VOLUNTARY SET ASIDE OF ARABLE LAND IN AUSTRIA

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Abstract

In this report microeconometric methods are applied to explain the voluntary set aside of arable land of Austrian farms. The descriptive analysis of the data shows that the majority of the small scale farms do not set aside arable land. But if they do set aside land, they set aside substantial shares.

The microeconometric estimations confirm that the decision to set aside consists of two steps. The first step is whether to set aside at all and the second step is how much to set aside. The type of a farm has the biggest effect on the decision. Soil quality, the distribution of the soil quality, off farm work and the participation in the ÖPUL-program have significant, but generally small, influence as well. The results vary somewhat for different major production areas. If the two step model is used to calculate the expected set aside of a farm, it generally is low as farms have low probabilities to set aside.

Most of the farms under the general regulation set aside small shares of arable land. That is due to the fact that every set aside that is more than the mandatory 10 percent is defined a voluntary set aside. Therefore, unfortunately, the statistical estimations are almost impossible to render and hence set aside is not as well explained by the model for farms under the general regulation as for the small scale farms.

The main conclusion of the research is that there were no factors that lead to massive set aside. This can be interpreted as a sign that cultivating arable land generally still pays in Austria.

Zusammenfassung

In dieser Diplomarbeit werden mikroökonometrische Methoden angewandt um zu erklären wie viel Acker österreichische Bauern freiwillig stilllegen. Die deskriptive Analyse der Daten zeigt, dass der weitaus größte Teil der Kleinerzeuger nichts stilllegt, wenn jedoch stillgelegt wird, sind dies durchaus beachtliche Anteile der Ackerfläche.

Für Kleinerzeuger bestätigen die mikroökonometrischen Schätzungen, dass es sich um eine zweistufige Entscheidung handelt. In der ersten Stufe wird entschieden ob überhaupt stillgelegt wird und in der zweiten Stufe wird entschieden wieviel stillgelegt wird. Der größte Einflussfaktor für die Stilllegungsentscheidung ist der Typ des landwirtschaftlichen Betriebs. Auch für Bodenqualität, die Unterscheide der Bodenqualität der einzelnen Äcker, die Erwerbsart und ÖPUL-Teilnahme können signifikante, aber nicht besonders große, Einflüsse gefunden werden. Die Ergebnisse variieren leicht zwischen den verschiedenen Hauptproduktionsgebieten. In Summe sind die prognostizierten Stilllegungen gering.

Von den Betrieben unter der allgemeinen Regelung legt die Mehrzahl sehr geringe Anteile der Äcker freiwillig still, da alles was über die verpflichtenden 10 Prozent Stilllegung hinausgeht, als freiwillige Stilllegung zu rechnen ist. Dieser Umstand führt dazu, dass der Erklärungsgrad des Modells für Erzeuger die der allgemeinen Regelung unterliegen geringer ist als jener für Kleinerzeuger.

Zusammenfassen kann gesagt werden, dass keine Faktoren gefunden wurden, die zu einer massiven Flächenstilllegung führen. Dies kann als Zeichen dafür gewertet werden, dass sich das bestellen von Äckern im Allgemein in Österreich noch rechnet.

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Chapter 1

Problem Setting

In the European Union farms receive direct payments for not cultivating their fields. That is the amazing reality for those who are not concerned with agricultural policy. Those familiar with the situation, know that direct payments for non-cultivation of fields, called "set aside", were introduced as long ago as 1992 under the MacSharry Reform, when it was a measure to deal with overproduction. In the first year of the MacSharry Reform a set aside of 15% was mandatory, but that was changed a year later when it became voluntary to set aside land. It is estimated that cereal production would have been 10 million tons per year less between 1992 and 2001 if mandatory set aside had been maintained (Herman [20], page 27). In the Agenda 2000 Reform, which has led to the the current regulation, set aside of 10% became, with a few exceptions, mandatory again, but voluntary set aside above these 10% is still possible. The farms excepted from mandatory set aside are small scale farms.

In Austria the majority of the farms are small scale farms. As a sophisticated system for administration of the agricultural subsidies is in place, a large amount of data has been collected. The special situation that a mandatory set aside system is in place at the same time as a voluntary set aside system in combination with the availability of data is an excellent starting point for econometric research on how farmers make their decision. The focus here is to analyze which farms tend to set aside arable land. The findings are applied to the current discussion about decoupling.

The next chapter gives an overview of the legal foundations of set aside. Chapter 3 discusses what determines the set aside decision. Chapter 4 describes the sources of data and chapter 5 the models used for the calculations. The results are presented in chapter 6. In the last chapter a possible way to apply the results in the current discussion about decoupling and some ideas how research on this subject could be continued are presented. In appendix B some technical terms are translated to German. When the technical terms are used for the first time they are written in *italic*.

Chapter 2

The Legal Background

The most important regulation concerning set aside is the Support Scheme for Producers of Certain Arable Crops. But there are other laws that are relevant as background information for an economic analysis of the set aside as well. Partly these laws interact with each other and partly they specify each other. This chapter will give an overview sufficient as background for an economic analysis of set aside and will go into detail only where necessary. For those interested in details, the references to the respective laws are provided.

2.1 EU regulations concerning set aside

With the reform package Agenda 2000, a whole range of regulations were passed. The new regulations brought about a lot of changes and some of them concerned set aside. Set aside is regulated in EU Regulation 1251/1999 [6] that deals with the Support System for Producers of Certain Arable Crops. When I use the term “set aside” in this report, I will always use it in the way defined in this regulation.

2.1.1 Support System for Producers of Certain Arable Crops

Information about the direct payments for arable crops can be found in EU regulation 1251/1999 [6], 2316/1999 [10] and the Austrian regulation 496/1999 [29]. The support system grants payments per hectare of arable land per year based on historical yields of the region. These payments are also called “direct payments”. All of Austria is regarded as one region and the average yield of Austria was fixed to 5.27 tons per hectare. The payment is set to 63.00 €/ton for cereals and set aside, and to 72.50 €/ton for protein crops from 2001 onwards. For linseed it is set to 75.63 €/ton for 2001 and to 63.00 €/ton from 2002 onwards. For oilseed it is 63.00 €/ton from 2002 onwards. Hence, an Austrian producer receives 332.01 €/ha cereals, linseed, flax, hemp, oilseed and set aside and 382.075 €/ha protein crops in 2002. A supplement to the area payment of 344.50 €/ton is paid for areas down to durum wheat in traditional production zones. In the case of Austria, farms in Pannonia and in some regions of Lower Austria are eligible for this supplement, for details see Regulation 2316/1999 [10], page 22. The regulation for Certain Arable Crops allows countries to distinguish between irrigated and non-irrigated fields, to make grass silage eligible for area payments and to have a separate average yield for maize. Austria doesn’t apply any these three options.

As a condition to get direct payments granted, producers have to set aside 10 percent of their application area. Only small scale producers are excepted from this obligation. A producer is regarded as a small scale producer, if the production is less than 92 tons of cereals a year. For Austria the production of 92 tons equals 17.46 hectare as the average yield for Austria is fixed to 5.27 tons per hectare.

The minimum period for which land is set aside must extend at least over the growing cycle of the arable crops. It starts on 15 January of the year the application is handed in and ends on 31 August of the same year. However, there are exceptions to take special circumstances into account.

To receive direct payments granted the field must be at least 0.1 hectare or be a *field* in the sense of the definition in BGBl Nr 964/1994 [30] and have fixed borders.

Set aside payments are limited to a maximum of 50 percent of the application area of a farm. Once a field is set aside, the following rules have to be followed:

- The area must not be planted with more than 50 percent of cereals, oilseeds and protein crops.
- The cover of the set aside area must not be put to any use or conservation until the end of the set aside period on 31 August.
- The area must not be used for any agricultural or non agricultural purpose.
- The area has to be given the chance to get a natural cover or a cover has to be planted.

The land set aside can be used for production of products which main use is not human or animal consumption. These will be referred to as "non food crops". There is no obligation for rotation of land set aside.

2.1.2 Common organization of the markets of cereals

Together with the increase of direct payments intervention prices were reduced through Agenda 2000. This is determined in Regulation 1253/1999 [7]. The intervention price for cereals is set to 101.31 €/ton from the 2001/2002 marketing year onwards. This is the price at wholesale stage for goods delivered to warehouse before unloading. The intervention price is subject to monthly increases for the whole or part of the marketing year. The price at farm gate, which is the price of interest for the interpretation, is respectively lower.

2.2 Austrian laws concerning set aside

ÖPUL (Austrian programme to promote agricultural production methods compatible with the requirements of the protection of the environment, extensive production, and the maintenance of the countryside) is the Austrian Agri-Environmental Plan based on EU regulation 1257/1999 [8] and 445/2002 [11]. Is a complicated system of subsidies and regulations which compensates farmers for output reduction due to farming with less environmental impact. ÖPUL is a voluntary program, but every farmer on the Austrian territory can participate in ÖPUL. The program is financed by the European Agricultural Guidance and Guarantee Fund and by Austria. The EU pays 50 percent of the means while the rest is provided by Austria (federal provinces and the federal state). The federal province of Pannonia is an exception from this finance scheme as it is objective 1 area and the EU pays 75 percent of the ÖPUL expenditures.

It is not my intention to provide an overview about ÖPUL and its measures as this has already been done by various authors, e.g. see Grüner Bericht 2001 [13], page 160. The focus here is on measures that interact with set aside. To provide the necessary background information I will also present the requirements to be eligible for ÖPUL premiums and give figures about the premiums.

This is the set of requirements to be eligible for ÖPUL premiums [14]:

- The areas must be situated in Austria.
- The obligation is applicable for a period of 5 years (except 10 or 20 years for measures of nature preservation).
- The minimum farm size for participation amounts to 2 ha of utilized agricultural area, however if 0.25 ha of it are special crops (wine, fruit, herbs) the minimum farm size is only 0.5 ha of the utilized agricultural area.
- A double subsidization for the fulfilment of the same requirement, even in other fields of subsidization, is not permissible.

If the conditions are met, the farm can choose out of more than 30 different measures. Depending on the set of measures chosen, the subsidies are calculated. But the subsidies for area based premiums are modulated. The per hectare payment for one measure depends on the size of the area the measure is applied on. For an area

- up to 100 ha, 100% of the premium for the respective measure is payed
- from 100 ha to 300 ha, 85 % of the premium for the respective measure is payed
- from 300 ha to 1000 ha, 75% of the premium for the respective measure is payed
- for an area bigger than 1000 ha, 65% of the premium for the respective measure is payed.

If a farm participates in the measure "Organic Farming", the reduction is reduced by 50 percent. For example, the subsidies for a farm that applies for an area bigger than 1000 ha are not cut by 35 %, but just by 17.5%. On top of that, there is a premium ceiling for arable land and grassland of 690.39 €/ha. If the farm participates in certain measures, such as projects in favor of preventive water protection or creation of new landscape elements, the premium ceiling is increased to 872.07 €/ha.

Not all ÖPUL measures can be combined with each other. For details which measures can be combined see the table in appendix 20 of the ÖPUL Regulation [31].

Special rules apply for the combination of set aside and ÖPUL measures: Generally, ÖPUL does not grant any premiums for areas set aside under the Support Scheme for Producers of Certain Arable Crops. But there are three exceptions: Design of new landscape elements, preventive water protection in *redarea fields* and areas set aside where renewable resources are grown. For a description of these measures see appendix A. These three measures can be part of ÖPUL and be set aside at the same time. However, if done so, the subsidies cannot exceed 332 €/ha.

While a field can be part of these three ÖPUL measures and be set aside at the same time, the farmer must decide, whether she[1] prefers to have the payment for the ÖPUL measures or have the payment for set aside.

[1]To keep it simple, throughout the report the female form is used instead of both.

For the creation of new landscape elements and redareas water protection measures, ÖPUL premiums are much higher than set aside payment. But for growing sustainable resources, set aside payments are higher than the basic ÖPUL subsidy. An overview of the subsidies under ÖPUL and set aside is shown in table 2.1

Table 2.1: ÖPUL and set aside payments

	ÖPUL	set aside
creation new elements	min. 327.03 €	332.01 €
redareas water protection	min. 436.04 €	332.01 €
sustainable resources	min.(basic subsidy) 36.34 €	332.01 €

ÖPUL and other public support: ÖPUL does not grant any support, if the measure is already supported by another public support system (eg. environmental measures).

There are numerous other ÖPUL measures that influence the producer surplus of arable land cultivation. But non of these can be applied when the area is set aside. While it makes sense to keep in mind that ÖPUL benefits can be as much as 872 €/ha, it is far beyond the scope of this report to present the highly complex system of measures.

Focus: climate index, yield index and land register

The Austrian land registration system covers the whole country and can be found in the land register. As some of the data used in this report are from the land register I will present some key terms here.

In the land register all *properties* are listed. The definition of a property is given in BGBl 306/1968 [28]. Basically it is a piece of land with an associated number. Apart from other information about a property, the land register tells about the size and the *yield index* of a property. The yield index is the product of the size of a property in are and the *green land index* or *arable land index* [27]. The green land index and the arable land index are determined by land surveying. The natural circumstances such as soil quality, landscape, climate and water conditions found by a local inspector are used to calculate the index. It is derived through a formula and is between 1 and 100. The higher the index, the more productive the property. Green land and arable land indices are only determined for properties used for agricultural purpose. Evaluation of a property should be done every 20 years. But due to financial restrictions in practice it is not done that often. Therefore there are still properties which were estimated only in the 1950s. But in the meantime the soil quality might have changed significantly due to dried up swamps or deeper ploughs. Generally the soil quality has increased and increases up to 10 points are not uncommon. Four years ago, it was started to capture the data electronically in the DBE (Digitale Bodenschätzungs Ergebnisse). But it will still take a couple of years till all the data are captured electronically.

Farmers not necessarily cultivate land according to the borders of properties but rather according to what makes sense from an agricultural viewpoint. Data from the administration of the support schemes are based on *fields*, rather than on properties. A field is a clearly marked, in nature visible, cultivation unit consisting of just one type of cultivation purpose [30]. To determine the green land index or arable land index of a field, the weighted average of the intersections of the properties can be used.

The *climate index* is the yield index divided by the size of a property in are. Since a property can consist of different green land and arable land indices and the yield index is the weighted average of the arable land and green land indices there is a potential difference between arable and green land index and the climate index. The climate index is by fare the more common term.

Chapter 3

The Decision Farmers Face

This section discusses what influences the decision to set land aside. I only consider farms that do participate in the Support Scheme for Producers of Certain Arable Crops. Therefore I do not discuss the influence of mandatory set aside on the decision to take part in the Support Scheme for Producers of Certain Arable Crops (see e.g. Colman and Roberts [5], page 108, for more discussion on this). Mandatory set aside is not discussed here since there is no choice that could be analyzed. Never the less, mandatory set aside does play a role in the voluntary set aside decision and its influence will be discussed. The following section first analyzes the benefits of set aside, the opportunity costs of set aside and outlines the influence of structural differences, information and risk.

3.1 Set aside benefits

The first benefit from set aside to mention are the set aside premiums. An aspect to consider is that non food crops can be grown on set aside land. But as there is no other support system for non food crops in place, the decision will rather be other way round: if a farmer decides to grow non food crops, setting aside land is the way to get premiums for it.

Except for the plantation of non food crops, the land set aside must not be used for any purpose that yields economic benefits. While it is possible to claim the set aside land for ÖPUL measures, the premiums must not be higher than those from the set aside program. Therefore there are no direct benefits from setting aside land except for the premiums and the plantation of non food crops.

