



*Voluntary forest set-  
asides in Sweden*  
*-an empirical and theoretical analysis*

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*Voluntary forest set-asides in Sweden*  
*-an empirical and theoretical analysis*

*Frivilliga skogsavsättningar i Sverige*  
*-en empirisk och teoretisk analys*

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# Abstract

Voluntary forest set-asides have increased in Sweden since 1996 when they were first introduced. The theory of voluntary agreements states that they should be cost minimizing and flexible. The principle with voluntary forest set-asides is that the forest owners in a voluntary way should set forest with a high biological value aside from production. The voluntary forest set aside should be a connecting area of productive forest land (0.5 ha) where no actions that can hurt the biodiversity are allowed. In Sweden the environmental goal, *Sustainable Forests*, states that until 2010, 730 000 ha forest should be set aside below the mountain border.

Profit maximising forest owners set aside forest where the marginal benefits are equal to the marginal cost. An estimated marginal cost curve for Sweden, based on the average assessed value/ha forest as the opportunity cost, shows the supply of set-asides. Two different supply curves are estimated; the first is based on certificated forest and the second are adjusted with the results concerning voluntary forest set-asides from the Forest Agency. The differences between these two curves are considerable, which could have an effect if the government intends to introduce a subsidy. For both curves the lower part show a relative low increase of marginal cost but as hectares of voluntary set-asides increase the marginal cost rises faster. The reason is that in Sweden large amount of forest can be set aside to a low opportunity cost in the north but in the south the opportunity cost rises for the set-asides and less hectares are set aside. The flexibility from forest set-asides can vary for forest companies and small forest owners. In Sweden the small forest owners have the smallest share of forest set-asides which may be caused by their lower benefits as compared to the forest companies.

The statistical estimates are based on too few investigations of the voluntary forest set-asides in Sweden to give a proper picture about their cost. The reason is that no investigations have estimated how much forest that is set aside in each county. A robust conclusion is, however, that the area of voluntary set-asides depends on the location in Sweden they are made. There is also a difference in relative area of forest set aside by small and large forest owners.

Key terms: forest set-asides, voluntary agreements, marginal cost curve

# Sammanfattning

Frivilliga överenskommelser som politiskt instrument ökar inom miljörelaterade områden. De ses som flexibla och kostnadsminimerande. 1996 bildades begreppet frivilliga avsättningar. Tanken är att skogsägarna på en frivillig väg ska avsätta skog med högre biologiska värden från produktionen. Definitionen av en frivillig avsättning är ett område på 0.5 ha sammanhängande produktiv skogsmark inom vilket åtgärder som kan skada den biologiska mångfalden inte får utföras. I och med miljömålet levande skogar har regeringen fastställt ett mål för frivilliga avsättningar. Till år 2010 bör ca 730 000 ha skog vara avsatt nedanför fjällgränsen.

En vinstmaximerande skogsägare avsätter skog där marginalnyttan från avsättningen är lika stor som marginalkostnaden från avsättningen. För Sverige visar en skattad marginalkostnadskurva baserad på taxeringsvärdet per hektar som alternativkostnad hur utbudet av frivilliga avsättningar kan se ut. Två olika utbudskurvor skattas, en baserad på certifierad skog och den andra när justeringar efter resultat från Skogstyrelsen gjorts. Dessa båda kurvor visar på stora skillnader, vilket kan ha en effekt om Sveriges regering skulle vilja införa en subvention för att öka de frivilliga avsättningarna. Gemensamt för båda är att marginalkostnaden inte ökar i så hög trakt den första delen av kurvan för att därefter öka i en högre takt. Detta beror främst på att större areal i norra Sverige kan tas undan från produktionen till en lägre alternativkostnad men ju längre söderut i Sverige avsättningarna görs desto högre blir alternativkostnaden och färre hektar avsätts. Flexibiliteten inom frivilliga överenskommelser kan variera mellan större skogsbolag och mindre skogsägare. I Sverige är det småskogsägarna som avsätter procentuellt minst skog vilket kan bero på att deras marginalnytta från avsättningarna inte överstiger marginalkostnaden.

De statistiska skattningarna är baserade på för få undersökningar om frivilliga avsättningar för att kunna ge en bild av dess kostnad. Detta beror på att det inte finns undersökningar som visar hur mycket areal som avsätts i varje län i Sverige. Men för mängden hektar som avsätts har det betydelse var i Sverige avsättningarna görs och det har även betydelse vilken typ av skogsägare, småskogsägare eller bolag, det handlar om.

Key terms: frivilliga skogsavsättningar, frivilliga överenskommelser, marginalkostnadskurva

# Abbreviations

FSC = Forest Stewardship Council

PEFC = Pan European Forest Certification Scheme

VA = voluntary agreements

VFSs = voluntary forest set-asides

VPA = voluntary public agreement

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# 1 Introduction

## 1.1 Problem background

Voluntary Agreements (VAs) are becoming an attractive option within environmental policy. The main reason is that they are seen as less costly than regulation since they can reach the environment goal in a more flexible and cost minimizing way (Segerson & Li, 2000). In Sweden a mean to protect forest is voluntary forest set-asides (VFSs). The definition of voluntary forest set-asides is:

*“0.5 ha voluntary set aside connected productive forest land, within which forestry and other measures that can damage the biodiversity are not allowed”*

(Own translation, Skogsstyrelsen, p 3, December 2001.)

In Sweden most of the forest land, 51 %, has private owners, the rest is divided between forest companies, 24 %, the state, 18 %, other private owners, 6 % and other public owners, 1 % (skogstyrelsen 2006). Many of the private owners are organised in the forest associations Södra, Mellanskog, Norra skogsägarna or Norrskog (www, Lantbrukarnas riksförbund<sup>1</sup>, 2006).

An important part of the new forest policy, introduced 1993, was to regard biodiversity as the base for well functioning and stabile ecosystems. The change in the forest policy was needed because in the earlier version from 1979 the environmental questions were not given proper weight. It was also important for the new forest policy to work together with the overall policies and contribute to deregulation and increased competition in Sweden. The main idea underlying the forest policy is to increase the forest owners' ambitions to do more than what is legislative through voluntary actions by providing consultation and education. The state has the main responsibility to see to that counselling is available for the forest owners, who need information (Skogsstyrelsen, November, 2001).

The concept of voluntary forest set-asides (VFSs) was introduced 1996 when the Swedish Forest Agency evaluated some parts of the new forest policy. The word voluntary means that the forest owner himself makes the decision to put forest aside from production. The decision is therefore not the result of what the authorities say or some kind of formal agreement, further the forest owner does not receive any financial compensation for the VFSs (Skogsstyrelsen, December, 2001).

The VFSs are supposed to be seen as a complement to the protections of forest financed by the government. The forest owner has to know the occurrence of biotopes on his land, and therefore new ways to obtain information are required. Today, the green forest plans which consist of consulting and information play an important role for voluntary forest set-asides (Skogstyrelsen, 2001). All counselling organizations like the Forest Agency, forest associations and counselling firms suggest where and how much forest the owner should set aside from production. The amount varies, but approximately 3 % - 5 % of the total forest land is suggested to be set aside (Skogstyrelsen October 2001).

The owner can also get his forest certificated through one of the two certifications systems. FSC, Forest Stewardship Council, is an international independent organization that consists of environmental organizations, forest producers, companies buying forest etc. For each country participating in FSC national rules are decided. One requirement to get certificated through FSC in Sweden a minimum of 5 % VFSs. Today 45 % of the Swedish forest is FSC-

certificated, this includes all the big forest companies (www, Svenska naturskyddsföreningen<sup>1</sup>, 2006). The second, and more industry oriented certification system is the PEFC, Pan European Forest Certification Scheme which was initiated by the forest associations. The Swedish PEFC was approved by the international PEFC council in 2000. In Sweden the PEFC's main participant is SÄF (Swedish association of forest owners) divided in Norra, Södra and Mellan. No environmental organization has chosen to support the Swedish PEFC (www, pefc<sup>1</sup>, 2006). All four forest associations organised under LRF today recommend 5 % VFSs under PEFC (www, Norra Skogsägarna<sup>1</sup>, Mellanskog<sup>1</sup>, Södra<sup>1</sup>, Skogsägarna Norrskog<sup>1</sup>, 2006).

*”Sustainable forests: The natural productive capacity of forests and forest land must be protected and biological diversity and culture heritage and recreational assets preserved”* (prop. 1997/98:145, p 6, English summary)

The Swedish parliament accepted 15 environmental objectives in April 1999 and *Sustainable Forests* is one of these. The aim is to manage the forests in a sustainable way. The intention is that the objectives should be reached until 2020 so that the next generation also can profit from the forests (www, Sveriges Miljömål<sup>1</sup>, 2006). The reasons for this objective were the fact that 95 % of the productive forest land was used for forestry and this was seen as a threat against valuable biotopes (prop. 1997/ 98: 145). To reach the part objective, 730 000 ha forest should be set aside below the mountain border in a voluntarily way until 2010 (www, Sveriges Miljömål<sup>2</sup>, 2006).

## 1.2 Aim

The aim of this thesis is to analyse the potential of VFSs from a theoretical perspective, and to estimate a supply curve, i.e. a marginal cost curve for VFSs in Sweden. The results are compared with the results from the Forest Agency concerning VFSs. Which conclusions can be made from these results? How are the VFSs working with respect to flexibility and cost minimization, and where in Sweden it is likely that VFSs can be made? What can be said about the incentives for VFSs and is there a difference between the amounts of forest set aside by different owners?

## 1.3 Method

This thesis applies micro economic analysis for evaluating the VFSs in Sweden in a theoretical and empirical way. The empirical model will be based on data from the FSC since they have estimated the forest area that is certificated in each county. From this data an estimation of the marginal cost curve of VFSs in Sweden will be made. By accumulating the hectare of VFSs at different assessed values/ ha from two years a regression analysis is then made. This analysis provides an estimated curve that is used as base for the marginal cost curve. The estimated curve will then finally be compared with the data presented by the Forest Agency.

## 1.4 Limitations

The forest is a wide subject with many aspects, but in this thesis the focus will be on VFSs in Sweden based on the results published by the Forest Agency. Aspects like how forestry in Sweden is managed, the wood market, forest owners' relationship with their forest, and how the forest is inherited will not be addressed. Recently in Sweden storms have had and have a great impact on forest in the south. Their affect on the VFSs will not be discussed in this thesis. No investigations have been made for the entire Sweden concerning the biological value of the VFSs and therefore this thesis will not estimate which kind of forest that is set-aside. The assessed value used in this thesis is a general value for each county, and does not show the assessed value for the VFSs, since there is no knowledge of the exact location of these within each county.

## 1.4 Disposition

In the second chapter a theoretical analysis will be presented that compares the VFSs with the economic theory of voluntary agreements. This analysis will be the basis for chapter three where the empirical results, the estimated marginal cost curve and the results from the Forest Agency are presented. In the fourth chapter a summary and a discussion based on the previous chapters will be done.

