coastal southern regions (the plain and the central districts of Götaland, PA1 and PA2) acted similarly. These regions are the ones with the lowest and the highest fertility of arable land, respectively. *Ceteris paribus*, being located in the north or in the south reduces the probability of joining the conversion programme, and among those who joined the programme, a lower share of arable land is converted in these areas. Regional characteristics can appear in many different forms, and one important effect can be due to expectations of the future of agriculture. Overall, price reductions were expected to emanate from the deregulation reform, which thus would reduce the profitability of farming. However, it was stated in the Government Bill that the regional support to the north should remain, and thus it is reasonable to believe that farmers in this region had a good hope that profitability despite lower market prices would remain satisfactory due to special subsidies. It is, furthermore, reasonable to believe that farmers in the south, in the most fertile arable land in Sweden, expected farming to be more profitable here relative to less fertile regions. This interpretation suggests that farmers' expectations are important for the outcome of the reform, a feature indicated also by e.g. Burfisher and Hopkins (2003) and Goodwin and Mishra (2002).

Swedish experiences and the MTR – what can be generalised?

There are several important differences between the Swedish reform and the MTR that have to be kept in mind while reflecting upon possible implications of the Swedish experiences for the impact of MTR and the land use.

Profitability and the impact on farm income: several studies indicate (e.g. Bäckstrand, 2003) that the MTR reform is expected to result in an increase of farm income and producer surplus. The opposite was the case in Sweden, according to a study by Jonasson (1993) producer surplus was expected to fall considerably. The same effect was found with respect to prices. Removal of export subsidies in Sweden was expected to push prices of surplus commodities, like grains, down. A likely result of the MTR is an increase of producer prices.

The single farm payment is an annual payment with no other obligation than that the land, if not used in production should be kept in a good agricultural cultivation. Under this scheme, a farmer can choose not to produce one year and return to production the next year. The Swedish reform required the farmer to remove the land out of production and to convert it to other uses. This is, undoubtedly, a considerable difference. However, it should be observed that although farmers who participated in the programme were obliged to convert to alternative land uses at the end of the five year period, it was never explicitly stated *how long* the land should remain in this new use. In addition, farmers could convert to pasture – an option for which re-conversion to arable land is easy. Those two circumstances together imply that in reality farmers were not denied a possibility to return to production. Furthermore, in the MTR farmers do not make a special application to remove land from production, while in Sweden all farmers who wanted to convert had to apply for conversion grants. Thus the transaction costs to remove land from production were higher as a consequence of the Swedish reform, a fact which probably had a negative effect on the amount of land withdrawn from production.

Because the conversion programme was directed towards land previously used for price regulated crops and because the conversion even included a conversion of land to pasture, some of the effects of the reform are specific to Sweden. However, conclusions related to (i) the age of the farmer and life-cycle factors, (ii) the size of the operation, (iii) the economic conditions in the region where the farm is located, (iv) the natural conditions for agriculture (fertility of land), (v) the degree of specialisation and (vi) expectations seem potentially applicable conditions within the EU in accordance with the discussion below.

(i) Likely participants in the conversion programme in Sweden included middle aged farmer rather than young or old farmers. The effect of *life-cycle* factors has also been established in earlier studies. It is highly probable that similar patterns apply to the MTR reform. When production is no longer required to receive payments, farmers in the middle of their farming career are more likely to reconsider their choice of the vocation and opt for an alternative occupation than farmers who are in the very beginning or approach the end of their farming career.

(ii) The Swedish experience show that the *size of the farm* measured as the area of arable land affected the decision to convert. If this effect applies to the MTR reform, the effect would thus be that the reduction of farm operations would be more likely to be found on large farms.

(iii) The effect of a higher *economic potential* in the region affected the probability to convert negatively in the Swedish conversion programme. This could indicate that farmers in more prosperous regions had off-farm employment already. This fact could imply that the production would remain in areas with a high economic potential, where the farm operator is less dependent on the farm income.

(iv) *The natural condition for agriculture* affected the decision to convert negatively. If this effect apply to the MTR reform the reductions in farm activities is likely to take place on the less fertile land.

(v) The Swedish experience shows that *the type of farming and the degree of specialisation* also affected the decision of converting. Highly specialised farm operations reduce the probability of converting which is also the case with a labour intensive livestock farming. Again, this is an effect that might apply to the MTR.

(vi) *Expectations* have been argued to be an important factor for a farmer's decisions. In Sweden the farmers located in the north, with the least fertile arable land, were less likely to remove land from production. One rationale of this decision could be the statement by the Government that a regional support to the north should remain. This suggests that the farmers' expectations, and expectations among different groups of farmers, of the future of the CAP will be important for the amount of land removed from production.

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Appendix. List of Variables

AGE	Age of farmer
AGESQ	(=AGE*AGE)
POTIND	The index over the economic potential in municipality *i* is defined as $P_i = \sum_j \frac{M_j}{\exp(d_{ij})}$ where M_j is the economic mass in municipality *j* (total income) and d_{ij} describes the distance (in 10 kilometers) between the largest cities in *i* and *j* (see e.g. Spiekermann et al., 2002).
SPECLS	The degree of specialisation in livestock farming Calculatet with a Herfindahl index: $H = \sum_{i=1}^{n} \left(\frac{x_i}{x} \right)^2$ where x_i is the number of livestock of a certain species, and x is the total number of livestock on the farm.
SPECCR	The degree of specialisation in crop farming measured with a Herfindahl index (see above).
DUMLS	Dummy variable for grazing livestock as main activity (as coded in the Central Farm Register).
DCR	(=SPECCR *DUMLS) (will get a value between 0 and 1 for farms coded as livestock farms) measures the interaction between grazing livestock farming and the degree of specialization in crop farming .
DLS	(=SPECLS* DUMLS) measures the interaction between grazing livestock farming and the degree of specialization in live stock.
STANDARD	Standard hours in farming, i.e. a standardized size parameter based on the size of the farm and the type of farming.
AREA	Area of arable land 1992 + converted areas, i,e. the area of arable land that would prevail if no conversion had taken place.
NORMY	A standardized yield in the yield district in kilogram per hectare 1990 determined by the Swedish Board of Agriculture (a measure of fertility of land).
NORMAREA	=(AREA* NORMY); measure of the interaction between the area of arable land and the fertility of land.
SHARE	(=converted area/ AREA) the share of converted arable land in relation to the arable land if no conversion had taken place.
Production Areas	Dummy variables: 1 if the farm is located in the area.
PA1	Plain districts in southern Götaland.
PA2	Central districts in Götaland.
PA3	Plain districts in northern Götaland.
PA4	Plain districts in Svealand.
PA5	Forest districts in Götaland.
PA6	Forest districts in central Sweden.
PA7	Lower parts of Norrland.
PA8	Upper parts of Norrland (excluded region).
RELPRCR	Share of price regulated crops in relation to the total of arable land in 1990.
RELAR	Arable land 1992 in relation to 1990, i.e. >1 if the farms has expanded.