But there are some external effects that can influence the set aside decision: while it is still doubted by some scientists (see Garstang et al [17]), most experts expect benefits for farmers from rotational set aside. This includes positive spill over effects on other fields as well.

Expected marginal benefit from reduced work

To set land aside results in a reduction of work. Therefore the farmer has more time to spend on other things. It will depend on the expected marginal benefits of the time not spent for cultivating the field, how attractive it is to set a field aside.

Off farm wage

On way of spending the time is to do payed work. If the farmer has another job already, it could be quite easy to increase the working hours. But if it is difficult to find a job for a couple of hours only, it doesn't make sense to set aside for the purpose of doing off farm work. How much a job pays, will also depend on the geographical position of the farm and the education and experience of the farmer. Last, but not least, the situation on the labor market will influence the decision.

The higher the expected wage is, the higher the opportunity costs for cultivating land are. Therefore it will be more attractive to set land aside, if the expected wage is higher.

Focus on other farm activities

Another way of spending ones time could be to focus on other farm activities. This could be for example to spend time for education, for the construction of a new farm building or by specializing in another production area. The more such activities pay at the margin, the more attractive it is to set land aside.

More leisure

Last but not least, reduced work through set aside can be used for leisure.

3.2 Opportunity costs

The alternative to participation in a set aside program is non-participation. Therefore the opportunity costs to set aside are determined by all activities you can do if you don't set aside. This can, of course, be done in a lot of different ways. You can for example cultivate your fields, build a swimming pool on the property or simply sell it. All of these activities will yield different producers surpluses. The lease for fields, the prices of properties and many other parameters will play a role. I will only discuss the opportunity costs from cultivating the field, because I want to remain in the frame of the options given by the Support Scheme for Producers of Certain Arable Crops.

Expected marginal producer surplus from cultivation

When considering to set land aside, the farmer will ask how much loss or surplus she will have through not cultivating the field set aside. The producer surplus is determined by prices, efficiency, the weather and many factors more. Taking all of them in consideration, the farmer will have an expected producer surplus for each field. As the set aside decision is continuous, many of the factors unknown (yield, prices, ...) and the producer surplus probably not linear in the cultivated area, it makes sense to talk about the expected producer surplus at the margin. The producer surplus from cultivating a field is, beside others, dependent on the realization of the following variables:

Input prices

The prices of input goods such as labor, seeds, fertilizer, machines, fuel and so on have a direct impact on the producer surplus.

It is important to distinguish between fixed and variable costs, as fixed costs don't change if some hectares are set aside, while variable costs do. This leads to the conclusion that those farms with high fixed costs (for example if they made investments) tend not to set aside land. Roberts et al [34] find in their paper about English farms that the fixed costs proportion has a significant, surprisingly high, impact on the indifference price[1]. They found that bigger farms, with higher fixed costs proportions, are the latest to set land aside if market prices fall.

Producer prices

The expected prices of the goods produced would have a major influence on the set aside decision. But due to the market interventions of the EU, there is not too much variation possible. But the possibility to choose between different cultures gives some room for speculations.

Soil quality and its distribution

Standard assumption in theoretical literature is that farmers set aside their worst land if they decide to set aside land (e.g. see Colman and Roberts [5], Rygenstad and Fraser [36]) or Bourgeon et al [3]). In many papers that deal with efficiency and incentive questions of set aside this assumption is fundamental but often empirically not scrutinized. Authors who did challenge this assumption were Hoag et al [21]. In their empirical work for farms in North Carolina in the USA, they found that "worst-land-out-first, where land quality is measured by yield potential, does not describe actual farm behavior".

To go more into detail about the influence of soil quality and its distribution on the set aside decision, it is handy do differentiate the following cases:

1. `All the fields of a farm have the same soil quality.` Therefore the standard deviation of the soil quality of the fields of a farm is zero. If soil quality was the only relevant variable for the decision whether to set aside land, the farmer will either set aside as much as possible or nothing. If the soil quality of the land is low, she will set aside as much as possible. If the soil quality of the land is high, she will set aside as little as necessary. At one point, where the utility of setting land aside is equal with the utility of cultivating the land, she doesn't mind what to do. I will refer to that point as `break even` point.

2. `Fields differ in soil quality.` Therefore the standard deviation of the soil quality of the fields of the farm is positive. Some of the fields might have a soil quality below the break even point and will therefore be set aside, others might be above the break even point and will therefore be cultivated. If the differences between the soil quality of the fields is higher, the standard deviation is higher. Given the average soil quality of a farm this will lead to the following set aside decisions.

   - If the average soil quality of the farm is below the break even point, the farmer will set aside as much as possible if the standard deviation is zero (because all the fields are below the break even point). The higher the standard deviation is and the closer the average soil quality is to the break even point, the more likely it is that one of her fields lies above the break even point and will therefore not be set aside.[2]
   - If the average soil quality of the farm is above the break even point, the farmer will not set aside anything if the standard deviation is zero (because all the fields are

[1]The indifference price is the producer price at which the farm is indifferent between setting land aside and cultivating land.

[2]Of course it is possible that, even with a high standard deviation, no field lies above the break even point and, therefore no field is cultivated. But, under the assumption of identically distributed soil qualities, the probability that a field's quality is higher than the break even point is higher with a higher standard deviation.

above the break even point). The higher the standard deviation is and the closer the average soil quality is to the break even point, the more likely it is that one of her fields is under the break even point and will therefore be set aside.

- If the average soil quality of the farm is exactly at the break even point, set aside and cultivation of fields will occur. The standard deviation doesn't help to explain the shares.

To sum up, the farmer will set aside those fields that are below the break even point. It therefore would be good to know the break even point of each farm and calculate the sizes of the fields under the break even point[3]. Unfortunately the break even point can't be observed. As a way out it is possible to observe the influence of the average soil quality and the standard deviation on the set aside decision and draw conclusion about the probability that that fields are set aside. How this could be done is discussed in the next paragraphs.

Average soil quality: It is more likely that a farm with low average soil quality sets aside land, than a farm with high average soil quality.

Standard deviation of soil quality: Expectations concerning standard deviation are more complicated. Consider the following case that is also summarized in table 3.1. There are two farms. Each has three fields. Farm A has two fields with soil quality 20 and one field with soil quality 60. Farm B has one field with soil quality 20 and two fields with soil quality 60. Assume all of the fields have the same size. Hence farm A has an average field quality of 33.33 and farm B 46.66. The standard deviation of each farm is 18.86. If the break even point of both farms is somewhere between 20 and 60, we would expect farm A to set aside two fields and farm B to set aside one field. Standard deviation does not help to explain that. But average soil quality does. Now consider farm C. Farm C has two fields with soil quality 10 and one field with soil quality 80. The average soil quality is 33.33 and the standard deviation is 33.00. If we compare farm A and farm C, we notice that they have the same average soil quality but C has a higher standard deviation. The problem is that whether a low standard deviation is an indicator that a lot or just a few fields are set aside, depends on the break even point. If the break even point is at 65, a high standard deviation would mean that farm A does set aside all the fields while farm C would keep its field that has soil quality 80 in production. In other words, the farm with higher standard deviation sets aside less. On the other hand, if the break even point is at soil quality 15, farm A wouldn't set aside anything while farm C would set aside it's two fields with soil quality 10. In other words, the farm with higher standard deviation sets aside more.

Table 3.1: Example: Average Soil Quality and Standard Deviation

soil quality	farm A	farm B	farm C
10			**
20	**	*	
60	*	**	
100			*
average soil quality	33.33	46.66	33.33
standard deviation	18.86	18.86	33.00

Generally I would assume that the majority of a farm's fields are above the break even

[3]All discussion is under the assumption that the only parameter relevant for the set aside decision is soil quality. This certainly is not the case, but for the sake of argument I want to stick to it.

point. That is because the break even point is dependent, among other factors, on the set aside premiums. Set aside premiums are set by the EU council and if the premiums were set so high that farming for the majority of farmers doesn't pay anymore, these farmers would give up farming. As this is not in the interest of the council, the premiums are set in a way that for the majority of the farms the average field is still above the break even point. I therefore expect a higher standard deviation of the climate index to increase the probability of set aside. This conclusion can certainly no proof, but it should be all right as a starting point.

Alternative subsidies

Subsidies often provide a substantial part of farm income. When considering what to grow, a farmer is well advised to check all possible subsidies available. While ÖPUL subsidies can reach up to 870 €/ha, set aside payments are just 332 €/ha.

3.3 Farm structure

When a farmer considers if she should set aside land, a lot will depend on the structure of the farm. If a farmer has just one field of arable land and she grows fodder for her livestock there, she will not set aside the land (unless it doesn't pay anymore to grow the fodder on your own). If a farmer takes part in an organic farming program which requires her to do rotational set aside, she will take part in the set aside program. If a farmer is "hobby farmer" and it is important to her to cultivate all the fields and not so much the profit of the farm, she will not care that much about premiums. Some of the farm structures are region specific. Farms in Tyrol, for example, have smaller arable land fields than farmers in Lower Austria.

3.4 Information of farm

A frequent complaint by farmers from the European Union is the high level of paper work necessary to get financial support. Although there is done a lot to make it as easy as possible for the farmers, it still remains complicated. To find the optimal strategy to maximize the benefit payments is a difficult task. Those who don't have the possibility to spend a lot of time to know all about the support scheme might miss out. This is especially true when it comes to the combination of different support schemes. I therefore assume that some farms don't choose voluntary set aside because they are not familiar with this measure. Unfortunately I didn't find any literature about information aspects of support schemes in agriculture. But in social policy and poverty research this is a well established field of research (e.g. see Riphahan [33]).

3.5 Risk

As the producer surplus is uncertain and the set aside premium is not uncertain, the level of risk aversion of the farmer could influence the farmer's decision to take part in the set aside program. Farmers who are more risk averse, would rather decide for set aside than those less risk averse or risk neutral.

Roberts et al [34] show in their empirical research about English farms that risk aversion and all elements of uncertainty don't have a big influence on the indifference price. Hope and Lingard [23] calculate how set aside premiums work under different levels of risk aversion and find that in different regions of England the risk aversion is different. I assume that risk aversion and uncertainty do not have much influence in Austria, as a lot of risks are absorbed by the community (minimum price guarantee, draught and food compensation payments, hail insurance).

Chapter 4

Description Of Source Of Data

The data used in the empirical part of this work comes from three different sources. The main source are administrative data from 2002. The second source is the Austrian Agricultural Structure Survey (Österreichische Agrarstrukturerhebung) from 1999. The third source is the land register.

4.1 Administrative data

As demanded by the EU, Austria has installed a highly sophisticated system for administration of the agricultural support schemes. This system is called INVEKOS (Integriertes Verwaltungs- und Kontrollsystem) and all relevant data are captured there. It is maintained by Agrar Markt Austria. For a detailed description of INVEKOS see the manual for INVEKOS provided by the ministry of agriculture [22]. INVEKOS is split up in different databases and therefore it is necessary to merge the data to work with them. The following paragraphs describe how I derived and merged the data. The codes in brackets are the names of the tables in INVEKOS.

- Farm number

  INVEKOS has a database that contains all administered farms (L006). There it is distinguished between main farms and subsidiary farms. A main farm can have subsidiary farms, while a subsidiary farm must have one, and only one, main farm. Subsidies can only be related to main farms. As the main farm decides in which support schemes to take part, I used the main farms as key for my database. Each main farm has an unequivocal number. For 2001 the "Grüner Bericht" [13] reports that there were 157,387 main farms of which 7,485 had one or more subsidiary farms. Whenever subsidiary farms were used as key in other databases, I aggregated the respective variable. For details how I did that see the respective descriptions.

- ÖPUL

  INVEKOS contains a database (L008) that lists which farms participate in which ÖPUL program. But all I was interested to know was, whether a farm took part in any ÖPUL program. Therefore I set up a dummy which is one in case the main farm participates in an ÖPUL programm and zero otherwise.

- Arable land area

I got the arable land area of a main farm from the table that lists the exact sum of what is planted on a farm (L008). Therefore the variable derived is the total amount of arable land of a farm, including arable land for which no direct payments were granted.

- Small scale farms

  To find out about the status (small scale or general regulation) of a main farm I used the table with the calculation about the area payments (L022). Of course only farms and their fields that applied for subsidies are included in this table. Therefore I only found out about status of farms that applied for Support for Producers of Certain Arable Crops.

- Area set aside

  To get the area set aside I used the table with the calculations about the area payments (L022). It lists which farm applied for which kind of area payment. I added up greenland and industrial set aside to get the area set aside. Theoretically it would have also been possible to use the table which I used to determine the arable land area (L008) as there is a column for idle land. But the definition of idle land there unfortunately doesn't match the definition used by the EU area payment scheme.

4.2 Survey data

The Austrian Agricultural Structure Survey [1] had to be done as a consequence of the EU directive 2467/96. The effective day of the survey was 1 June 1999. The data were collected by the municipalities and processed by Statistik Austria. The database consists of 217,500 farms. 150,468 of these farms are also captured in the INVEKOS database.

- Part time farm

  The database contains information on the kind of employment of the farmers. In case the couple who owns the farm spent at least 50 % of their working time during the last year on the farm, the farm is considered a full time farm. Additionally the standard gross margin (a measure for the profit of a farm) must exceed 6540 €. A part time farm is where more than 50 percent of working time of the couple is spent for off farm work. In case the owner of the farm is not a natural person, this distinction doesn't make sense. Instead, it is classified as legal person run farm.

- Livestock

  The agricultural survey lists the livestock of a farm. For the purpose of this investigation, only an aggregated number was of interest. I decided to use the weights shown in table 4.1, based on the ÖPUL Investitionsförderung (e.g. in Grüner Bericht 2002 [13], page 333).

  The weights are multiplied by the number of the respective animals on the farm and added up.

- Machines

  Similar to the livestock weight had to be given to the machines of farm. I opted for using the kilowatt as weight for each machine, assuming that the kilowatt are identically distributed over the range of each class. For the machines not in classes, I just estimated a value. See table 4.2.

The weights are multiplied by the number of the respective machines on the farm and added up.

4.3 Land register data

- Climate Index

  The most complicated part of the database query was getting data about the soil quality. Thankfully the *yield index* is part of the Austrian land register book. The yield index is the soil quality (for details see chapter 1) multiplied by the size of a property . The tricky thing is that fields are not necessarily identical to properties. But applications for subsidies are made on the base of fields. Therefore I had to derive the soil quality of fields by splitting the properties in intersection areas with the fields, weighting their yield indices by their size and adding them, grouped by the field, up. More formally written that is

$$BKZ_{field} = \left(\sum_{i=1}^{n} BKZ_{intersection,i} * (area_{intersection,i}) \right) * \frac{1}{area_{field}} \tag{4.1}$$

  where i runs from 1 to n and stands for each intersection of a field with a property. BKZ is short for Bodenklimazahl, the German expression for climate index.

  The calculations was further complicated since not for all properties yield indices are available. A possible reason for this is that the surveyor, when resurveying the land, decided that the property was not used for agricultural purpose anymore and therefore didn't reevaluate the property. Or, if the borders of the property changed, the entry of the yield index was not recalculated as the data are getting digitalisized at the moment

Table 4.1: Weights for livestock

horse	1.00
cattle	1.00
pig	0.30
sheep	0.15
goat	0.15
poultry	0.04
game	0.15

Table 4.2: Weights for machines

tractor with less than 25 kw	12.50
tractor with 25 to less than 40 kw	32.50
tractor with 40 to less than 60 kw	50.00
tractor with 60 to less than 80 kw	70.00
tractor with 80 to less than 100 kw	90.00
tractor with more than 100 kw	120.00
combine harvester	120.00
potato and beet-root harvesting machine, with engine	120.00
potato and beet-root harvesting machine, dragged	12.50

and it is planed to recalculate the yield indices all at once. I couldn't observe any system why some field have and some don't have a yield index and therefore I assumed the yield indices available are an unbiased random sample and can be used as representative sample.