# 2 Model for VFSs

Voluntary agreements can usually take one of the three following forms. The first is a unilateral action which means that a polluter or a group of polluters take the incentive themselves to abate. The government is not involved directly but can encourage and assess these agreements. The second form of voluntary agreement is bilateral agreements between a regulatory agency and a polluter which is based on negotiation, and the third form is a voluntary program where the regulator decides the obligations (Alberini & Segerson, 2002). One can define a voluntary forest set-aside (VFSs) as unilateral initiatives which are introduced by the forest companies and associations to protect forest. For example, the government was not allowed to be part of the negotiations when the standards for FSC in Sweden concerning among other things the minimum requirement of VFSs were set. Instead the main participants were the industry and some environmental groups, like WWF Sweden and SNF (Boström, 2002). The government in Sweden encourages the voluntary actions by designing an environmental goal, *Sustainable Forests*, which includes an objective for VFSs (www, Sveriges Miljömål<sup>2</sup>, 2006).

## 2.1 Forest companies and private owners

The voluntary agreement (VA) is an attractive policy instrument compared to regulation if it leads to potential cost savings due to more flexibility. With a VA the polluters can choose which strategy to use to reach an environmental target. The firm will not participate unless his pay off is at least as high as it would have been without participating. There must be some gains from the VA or at least no net loss. A mandatory instrument like a tax or regulation can

lead to a higher cost for the firms and they can therefore be worse off than if a VA would have been used (Alberini & Segerson, 2002).

One forest owner,  $i$ , has both marginal benefits ( $MB^i$ ) and marginal cost ( $MC^i$ ) from the VFSs. Possible benefits will be discussed in the following part of this section. Possible cost can be the loss in profit from non-harvested forest or need to seek information about VFSs. It is assumed that the  $MC^i$  increase and the  $MB^i$  decrease with the area of VFSs. The optimal choice,  $VFSs^*$  is where  $MC^i = MB^i$ . If the VFSs are below  $VFSs^*$  the  $MB^i$  is greater than the  $MC^i$  and the forest owner can increase his benefits more than his cost by setting more forest aside. If the VFSs are higher then  $VFSs^*$  the forest owner can reduce his cost by more than he can increase his benefits. He can therefore increase his net benefits by setting less forest aside. The net benefits represent the area below the  $MB^i$  and over  $MC^i$  up to the  $VFSs^*$  (Perman et al, 2003) See figure 1.

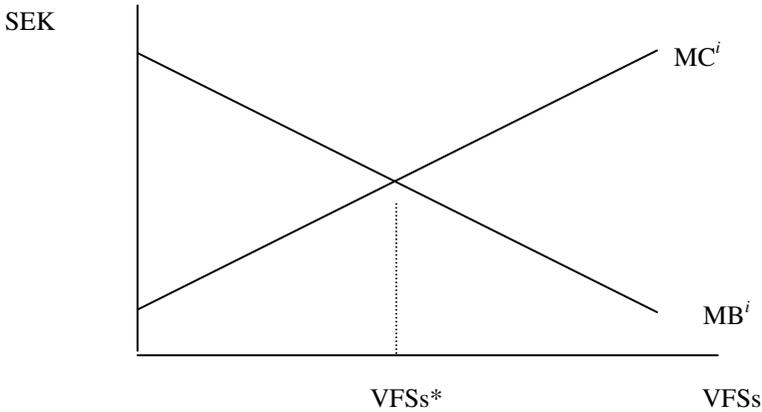


Figure 1: Optimal voluntary forest set-asides for one forest firm (Source: own adaptation of Perman et al, p 120, 2003)

One benefit that can come from VAs is environmental stewardship, which means that the participation in a VA is motivated by personal satisfaction or utility gains from contributing to something that protects the environment. This is more common when the pollution stems from individual behaviour and not from organization behaviour (Alberini & Segerson, 2002). With VFSs it is likely that the small forest owner can feel this personal satisfaction from putting forest aside from production. Usually the forest is inherited and the owner can feel an increase in utility when preserving forest for the next generation. It is not likely that the larger forest companies see the personal satisfaction as an incentive for VFSs. The forest industry can have benefits from the good-will that comes from making VFSs. Through the VFSs they might be able to influence the government and signal themselves as "good" (ibid). Another strong incentive for the industry to join the VA is that they can avoid negative publicity by doing something "good" ( Karamanos, 2002).

There are also market-based incentives, when consumers with a "green" preference can influence the market and increase the demand for more environmental friendly products (Alberini & Segerson, 2002). This leads to shifts of the demand and supply curves which make the environmental activity more profitable. Consumers have reached an income level at which they are willing to pay for the environmentally friendly products. The basic notion of "greener" production is that it gives the firms an opportunity to differentiate their products

which enables them to set a higher price (Lyon & Maxwell, 2004). For the forest owners it is mainly through FSC and PEFC that they can obtain the certificate that says that their product is "greener" than conventional managed forest. There has also been pressure on the wood market, important companies like IKEA and other furniture companies only buy certificated wood (Boström, 2002). Forest associations also have different incentives like bonus to forest owners who get certificated and some also offer a different price for certificated wood (www, Skogsägarna Norrskog<sup>2</sup>, Norra Skogsägarna<sup>1</sup>, Mellanskog<sup>1</sup>, Södra<sup>2</sup>, 2006). The government can create incentives for the firms to join the VA if the market-based incentives are not strong enough. Common positive incitements are financial like cost-sharing or subsidies (Alberini & Segerson, 2002). The government should set the subsidy ( $\mu^*$ ) to a level where the desirable amount of environmental improvement, here ha of VFSs ( $VFSs^*$ ) is done, see figure 2. The subsidy would then represent the marginal benefit for the forest owner at  $VFSs^*$ . The subsidy would give an incentive to set forest aside and it would be profitable for the forest owner to set forest aside as long as his marginal cost is lower than the subsidy obtained per ha of VFSs. The optimal outcome is when the subsidy is equal to the marginal cost from VFSs (Perman et al, 2003). A government investigation suggests that a financial compensation should be given to the forest owners who make VFSs (SOU 2006:81). Today the forest owners do not get any compensation from the government for the VFSs they make. A positive incitement from the Swedish government that is used today is the counselling and information about VFSs that they provide through the Forest Agency (Skogsstyrelsen, November, 2001).

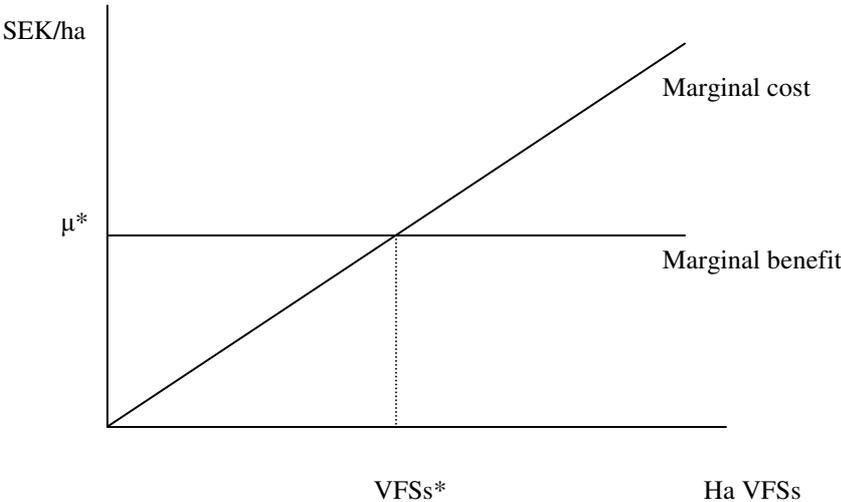


Figure 2: The efficient level of VFSs under a subsidy (Source: own adaptation of Perman et al, p 218, 2003)

The government can also provide negative inducements to make the VA work. The most common is a threat to impose a regulation like a tax. Then the VA could be a way for the firm to pre-empt future legislation (Alberini & Segerson, 2002). For this incentive to be effective it must be credible, in other words the regulator must be willing to implement the policy if the VA is not set in place. The threat is more credible if there is an existing regulation and the VA can lead to an exception from it. The VA should therefore be more successful if it is supported by an underlying regulation framework (Alberini & Segerson, 2002). There was no underlying regulation for the VFSs in the middle of the 90ths when the concept was

introduced. Instead, with the new forest policy, deregulation was promoted (Skogsstyrelsen, November, 2001). It could have been the case that there was a threat of future regulations in the middle of the 90ths when the conditions for the certification system, FSC was negotiated. Anna Lind, then the environmental minister of Sweden, did make a statement that if the forest industry and the environmental groups could not reach an agreement over the terms of certification the government would take over the negotiations. The conditions for the agreement were then negotiated without the government. Representatives from the different organisations present during these negotiations state that the threat had little or no effect (Boström, 2002).

Segerson and Li 1999, have adopted a model that shows firms' incentives to enter a VA when there are no incentives from the government, and also when they threat to impose a mandatory tax or abatement level. This model shows that the firm, here the forest owner, will have incentives to choose voluntary actions, VFSs, even in the absence of a mandatory threat. The forest owner will make VFSs if the increased profits from selling certificated wood or benefits from e.g. environmental stewardship exceed the cost of implementing VFSs. The alternative, when it is certain that a mandatory regulation will be implemented, the forest owner will always prefer to make VFSs, in order to gain flexibility. Any positive legislation threat is enough to initiate a VA and the level of abatement is related directly to the magnitude of the legislation. With a weak threat the level will be low and with a strong threat the abatement level will be higher (Segerson & Li, 1999).

There can be a free-rider incentive associated with the VA (Albertini & Segerson, 2002). This is more common when the regulator sets an industry target for the VA and threat to introduce a tax if the target is not reached. Then, if the tax can be avoided without all firms in the industry participating, some firms might choose not to join. They can then enjoy the benefit of not having a tax that comes from the participation in the VA by other firms. These firms hope that what the others are doing will be enough to prevent the new regulation. Still the VA can be successful as an industry wide program with a fixed target, because if the VA is not met all firms are worse off if the regulation gets imposed. Therefore it exists an incentive for firms to join as long as the cost of participation is the same or not higher than the cost that would have come with the regulation (ibid).The incentive to free-ride goes away if the voluntary agreement only gets implemented if all join. This would mean that if one firm free-ride the VA will collapse (Segerson and Miceli, 1999).

In Sweden the government has the environmental objective, *Sustainable Forest*, where it is said how much VFSs they want for Sweden until 2020 (www, Sveriges Miljömål<sup>2</sup>, 2006). This could perhaps induce forest companies and forest owners to free-ride, if some forest owners can benefit from a better public image for the industry as whole when others do a lot of VFSs. Smaller forest owners might feel that they do not have to do anything since the larger forest companies make VFSs and they can not contribute with that much. When some small forest owners in Sweden were asked about VFSs a few thought it was unfair that they had to do any (Jansson, 2005). The Forest Agency should focus on the big forest companies who in their eyes got away to easy (ibid).

## 2.2 The society and government

One of the strongest social motivations for VAs is that they can reduce the cost of meeting environmental standards through flexibility and incentives for innovations. With a VA the

firms are free to choose in which way they want to reach the environmental target. The firms can then choose a more cost minimizing way since they are able to design their own strategy. These cost savings can be seen as social benefits since they can lead to resources being freed up, which then can be used for the production of other goods (Segerson & Li 1999).