The next step was to exclude all non arable land fields. I kept 605,318 fields in my database where 436 had climate indices less than 1 or more than 100. I found out that the entries of these data had already mistakes in the land registry book and therefore I deleted them.

Using only arable land with yield index, I calculated the average climate index of each farm. Basically I did the same thing I was doing when I calculated the climate index for a field: Weighting and summing up.

I got average climate indices for 70,269 farms.

4.4 Data merging

Data from the various tables had to be merged. As primary key for all the variables I used the main farm number. The number of main farms varied between the different tables. For my calculations I just used those farms that had entries for all interesting variables in order to end up with a database without missing variables.

The agricultural survey contains 217,000 farms while INVEKOS lists only 155,558 farms. Since only the farms that apply for subsidies are saved in INVEKOS, the difference can be explained by the farms that do not participate in programs. There are certain conditions, such as a minimum size that might prevent some farms from taking part in certain programs. Also some differences occur since the agricultural structure survey was done in 1999 and the INVEKOS dates are from 2002. In the meantime some farms might have merged or given up. There are 66,123 farms that are listed in the agricultural structure survey but not in INVEKOS and 13,178 farms that are in INVEKOS but not in the agricultural structure survey.

The table with the lowest number of farms was the table with the climate indices for farms. It contained 70,269 entries. This is mainly due to the fact that only farms with arable land with yield index are included. Merging these two was the biggest reduction of data. Comparing the sum of arable land of each farm it turned out that there were 42 farms which should have arable land according to the land register book, but didn't according to the INVEKOS database. Since INVEKOS is much more up to date, I deleted the 42 entries. Of course there are differences concerning the arable land area between land registry book and INVEKOS data for other farms as well. But since the land registry book is just used to get information on the soil quality that shouldn't matter too much.

Through merging with the set aside data there was a loss of 9957 farms. These were farms that had arable land according to the table that lists how much is grown (L013), but were not listed in the table with the subsidies. Therefore they didn't apply for subsidies. To find out which farms I lost through this merger, I calculated the average size of arable land (calculated area) of these farms and it turned out that these farms were substantially lower than those that remained in the sample, as shown in table 4.3.

This supports the hypothesis that the farms with no entry in the subsidies table didn't apply for subsidies. Since I am not looking at the decision whether to take part in the Support Scheme for Producer of Arable Crops or not, it makes sense to exclude non participating farms from the database. Otherwise the estimations would be biased by the decision whether to take part in the Support Scheme for Producers of Certain Arable Crops.

Table 4.3: Arable land of not applying farms

farm type	average arable land area
no entry	239
small scale farmer	840
general regulation farmer	4,574

To get an overview how well I covered the farms taking part in the set aside programm I compared the total number of farms setting aside arable land with the number of farms that set aside arable land in my database, see tabular 4.4.

Table 4.4: Coverage of set aside

number of farms that set aside arable land	29,095
number of farms that set aside arable land in my database	21,586

My database covers 75 % of the farms that set aside arable land. But only farms that take part in the Support Scheme for Producers of Arable Crops are part of the sample.

For my calculations those farms which had a voluntary set aside over 50% were thrown out (28 farms) and those whose application area was 0 were thrown out as well (359 farms).

Chapter 5

Model Description

The question of interest of this report is to find out which farms tend to participate in the set aside program voluntarily. As the decision is dependent on a huge number of properties of a farm, a model is needed that includes the most important ones. The idea is to build an econometric model which helps to tell which factors have influence on the set aside decision and of which magnitude the influence is.

But before I begin with the actual model building, I want to present some tables that summarizes the data described in chapter 4.

What might be quite interesting for the beginning are some figures about the absolute magnitude of set aside which are presented in tabel 5.1.

Table 5.1: Absolute figures of sample

Sum of arable land in ha	1,002,738
Sum of arable land applied for Support Scheme	825,590
Sum of voluntarily set aside arable land	25,514
Sum of mandatory set aside arable land	54,703
Sum of mandatorily and voluntarily set aside arable land	80,217

The figures of table 5.1 are calculated from the data I merged. To compare it with the data from the INVEKOS table that summarizes the cultures of each farm (L008), have a look at table 5.2. While the percentage of set aside in my database is 9.72%, it 9.43% in the INVEKOS original table. That indicates that there is a certain bias in my sample, but not too much.

Apart from that, table 5.1 shows that less than a tenth of arable land is withdrawn from cultivation by set aside. At the same time it shows that voluntary set aside is not just a theoretical option but is used in practice.

Table 5.2: Absolute figure of INVEKOS

Sum of arable land applied for support scheme in ha	1,106,699
Sum of mandatory and voluntarily set aside arable land	104,398

But more important are relative figures which are summarized in table 5.3. It is, again, calculated from the data sample and does therefore not cover all Austrian farms. As well there are small differences to the database used for statistical estimations in the next chapter, as the farms in this table which applied for 0 hectare (359 farms) and those that got more than 50% of their application area granted as set aside land[1] (28 farms) are still part of the table presented here (compare with end of chapter 4).

The farms shown in the first part of the table don't have any voluntary set aside land. As expected, there are much more small scale farmers that don't set aside anything than farmers under the general regulation, as the latter must do mandatory set aside. Since every set aside above 10% of the application area is voluntary set aside, it often happens that a field has a bit more than 10%, but never-the-less the whole field is set aside.

The middle part of the table shows those farms that do voluntary set aside. Here the number of small scale farmers is much lower as most small scale farms don't set aside any land.

The last part of the table shows all the farms: those that set aside land and those that don't. Comparing the average values of the variables for small scale farms and farms under the general regulation shows that almost all the variables differ substantially. Of special interest is that for those small scale farms who do set aside, the average voluntary set aside is 24% of the application area while it is only 3% for farms under the general regulation. That doesn't come as a surprise as farms under the general regulation have to set aside 10% of their land and therefore there is less need for voluntary set aside. This structural difference is the reason why small scale farms and farms under the general regulation will be analyzed separately.

The figure I want to explain in this work is the share of voluntary set aside of the application area. Formally, growing non food crops (such as renewable resources) is part of set aside, but in practice it has little to do with letting a field lie fallow. As it is much more meaningful for the purpose of interpretation, I will deduct non food crops set aside from set aside. That allows to interpret set aside area as not cultivated area. Therefore I can get negative voluntary set aside. For example, consider a farm that sets 10% mandatorily aside and all of this set aside is non food crops set aside. If the farm doesn't do any voluntary set aside, it has a 10% negative set aside.

For small scale farms 9.8% of set aside is non food crops set aside. That are 213 hectares of non food crops set aside. For farms under the general regulation the situation is a bit more difficult, since you can't tell which fields are set aside voluntarily and which mandatorily. But if you add mandatory and voluntary set aside up, you find that 83.6% are non food crops set aside. This difference is remarkable and an interesting result per se. From here onward, set aside means set aside without non food crops set aside.

Figure 5.1 shows the percentage of application area set aside by small scale farmers. The first bar shows that about 38,188 small scale farmers set aside between 0 and 2 percent of their land. Almost all of these farms (38,166 farms) don't set aside anything. The other bars from the figure are much lower, because compared to the number of small scale farms who don't set aside anything, the number of farms that set aside land is diminishing. To see how much the small scale farmers that do take part in the set aside program set aside, have a look at figure 5.2. The first bar shows the number of farms that set aside more than 0 but less than 2%. The second bar shows farms that set aside between 2 and 4% and so on. The figure shows that if small scale farmers decide to take part in the set aside program, they are willing to set aside substantial parts of their arable land.

Figure 5.3 shows how much farms under the general regulation set aside. It immediately is clear that set aside has another structure than in the case of the small scale farmers: there is an impressive number of farms with small positive or negative set aside percentages and almost no farms with higher set aside shares.

The differences between small scale farms and farms under the general regulation demon-

[1]This is likely to be possible because of small measurement mistakes for applications of small areas

Table 5.3: Overview of variables of the sample

		small scale	general reg	all
no vol sa				
	av vol sa %	0	0	0
	av vol sa	0	0	0
	num vol sa	0	0	0
	av clim ind	38.39	52.93	38.56
	av min clim ind	31.66	30.61	31.66
	av st dev	4.95	11.05	5.03
	av arab	8.25	71.51	8.97
	av anim	29.29	32.02	29.32
	av mash	100.02	222.31	101.41
	num oepul	34578	428	35006
	num full	22630	356	22986
	num part	15727	81	15808
	num jur	83	5	88
	num farms	38440	442	38882
vol sa				
	av vol sa %	24.18	2.67	10.72
	av vol sa	1.62	1.00	1.23
	num vol sa	7753	12949	20702
	av clim ind	42.53	49.53	46.91
	av min clim ind	31.35	30.66	30.92
	av st div	7.52	9.59	8.81
	av arab	9.53	44.79	31.58
	av anim	10.94	53.70	37.68
	av mash	86.43	206.81	161.73
	num oepul	7312	12595	19907
	num full	2855	10576	13431
	num part	4871	2289	7160
	num jur	27	84	111
	num farms	7753	12949	20702
all				
	av vol sa %	4.06	2.59	3.72
	av vol sa	0.27	0.97	0.43
	num vol sa	7753	12949	20702
	av clim ind	39.09	49.64	41.46
	av min clim ind	31.61	30.66	31.40
	av st div	5.39	9.63	6.34
	av arab	8.47	45.67	16.83
	av anim	26.21	52.98	32.23
	av mash	97.74	207.32	122.37
	num oepul	41890	13023	54913
	num full	25485	10932	36417
	num part	20598	2370	22968
	num jur	110	89	199
	num farms	46193	13391	59584

Description of the Variables in table 5.4

Table 5.4: Key to the table 5.3:

av vol sa %:	average percentage of voluntary set aside a farm
av vol sa:	average ha set voluntarily aside a farm
num vol sa:	number of farms that set land voluntarily aside
av clim ind:	average climate index of a farms
av min clim ind:	average of the field with the lowest climate index of a farm
av st dev:	average standard diviation of the fields of a farm
av arab:	average arable land in ha
av anim:	average livestock a farm
av mash:	average machines of a farm
num oepul:	number of farms participating in ÖPUL
num full:	number of full time farms
num part:	number of part time farms
num jur:	number of legal person run farms
num farms:	total number of farms

strated in this section made me deal with the two types of farms separately. I will present the two models and their parameters in the next two sections.

5.1 Model for small scale farms

The current regulation allows farms to set aside between 0 and 50 % of their application area. Even though there are minimum requirements for set aside (0.1 hectares or a field according to the definition in BGBl Nr 964/1994 [30] with fixed borders) I will consider the decision as continuous. That can be justified by the fact that I will use the share of the application area and not the absolute areas as dependent variable. Therefore there will be no gap in my data and the gap that remains will only be relevant for farms with very small areas of arable land.

A common model to estimate percentages is the two limit Tobit model developed by Rosett and Nelson in 1975 [35]. For examples of applications in papers see Frostin and Holtmann [15] or Saltzman [37].

The two limit Tobit model is a model for a censored sample. The dependent variable of the values under and above certain limits can't be observed. More formally, the tobit model has the following structure (compare with Rosett and Nelson [35]):

The dependent variable Y is bounded below and above by L_1 and L_2 and is determined by

$$Y_t = L_1 \qquad \text{when} \qquad Y_t^* - \varepsilon_t \leq L_1, \tag{5.1}$$

$$Y_t = L_2 \qquad \text{when} \qquad Y_t^* - \varepsilon_t \geq L_2, \tag{5.2}$$

$$Y_t = Y_t^* - \varepsilon_t \qquad \text{when} \qquad L_1 \leq Y_t^* - \varepsilon_t \leq L_2, \tag{5.3}$$

where Y_t^* is a linear function of the independent variables X_t. The aim of the model is to estimate the function

$$Y_t^* = \sum_{i=1}^{k} \beta_i X_{it} \tag{5.4}$$

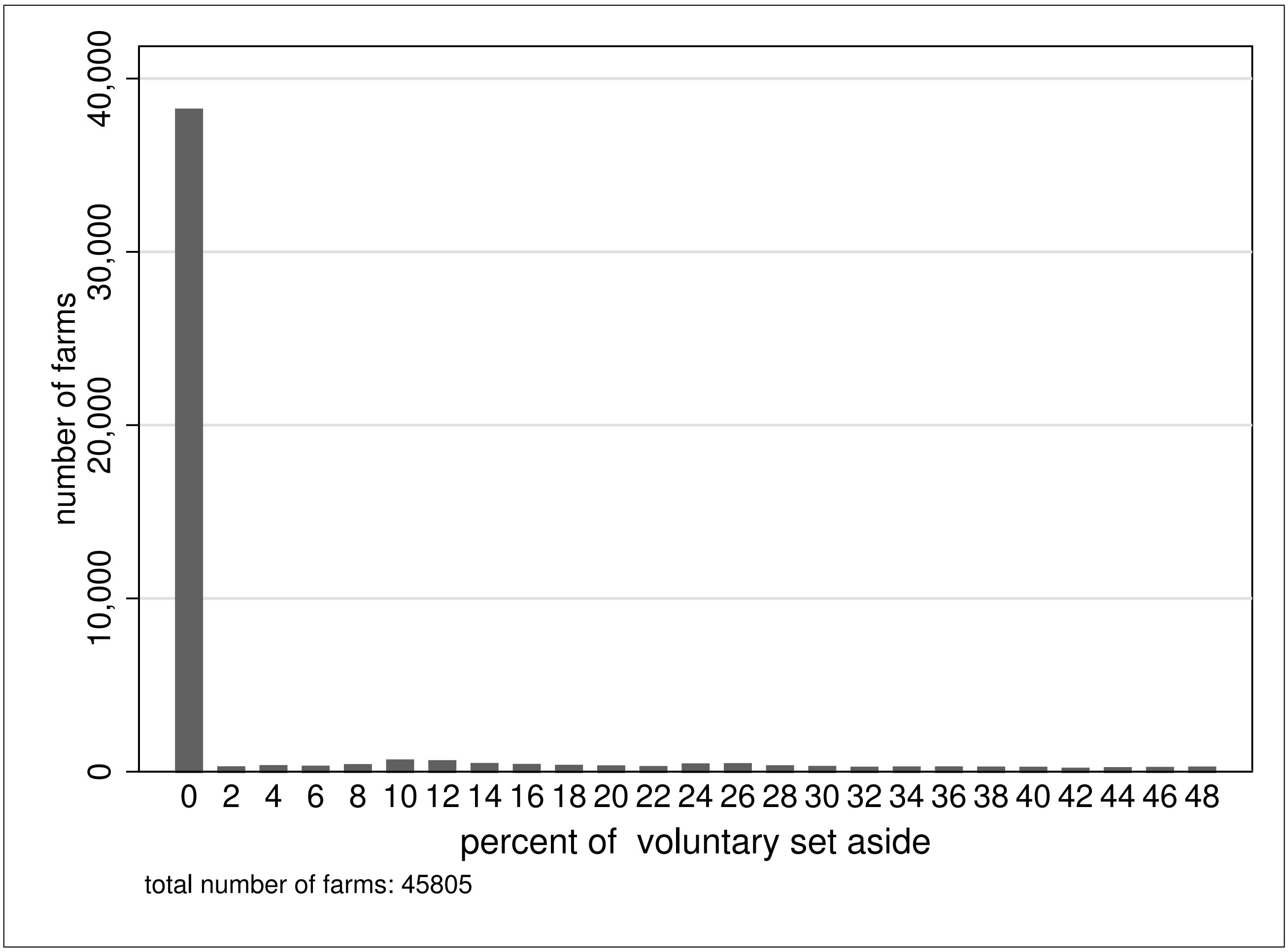

Figure 5.1: Percentage of voluntary set aside of small scale farms

The subscript t distinguishes observations and i accounts for the different regressor variables. The residual variable ε is assumed to be normally distributed with a zero mean and standard deviation σ.

The equation is estimated by maximizing the likelihood function. For lighter notation let $\Phi(\cdot)$ be the cumulated density function and $\phi(\cdot)$ the probability density function for the standard normal distribution. It can be shown that

$$\Pr(y = L_1|x_t) = \Phi\left(\frac{L_1 - x\beta}{\sigma}\right) \tag{5.5}$$

$$\Pr(y = L_2|x_t) = 1 - \Phi\left(\frac{L_2 - x\beta}{\sigma}\right) = \Phi\left(\frac{x\beta - L_2}{\sigma}\right) \tag{5.6}$$

Then the likelihood function includes components for upper censoring, lower censoring and no censoring. Instead of complicated indices, it is indicated under the $\sum$, which observation are to be used.

$$\ln L = \sum_{lower} \ln\Phi\left(\frac{L_1 - x\beta}{\sigma}\right) + \sum_{uncensored} \ln\frac{1}{\sigma}\phi\left(\frac{y - x_t\beta}{\sigma}\right) + \sum_{upper} \ln\Phi\left(\frac{x\beta - L_2}{\sigma}\right) \tag{5.7}$$

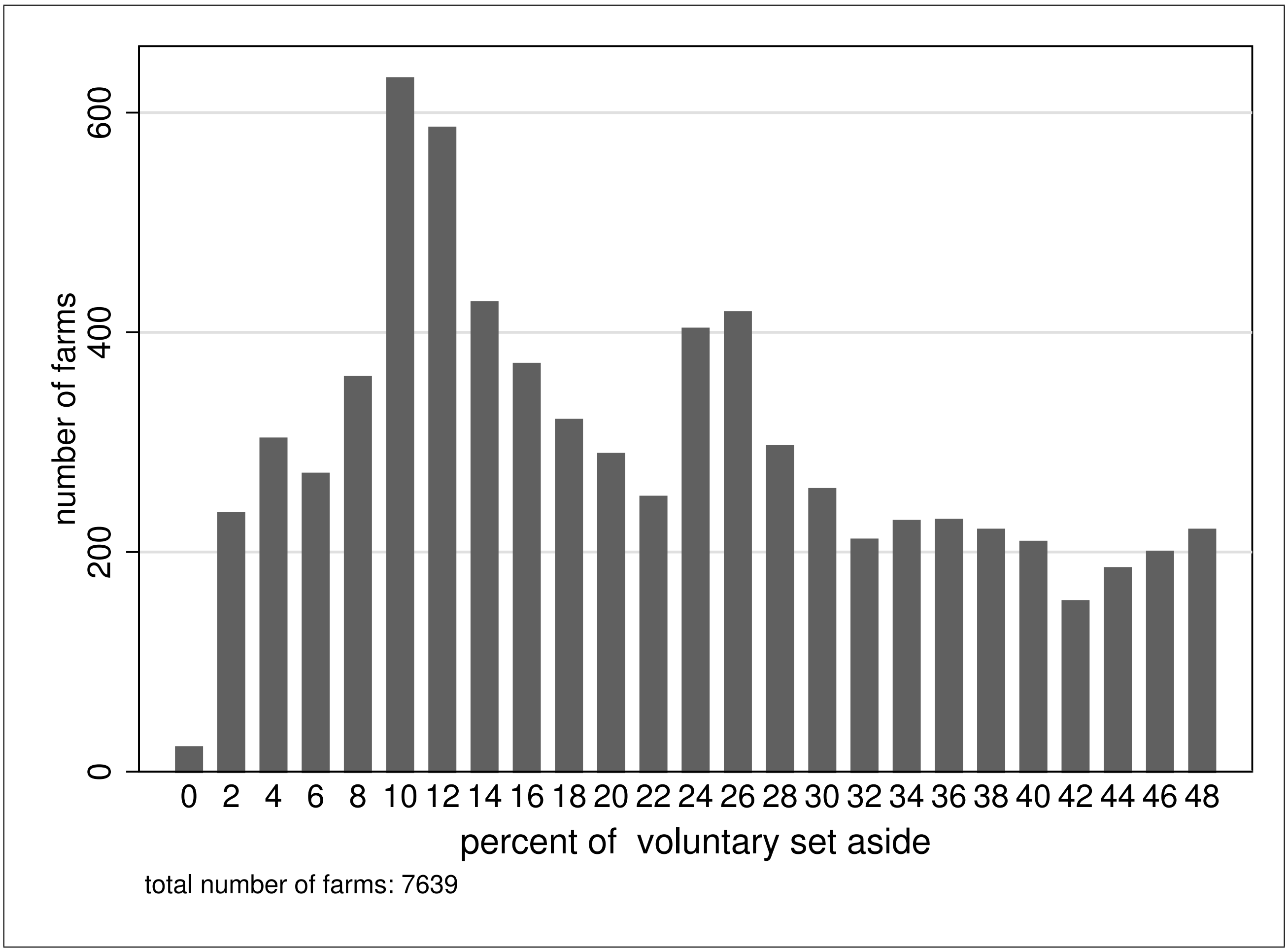

Figure 5.2: Percentage of voluntary set aside of small scale farms that set aside more than 0.

The main idea of the model is to estimate the partly unobservable y^*. For the censored part, this can only be done by computing the probability of being censored and using this quantity in the likelihood equation.

In this model, I want to explain the percentage of the application area the farm sets voluntarily aside. The uncensored observations are those, bigger than zero and less than 50[2]. The censored observations are those with 50% or 0% set aside. Taking 0 set aside as a censored observation implies assuming that it is theoretically possible to set aside less than nothing. That might at the first moment seem confusing, but it will turn out be a useful tool.

Before interpreting the results, it is necessary to check if the model assumptions are met. In particular, that the model is correctly specified and that the residuals are homoscedastic and normally distributed. Checking for heteroscedasticity and non normality is crucial in the tobit model because, unlike in the linear regression model, the maximum likelihood estimator can be inconsistent if heteroscedasticity or non normality is given (see Maddala [26], page 178, and Bera et al [2]). To test for these assumptions I followed the tests suggested by Greene [19]. I used the Cragg/Greene test to test if the specification is appropriate and the Chasher-Irish and the Pagan-Vella test to test for non normality. The Cragg/Greene test is based on the fact that the tobit model can be seen as a special case of Cragg's Model [12], which consists of a probit model to model the binary decision and of a truncated model for the observed observations. Tobit is

[2]For convenience I use the space $]0, 50]$ instead of $]0, 0.5]$

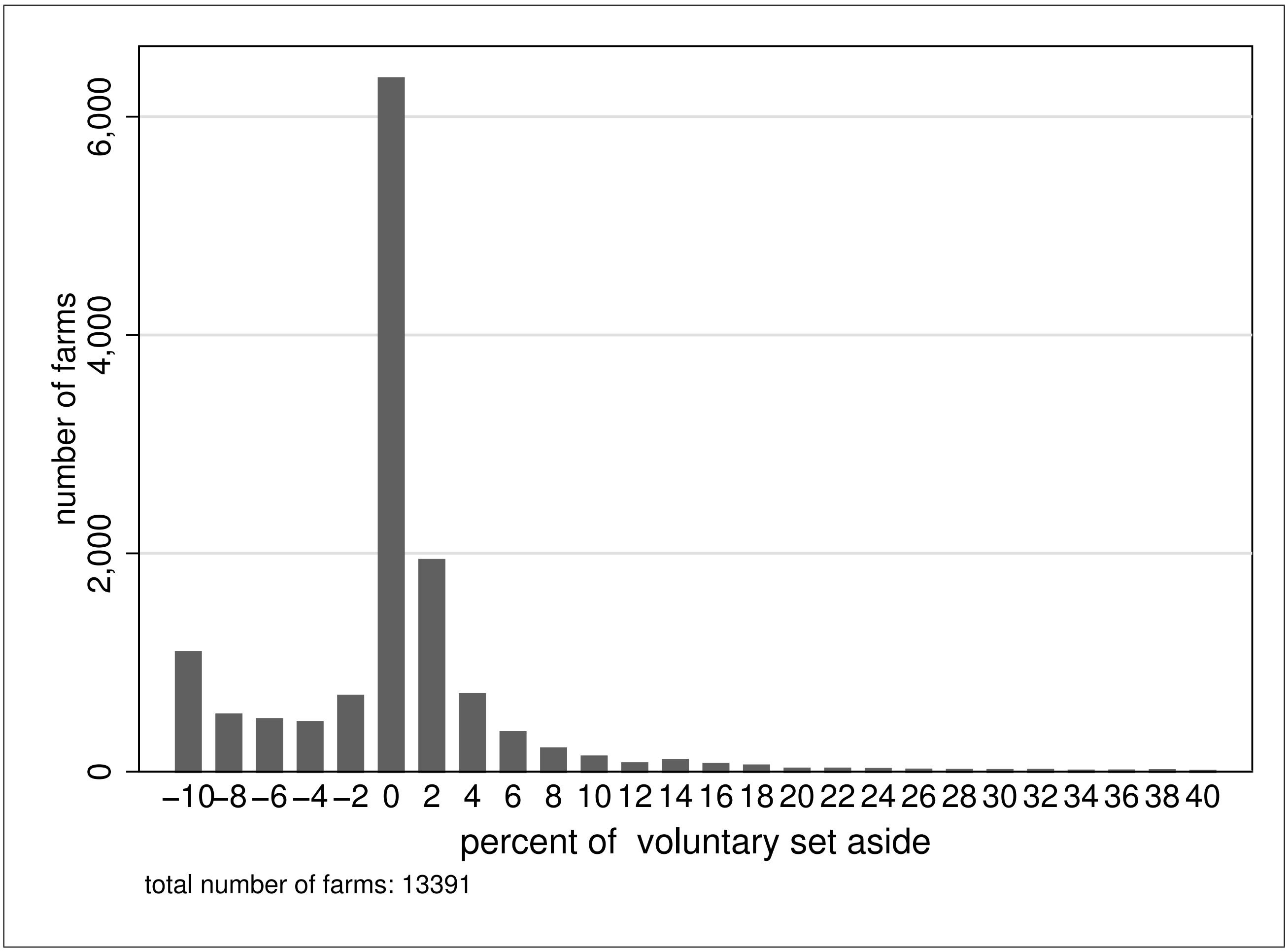

Figure 5.3: Percentage of voluntary set aside of farms under the general regulation

basically the same as the two, just put together in one equation plus the assumption that the effects of the variables are the same in the binary and the truncated model. This assumption is tested by the Cragg/Greene test. The test statistic is $\lambda = -2[ln(L_T) - (ln(L_P) + ln(L_{TR})]$ where L_T, L_P, L_{TR} are the likelihoods for the tobit, the probit and the truncated regression model (for details see Greene [19], page 951). The null hypothesis is that the effects are the same and the test statistic is χ^2 distributed with as many degrees of freedom as there are regressors plus one for the variance estimation. If the null hypothesis is rejected, you can estimate the two stage model from Cragg in stead of the tobit model.

The Chesher-Irish and Pagan-Vella statistics are used to check for non normality. Both, the Chesher-Irish and the Pagan-Vella statistics are presented only for one limit tobit models in Greene [19]. Therefore I adopted the calculation of the residuals for a two limit model.[3]. The Chesher-Irish test is a score test (lagrange multiplier test) which modifies the normal probability function to $Prob(\epsilon_i < t) = \Phi[\beta' x_i + \delta_1(\beta' x_i)^2 + \delta_2(\beta' x_i)^3]$ and tests the restrictions that δ_1 and δ_2 are 0. If the null hypothesis that δ_1 and δ_2 are 0 is true, normality can be assumed. The test statistic is χ^2 distributed with 2 degrees of freedom (as there are two restrictions). The Pagan-Vella test for normality makes use of the fact that the third and the fourth moment of

[3]To do that I also used the original paper of Chesher-Irish [4] because they use a more general model. But as far as I saw, the definition of the moments for the residuals differs between Greene and Chesher-Irish. The test statistics are constructed differently as well, but never the less the results are different – but both claim to be χ^2 distributed.

the residuals are 0 and $3\sigma^4$ in case of a normal distribution. It is χ^2 distributed with the number of regressors plus one for the variance as degrees of freedom.
To estimate the percentage set aside, I use the following explaining variables in my model:

climate index average: the climate index average is the average of the climate indices of the fields of a farm. The climate indices are weighted by the size of the field. The theoretical range is from 1 to 100.

climate index standard deviation: the standard deviation of the climate index is the standard deviation of the climate indices of the fields of a farm. The standard deviation of a farm that has just one field is set to 0.

ln(arable land): the arable land is given in hectare and is the total sum of arable land the farm cultivates (including leased arable land and arable land not received direct payments for). The logarithm of arable land is used, as it increases the fit of the model. What should be kept in mind is that farms that produce more than 92 tonnes are not included in the estimation for small scale farmers.

ln(kw/ha): this variable is the logarithm of the aggregated kilowatt per hectare application area. Theoretically you could expect that more machines were identical to higher fixed costs and would make it more costly to set aside land. Or you could argue that production with more machines is cheaper and therefore incentives to set aside are reduced. But for two reasons this argument will not work in empirical research. First, there is no scarcity of machines in Austrian agriculture. There are no farms that have to decide between setting the field aside or plowing it with the horse. Second, many of the farmers of this database do also have green land. Some of them have a lot of non arable land, and just a bit arable land. As they need machines for the non arable land as well, such farms will have very high kw/ha values. I therefore want to use kw/ha as an instrument variable to distinguish between farms with a lot of non arable land and those with mainly arable land. For higher fit of the model I took the logarithm of the kw/ha, even if this means that the interpretation is more complicated. For numerical reasons it set those farms with less then one kw/ha to 1 kw/ha.

ln(animals): the logarithm of the aggregated livestock of a farm. The variable should help to distinguish between specialized arable land farmers and those which have animals as well. The logarithm increases the fit of the model and is therefore used. The farms with no livestock were set to one for numerical reasons.

oepul: oepul is a dummy variable that is one if a farm takes part in the ÖPUL program and 0 if not.

full time: full time is a dummy variable that is 1 if the farmer is a full time farmer and 0 if the farmer is either a part time farmer or if the farm is a legal person run farm.

legal: legal is a dummy variable that is 1 if the farm is run by a legal person and 0 if it is a full time or part time farm.

hp1 to hp6 and hp8: These variables are a set of dummies for the major production areas. The reference production area is hp7. Production areas are areas with similar agricultural circumstances. For an overview about the major production areas figure 5.4 is included, for a detailed description use Wagner's books from 1990 [39] and [40].

An overview of the properties of the farms in the federal states and the main production areas is given in table 5.6 and table 5.5. Please note that the data include farms with 0 application area and set aside area bigger than 50% of their application area.