Besides the cost-efficiency, the European Commission recognised two other benefits from VAs. The first is increased pro-active approach to environmental improvements from the industry. With more traditional regulation instruments the firms involved are often consulted late in the process. A result from this could be that they take a more defensive position instead of a more pro-active. An open dialogue between the regulator and the industry might lessen the defensive response. A negotiation process can lead to a common understanding of the environmental problems. The second benefit is a faster achievement of objectives especially when the agreement involves a small number of companies. An example from the EU is that from a proposal to an environmental directive it takes about two years and then another two years until the directive gets adapted in the member states. This process would not be necessary if a VA was to be used (European Commission, 1996).

For the government possible incentives for VAs are that they can reduce the need for regulation and other policy instruments if the industry itself makes the necessary environmental improvements. VAs can create awareness and also address issues about which there are not enough knowledge and no will to introduce any regulation exists (Brink, 2002).

The flexibility from VFSs is that the forest owner can choose himself how much VFSs he wants and which forest he wants to take away from production. He can also choose to join a certification system which requires a minimum share of VFSs (Skogsstyrelsen, November, 2001). The pro-active approach would mean that the forest industry and associations themselves were a part of introducing the concept of VFSs. In the Swedish FSC negotiations the government was not involved. Instead the industry and some environmental groups negotiated (Boström, 2002). This might have increased the awareness about the importance of the VFSs.

A policy instrument can have a variety of transaction costs connected to it. These can be costs for searching information, monitoring and revising the instrument (Perman et al, 2003). In figure 3, the benefits and costs for the society from forest set-asides are shown. The marginal gross benefits from forest set-asides are represented by  $MV$ , this should represent the benefits from forest set-asides. The real cost of forest set-asides is represented by  $\sum_i MC_i$ , for example the cost of reduction in production when more forest is set aside. If these were the only costs from forest set-asides the optimal outcome would be  $FSS^*$ . To compare different regulation instruments the transaction cost,  $TRC$ , that comes from each instrument should be included (Perman et al, 2003). It is often argued that the VAs mean less transaction costs than regulation instruments. One reason is that VAs might cause fewer conflicts between the industry and government and that there are less legal procedures involved (Segerson & Miceli, 1998). There are some transaction costs that come with VAs, one example is the need for information and monitoring. In the figure the total cost of a VFSs is  $\sum_i MC_i + TRC^V$  and the optimal outcome under VFSs is  $VFSs^*$ . Possible transaction costs under VFSs are the work that the Forest Agency makes to evaluate the VFSs or the cost of the forest owners to seek information about key biotopes. The total cost when using a mandatory instrument like a tax is  $\sum_i MC_i + TRC^M$  and the optimal outcome when using a tax is  $MVFS^*$ . It is clear that the  $VFSs^*$  is preferred over the  $MVFS^*$  when the transaction cost are lower under this option. This is a simple model where the purpose is to create an illustrative picture. Any choice of policy instrument should be studied from case to case and usually it is difficult to see before the instrument is used the transaction costs associated with it (Perman et al, 2003).

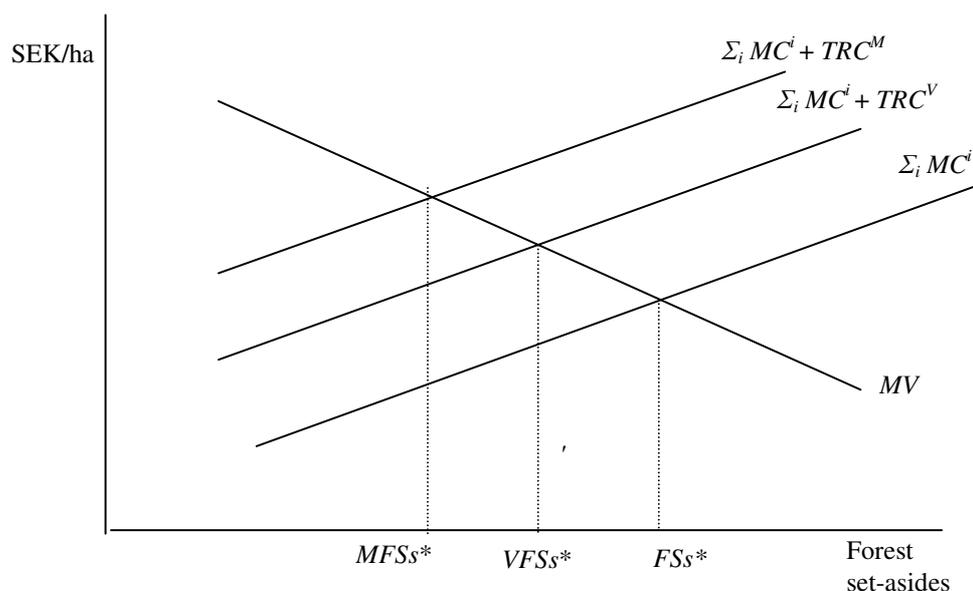


Figure 3: Optimal forest set-asides under regulation and voluntary approach  
 (Source: own adaptation of Perman et al, p 262, 2003)

For the government it is interesting to know the summation of the marginal cost from all forest owners since this would represent the supply curve of VFSs in Sweden. This supply curve can then be used for estimation of the effective level of a subsidy or a tax (Pindyck & Rubinfeld, 2001). In an investigation made by the government some suggestions about how to improve the VFSs are made (SOU 2006:81 ). In order to come to terms with some problems like monitoring and assuring the duration of the VFSs, a more formal agreement could be used. This would be an agreement between the government and the forest owners, a so called public voluntary agreement, PVA. It is also suggested that this agreement could include some financial compensation to the forest owners who join (ibid).

Lyon and Maxwell (2002) present a model that examines how firms react when facing a regulation, here a tax. They also estimate how self-regulation is affected when the government offers a PVA with subsidies to the firms that join. Lyon and Maxwell see two possible incentives for unilateral voluntary actions here VFSs. First, if the unilateral voluntary actions do not pre-empt the tax they might increase the industry profits when compared to no unilateral actions, maybe by weakening the tax proposed. Second, the self regulation might pre-empt the tax and this could give the industry larger profits than if there had been no self regulation. With the PVA more self-regulation does not increase the social benefits, this is because then the program might provide unnecessary subsidies to firms that would have made the environmental improvement anyway. For example, the forest owners who already have made forest set-asides would get a subsidy for the voluntary actions they made before. This clearly would not be an incentive for self-regulation. In the eyes of the society, the increase of self-regulation could then be desirable under a tax proposal but not under a PVA proposal. For the forest industry this could mean that VFSs are only desirable if they are strong enough to pre-empt a tax (Lyon & Maxwell, 2002).

The VA might not lead to environmental improvement. Instead the improvements made by the industry could have taken place without the VA, so called business-as-usual behaviour

(Brink, 2002). This could mean that the VFSs made by the forest owners are the same forest set-asides that would have been there without green forest plans and certification systems. It can be the forest that would have been left anyway since it is not good enough or the owner wants to keep it for hunting. But still the forest owners would get credit for these as VFSs. Holmen, one of the larger forest companies in Sweden, for example, kept VFSs in the north with a lower biological value than the forest they had harvested (Nygren, 2005).

## 2.3 How to make and evaluate a VA

Previous in this chapter VFSs have been analysed from the view of firms, the government and the society. The last part of this chapter will examine how a good VA should be formulated and a summary of the chapter will also be made.

There are some key features that can increase the efficiency of a VA. The first is the existence of a regulatory threat because it creates incentives for the firms to join the VA and it decreases the need for financial incentives like subsidies. For the regulator, a strong threat means a greater bargaining power and a possibility to negotiate a higher level of abatement. It is crucial though that the threat is credible. To be able to use the threat effectively a reliable monitoring of the VA should be in place. The monitoring should be able to say whether or not the targets have been met (Albertini & Segerson, 2002).

The monitoring also prevent the industry from initiating a VA that is just a little bit better than business-as-usual just so they can pre-empt a more effective instrument. For this reason there should exist a comparable alternative along the VA (Brink, 2002). A recent investigation published by the government has evaluated the VFSs within the object of *Sustainable Forests* and it points out that the sub-goal of VFSs, in year 2010, has been hard to follow up (SOU 2006:81). The main reason is that the government has agreed on an object that assumes voluntary actions from the forest owners and therefore lack the possibility to require information about the VFSs. There is little reliable material available with information about the value, duration and location of the VFSs. The investigations that the Forest Agency has made lead to criticism about the way the follow up of VFSs are carried out. The main objection is that the government should not have anything to do with what forest owners do on a voluntary basis. A reason why VFSs are difficult to evaluate is also because there is unwillingness among forest owners to inform where their VFSs are located (ibid).

How effective the VAs are when it comes to the ability to reach the intended results like emission results or energy saving is difficult to say. This area has been inconclusively explored since there is not enough data to evaluate them. Often a clear baseline is missing because it might be difficult to get data on the situation before the voluntary initiative, the business-as-usual stage. There has been some proof that the information flow between the industry and government that a VA create have made both parts more aware of new more environmental friendly technology and more flexible to respond to the new knowledge. The difficulties with evaluating the VAs might make them less popular in the future. They need to have clear defined targets in order to work (Paton, 2002).

To conclude this chapter a summary based on some key questions as formulated in Segerson and Albertini, 2002, will be answered. The VFSs can be defined as a unilateral agreement. Before 1996 the definition for VFSs did not exist and therefore a comparable baseline for the VFSs is difficult to estimate. For the VFSs there seem to be initiatives since VFSs are being done, these incentives can be certification, green plans and stewardship. So far, neither positive or negative government inducements have been used for the VFSs. There exists a

suggestion that a financial compensation should be given to the forest owners who make VFSs. In this investigation no strong threat of regulated VFSs has been found. The last evaluating question is if the cost of meeting the environmental target is lower under a VA than under the use of an alternative instrument? Do the individual firms have the flexibility to choose strategy and will the abatement be allocated across the polluters so that differences in abatement cost are used and the aggregated cost of meeting the target is reduced (Alertini & Segerson, 2002)? The cost of VFSs will be more closely evaluated in the following empirical chapter.

## 3 Estimations based on FSC and the Forest Agency

In this chapter empirical estimations of two supply curves, i.e. a marginal cost curves, for the VFSs made in Sweden will be presented. First a cost estimation of the VFSs based on data from FSC-Sweden will be done, concerning certificated forest in different counties of Sweden. Then the model estimated will be compared to the estimations that the Swedish Forest Agency has made concerning VFSs in different regions in Sweden. The results will also be evaluated with help from the theory presented in the previous chapter.