It would be also interesting to include a set of dummies for the federal states because it would allow to interpret these dummies as a measure of influence of province based politics. But as for some states the numbers are quite small and the interpretation would probably become highly problematic, I decided to refrain from that idea.

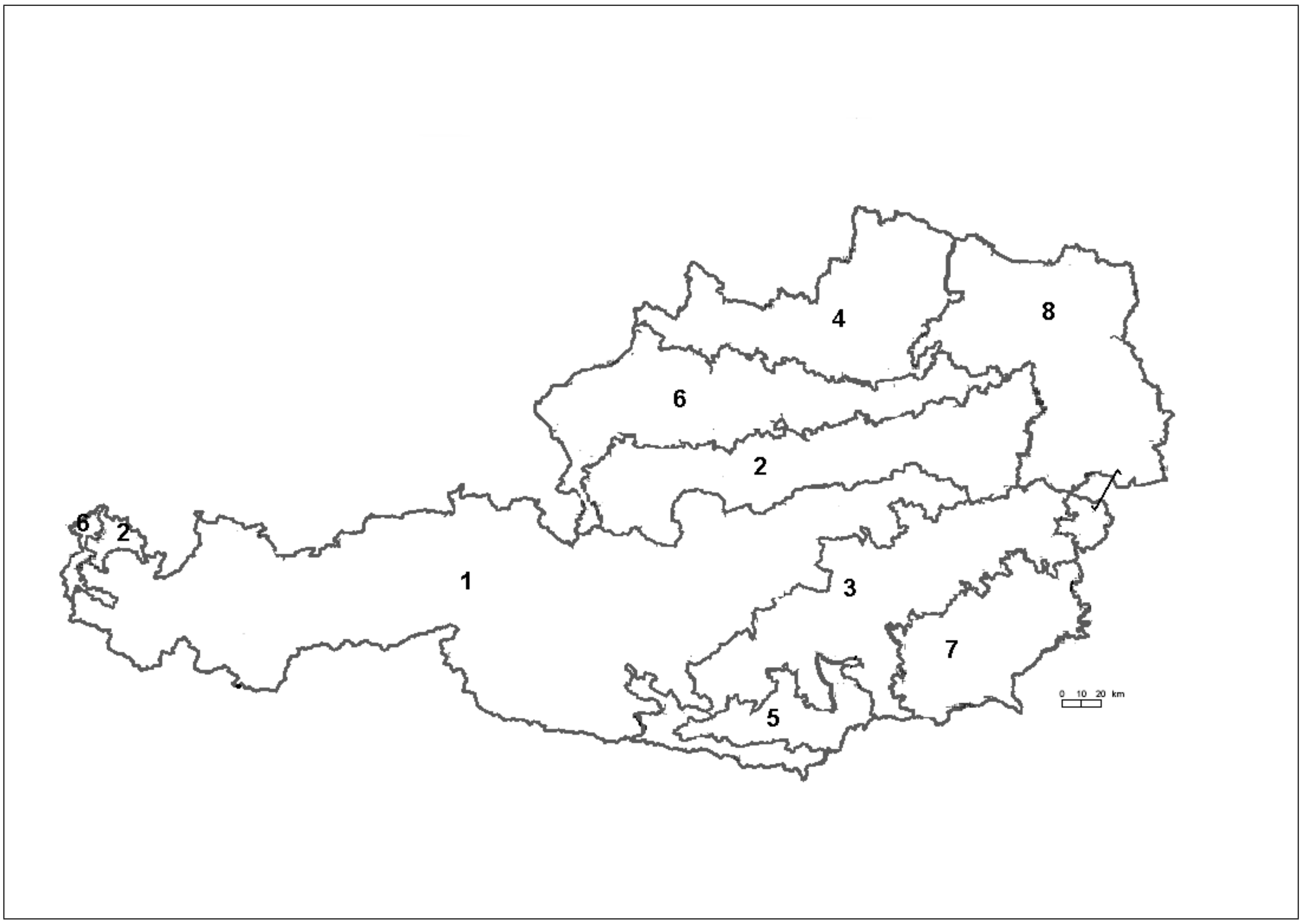

Figure 5.4: Major production areas. For the names of the major production areas see appendix B.

5.2 Model for farms under general regulation

Farms under the general regulation do have to set aside 10% of their application area. Therefore their decision is structurally different from that of small scale farmers. As shown in this chapter in bar chart 5.3, a lot of farms do set aside only small amounts of land. Most times the area set aside is just that part of a mandatorily set aside field that exceeds the 10%. The consequence is that farms that voluntarily set aside land don't have common properties and statistical estimations are hardly possible. As it is impossible to extract "real" set aside from the data, there is no reasonable statistical estimation possible. Theoretically it would be possible to exclude all voluntary set aside below e.g. 3%, but that leads to a couple of problems. First, through the subtraction of non food crops, there are negative set aside values and all these would be excluded. Second, the percentage of the application area can be quite different in absolute sizes. For a big farm 3% could be a couple of fields while for a small farm it might only be the rest of a mandatory set aside field. A way out might be, to differentiate according to absolute sizes of voluntary set aside. But this leads to the question, where to set the limit. It would be tempting to choose the limit where the fit of the model is best, but that obviously would be data mining and would not help to get good results. I therefore included all data and use the same model as the one for the small scale farms except for two points. First, the left limit of the censored data will be -10 in stead of 0[4]. A second difference is that it doesn't make sense to use the argument that the effects of the coefficients for the decision whether and how much to set aside voluntarily are different. As each of the farms under the general regulation is already setting aside 10%, there basically is just the "how much" decision. Therefore it is not necessary to do the Cragg/Greene specification test.

The models for small scale farms and farms under the general regulation do not cover all the aspects discussed in chapter 3. But at least some of them are part of the model. The opportunity costs are covered by the full time dummy, the climate index and the ÖPUL dummy. Producer prices and input prices are not included, as they are expected to be about the same for all farms (and therefore would only change the intercept). The structure of the farm is described by the livestock, kilowatt, arable land and regional dummy. Aspects of information or risk are not part of the estimation since meaningful data are difficult to get.

[4]As there are no observations with a voluntary set aside at the upper limit of 50%, a one side limited tobit model is identical to a tow sided model.

Table 5.5: Description of distribution over major production areas

prod. area	sum farms	sum vol. set aside	sum small scale	sum oepul	sum full time	sum jur. person	av. clim. ind	av. st. div. clim. ind.	av. arable land	av. animals	av. machines	av. vol set aside
1	2881	42	2870	2775	1785	15	37.23	5.16	5.36	29.76	74.13	0.0040
2	1214	162	1141	1168	810	2	36.90	4.82	8.56	35.52	119.69	0.0207
3	4071	788	3836	3801	2284	12	31.96	5.36	10.41	28.13	89.48	0.0458
4	15464	3124	13664	15025	9668	32	28.05	4.02	11.67	27.59	122.39	0.0235
5	3387	925	2918	2618	1856	16	42.09	7.91	12.08	34.44	83.23	0.0427
6	17107	5629	13000	15542	11198	51	49.30	5.48	16.34	50.02	135.94	0.0238
7	4134	2107	3450	3192	1497	6	41.93	5.59	13.99	23.02	81.30	0.1092
8	11326	7925	5314	10792	7319	65	52.53	11.40	33.14	16.12	152.89	0.0550
all	59584	20702	46193	54913	36417	199	41.46	6.34	16.83	32.23	122.36	0.0373

Key for table 5.5 and table 5.6:

prod.area: production area: 1 High Alpine area, 2 Subalpine area, 3 Eastern fringe of the Alps, 4 Waldviertel und Muehlviertel, 5 Carinthian basin, 6 Alpine foreland, 7 Southeastern area of plains and hills, 8 Northeastern area of plains and hills

States: 1 Pannonia, 2 Carinthia, 3 Lower Austria, 4 Upper Austria 5 Salzburg, 6 Styria, 7 Tyrol, 8 Vorarlberg, 9 Vienna

sum farms: number of farms

sum vol. set aside: sum of farms that set aside arable land voluntarily

sum small scale: number of small scale farmers

sum oepul: number of farms participating in an ÖPUL programm

sum full time: number of full time farms

sum jur. person: number of farms with legal person as head of the farm

av. clim. ind: average climate index of farms

av. st. div. clim. ind.: average standard deviation of climate index of a farm.

av. arable land: average size of arable land of a farm in ha

av. animals: average size of livestock of a farm

av. machines: average size of machine stock of a farm measured in kw

av. vol. set aside: average percentage of voluntarily set aside land of Support Scheme for Producers of Special Arable Crops area

Table 5.6: Description of distribution over states

state	sum farms	sum vol. set aside	sum small scale	sum oepul	sum full time	sum jur. person	av. clim. ind	av. st. div. clim. ind.	av. arable land	av. animals	av. machines	av. vol set aside
1	6404	4097	4518	5676	2515	22	43.67	8.91	22.85	10.78	98.94	0.1121
2	5730	1138	5184	4809	3290	22	39.48	7.42	10.55	33.32	80.81	0.0335
3	21330	10208	13913	20172	14083.00	82.00	41.39	7.92	22.79	26.39	145.89	0.0391
4	21302	4861	17942	20063	13608	49	41.49	4.06	12.90	43.05	126.05	0.0191
5	733	8	728	716	525	5	41.03	3.14	6.30	34.58	96.93	0.0018
6	2089	388	1914	1571	1136	2	40.27	4.64	9.40	40.09	77.77	0.0334
7	1695	1	1694	1621	1044	14	40.68	4.92	4.62	30.40	77.15	0.0000
8	301	1	300	285	216	3	47.97	7.89	8.64	65.05	109.87	0.0000
9	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.0000
all	59584	20702	46193	54913	36417	199	41.46	6.34	16.83	32.23	122.36	0.0373

Chapter 6

Estimation Results

This chapter presents the results of the estimations for the models from chapter 5, discusses the statistical properties and includes a first interpretation of the results . First the small scale farmers and than the farms under the general regulation are discussed.

6.1 Small scale farms

The results of a tobit model can be reported in three different ways (see e.g. Greene [18] , page 694). You can either report the change of the latent variable $\frac{\partial E(y^*|x)}{\partial x_k}$, the change in the truncated outcome $\frac{\partial E(y|L_1<y<L_2,x)}{\partial x_k}$ or the change in the censored outcome $\frac{\partial E(y|x)}{\partial x_k}$. In case of dummy variables the respective discrete change should be used (see e.g. Long [25], page 207).

As I am not just interested in how much a farm is expected to set aside, but also in the hypothetical values over 50 and under 0 percent the latent change is the most appropriate way to present the results. An expected set aside of less than 0% would mean that a farm is far from reducing its production area. An expected set aside of more than 50% would be interpreted as the wish of a farm to reduce production area even more than possible.

The estimation results of the marginal effects of the continuous variables and the discrete change of the dummy variables on the latent variable $E(y^*|x)$ are given table 6.1.

As shown in table 6.1 the hypotheses of correct specification and normality must be discarded as the Cragg/Greene and the Pagan-Vella test's null hypotheses don't hold. The misspecification indicates that the tobit model is not correct. Therefore I have to use Cragg's model [12]. By doing so, it is possible to take care of the different effects of the variables depending on whether it is the decision to set aside at all or how much to set aside. The results of the two regressions are shown in table 6.2. The table shows the coefficients of the latent variable for the probit model and the truncated model.

An inspection of the coefficients reveals why the tobit model didn't fit: For ln(arable land), hp1, hp3 and hp5 the signs of the coefficients are differently. Some of the variables are significant in the probit, but not significant in the truncated model. As the results are that different, it makes sense to analyze the decisions separately.

For the interpretation of the **probit model** the marginal effects at the means are shown in table 6.3. As you can see, the marginal effects of the probability that set aside occurs is quite different from the coefficients of the linear coefficients reported in table 6.2. To demonstrate in which part of the probability function the observations are located, I calculated the 5, 50 and 95 percentiles of the observations. The 5 percentile is at 0.006, the 50 percentile at 0.073 and

Table 6.1: Tobit model for mall scale farms in all production areas, latent variable, marginal change for continuous and discrete change for dummy variables

Variable	Coefficient	(Std. Err.)
climate index	-0.250**	(0.025)
st dev clim ind	0.518**	(0.054)
ln(arab land)	7.111**	(0.384)
ln(animals)	-11.928**	(0.222)
ln(kw/ha)	-6.174**	(0.275)
oepul	18.418**	(0.986)
full time	-4.907**	(0.599)
legal	-5.591	(4.682)
hp1	-47.641**	(2.453)
hp2	-26.088**	(2.071)
hp3	-19.195**	(1.122)
hp4	-28.799**	(0.960)
hp5	-16.064**	(1.166)
hp6	-20.729**	(0.895)
hp8	-21.677**	(0.963)
intercept	10.520**	(1.660)
σ	32.443**	(0.319)
Log-likelihood		-45082.16
left-censored		37856
uncensored		7295
right-censored		344
total		45495
Cragg/Green	7130.96	
Chasher-Irish‡	0.00**	
Pagan-Vella‡	879.05	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%.

‡: random sample of 7999 used due to limited computer capacities

Table 6.2: Cragg's model for all small scale farms, latent variable, marginal change for continuous and discrete change for dummy variables

Variable	Pr(set aside=1)	% set aside
climate index	-0.006**	-0.235**
st dev clim ind	0.018**	-0.048
ln(arab land)	0.353**	-12.600**
ln(animals)	-0.381**	-2.540**
ln(kw/ha)	-0.208**	-0.253
oepul	0.638**	0.630
full time	-0.155**	0.098
legal	-0.157	1.109
hp1	-1.563**	14.205**
hp2	-0.868**	-1.671
hp3	-0.724**	3.045**
hp4	-0.957**	-4.852**
hp5	-0.600**	3.352**
hp6	-0.709**	-2.695**
hp8	-0.703**	-3.696**
intercept	0.053	61.756**
σ	13.600**	–
obs.	45495	7295
Log-likelihood	-26772.331	-26772.331

Significance levels : † : 10% $*$: 5% $**$: 1%

the the 95 percentile at 0.623. The range of the observations thus falls in the non linear part of the function and therefore it is necessary to discuss the marginal effects.

To get a feeling for the importance of the variables have a look at table 6.4. It shows the probability of set aside at the minimum and the maximum for each variable, while holding all other variables at their mean. The range, reported in the forth column, gives an idea which influence the variable has on the probabilities. The three variables to capture the structural differences, ln(arab land), ln(animals) and ln(kw/ha), have a big actual impact. Surprisingly also the standard deviation of the climate index is accountable for much of the differences in the probability. This is especially interesting in comparison with the range of the average climate index, which isn't too much. The connection between these two variables can be seen in figure 6.1. It shows the influence of the standard deviation on the probability to set land aside where all other variables except for the average climate index are set to their means. The four curves represent different values of average climate indices. The lines between the points are simple linear interpolations. The figure reveals the non-linear relation between the set aside decision and the standard deviation. The higher the standard deviation the higher is the marginal influence. At lower average climate indices its effect is stronger than at lower average climate indices.

Most important to explain the likelihood that arable land is set aside is the farm type. The typical arable land farm has a lot of arable land, a small livestock and a low average of kw per ha. Given the sings of the coefficients it is clear that arable land farms set aside much more likely than farms with just a bit of arable land, a big livestock and a high share os non-arable land. The next important result is that the deviation of the climate index plays a much more important role in the binary decision than the average climate index. An explanation of that is that at the margin the field with the lowest climate index is the decisive one. The influence of the dummy variables is not very big. ÖPUL participants are 0.08% more likely to set aside. Full time farmers are 0.03% less likely than part time farms and legal persons run farms to set aside arable land. The farms in hp7 are most likely to set aside arable land. Farms in other production areas are between 0.08 and 0.13% less likely to set aside arable land.

I now turn to the results of the **truncated regression model**. The coefficients of the latent variable are generally higher than those of the marginal effect at the mean, which is a result of the fact that I took the mean value. If I had calculated the coefficients at any other point, the marginal effects could have been bigger or smaller. As in the probit model, this makes a short and easy interpretation difficult. But some facts are obvious: in contrary to the probit model, now the climate index is more important than the standard deviation of the climate index which is not even significant. The higher a farm's average climate index is, the less it sets aside[1]. A climate index ten points higher, leads to a 2.35% higher expected set aside. Interestingly, the effects of the variables to explain differences due to structural differences are not identical to those of the probit model. The variable for the share of the arable land, ln(kw/ha), is not

[1]Some might be interested in this result, as it is an indicator that "farm level land quality slippage" as well as "land quality slippage due to regional differences" occurs. Slippage is an often observed phenomena associated with set aside programs where increased per hectares yields are observed and the commodity's total supply is reduced proportionally less than the program-induced reduction in the number of hectares devoted to the crop. This phenomenon is known in the agricultural economics profession as slippage [21]. It is defined as [16]:

$$slippage = 1 - \frac{\%\ change\ in\ output}{\%\ hectare\ reduction} \tag{6.1}$$

"Farm level land quality slippage" is slippage within a farm because of the soil quality. "Land quality slippage due to regional differences" is slippage due to the fact that farms with better soil quality don't participate in set aside programs that much (for more on this see Hoag et al [21]).

Table 6.3: Probit model for all small scale farms, marginal effects at mean for continuous variables and discrete change from 0 to 1 for dummy variables.

Variable	**Pr(set aside=1)**	**%set aside**
climate index	-0.001**	-0.163**
st dev clim ind	0.003**	-0.033
ln(arab land)	0.062**	-8.717**
ln(animals)	-0.067**	-1.757**
ln(kw/ha)	-0.037**	-0.175
oepul	0.079**	0.436
full time	-0.028**	0.068
legal	-0.025	0.767
hp1	-0.115**	9.829**
hp2	-0.087**	-1.156
hp3	-0.085**	2.107**
hp4	-0.134**	-3.357**
hp5	-0.074**	2.319**
hp6	-0.103**	-1.865**
hp8	-0.087**	-2.557**
intercept	–	42.729**

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 6.4: Range of variables in probit

variable	at max	at min	range
clim ind	0.0520	0.1495	0.0975
st dev	0.3354	0.0846	0.2508
ln(arab land)	0.5088	0.0271	0.4817
ln(animals)	0.0003	0.3681	0.3678
ln(kw/ha)	0.0190	0.2484	0.2294
oepul	0.1109	0.0314	0.0795
full time	0.0889	0.1165	0.0276
legal	0.0755	0.1005	0.0250
hp1	0.0030	0.1183	0.1153
hp2	0.0168	0.1042	0.0874
hp3	0.0260	0.1114	0.0854
hp4	0.0254	0.1596	0.1342
hp5	0.0328	0.1073	0.0745
hp6	0.0369	0.1404	0.1035
hp8	0.0286	0.1154	0.0868

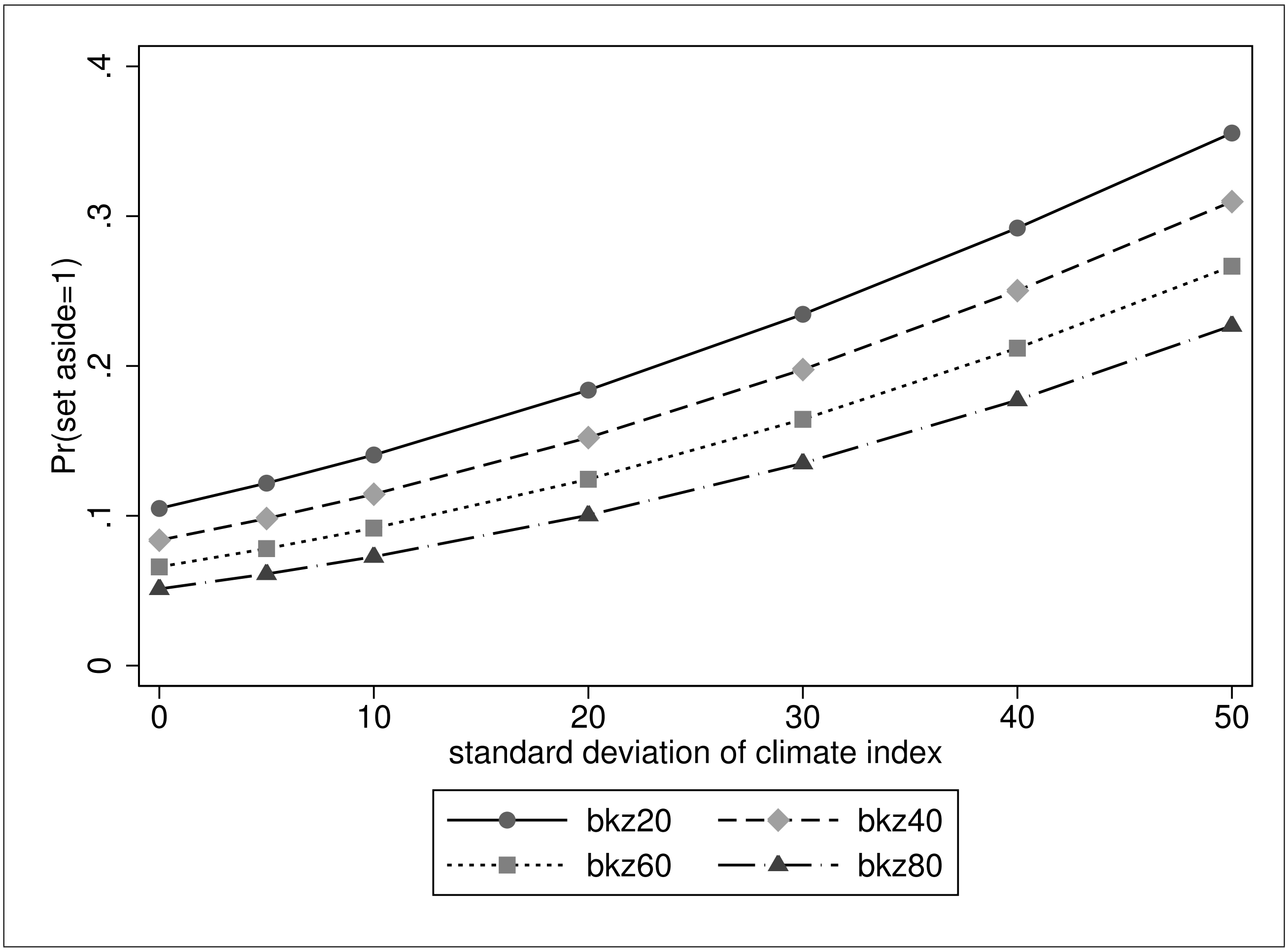

Figure 6.1: Influence of standard deviation of climate index on probability to set aside at various levels of average climate index

significant. In other word, ln(kw/ha) has no influence. The influence of ln(arab land) is very strong, but negative! For interpretation it must not be forgotten that the logarithm of arable land is used. Hence the first couple of hectare matter a lot while the following have fare less influence. Farms with more arable land set aside less. A way to explain this is to say that the more specialized farms with more arable land make use of the option to set aside the worst field, while this strategy is not used by farms with few hectares of arable land. The farms with few arable land set aside less likely, but if they set aside, they set aside a lot. Generally, it should be kept in mind that non of these farmers have very much arable arable land, since all of them are small scale farms. An exception can be those farms that have a lot of arable land but apply only for a small fraction of it. The dummies for ÖPUL, full time and legal are insignificant. The coefficient of hp1 is stunningly high, but with only 30 farms actually setting aside arable land in hp1, the result is of limited relevance. To sum up, it remains to say that the structural differences are very important when it comes to the decision how much to set aside, but also the average climate index plays a role.

Major production areas

The significant coefficients for the production area dummies in the regressions showed that set aside behavior differs locally. That leads to the idea to have a closer look at the production areas each by each. As it might be possible that the tobit model holds for some production areas, I present the results of the tobit estimations in table 6.5. As the values of the Cragg/Greene estimates tell, the tobit model can't be used for any of the major production areas. Therefore I estimated the Cragg model for all the production areas. The results can be found in table 6.6 and table 6.7. The first thing to mention about the results is that – in absolute terms – the number of farms that set aside arable land in production area 1 and 2 is very small. Therefore I will not discuss the results of these two production areas any further. For the others the results are, with some exceptions, the same as for all production areas together: the variables for the farm type are important in all production areas, the standard deviation is more important than the climate index in the probit model and the opposite is true for the truncated regression. It is interesting that almost all dummies in the truncated regressions are not significant. But now turn to the exceptions: hp3, the eastern fringe of the Alps, has, as hp4, a positive climate index coefficient in the probit model while, as in hp7, the coefficient for the standard deviation of the climate index is not significant. The comparatively high coefficient for full time farms and the low influence of the ÖPUL dummy is worth mentioning about hp3. Hp4 shares the low ÖPUL coefficient with hp3 as well as the positive climate index of the probit. But the climate index of the truncated regression is much smaller in hp4 than everywhere else. The Carinthian basin, hp5, is the only production area where the climate index is not significant. For hp7, the production area with the highest average set aside, the highest influence of the climate index in the probit model is derived. There are a couple of comments to be made about hp8, the production area with the biggest arable land farms. The ln(arable land) and ln(animals) coefficients of the probit model are relatively low, but still influential. ÖPUL in the probit model is relatively big, reaching almost one percent. But the most interesting result of the probit model is the positive sign of the full time dummy. Full time is also significant in the truncated regression and the influence is, with 2.5, relatively strong.

To sum up, in general the findings of the regression with all small scale farms get confirmed by the regressions for the production areas. For a more detailed interpretation it is necessary to do detailed research about the production areas. Those interested in more information about production areas may be referred to Wagners two books about the production areas in

Austria [39] and [40].

Table 6.5: Tobit model for small scale farms in different production areas

Variable	**hp1**	**hp2**	**hp3**	**hp4**	**hp5**	**hp6**	**hp7**	**hp8**
climate index	-3.262**	-0.670*	0.286**	0.176*	-0.243*	-0.305**	-0.547**	-0.354**
st dev clim ind	0.208	0.939†	0.351	0.987**	0.492*	0.446**	0.344*	0.155*
ln(arab land)	36.588**	14.998**	12.924**	10.840**	12.760**	9.003**	7.665**	-1.582**
ln(animals)	-40.247**	-14.482**	-20.872**	-15.278**	-14.763**	-9.644**	-11.704**	-5.583**
ln(kw/ha)	-17.461**	-7.162**	-7.493**	-9.872**	-3.649**	-7.828**	-3.884**	-2.170**
oepul	-20.912	9.241	16.248**	10.058**	26.751**	16.434**	18.544**	25.271**
full time	1.458	-2.418	-16.708**	-7.928**	-8.140**	-7.105**	-6.764**	4.766**
legal	-363.647	45.569	-49.484†	-23.838†	-3.137	-3.594	-24.350	9.273†
intercept	66.870†	-6.000	-14.766*	-18.612**	-29.799**	-8.168*	18.425**	-2.248
σ	73.669**	35.785**	37.368**	36.914**	40.276**	31.478**	30.745**	25.227**
left-censored	2758	1029	3219	12152	2407	11317	1947	3027
uncensored	27	86	521	1248	442	1523	1296	2153
right-censored	3	2	40	60	24	42	130	43
total	2788	1117	3780	13460	2873	12882	3372	5223
Cragg/Greene	74.43	78.95	776.19	1285.29	492.11	1005.74	1724.65	1315.85
Chesher-Irish	663.82	522.20	1769.69	4083.34	1958.43	4649.37	2524.93	4344.44
Pagan-Vella	708.47	261.61	305.24	1835.51	1052.99	2081.38	12.39	462.59

Significance levels : † : 10% $*$: 5% $**$: 1%

The Chasher-Irish and Pagan-Vella tests for hp4 and hp6 are computed from a 7999 observations random sample

Table 6.6: Cragg's model for small scale farms in production area 1 to 4

Variable	hp1		hp2		hp3		hp4	
	probit	trunc	probit	trunc	probit	trunc	probit	trunc
clim ind	-0.045**	-1.062	-0.017**	-0.559**	0.011**	-0.199**	0.006**	-0.084**
st dev	0.005	0.913	0.028	-0.478	0.012	-0.144	0.030**	-0.105
ln(arab land)	0.541**	-24.794	0.485**	-1.386	0.491**	-11.447**	0.398**	-11.319**
ln(animals)	-0.555**	-13.725	-0.411**	-2.807**	-0.611**	-1.390**	-0.433**	-1.665**
ln(kw/ha)	-0.254**	3.178	-0.207**	-0.804	-0.235**	-0.169	-0.284**	0.195
oepul	-0.239	-10.827	0.338	-4.315	0.471**	1.755	0.319**	2.494
full time	0.029	2.416	-0.116	0.368	-0.453**	-2.390	-0.217**	-1.623
legal	—	—	—	-15.563	-1.174	-36.991	-0.794**	15.049
intercept	0.857	148.941**	-0.387	58.937**	-0.638**	59.783**	-0.715**	47.246**
σ	—	13.959**	—	10.952**	—	12.970**	—	11.661**
obs.	2774	27	1116	86	3780	521	13460	1248

Significance levels : † : 10% $*$: 5% $**$: 1%

The legal person run farms were dropped in hp1 and hp2, since none of them set aside arable land

Table 6.7: Cragg's model for small scale farms in production area 5 to 8

Variable	hp5		hp6		hp7		hp8	
	probit	trunc	probit	trunc	probit	trunc	probit	trunc
clim ind	-0.006	-0.107	-0.008**	-0.283**	-0.014**	-0.249**	-0.012**	-0.277**
st dev	0.014**	-0.151	0.015**	-0.107	0.011	-0.021	0.008**	-0.040
ln(arab land)	0.408**	-9.444**	0.389**	-11.544**	0.525**	-13.893**	0.131**	-14.368**
ln(animals)	-0.372**	-3.762**	-0.318**	-2.311**	-0.430**	-3.580**	-0.234**	-2.319**
ln(kw/ha)	-0.115**	1.096	-0.268**	0.178	-0.136**	-1.796**	-0.107**	0.065
oepul	0.735**	-3.498	0.565**	1.062	0.684**	1.212	0.953**	0.009
full time	-0.232**	-0.485	-0.229**	-1.021	-0.218**	-1.101	0.193**	2.520**
legal	-0.036	-7.501	-0.061	9.334	-1.120	17.884	0.433†	-1.027
intercept	-0.897**	57.564**	-0.527**	57.942**	0.002	68.679**	-0.523**	62.383**
σ	—	13.989**	—	13.850**	—	14.757**	—	13.799**
obs.	2873	442	12882	1523	3372	1295	5223	2153

Significance levels : † : 10% $*$: 5% $**$: 1%

6.2 General regulation

The estimation results for the farms under the general regulation are presented in table 6.8.