### 3.1 Estimation of VFS supply curve

The Swedish FSC has made estimations of the total area of FSC-certificated forest for each county in Sweden year 2004 and year 2006 (www, FSC<sup>1</sup>, 2006). In this thesis this data is used to estimate how the cost of VFSs influences the amount of ha VFSs in Sweden. As mentioned in the previous chapter, VFSs are not only done through FSC-certification in Sweden. Since this is the only county based data presented, this will represent the VFSs made in Sweden. To be able to do this a strong assumption concerning VFSs within FSC is made. FSC-Sweden requires a minimum of 5 % of the forest to be set aside from production and here it is assumed that this is the case. It should be known that a lot of forest owners can set more forest aside. The common recommendation from certificate firms, counsellors and associations is about 5 % VFSs and large forest companies like Holmen Skog, have a goal of 5 % (Skogstyrelsen, October 2001, pers. com. Kårén, 2006). From the FSC-area for each county 5 % is therefore estimated to be VFSs (see appendix 1). These results are presented in table 1 where the county with the most hectares of VFSs is presented first. Within the parentheses are the areas of VFSs calculated as a share of total productive forest land for each county rounded off to one decimal (see appendix 2).

*Table 1: Voluntary forest set-asides in ha, as five percent of total county FSC area*  
(Source: own adaptation of www, FSC<sup>1</sup>, 2006)

County	5% from FSC 2004	5% from FSC 2006
Norrbottn	115063 (3.1)	114897 (3.1)
Västerbotten	87864 (2.8)	86591 (2.7)
Jämtland	71657 (2.7)	72392 (2.7)
Västernorrland	43571 (2.5)	43594 (2.5)
Dalarna	42651 (2.2)	42551 (2.2)
Gävleborg	36792 (2.4)	36990 (2.4)
Värmland	23800 (1.8)	23916 (1.8)
Örebro	14645 (2.5)	15073 (2.6)
Uppsala	9298 (2.2)	9299 (2.2)
Västmanland	6628 (1.7)	6583 (1.7)
Västra Götaland	5869 (0.5)	6530 (0.5)
Östergötland	5456 (0.9)	5867 (0.9)
Kalmar	4870 (0.7)	4901 (0.7)
Skåne	4132 (1.1)	4744 (1.3)
Kronoberg	4113 (0.6)	4181 (0.7)
Stockholm	3750 (1.4)	3567 (1.4)
Jönköping	3544 (0.5)	3687 (0.5)
Södermanland	3039 (0.9)	3099 (0.9)
Blekinge	1148 (0.6)	1196 (0.7)
Halland	1117 (0.4)	1312 (0.4)
Gotland	370 (0.3)	374 (0.3)

In table 1, it can be seen that the largest areas of VFSs are in the north of Sweden in the counties of Norrbotten, Västerbotten and Jämtland. Compared to the total area of productive forest the counties with the highest share of VFSs are the counties in the north with 2.7 – 3.1 % VFSs. Then the assessed value for productive forest for the year 2004 and 2005 is calculated since no assessed value for 2006 yet is published (Skogstyrelsen, 2006) (See appendix 3). The main cost for the forest owners should be the loss of profit, the opportunity cost when they set forest aside from production and which is here estimated as the assessed value for the forest land. There are other costs associated with VFSs like cost of searching for information and cost of certification. However is it hard to estimate which part of these costs that are related to the VFSs. Andreas Renöfält, SGS Sweden, who is one of the largest certification organisations, thinks that there should not be any great certification cost connected to the VFSs since the certification is a lot more and deals with the management of the forest, and the VFSs basically mean to put forest aside from production (Pers.com., Renöfält, 2006). Here the assessed value is an average value for the whole county and it should be known that the assessed value can vary a little within the county. The result is presented in table 2 and shows the county with the lowest assessed value/ha first.

Table 2: Assessed value for productive forest land in SEK per ha for each county expressed in prices of 2005 (Source: own adaptation of www, skogstyrelsen<sup>1</sup>, 2007)

County	2004	2005
Norrboten	2715	4191
Jämtland	5036	5682
Västerbotten	5453	6724
Gotland	6328	8975
Västernorrland	7199	8002
Dalarna	9926	10066
Gävleborg	10190	11797
Värmland	12743	14921
Västmanland	15037	20128
Uppsala	15848	19060
Örebro	16859	19452
Södermanland	17656	23825
Västra Götaland	17854	21724
Stockholm	19688	22911
Östergötland	19697	27071
Kalmar	21954	24743
Halland	23371	28231
Jönköpings	25315	29087
Kronoberg	25376	29218
Blekinge	28051	31661
Skåne	29563	36505

Table 2 shows that the lowest costs of VFSs are also found in the counties of Norrbotten, Västerbotten and Jämtland. By using the data from 2004 and 2006 (the assessed value/ha from 2005 will represent 2006 here) a marginal cost curve for the VFSs made within FSC in Sweden can be estimated. In order to see which effect differences in cost have on the amount of VFSs being made, the ha of VFSs made under each assessed value/ha are accumulated starting with the lowest value. In other words, it is calculated how the differences in cost affect the amount of VFSs being made in Sweden, see table 3.

Table 3: Accumulated ha of VFSs from FSC for each county and year (Source: own adaptation of www, FSC<sup>1</sup>, 2006, Skogstyrelsen<sup>1</sup>, 2007)

Year	2004	Year	2006
Assessed value	Accumaleted VFSs	Assessed value	Accumaleted VFSs
2715	115063	4191	114897
5036	186720	5682	187289
5453	274584	6724	273880
6328	274954	8002	317474
7199	318525	8975	317848
9926	361176	10066	360399
10190	397968	11797	397389
12743	421768	14921	421305
15037	428396	19060	430604
15848	437694	19452	445677
16859	452339	20128	452260
17656	455378	21724	458790
17854	461247	22911	462357
19688	464997	23825	465456
19697	470453	24743	470357
21954	475323	27071	476224
23371	476440	28231	477536
25315	479984	29087	481223
25376	479984	29218	485404
28051	485245	31661	486600
29563	489377	36505	491344

In table 3 it is possible to see the differences between the two years. Most counties show more set-asides even though the opportunity cost rises which can be seen as strange. One possible explanation could be that here it is assumed that 5 % is set aside. In reality, it could be more and when the cost increases the share of VFSs might decrease to the minimum requirement of 5 %. This effect is not taken into account. For 2006, what can be seen is that the assessed value/ha is in general higher than for 2004. In order to estimate a marginal cost curve for Sweden the ha of VFSs from both years are accumulated and this gives the following result, see figure 4.

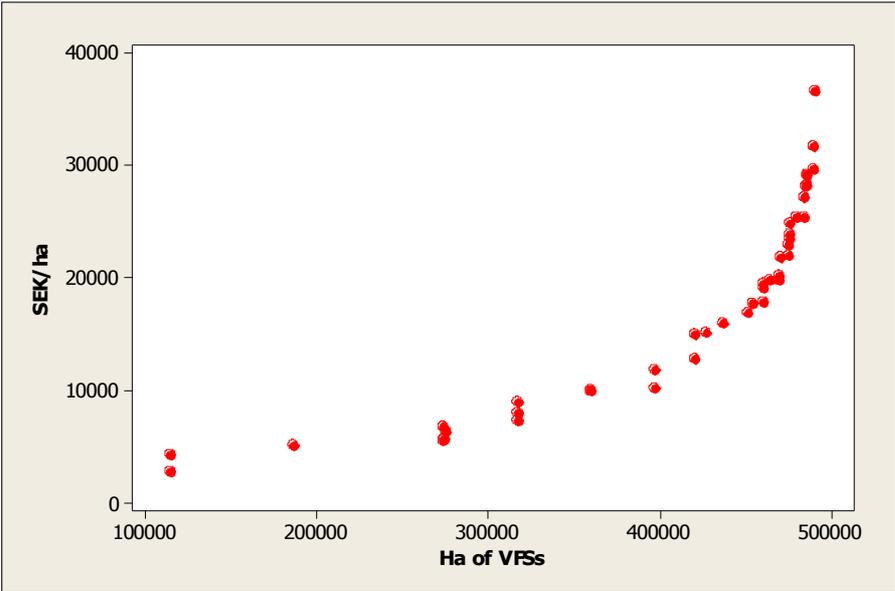


Figure 4: Assessed value and accumulated ha of VFSs for 2004 and 2006 (Source: own adaptation)

The counties with a low assessed value/ha Norrbotten, Västerbotten and Jämtland are represented in the lower part. The counties with a higher assessed value/ha Skåne, Blekinge and Kronoberg are represented up right.

The marginal cost curve shows the additional cost from a change in ha of VFSs. To estimate the marginal cost curve that fits the data presented best, a regression analysis is done in MINITAB. A quadratic equation is estimated, which is written as

$$y = a + d + bx + cx^2 + \varepsilon \tag{3.1}$$

where  $y$  is the cost/ha,  $x$  is the area of VFSs in ha,  $d$  is the dummy for year 2004 and  $\varepsilon$  is the error term which is assumed to follow a  $N(0, \sigma^2)$ . Here, it is assumed that there is no other cost than the opportunity cost and the marginal cost function should therefore start in the origin. However, the regression analysis made in MINITAB includes an intercept. The first data from the FSC starts at about 114 000 ha and therefore the interesting interval should be from that point on, the intercept is therefore not further analysed. The regression analysis (see appendix 4) gives the following result:

$$y = 17641 - 1961\gamma - 0.129x + 0.0000003x^2 \tag{3.2}$$

The T-value is 2.27 for  $\gamma$ , 4.87 for  $x$  and 7.75 for  $x^2$  and the  $R^2$  for the entire equation is 90.1%. The  $\gamma$  is the Dummy-Variable which represents the different years. In function 3.2 it is shown that for year 2004 the cost is in average 1961 SEK/ha lower than for the year 2006.

$$\gamma \begin{cases} = 1 & \text{if value from year 2004} \\ = 0 & \text{if value from year 2006} \end{cases} \quad (3.3)$$

In figure 5 the regression line is drawn.

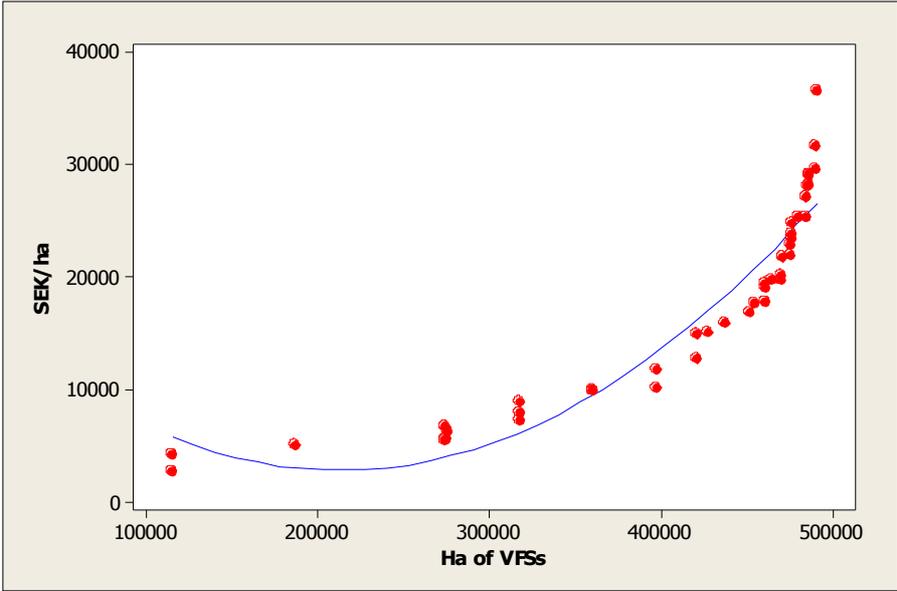


Figure 5: Regression line  
(Source: own adaptation)

This curve shows a decrease and a slow increase for the first 350 000 ha of VFSs and then the marginal cost of VFSs increase more rapidly. The reason are that larger areas are set aside in the north to a low marginal cost while smaller areas is set aside in the south to a higher marginal cost.