Unfortunately the tests for normality lead to the rejection of the null hypotheses of normally distributed errors. A way to deal with the problem of non-normality and heteroscedasticity is to use a robust estimator. One such estimator available is the censored least absolute deviations estimator (CLAD) suggested by Powell [32]. For the estimation I used the Stata insert from Jolliffe et al [24]. The estimator is a special case of the least absolute deviation estimators and therefore minimizes the absolute values instead of the squared deviations. To calculate the

Table 6.8: Farms under general regulation for all production areas

Variable	Coefficient	(Std. Err.)
climate index	-0.099**	(0.005)
st dev clim ind	0.038**	(0.012)
ln(arab land)	-1.660**	(0.114)
ln(animals)	-0.459**	(0.028)
ln(kw/ha)	-0.142	(0.089)
oepul	1.664**	(0.311)
full time	-0.249†	(0.134)
legal	1.990**	(0.631)
hp1	-1.768	(1.732)
hp2	-0.248	(0.705)
hp3	-0.226	(0.433)
hp4	-4.690**	(0.269)
hp5	-0.484	(0.346)
hp6	-1.945**	(0.245)
hp8	-3.072**	(0.246)
intercept	13.541**	(0.636)
σ	5.695**	(0.037)
left-censored		924
uncensored		12467
right-censored		0
total		13391
Cragg/Green	7130.96	
Chasher-Irish‡	7814.67	
Pagan-Vella‡	325.81	

Significance levels : † : 10% $*$: 5% $**$: 1%

‡: Calculated with a random sample of 7999 obs.

standard errors the insert uses a bootstrap procedure. I did a replication of 100 for a simple bootstrap estimate.

Table 6.9: CLAD estimation for all farms under general regulation

Variable	**Coefficient**	**(Std. Err.)**
clim ind	-0.015**	(0.001)
st dev clim ind	0.007**	(0.002)
ln(arab land)	-0.405**	(0.033)
ln(animals)	-0.079**	(0.006)
ln(kw/ha)	0.010	(0.015)
oepul	0.342**	(0.070)
full time	-0.058*	(0.023)
legal	0.604*	(0.245)
hp1	0.284	(0.473)
hp2	-0.363	(0.303)
hp3	-0.078	(0.329)
hp4	-1.011**	(0.130)
hp5	-0.551**	(0.122)
hp6	-0.681**	(0.126)
hp8	-0.887**	(0.122)
intercept	3.597**	(0.223)
obs.	13391	
reps.	100	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%
Sign. levels only valid if t-statistic is valid

The coefficients of the robust CLAD estimation are by far smaller than the results from the maximum likelihood estimation. The small influence of the two variables for the climate index is not surprising, as already 10% are set aside and therefore the worst fields are set aside already. Of special interest is the relatively high and negative coefficient for ln(arab land). These farms, that all have at least 17 hectares of arable land, set aside less, if they have more arable land. Scale effects are a possible explanation of this phenomenon. The two variables ln(animals) and ln(kw/ha) are not as influential as in the case of small scale farms, as all the farms are more or less specialized arable land farms. Therefore the interpretation should not be as instrumental variables but rather directly. Doing that, the low influence is not very surprising. A unique appearance of this estimation is the significance of the dummy for legal persons run farms. Farms that are legal person run set aside more than part and full time farms. The dummies for the production areas are comparatively low. Noticeably is the high negative influence in the Waldviertel and Mühlviertel (hp4).

Generally I must conclude that the magnitudes of the coefficients are all much lower for the farms under general regulation than for small scale farms. That is likely to have do with the fact that there is a certain similarity concerning the farm structure among farms that fall under the general regulation. The variables that try to explain the different structures consequently loose their ability to explain differences. Combined with the fact that, due to the mandatory set aside the climate index variables don't have much influence, there are are only the dummy variables left to explain set aside. Reducing the sample to production area 8 or 4 (the production areas with the highest number of observations), doesn't change the picture that the model for the farms under the general regulation doesn't explain set aside very well. I therefore conclude that the model presented here does not fulfil the purpose and another one has to be developed for farms under the general regulation.

Chapter 7

Application Of Results And Outlook

7.1 Interpretation

In the last chapters I tried to explain set aside. Especially, I tired to find out what the characteristics are of farms that set aside arable land voluntarily. The influence of different parameters was discussed in the previous chapter. But is there any further us for the results? However, set aside is a relatively unimportant part of the Common Agricultural Policy and it is likely that it will not play a more important role in the near future. Therefore, the question arises, whether the results are applicable to other aspects of agricultural policy. The main strategy to reorganize the Common Agricultural Policy is not "set aside" but "decoupling". Decoupling is also one of the main parts of the CAP reform following the Mid Term Review (Council Regulation 1782/2003 [9]). In EU agricultural language, decoupling means that the level of direct payments to farms does not depend on output, but is fixed for each farm. Although there are transitional regulations and not all sectors will be decoupled, in general, Regulation 1782/2003 follows the idea of decoupling. The new regulations enter into force in 2005.

What the actual effects of the new regulation will be in Austria, is unclear. Sinabell and Schmid [38] calculate in their model of the Austrian agricultural sector that one consequence of decoupled direct payments will be a reduction of arable land. A fear often expressed in public is that as a consequence of decoupled direct payments farms will stop the production of agricultural commodities. But if the current Support Scheme for Certain Arable Crops with its voluntary set aside option is compared with the idea of decoupling, it can be seen that the current regulation is not too far from a decoupled direct payment. Under the current scheme, a farm can either cultivate the arable land or leave it fallow: the direct payments are the same[1]. And that is exactly the idea of decoupled direct payments: you receive direct payments independent of what you do with your fields. So it should be possible to draw some conclusions about the behavior under decoupled direct payments by analyzing the voluntary set aside. Of course, there are differences: First, set aside is possible just for arable land while decoupling will be applied to all sectors (even if some will be just partially decoupled). Second, set aside is limited to 50% of the application area. Third, not all crops are supported under the current regulation and for some higher payments are provided. Fourth, under the current regulation applications are necessary for direct payments, and therefore what will be cultivated must be determined in advance. These differences are important when drawing conclusions on decoupling from voluntary set aside. Especially the limitation of set aside to arable land and

[1]For some crops, such as Durum wheat or protein crops higher per ha payments are granted. But this should not invalidate the general conclusion.

to a maximum of 50% are important. The first is important because one obviously cannot say, a cattle farmer will give up her cattle farm because she sets aside her arable land as these two activities depend on different factors. The second is important because there is a qualitative difference between giving up the cultivation of 50% of the fields and deciding not to produce at all. A way to deal with the first problem is to focus on the production area "north eastern area of plains and hills" (hp8), because here, the majority of farms are arable land farms. To get an overview of the set aside in production area 8 figure 7.1 depicts how many small scale farms make use of set aside. The first bar in figure 7.1 consists almost exclusively of farms that do not set aside at all (only 9 farms set aside more than 0 but less than 2%). Figure 7.2 shows only those farms that set aside land (about 42%), and as shown obviously, there are farms that set aside substantial parts of their land.

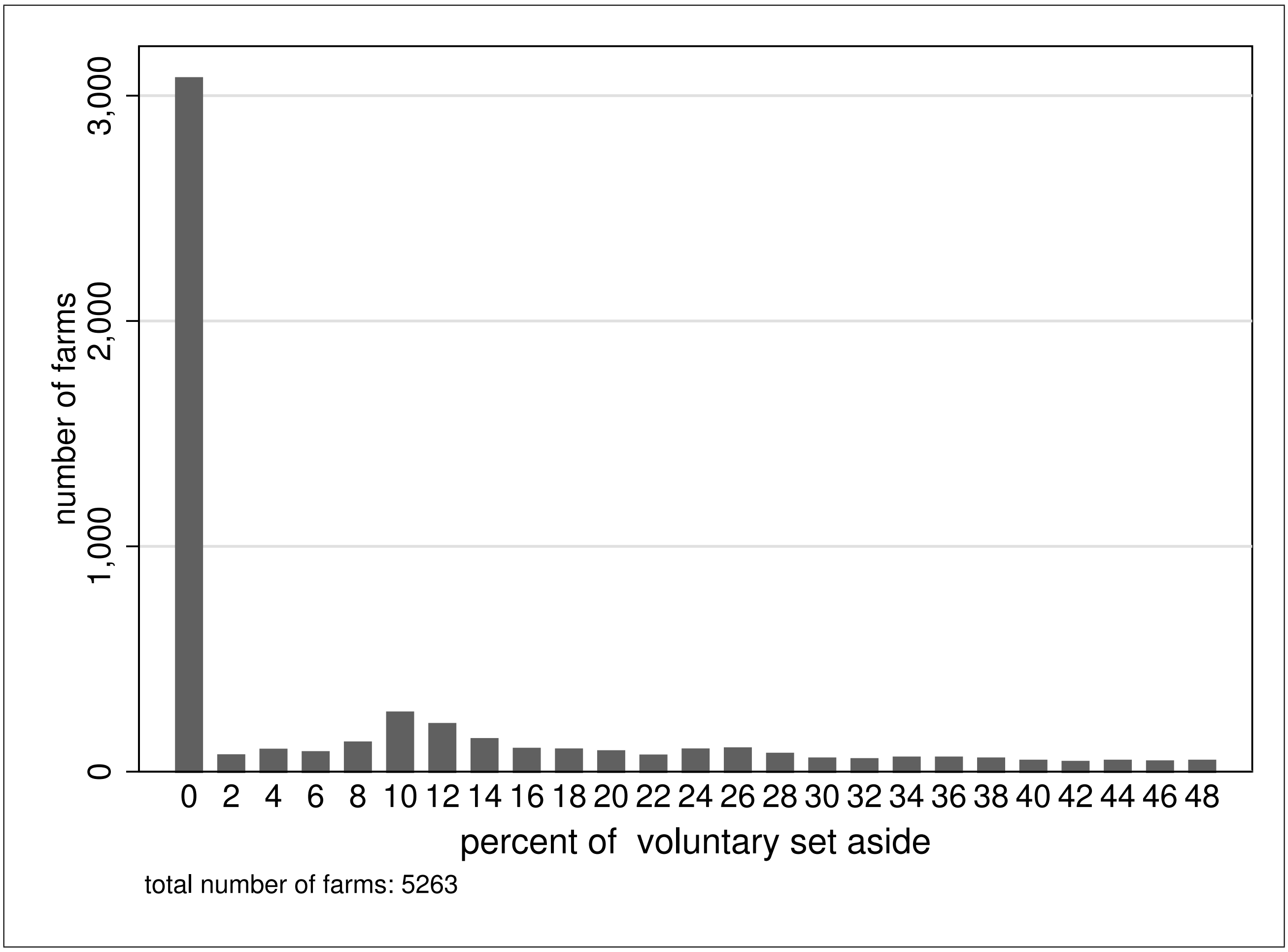

Figure 7.1: Voluntary set aside of small scale farms in production area 8

The consequence of decoupling of concern here is the change in cultivated area. Of course, some conclusions could be drawn just by taking observed values, but statistical estimates help to study the behavior systematically. The last two columns in table 6.7 show the coefficients for the coefficients for the probit and the truncated model for production area 8. The decision whether to reduce production is probably similar to the decision on how much to set aside: first, the farmer decides whether the new regulation has any influence on her production. In other words, she decides whether she should think about reducing production under the new support scheme. This decision is best represented by the probit model. The estimations are calculated under the restriction that results have to be between 0 and 1. The result indicates

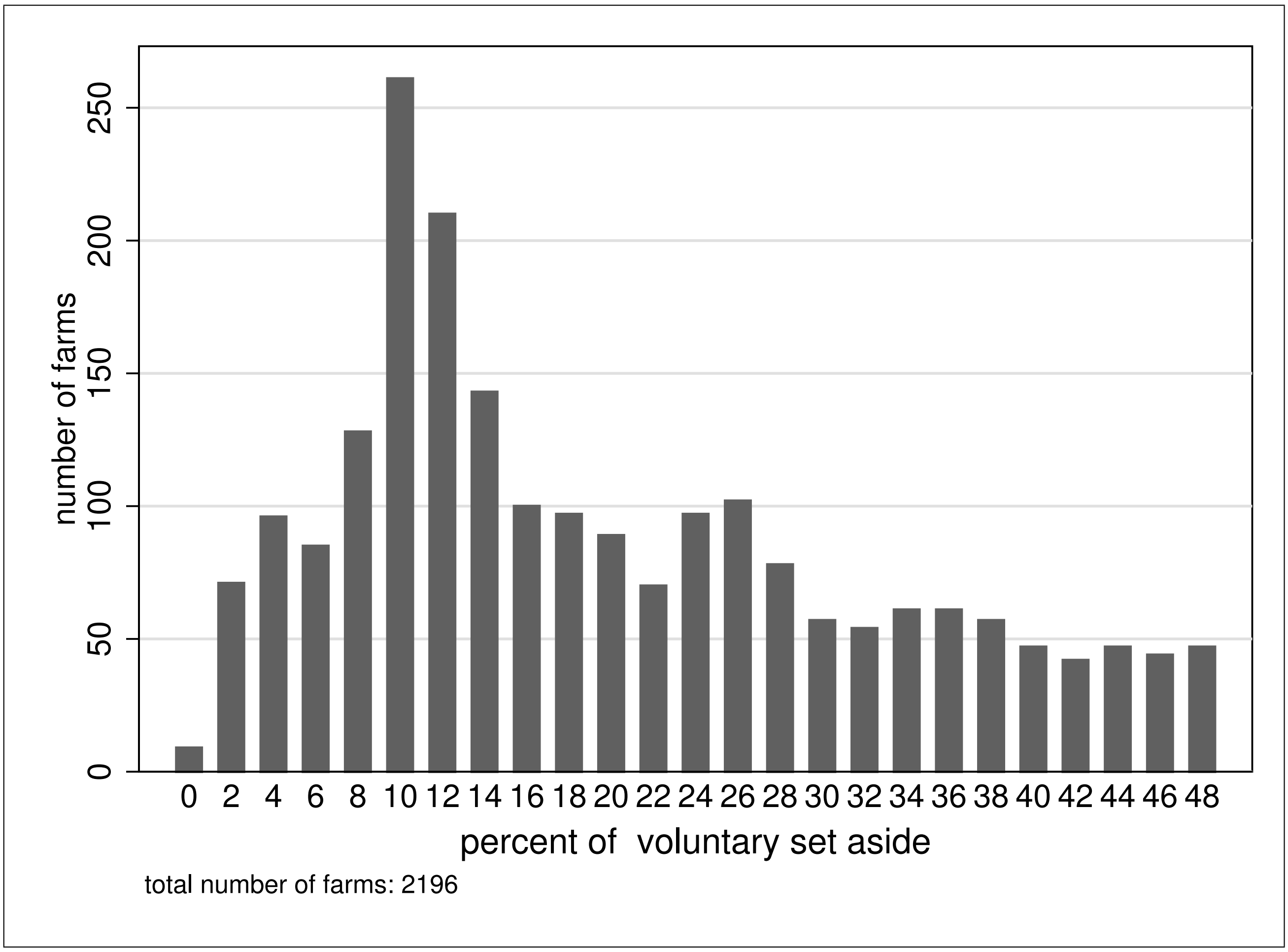

Figure 7.2: Voluntary set aside of small scale farms in production area 8 where set aside more than 0

the probability that a farm falls into the group of farms that consider to reduce production. The next step in the farmers decision is, to determine how much to reduce production. This decision is best estimated by the truncated model. I used the underlying latent variable for estimation and therefore results under 0 and above 50 are possible. To determine the expected value of the farmers decision under the new regulation, I multiplied the probability that she decides to change her production with the expected extent of change[2].

To test how appropriate this expected value is, I regressed the fitted values on the observed values for all small scale farm observations in hp8. The intercept is 11.2 percent points and the coefficient for the fitted values is 0.92. R^2 is only 0.11, therefore the explaining capabilities of the model must be regarded as limited. The fitted values are on average 11.2 percent points higher than the observed values. An increase of the observed value leads to an increase of the fitted value only by 0.92. The scatter plot of the expected production reduction versus the observed set aside is shown in figur 7.3.

The expected reduction of production for some types of farms can be found in table 7.1 and 7.2. The expected reduction of production was calculated for different climate indices and standard deviations of the climate index (the values chosen are the 5th, 50th and 95th percentile) and for full and part time farms. The other values were fixed at the level shown

[2]Alternatively you could determine a value for the probability (e.g. 0.5) and when the likelihood is higher than that, the expected set aside is the outcome of the truncated model.

in the table. Under the assumption that comparison of set aside with reduction of production under decoupling, with all exogenous circumstances remaining the same (especially prices), is permissible, cultivated areas can be expected to reduce for all farms with the characteristics shown in table 7.1 and 7.2. But the expected reduction in general remains low. This is supported by table 7.3 and 7.4, which lists the variables of the ten farms with the lowest and highest expected reductions[3]. Finally, table 7.5 confirms the diagnosis that reduction of production will not be a major problem as 90% of the farms will not reduce production by more than 15% and 70% will not reduce production by more than 10%. These conclusions are only valid under the assumption that the model is valid and that the exogenous variables do not change. However, both assumptions must be seriously questioned. But an extension of the model to increase the explaining capability of the model is beyond the framework of this study.

Table 7.1: Expected reduction of production of full time farms

clim ind	19	19	19	42	42	42	64	64	64
st dev clim ind	0	11	21	0	11	21	0	11	21
fitted probit	0.65	0.68	0.71	0.54	0.57	0.60	0.43	0.46	0.49
fitted truncated	28.25	27.81	27.41	21.88	21.44	21.04	15.78	15.34	14.94
expected reduction	18.30	18.86	19.33	11.75	12.22	12.62	6.76	7.08	7.35

Other variables: arabl land=9, animals=0, kw/ha=15.7, oepul=1 full time=1 legal=0

Table 7.2: Expected reduction of production of part time farms

clim ind	19	19	19	42	42	42	64	64	64
st dev clim ind	0	11	21	0	11	21	0	11	21
fitted probit	0.57	0.61	0.64	0.46	0.49	0.52	0.35	0.39	0.42
fitted truncated	25.73	25.29	24.89	19.36	18.92	18.52	13.26	12.82	12.42
expected reduction	14.77	15.34	15.82	8.91	9.34	9.70	4.70	4.95	5.16

Other variables: arabl land=9, animals=0, kw/ha=15.7, oepul=0 full time=1 legal=0

Table 7.3: Variables of the observations with the lowest expected reduction

clim ind	**st dev**	**arab land**	**animals**	**kw/ha**	**oepul**	**full t**	**legal**	**exp red**
45.37	4.65	61	97.00	0.00	1	1	0	-5.78
60.69	13.97	49	0.00	2.86	1	1	0	-5.36
76.05	4.59	42	0.00	9.67	1	1	0	-4.79
71.86	11.07	41	3.75	9.55	1	1	0	-4.70
45.30	15.95	59	94.00	14.15	1	1	0	-4.54
67.92	17.63	38	0.00	10.98	1	0	0	-4.40
59.97	10.57	48	0.00	17.09	1	1	0	-4.27
48.17	9.01	50	3.40	14.33	1	1	0	-3.94
70.07	9.14	37	103.80	0.00	1	1	0	-3.74
68.37	10.44	52	80.60	12.99	1	1	0	-3.72

[3]Interestingly there are a number of entries with 0 kw/ha. Further investigation is neede on how that comes about.

Table 7.4: Variables of the observations with the highest expected reduction

clim ind	st dev	arab land	animals	kw/ha	oepul	full t	legal	exp red
15.38	9.33	3	0.00	0.00	1	0	0	28.32
15.88	14.16	3	0.00	0.00	1	0	0	28.55
18.12	3.30	1	0.00	8.56	1	0	0	28.70
32.70	14.14	1	0.00	0.00	1	0	0	29.13
10.81	13.27	3	0.60	20.06	1	1	0	30.22
21.00	0.00	1	0.00	0.00	1	0	0	32.08
3.12	0.50	3	0.00	0.00	1	0	0	32.23
28.21	12.00	2	0.00	0.00	1	0	1	32.59
3.00	0.00	2	0.00	50.51	1	1	0	32.69

Table 7.5: Expected reduction at different percentiles in %

percentile	5	10	20	30	40	50	60	70	80	90	95
exp red	-0.39	0.70	2.49	4.01	5.40	6.73	8.24	10.01	12.12	15.21	17.91

7.2 Outlook

This report made a model to estimate set aside and a first analysis of the implications of decoupling. But further research is needed to gain better insight. The main thrust must be to increase the explanatory capacities of the model. A first, and very simple step, would be to add more variables to the existing model: for example farm type, membership in an organic farming organization and demographic information. A crucial and very important point would be to include prices. One way to do this would be to use data for all variables for the years 2000 to 2004 and estimate the model with panel data. That would allow to test whether farms react to price differences.

The quality of the results could also be increased, if more information on the climate index was available. In particular, the information when which municipality was updated, could help to increase the quality of the climate index.

A totaly new area of research could be opened up, if it were known which fields were set aside[4]. This information should be available from 2005 on, when the the GIS (Geo Informations System) of the Ministry of Agriculture is in place. The influence of the climate index, the accessability (for example GPS coordinates of the farm house and the fields) and maybe the shape of the field on set aside could be elements of a future estimation.

For predictions of the effects of decoupling, focus should be put on production area 8, which is well suited for this type of analysis. Then better estimates should be possible than the first approximation presented here.

[4]The only information I used, was how much a farm sets aside, but not which fields.

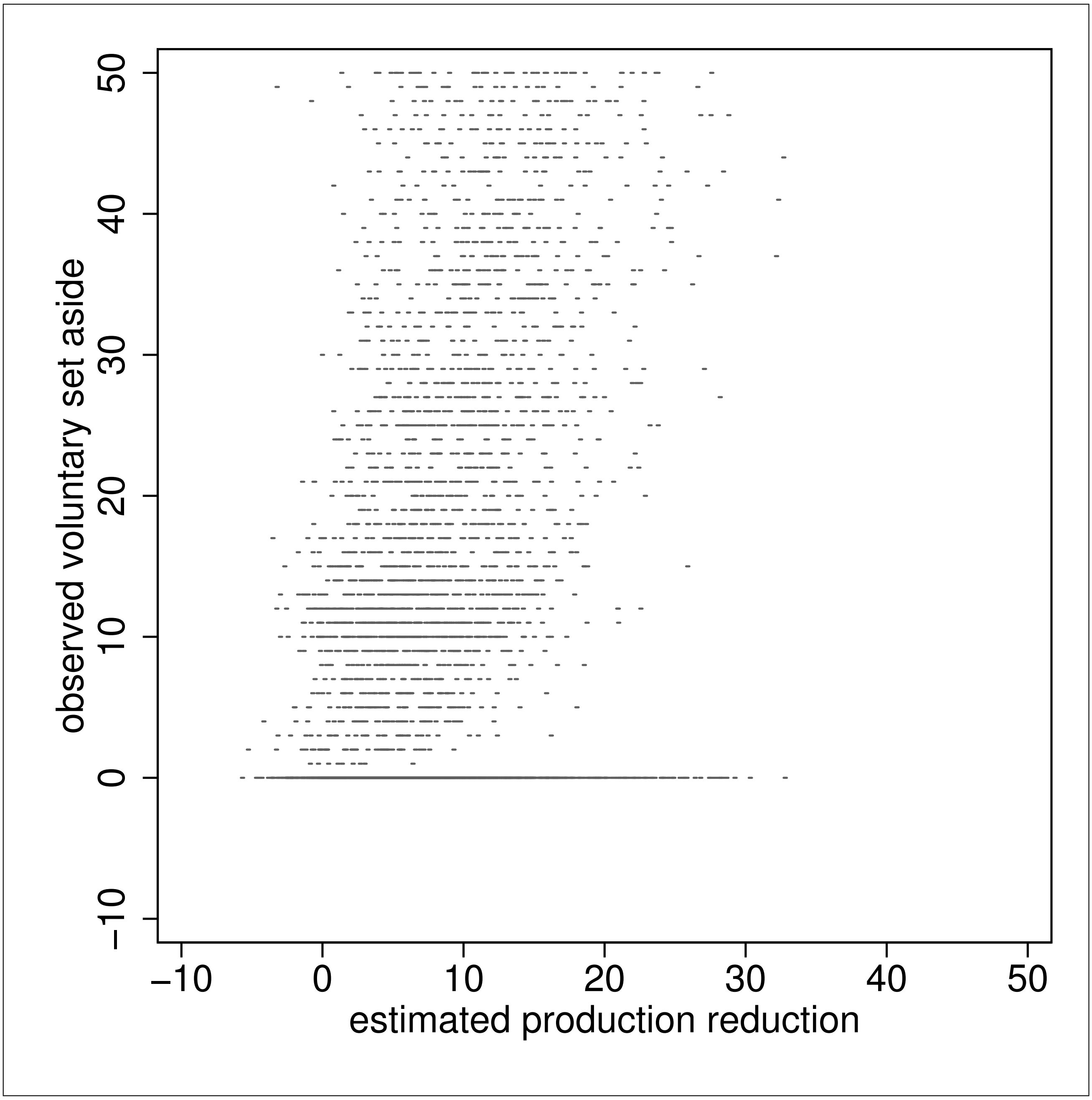

Figure 7.3: Expected reduction of production vs. observed set aside in %

Appendix A

ÖPUL And Set Aside

ÖPUL measures that can be counted as set aside areas:

1. `Design of new landscape elements (2.28):`

   Is a transformation from an ecologically less important area to an area that can provide important ecologic functions as part of a regional project. The conditions are:

   - the measure must be part of an official environmental plan of the government of the federal province and the participating farm has to lay down under which conditions it takes part in the federal province's program.
   - renunciation of pesticides
   - renunciation of fertilizers
   - renunciation of *sewage sludge* and *sewage sludge compost*
   - renunciation of usage of area except usage is part of the project
   - (optional) creation of an environmental protection plan to coordinate the environmental protection activities.

   Depending on the the duration and the soil quality of the area where the new landscape elements are to be designed, the payments for arable land and green land are presented in table A.1 and table A.2

Table A.1: Payments for arable land in Euros per year

	5 years	10 years	20 years
climate index > 60	472.37	526.88	617.72
climate index 30–60	399.70	454.21	545.05
climate index < 30	327.03	381.53	472.37

Table A.2: Payments for green land in Euros per year

	5 years	min 10 years
yield level 1	508.71	581.38
yield level 2	290.69	363.36

Additionally to the payments from above for the creation of new landscape elements, special efforts are remunerated. The remunerations are shown in table A.3. If a farm participates in developing an environmental plan, additional 72.67 € for a maximum of 10 fields are payed.

Table A.3: Supplements for special efforts (project specific determination of step) per year

	effort	example	€/year
first step	low	*chopping*, cutting off river bank strips	72.67
second step	middle	difficult *chopping*, *grubbing*, removal of copse	145.35
third step	high	difficult structure of the area or steepness	218.02

Measure 2.8 can be combined with the following measures: Basic subsidy (2.1), Integrated fruit production (2.7), Erosion control in fruit growing (2.24) and Projects in favor of preventive water protection (2.31).

2. `Preventive Water Protection in` ***`Redarea`*** `fields (2.31):`

   This measure is available only in Lower Austria and Pannonia.

   This measure can be applied, if the following condition hold for the cultivated field:

   - the climate index of the filed must be lower than 30 (redarea). In case a field has more than one climate index, the weighted average has to be used.
   - in case a farm also cultivates redarea fields, at least 5 % of the fields have to be integrated in the measure. In case there are conflicts with other environmental protection programs, this percentage can be reduced by the office in charge.
   - redarea fields up to 30% of the arable land can be included in the measure. But the federal province can increase the share if it pays for the additional costs.
   - redarea fields can be part of the measure "creation of new landscape elements" as a new cover grows on the field.
   - In case redareas fields are not included in the "creation of new landscape elements" measure, the following conditions have to be met
     - sowing of an appropriate meadow at the beginning of the first year of the treaty. It must not be plowed till the end of the year.
     - cultivation of the area either by cutting or by chopping.
     - no use of fertilizer or pesticide
     - no use of sewage sludge and sewage sludge compost.

   The premium for participating in this measure are is 436.04 €/ha redarea.

   Measure 2.31 can be combined with the following measures: Basic subsidy (2.1), Organic farming (2.2), Renunciation of yield-increasing inputs on arable land (2.4), Reduction of the use of yield-increasing inputs on arable land(2.6), Integrated fruit production(2.7), Renunciation of the use of herbicides in fruit growing(2.8), 9 Integrated viticulture(2.9), 10 Renunciation of the use of herbicides in viticulture(2.10), 11 Integrated production in vegetable gardening as well as in field growing of medicinal and spice plants(2.11), Integrated production in field growing of ornamental plants(2.12), Integrated production in protected cultivation(2.13), Renunciation of the use of growth regulators(2.14), Renunciation of the use of fungicides(2.15), Renunciation of the use of silage in certain areas(2.16), Cultivation of rare agricultural crops(2.20), Greening of arable areas in autumn and winter(2.22), Erosion control in arable farming(2.23), Erosion control in fruit growing(2.24), Erosion control in viticulture(2.25), Small-scaled structures worth being preserved(2.26), Tending of ecologically valuable areas(2.27), Designing new landscape elements(2.28).

3. `Areas set aside where renewable resources are grown`

   Areas where renewable resources are grown, can be counted as set aside. This option is especially interesting for farms under the general regulation that take part in an ÖPUL measure where they grow non food crops. They can count these fields as their mandatory set aside.

Appendix B

Translation Of Technical Terms

Some of the words used in this report are technical terms with a specific meaning in Austria. As the translation might lead to confusion, here is a list of technical terms and their translation.

- *arable land index*: Ackerzahl
- *chop*: häckseln
- *climate index*: Bodenklimazahl (BKZ)
- *farm under the general regulation*: Erzeuger die nicht unter die Kleinerzeugerregelung fallen
- *field*: Feldstück
- *green land index*: Grünlandzahl
- *grub*: grubbern, Boden mit Grubber bearbeiten
- *legal person run farm*: juristischer Betrieb
- *major production area*: Hauptproduktionsgebiet (HPG)
  - *high alpine area*: Hochalpengebiet (HPG 1)
  - *subalpine area*: Voralpengebiet (HPG 2)
  - *eastern fringe of the alps*: Alpenostrand (HPG 3)
  - *Waldviertel and Muehlviertel*: Waldviertel und Mühlviertel (HPG 4)
  - *Carinthian basin*: Kärntner Becken (HPG 5)
  - *alpine foreland*: Alpenvorland (HPG 6)
  - *southeastern area of plains and hills*: Südöstliches Flach und Hügelland (HPG 7)
  - *northeastern area of plains and hills*: Nordöstliches Flach- und Hügelland (HPG 8)
- *municipality*: Katastralgemeinde
- *property*: Grundstück
- *redareas*: Rotflächen

- *sewage sludge*: Klärschlamm
- *sewage sludge compost*: Klärschlammkompost
- *small scale farmer*: Kleinerzeuger
- *standard gross margin*: Standarddeckungsbeitrag
- *yield index*: Ertragsmesszahl (EMZ)

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