In the example above the total amount of VFSs in Sweden is 491 344 ha for 2006. The Forest Agency has estimated that there was 993 000 ha of VFSs made in Sweden 2002 (www, Skogstyrelsen<sup>1</sup>, 2007). From this about 800 000 – 850 000 ha is estimated to be below the mountain border (www, miljömål<sup>2</sup>, 2006). Therefore each county should have the potential to set more forest aside under each assessed value/ha. The estimations made by the Forest Agency only show the VFSs for five different regions in Sweden and all counties except for the county of Gotland is included in these regions. The regions are illustrated in figure 6 on the following page.



*Figure 6: Regions for VFSs estimation in Sweden  
(Source: Skogstyrelsen, p 99, 2006)*

The results from the five regions can then be applied to the results from FSC-Sweden. Since the estimations made by the Forest Agency do not show which forest that is below the mountain border, all ha of VFSs made are included here. The Forest Agency estimates that region 1 and 2 together set 456 000 ha of forest aside, see table 4, compared to the estimated 201 488 ha of VFSs 2006 for the same region, see Norrbotten and Västerbotten in table 1. This would mean that the counties of Norrbotten and Västerbotten have the potential to set 126% more forest aside then estimated previously. In table 4, the ha of VFSs made in each region are compared to the results for the counties of that region (table 1) and the potential increase in ha is estimated for each region.

*Table 4: Ha of VFSs in different regions and the potential increase in per cent  
(Source: own adaptation of www, FSC<sup>1</sup>, 2006, Skogstyrelsen<sup>1</sup>, 2007)*

Year	Forest Agency 2002	FSC 2004	Potential in %	FSC 2006	Potential in %
Region 1+2	456 000	202927	125	201488	124
Region 3	292 000	218471	34	219433	33
Region 4	149 000	61212	143	62787	137
Region 5	96 000	6397	1400	7252	1224
Tot	993 000	489007	103	490960	102

To estimate a marginal cost curve based on the results from the Forest Agency the data from the FSC for each county is adjusted with the potential of its' region for all counties but Gotland, see table 5.

*Table 5: Adjustment of ha of VFSs for each county after Forest Agency  
(Source: own adaptation of www, FSC<sup>1</sup>, 2006, Skogstyrelsen<sup>1</sup>, 2007)*

	County	Ha of VFSs 2004	Ha of VFSs 2006
Region 1+2	Norrbottn	258891	259667
	Västerbottn	197694	195696
Region 3	Jämtland	96020	96281
	Västernorrland	58385	57980
	Gävleborg	49301	49197
	Dalarna	57152	56593
	Värmland	31892	31808
Region 4	Örebro	35587	35723
	Västmanland	16106	15602
	Uppsala	22594	22039
	Stockholm	9112	8454
	Södermanland	7385	7345
	Östergötland	13258	13905
	Västra Götaland	14262	15476
	Jönköping	8612	8738
	Kronoberg	9995	9909
	Kalmar	11834	11615
	Gotland	370	374
Region 5	Halland	16755	17371
	Blekinge	17220	15835
	Skåne	61980	62811
	Tot.	994405	992419

The results from table 5 can then be used to estimate a new marginal cost curve. As with the previously estimated curve, the ha of VFSs made under each assessed value/ha (see table 2) are accumulated starting with the lowest value. In table 6 the results are presented.

*Table 6: Accumulated ha of VFSs for each county and year after the Forest Agency  
(Source: own adaptation of www, FSC<sup>1</sup>, 2006, Skogstyrelsen<sup>1</sup>, 2007)*

Year 2004		Year 2006	
Assessed value/ha	Accumulated VFSs	Assessed value/ha	Accumulated VFSs
2715	258891	4191	259667
5036	354911	6724	455363
5453	552605	5682	551644
6328	552975	8002	609624
7199	611360	11797	658821
9926	668512	10066	715414
10190	717813	14921	747222
12743	749705	19452	782945
15037	765811	20128	798547
15848	788405	19060	820586
16859	823992	22911	829040
17656	831377	23825	829040
17854	845639	27071	850290
19688	854751	21724	865766
19697	868009	29087	874504
21954	879843	29218	884413
23371	896598	24743	896028
25315	905210	8975	896402
25376	915205	28231	913773
28051	932425	31661	929608
29563	994405	36505	992419

The ha of VFSs for both years are accumulated and a regression analysis is made in MINITAB ( see Appendix 5) with the following result:

$$y = 15636 - 1235\gamma - 0.0607x + 0.00000008x^2 \quad (3.4)$$

The T-value is 3.13 for  $\gamma$ , 9.43 for  $x$  and 16.35 for  $x^2$  and the  $R^2$  for the entire equation is 97.9 %. In figure 7 this regression is illustrated.

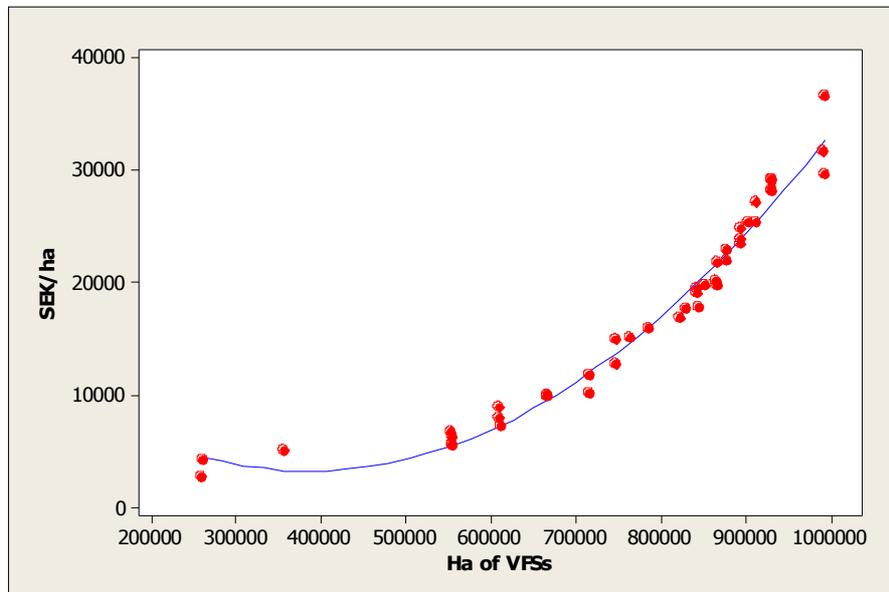


Figure 7: Regression line for VFSs after Forest Agency  
(Source: own adaptation)

As before the counties of the north are represented in the lower part and in the highest part the counties of the south are represented.

This curve shows a slow increase of the marginal cost for the first 600 000 ha of forest that is set aside. This comes from the fact that large areas of forest are set aside in the north of Sweden to a low cost. After the first 600 000 ha VFSs, the marginal cost increase more rapidly, since the counties with a higher marginal cost set less forest aside. To use the results from the Forest Agency is difficult since they show that in total 993 000 ha is set aside. This represents 800 000 – 850 000 below the mountain border and these are the set-asides that should be 730 000 ha according to the goal from *Sustainable Forests* (www, miljömål<sup>2</sup>, 2006). There is also the problem that a great part is based on questionnaires and it is likely that the set-asides in region 5 do not all represent productive forest (Pers.com. Ståhl<sup>1,2</sup>, 2006).

### 3.2 Subsidy policy for VFSs

Since the concept of VFSs was introduced 1996, the amount of ha VFSs has increased. The environmental object, *Sustainable Forests*, was introduced 1998 and latest published results state that sub-goal for 2010 is reached. During 2005 the Forest Agency has investigated all VFSs in Sweden and the results indicate that the small forest owners put less forest aside than suggested in earlier estimations and that the overall area of VFSs has decreased. It is now likely that more VFSs have to be done to reach the goal of 2010 (www, miljömål<sup>2</sup>, 2006). Table 7 reports set-aside areas for different regions and for different years, where the share of the total forest that the VFSs represent is within parentheses.

Table 7: Voluntary forest set-asides in ha and region for all owners in Sweden  
(Source: own adaptation after www, Skogstyrelsen<sup>1</sup>, 2007)

Year	1996	2000	2002
Region 1+2	81000	377000 (5.4)	456000 (6.5)
Region 3	134000	198000 (2.3)	292000 (3.4)
Region 4	88000	132000 (2.2)	149000 (2.5)
Region 5	12000	95000 (11.7)	96000 (11.8)
Tot	(1.5) 328000	802000 (3.6)	993000 (4.4)

If the goal of *Sustainable forests* is not reached the government might have to introduce a subsidy to increase the VFSs. As mentioned in the previous chapter, a governmental investigation, SOU 2006:81, suggests that a financial compensation could be given to the forest owners who join a more formal agreement. In order to derive the necessary subsidy per ha for achieving the target of 730 000 ha the functions 3.2 and 3.4 can be used. To reach the goal of *Sustainable Forests*,  $x$  is set equal to the goal of 730 000 ha VFSs and then equation 3.2 and 3.4 are solved for  $y$  which represent the subsidy ( $\gamma = 0$ ). The result is that a subsidy of 83 341 SEK/ha is required to reach 730 000 ha of VFSs when equation 3.2 is used. When equation 3.4 is used a subsidy of 13 957 SEK/ha is needed to reach the goal of 730 000 ha VFSs. In figure 8 the different supply curves 3.2 and 3.4 are illustrated and the different subsidies are represented as horizontal lines.

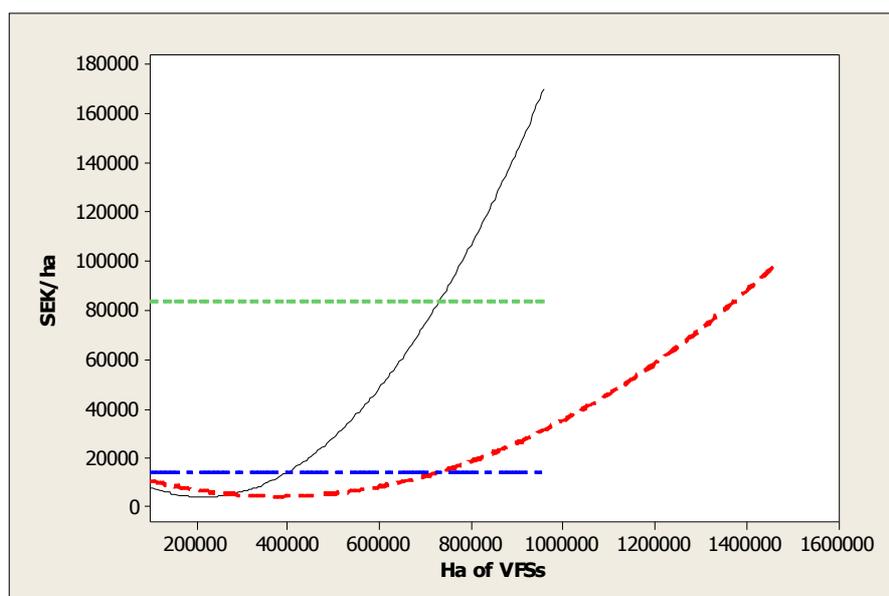


Figure 8: Different supply curves and different subsidies for VFSs  
(Source: Own adaptation)

In figure 8 the differences between the two supply curves are evident. This implies that if a subsidy was to be introduced the true effect from it can be hard to estimate. More investigations that estimate the amount of VFSs in Sweden is needed in order to evaluate the response of a subsidy for VFSs. Here the supply curves are based on assumptions and do not provide an accurate picture. The VFSs made within FSC should be seen as the minimum amount of VFSs that are made in Sweden. The VFSs that are included in the estimations from the Forest Agency is not all below the mountain border and can therefore be seen as a maximum. The true supply curve of VFSs can therefore be anywhere between the curves estimated here.

### 3.3 VFSs made by different forest owners

In this part reports from the Forest Agency concerning VFSs are presented. The reports that have estimated the area of VFSs made by different forest owners in Sweden are from 1996, 2000 and 2002. The estimations are divided in three owner groups, large forest owners (which include Sveaskog, Statens fastighetsverk, Bergvik skog, Holmen Skog and SCA), mid-size forest owners with more than 5 000 ha productive forest land who are not included in the large forest owners, and small forest owners with less than 5 000 ha productive forest land (Skogsstyrelsen<sup>1</sup>, 2007). These results are interesting since they show some differences between the owner types. First, the larger forest owners' development of VFSs is presented in table 8.

*Table 8: Voluntary forest set-asides in ha and region for large forest owners*  
(Source: own adaptation of www, Skogsstyrelsen<sup>1</sup>, 2007)

Year	1996	2000	2002
Region 1+2	54000	279000 (7.3)	358000 (9.3)
Region 3	60000	104000 (2.6)	198000 (4.9)
Region 4	15000	33000 (3.6)	50000 (5.4)
Region 5	0	1000 (2.8)	1000 (2.8)
Tot	(1.5) 130000	417000 (4.7)	608000 (6.9)

For the large forest owners estimations have been done for three years. Like for all forest owners, table 7, the total ha of VFSs has increased since 1996. It is only in region 5 that the amount of VFSs have been unchanged 2000 and 2002. The difference from table 7 is that the share of VFSs is much lower in region 5 and higher in region 1+2, 3 and 4. The next category is the mid-size forest owners, see table 9.

*Table 9: Voluntary forest set-asides in ha and region for mid-size forest owners*  
(Source: own adaptation of www, Skogsstyrelsen<sup>1</sup>, 2007)

Year	1996	2000
Region 1+2	19000	32000 (7.8)
Region 3	14000	20000 (4.4)
Region 4	21000	36000 (7.7)
Region 5	2000	3000 (5.1)
Tot	(3.5) 60000	91000 (5.1)

Here estimations have only been done for two years and they are based on questionnaires (Pers.com. Stål<sup>1</sup>, 2006). The main differences when compared with the results for all owners, table 7, are region 5 and region 4, but still the mid-size owners have a more even distribution of VFSs seen as a share of the total mid-size owned forest. The last category is the small forest owners, see table 10. These estimations from the Forest Agency are also based on questionnaires (Pers.com. Stål<sup>1</sup>, 2006).

*Table 10: Voluntary forest set-asides in ha and region for small forest owners*  
(Source: own adaptation of www, Skogsstyrelsen<sup>1</sup>, 2007)

Year	1996	2000
Region 1+2	17000	66000 (2.4)
Region 3	60000	74000 (1.8)
Region 4	51000	63000 (1.4)
Region 5	10000	91000 12.7)
Tot	(1.2) 138000	294000 (2.4)

For the small forest owners the main difference from the large and mid-size owners, table 8 and 9, is region 5 where they set 12.7 % aside from production. The main difference from the results for all owners, table 7, are region 1 and 2 where a much smaller share is set aside. The same is seen for region 3 and 4 but the differences are smaller. The small forest owners are the ones who set the least forest aside, 2.4 % compared to 5.1 % for the mid-size owners and 6.9 % for the large forest owners.

To get an overview of the opportunity cost in different regions from the VFSs, a comparison with the assessed value in average per ha has been made. By using the assessed value for productive forest land, in each county and for the different years, and dividing it with the area of productive forest land an assessed value/ha for each region is calculated (see appendix 6). The assessed value here becomes an average value and it should be known that it can vary a lot within the region. The estimated average assessed value for the different regions can be seen in table 11.

*Table 11: Assessed value in average for each region, SEK/ ha represented in prices of 2002*  
(Source: own adaptation of www, Skogsstyrelsen<sup>1</sup>, 2007)

Year	1996	2000	2002
Region 1+2	3405	3838	3787
Region 3	7352	8470	8462
Region 4	14662	17406	18221
Region 5	19578	24044	25324

This would mean that the greatest cost of VFSs is in region 5 and the lowest cost is in region 1+2. The results from region 5 are puzzling since the highest share of VFSs is done where the cost from VFSs is the highest. Considering table 8 and 9, large and mid-size owners, the highest share of VFSs are made in region 1 and 2. The small forest owners are the ones who set the most forest aside in region 5 to a high cost, this could mean that their benefits from the VFSs are high. Per-Olof Ståhl at the Forest Agency see a possible explanation in the fact that in the south of Sweden there are more pasture land with trees. These areas do not hold that much wood but are still classified as forest land and have little economical effect for the forest owner. In the model all land is seen as productive forest land. He also suggests another possible explanation that would be hard to prove, the forest owners in the south might be better at setting forest aside (Pers. com. Ståhl<sup>2</sup>, 2006).

To conclude the results from the Forest Agency the small forest owners are the ones who set the least forest aside. From what was presented in the previous chapter one could argue that they do not feel a need for signalling like big forest companies might do. This may suggest that big forest owners fear the government may implement a regulation if they fail making enough VFSs. The media image is more important for the big forest owners and therefore they want to signal themselves as “good”. The small forest owners do not individually have a lot of media attention and do not care as much about doing what is “good”.

There can also be a difference in the willingness to certificate the forest. Small forest owners do not harvest as often as big forest companies. Therefore they might not care if they get a little more for a “greener” product when they consider what they have to change in their forest management. The forest owner associations however, are all promoting certification. The large forest companies are all certificated with FSC and some also with PEFC (www, Bergvik Skog, Holmen Skog, Sveaskog, Svenska cellulosabolaget, Statens fastighetsverk, 2006). For them it should be easier to implement the forest management needed and the fact, as mentioned before, that other companies like IKEA only buy certificated wood should also affect their behaviour. The small forest owners might also want a financial compensation for making VFSs and according to Maxwell and Lyon (2003) a suspicion that the government will introduce a voluntary public agreement, VPA, will have the effect that no VFSs will be made before the VPA. The benefits from VFSs can be higher for large forest companies: improving public relations, power to influence future regulations, and possibility to sell “green” products. The small forest owners might not hold these benefits as high.

In Jansson (2005), 21 small forest owners in Uppland were asked about their knowledge of VFSs. Three of the owners who had VFSs were not aware of it since they had someone who planned their forest. This shows the power the person who plan the forest has. Most of the owners actually pointed to the forest plans as the grounds for having VFSs. There were also owners who did not trust the Forest Agency. Three forest owners had VFSs that were not documented within any plan and they also had the view that the Forest Agency should not interfere with how they managed their forest (ibid). This could have an effect on the results from the Forest Agency if the persons asked have no knowledge of VFSs or if they do not want the Forest Agency to know what they do.

From the estimated marginal cost curves the conclusion that could be drawn is that small forest owners might have a higher marginal cost for their forest. The large forest owners set large areas in the north side with a low marginal cost, first interval of the curves, the small forest owners do not have the possibility to choose where in Sweden to make their VFSs and they might be situated where the marginal cost of VFSs is high. One of the benefits with VAs is that they are flexible and cost minimizing; it is possible to choose how to make the environmental improvement. These benefits might be harder to obtain for a small forest owner.

The empirical results from the Forest Agency do not investigate the quality of the VFSs, if it is forest with a high biological value that is being set aside. In May/ June 2007, a new report will be published that will show VFSs in counties of Sweden and the quality of these VFSs (Pers.com. Ståhl<sup>1</sup>, 2006).

## 4 Summary and Discussion

The purpose of this thesis was to analyse the potential of VFSs from a theoretical perspective, and to estimate a supply curve, i.e. a marginal cost curve, for VFSs in Sweden. The results were then compared with the results from the Forest Agency concerning VFSs. How are the VFSs working with respect to flexibility and cost minimization and where in Sweden it is likely that VFSs can be made? What can be said about the incentives for VFSs and is there a difference between the amount of forest set aside by different owners?

When talking about the benefits from VAs it is clear that it is the cost minimization and the flexibility that make them attractive. The VFSs represent this feature as they can be seen as voluntary and the forest owners are free to choose which forest to set aside. But the empirical

result from the Forest Agency shows that it is mainly the larger forest companies who can use the flexibility and the cost minimizing benefits from the VFSs. They have larger areas of forest and can choose to set forest aside to low marginal cost. The small forest owners are more bound, if they want to set forest aside they might have to do this to a high marginal cost. For the forest owner the benefits and cost from VFSs can vary.

In this thesis only the opportunity cost has been estimated though there might be other costs associated with the VFSs. For the forest owner to make any VFSs the marginal benefits have to be higher than or just as high as the marginal cost. As presented in the empirical part the marginal cost varies in Sweden. For forest to be set aside in Skåne, in the south, the benefits need to be higher than in the north of Sweden. This might be true, but it is also clear that less forest is set aside in the south. Since the larger forest owners set more forest aside it can be that they have higher marginal benefits than the small forest owners. This can come from the fact that they might have a stronger possibility to influence the authorities or benefit more from an environmental friendly image.

The VFSs can be seen as a form of self regulation and the strongest reason for this would be a potential threat. However, little evidence of a strong threat of legislation has been found in this thesis. There is some evidence that the authorities are not happy with the VFSs mostly since they are hard to monitor and nothing is said about the duration of the VFSs. The free rider incentive that is associated with VAs when some firms benefit from the environmental improvements made by others might apply here. The smaller forest owners can have advantages from the self regulation made by the large forest companies. For the society the benefit from a VA is that it reduces the cost and potential transaction cost associated with a more formal alternative. No arguments that the transaction cost associated with VFSs should have a great impact have been found. The monitoring is done by the Forest Agency and since there is no alternative to compare it with, here this argument cannot be used to say that the VFSs have a lower cost than legislation. From the literature concerning VA, the conclusion can be drawn that in general legislative regulations should have a higher transaction cost than the VAs. The investigation made by the government suggests that a VPA should be introduced, an agreement between the government and the forest owner about the VFSs, which can lead to financial compensation to the owner. The forest owners have little reason to self regulate when a VPA is suggested unless they can pre-empt a future legislation through the VPA. In this case the VPA was suggested in October 2006, and should not have had any affect. However in the future less VFSs might be done if there is not a real legislative threat behind a suggested VPA for the VFSs.

In this thesis the estimated supply curves for VFSs in Sweden is based on some assumptions and therefore represents a minimum and a maximum curve. Both curves have a slow increase in the beginning which comes from the fact that large areas can be set aside in the North of Sweden to a low cost. When these supply curves are used to estimate the subsidy needed to reach the goal of 730 000 ha VFSs, the results differ a lot. For the supply curve based on the minimum requirement from the FSC a subsidy of 83 341 SEK/ha is required. When using the supply curve which has been changed after the potential for each region according to the Forest Agency, the subsidy required is 13 957 SEK/ha. This implies the importance of investigations concerning the amount of VFSs being made. The true supply curve should be somewhere between the curves estimated here.

There is a difference between the amount of VFSs being made by different forest owners. The large and the mid sized forest owners set the most forest aside. They also have the highest

share of VFSs made in the north to a low opportunity cost. The results from region 5 with the highest opportunity cost are surprising though. Here, the large forest owners and the mid-size owners have their smallest share of VFSs. The results for the small forest owners differ a lot. It seems unlikely that they should set such a large share aside from production. One reason for this might be that pasture land with trees is included here as productive forest. Another reason can be that the estimations made by the Forest Agency are wrong. The results published in the beginning of year 2006 indicated that the small forest owners set much less forest aside than previously estimated and that the goal of 730 000 ha VFSs might not be reached until 2010. The conclusions that can be drawn are that by estimating supply curves for VFSs made in Sweden estimations concerning subsidies and marginal costs can be made. The results however have a lot of uncertainty and more accurate data should be used to give a proper picture. What can be concluded is that the marginal cost varies depending on where the VFSs are located in Sweden. There is also a difference between the amount of VFSs made by large forest owners and small forest owners.

For a VA to be a functional policy instrument it should lead to environmental improvement in a cost minimizing way. The environmental improvements are something that can not be evaluated in this thesis. There are no investigations made for the entire Sweden that state which kind of forest that is set aside. Even though today, when using published results, there are about 800 000 ha of VFSs below the mountain border, and still nothing is said about the biological value of these VFSs.

It is easier for the VA to work if there is a credible threat of regulation from the government. No strong threats have been found during this thesis and this could be an explanation why it seems unlikely that the goal for 2010 will be reached. Another requirement is the cost effectiveness, and this is something that the VFSs should represent for the larger forest owners. The smaller forest owners might not see the VFSs as cost effective, if they must set 5 % aside to a high marginal cost as a certification requirement or through a forest plan. There is flexibility, the forest owner choose himself which forest to set aside. However, if the forest owners see 5 % as the standard and just follow the requirements it would be more like a set target.

The marginal cost curve estimated based on the minimum requirement of FSC rises fast when a larger amount of forest is set aside. If there is not enough net benefit from the VFSs the goal for Sweden of 730 000 ha might lead to a net loss. The estimated subsidy needed to meet the target for *Sustainable Forests* becomes quite high when compared to the assessed value from the counties, 83 341 SEK/ha. When using the curve adapted after the results from the Forest Agency 13 957 SEK/ha would be the subsidy to reach 730 000 ha VFSs. The largest benefits from a subsidy should be in the north where the opportunity costs are low. In recent results the Forest Agency estimates that less forest than believed is set aside from small forest owners. It would be possible to give financial support to them in order to create incentives for VFSs.

Suggestion for future studies would be a more exact cost analysis of the VFSs, when new results from the Forest Agency are published. With these new results the quality and the assessed value of the VFSs along with the exact data from counties or communities can provide more exact estimations. It would also be useful to estimate the benefits from VFSs.

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## 6. Appendix

### Appendix 1

Total area of FSC in each county (www,FSC<sup>1</sup>, 2006)

Länsviss areal 2006				
Län	2006	2004	Förändring Ha	Förändring %
Blekinge	23922	22964	958	4%
Dalarna	851023	853010	-1987	0%
Gotland	7481	7409	72	1%
Gävleborg	739800	735836	3964	1%
Halland	26230	22336	3894	17%
Jämtland	1447830	1433146	14684	1%
Jönköping	73735	70881	2854	4%
Kalmar	98015	97408	607	1%
Kronoberg	83619	82268	1351	2%
Norrbottn	2297936	2301272	-3336	0%
Skåne	94875	82641	12234	15%
Stockholm	71333	75006	-3673	-5%
Södermanland	61977	60776	1201	2%
Uppsala	185981	185960	21	0%
Värmland	478327	475996	2331	0%
Västerbotten	1731820	1757275	-25455	-1%
Västernorrland	871874	871411	463	0%
Västmanland	131660	132552	-892	-1%
Västra Götaland	130603	117374	13229	11%
Örebro	301464	292907	8557	3%
Östergötland	117347	109129	8218	8%
<b>Summa</b>	<b>9826852</b>	<b>9787557</b>	<b>39295</b>	<b>0,40%</b>

## Appendix 2

### Total area of productive forest for each county

Areal skogsmark och impediment<sup>1</sup> med fördelning på län och ägarkategorier under perioden 1999-2003

Area of forest and unproductive land by county and ownership categories during 1999-2003

Län och landsdel <sup>2</sup> County/region <sup>2</sup>	Ägarkategori Ownership category		Samtliga All categories					
	Allmänna Public forest	Aktiebolag Forest company	Privata Private	Skogsmark Forest land	Impediment Non-productive	Skogsmark Forest land	Impediment Non-productive	
Areal, 1 000 hektar		Area, 1.000 hectares						
Norrbottnens	510	308	1.905	646	1.200	628	3.615	1.582
Västerbottens	300	122	1.487	499	1.416	419	3.203	1.040
Jämtlands	139	108	1.395	417	1.125	411	2.659	936
Västernorrlands	55	8	940	156	733	129	1.728	293
Gävleborgs	115	11	729	91	655	98	1.499	200
Dalarnas	210	96	835	180	862	169	1.907	445
Värmlands	88	10	488	85	758	104	1.334	199
Örebro	57	3	264	35	257	27	578	65
Västmanlands	54	7	133	16	191	12	378	35
Uppsala	65	5	164	12	170	29	399	46
Stockholms	55	21	31	6	160	45	246	72
Södermanlands	53	5	68	7	218	33	339	45
Östergötlands	84	12	170	23	354	50	608	85
Västra Götalands	154	27	134	18	1.012	224	1.300	269
Jönköpings	45	3	93	10	593	43	731	56
Kronobergs	46	3	78	7	538	44	662	54
Kalmar	39	9	169	20	536	67	744	96
Gotlands	12	6	6	5	104	27	122	38
Hallands	35	5	10	2	253	37	298	44
Blekinge	14	4	12	0	157	10	183	14
Skåne	48	4	27	4	278	26	353	34
N Norrland	810	430	3.392	1.145	2.616	1.047	6.818	2.622
S Norrland	309	127	3.064	664	2.513	638	5.886	1.429
Svealand	582	147	1.983	341	2.616	419	5.181	907
Götaland	477	73	699	89	3.825	528	5.001	690
Hela landet Entire country	2.178	777	9.138	2.239	11.570	2.632	22.886	5.648

1. Med impediment avses ägoslagen myr inkl. annat klimatimpediment, berg och fjällbarrskog.

1. Non-productive refers to following land-use classes: swamp, other waste land because of climate conditions, rock surface and subalpine coniferous woodland.

2. Beträffande områdesindelningen, se bilaga 7, figur 2. 2. Boundaries of counties and regions shown in Appendix 7, Figure 2.

Källa: Riksskogstaxeringen. Source: Swedish National Forest Inventory.

**Areal skogsmark och impediment<sup>1</sup> med fördelning på län och ägarkategorier under perioden 1994-1998**  
**Area of forest and unproductive land by county and ownership categories during the period 1994-1998**

Län och landsdel	Ägarkategorier Ownership category <sup>2</sup>				Samtliga All			
	Allmänna Public forest	Aktiebolag Company forest	Privata Private forest		Skogsmark Forest land	Impediment Waste land	Skogsmark Forest land	Impediment Waste land
County and part of country								
	1 000 hektar							
Nltn	494	285	1.880	683	1.253	623	3.626	1.591
Vbtn	216	77	1.597	490	1.288	437	3.100	1.005
Jmtl	171	135	1.222	462	1.118	446	2.512	1.044
Vnrl	93	19	820	145	731	139	1.644	303
Gävl	87	15	695	86	713	63	1.495	164
Dirn	353	114	728	162	861	171	1.942	446
Vrml	63	6	459	83	797	121	1.319	210
Öreb	62	6	315	40	220	17	597	65
Vstm	48	5	155	35	195	22	398	62
Upps	54	7	170	21	170	21	394	50
Sthm	72	22	66	14	175	47	313	83
Södm	58	9	51	12	232	45	342	66
Östg	73	12	159	26	364	60	596	97
Vgöt	129	25	128	26	1.035	209	1.291	260
Skbg	44	0	62	9	315	18	422	27
Älvs	57	10	52	9	578	88	687	107
Gtbg	27	16	13	7	141	102	181	125
Jkpg	45	8	96	9	573	46	715	62
Kron	61	5	78	8	500	41	639	54
Kalm	37	6	117	15	548	109	702	129
Gotl	16	6	3	5	103	34	122	45
Hall	16	4	24	4	247	40	288	47
Blek	11	2	11	0	175	12	197	14
Skåne	35	2	38	5	310	13	382	20
N Norrl	710	362	3.477	1.173	2.541	1.061	6.727	2.596
S Norrl	350	169	2.737	694	2.562	649	5.651	1.512
Sveal	710	171	1.945	367	2.650	445	5.304	982
Göta	423	68	654	99	3.854	561	4.931	729
Hela landet The whole country	2.192	771	8.813	2.333	11.608	2.715	22.613	5.818

1. Med impediment avses ägoslagen myr inkl. annat klimatimpediment, berg och fjällbarrskog.

<sup>1</sup> Waste land or other non-productiv land, Potential yield under ideal management conditions not more than 1 m<sup>3</sup> per ha  
 By unproductive land means following land-use classes: swamp, other land unproductive because of climate conditions, rock surface and subalpine coniferous woodland.

[2 Definition på ägarkategorier](#)

[2 Ownership categories](#)

Källa: Riksskogstaxeringen

Source: The National Forest Inventory.

## Appendix 3

### Assessed value for productive forest for each county

**Tabell 14.8** **Taxeringsvärden för produktiv skogsmark**  
**Real estate tax assessment for forest land**

Län County	1981	1992	1998	1999	2000	2001	2002	2003	2004	2005
	miljoner SEK Million SEK									
Norrbottnens	2.428	5.879	7.691	8.489	8.919	9.889	9.538	9.921	9.887	15.321
Västerbottnens	3.134	11.900	13.300	14.573	15.482	16.680	15.762	16.375	17.245	21.350
Jämtlands	2.619	9.244	10.371	11.456	12.331	13.043	12.387	12.851	13.498	15.290
Västernorrlands	2.949	8.576	9.692	10.480	11.283	12.033	11.380	11.815	12.432	13.876
Gävleborgs	3.150	9.964	11.723	12.883	13.865	14.751	13.989	14.551	15.335	17.825
Dalarnas	4.142	11.584	14.495	15.978	17.214	18.277	19.043	18.624	18.952	19.296
Värmlands	4.767	9.992	12.246	13.509	14.547	15.460	16.101	15.732	17.096	20.099
Örebro	2.379	6.202	7.228	7.994	8.610	9.146	9.259	9.045	9.840	11.399
Västmanlands	1.252	3.222	4.096	4.524	4.864	5.167	5.394	5.275	5.736	7.709
Stockholms	811	2.859	3.592	4.005	4.319	4.595	4.817	4.683	5.079	5.934
Uppsala	1.423	4.317	4.678	5.166	5.559	5.897	6.157	6.022	6.535	7.891
Södermanlands	1.402	3.635	4.227	4.667	5.016	5.341	5.554	5.441	5.944	8.053
Östergötlands	2.708	7.290	8.653	9.552	10.281	10.977	11.438	11.195	12.203	16.838
Västra Götalands	5.337	12.866	16.055	17.737	19.099	20.321	21.186	20.778	22.566	27.568
Jönköpings	4.143	8.554	13.235	14.586	15.681	16.646	17.375	16.979	18.457	21.292
Kronobergs	3.746	8.563	11.590	12.770	13.765	14.634	15.255	14.913	16.201	18.729
Kalmar	3.783	8.866	11.481	12.673	13.649	14.504	15.138	14.858	16.225	18.359
Gotlands	205	469	537	592	636	678	705	689	750	1.068
Hallands	1.298	4.254	4.906	5.401	5.810	6.191	6.514	6.355	6.867	8.328
Blekinge	1.048	2.414	3.605	3.964	4.268	4.535	4.725	4.618	5.029	5.699
Skåne	2.065	5.855	7.629	8.444	9.073	9.624	10.061	9.859	10.718	13.288
Hela landet Entire country	54.787	146.505	181.029	199.445	214.270	228.387	231.775	230.579	246.595	295.216

Källa: SCB.

Source: Statistics Sweden.



### Assessed value for each county expressed in assessed value/ha

Län	Tax/ha 1996	Tax/ha 2000	Tax/ha 2002	Tax/ha 2004	Tax/ha 2005
BD Norrbottens	2121	2483	2609	2704	4191
AC Västerbottnens	4290	4869	4964	5431	6724
Z Jämtlands	4129	4657	4603	5016	5682
Y Västernorrlands	5895	6696	6563	7170	8002
X Gävleborgs	7841	9380	9258	10149	11797
W Dalarnas	7464	8896	9935	9886	10066
S Värmlands	9284	10938	11953	12692	14921
T Örebro	12107	14974	15800	16792	19452
U Västmanlands	10291	12568	13491	14977	20128
C Uppsala	11873	14290	14872	15785	19060
AB Stockholms	11476	16548	18598	19610	22911
D Södermanlands	12360	14840	16432	17586	23825
E Östergötlands	14518	17425	18389	19619	27071
O Västra Götalands	12436	14579	16695	17783	21724
F Jönköpings	18510	22306	23736	25214	29087
G Kronobergs	18138	20919	23799	25275	29218
H Kalmar	16355	18272	20402	21867	24743
I Gotlands	4402	5924	5924	6303	8975
N Hallands	17035	19695	22081	23278	28231
K Blekinge	18299	22946	26250	27939	31661
M Skåne	19971	26452	27640	29445	36505

## Appendix 4

### Regression Analysis: y versus x1; x1^2; dummy

The regression equation is  
 $y = 17641 - 0,129 x1 + 0,000000 x1^2 - 1961 \text{ dummy}$

Predictor	Coef	SE Coef	T	P
Constant	17641	4163	4,24	0,000
x1	-0,12904	0,02649	-4,87	0,000
x1^2	0,00000030	0,00000004	7,75	0,000
dummy	-1960,9	864,8	-2,27	0,029

S = 2793,58    R-Sq = 90,8%    R-Sq(adj) = 90,1%

#### Analysis of Variance

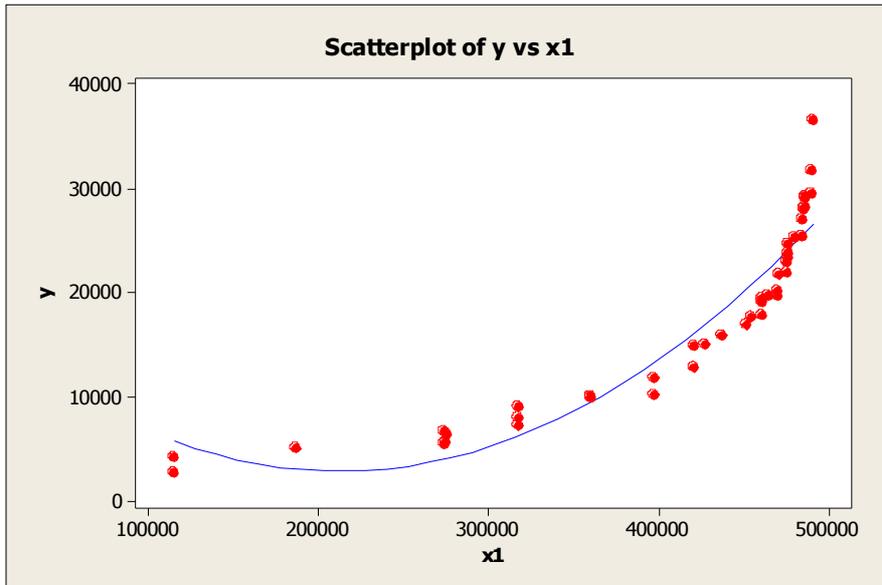
Source	DF	SS	MS	F	P
Regression	3	2922577763	974192588	124,83	0,000
Residual Error	38	296555440	7804091		
Total	41	3219133203			

Source	DF	Seq SS
x1	1	2401829460
x1^2	1	480626373
dummy	1	40121930

#### Unusual Observations

Obs	x1	y	Fit	SE Fit	Residual	St Resid
1	115063	2715	4852	1858	-2137	-1,02 X
2	114897	4191	6822	1875	-2631	-1,27 X
42	491344	36505	27519	770	8986	3,35R

R denotes an observation with a large standardized residual.  
X denotes an observation whose X value gives it large leverage.



## Appendix 5

### Regression Analysis: y2 versus x; x^2; dummy

The regression equation is

$$y2 = 15636 - 0,0607 x + 0,000000 x^2 - 1235 \text{ dummy}$$

Predictor	Coef	SE Coef	T	P
Constant	15636	2050	7,63	0,000
x	-0,060657	0,006435	-9,43	0,000
x^2	0,00000008	0,00000000	16,35	0,000
dummy	-1235,2	395,0	-3,13	0,003

S = 1270,42    R-Sq = 98,1%    R-Sq(adj) = 97,9%

#### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	3157802759	1052600920	652,19	0,000
Residual Error	38	61330444	1613959		
Total	41	3219133203			

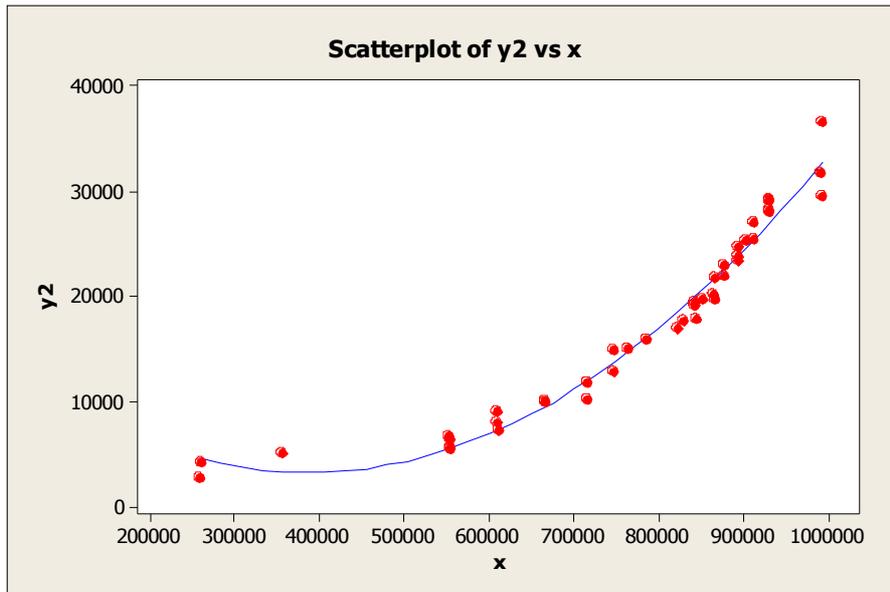
Source	DF	Seq SS
x	1	2696289757
x^2	1	445727337
dummy	1	15785665

#### Unusual Observations

Obs	x	y2	Fit	SE Fit	Residual	St Resid
1	258891	2715	3987	815	-1272	-1,31 X
2	259667	4191	5207	819	-1016	-1,05 X
40	992973	29563	31996	508	-2433	-2,09R
42	992419	36505	33178	469	3327	2,82R

R denotes an observation with a large standardized residual.

X denotes an observation whose X value gives it large leverage.



## Appendix 6

Assessed value for productive forest for each county and region

### Uttryckt i 2002 års priser

Län	Tax/ha 1996	Tax/ha 2000	Tax/ha 2002	
BD Norrbottens	2121	2483	2609	Region 1+2
AC Västerbottens	4290	4869	4964	
Z Jämtlands	4129	4657	4603	Region 3
Y Västernorrlands	5895	6696	6563	
X Gämeborgs	7841	9380	9258	
W Dalarnas	7464	8896	9935	
S Värmlands	9284	10938	11953	
T Örebro	12107	14974	15800	Region 4
U Västmanlands	10291	12568	13491	
C Uppsala	11873	14290	14872	
AB Stockholms	11476	16548	18598	
D Södermanlands	12360	14840	16432	
E Östergötlands	14518	17425	18389	
O Västra Götalands	12436	14579	16695	
F Jönköpings	18510	22306	23736	
G Kronobergs	18138	20919	23799	
H Kalmar	16355	18272	20402	
I Gotlands	4402		5924	
N Hallands	17035	19695	22081	Region 5
K Blekinge	18299	22946	26250	
M Skåne	19971	26452	27640	

2000:4,4%  
1996: 6,2%



Pris: 100:- (exkl moms)

Tryck: SLU, Institutionen för ekonomi, Uppsala 2007

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