Applied Economics of Multifunctional Agriculture

Policies, Costs and Trends

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Applied economics of multifunctional agriculture: policies, costs and trends.

Abstract

The thesis consists of an introduction and four articles that can be read independently of each other.

Article 1: "Biodiversity on Swedish pastures: Estimating biodiversity production costs", estimates the costs of producing biological diversity on Swedish permanent grasslands. A simple model is introduced where biodiversity on pastures is produced using grazing animals. In the article, biological diversity is considered a quantitative measure where a given quantity can be produced either by a small area with high quality or a larger area with lower quality. Box-Cox transformations are used in the empirical analysis and the results indicate that the biodiversity production costs differ between the two investigated regions.

Article 2: "Transaction Costs and Agri-Environmental Policy Measures: are Preferences Influencing Policy Implementation?", investigates the transaction cost determinants of a Swedish agri-environmental policy measure. The problem is whether unavoidable 'economic factors' drive the transaction costs, or if potentially avoidable 'political factors' have an undue impact. Although initial results indicate that the share of voters voting for particular political configurations influences the level of transaction costs, the extreme bounds analysis shows that only the economic variables are robust with respect to model specifications.

Article 3: "Multifunctionality – what does the literature tell us?", surveys the literature on multifunctional agriculture. It is shown *i.a.* that the level of transaction costs has to be considered when developing policies, that even optimal policies may be controversial from a trade perspective and that the spatial variation both in production and values should be accounted for.

Article 4: "Are the Mediterranean countries competitive in fresh fruit and vegetable exports?", investigates the competitiveness of ten Mediterranean countries' fruit and vegetable sectors, utilizing various indicators and the results of a constant market share analysis. The results show that the competitiveness generally has declined in the 1990s and that the countries do not fully utilize their potentials.

Keywords: Multifunctionality, fruit, vegetable, constant market share, biodiversity, pasture, production costs, public good, transaction costs, extreme bounds analysis.

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Contents

List of Publications

This thesis is based on the following articles, which are referred to by their Roman numerals:

I Nilsson, Fredrik O.L. (2007). Biodiversity on Swedish pastures: Estimating biodiversity production costs. *Journal of Environmental Management* In Press DOI:10.1016/J.JENVMAN.2007.08.015.

II Nilsson, Fredrik O.L. Transaction Costs and Agri-Environmental Policy Measures: are Preferences Influencing Policy Implementation. *Submitted Manuscript*.

III Nilsson, Fredrik O.L. Multifunctional Agriculture – What does the literature tell us? *Submitted Manuscript*.

IV Nilsson, Fredrik O.L., Lindberg, Emma and Surry, Yves (2007). Are the Mediterranean countries competitive in fresh fruit and vegetable exports? *Food Economics – Acta Agricult Scand C.* 4: 203-216.

Article I and Article IV are reproduced with the publishers' permissions.

1 Introduction

This thesis includes four articles that share the common foundation that they all concern the supply of agricultural products and services.[1] Three of the articles focus on the multifunctionality of agriculture and one of the articles concerns trade in agricultural products. The articles cover a rather wide spectrum of topics and utilize completely different methods. The thesis is thus more of a compilation of independent articles than a collection of articles with a common theme.

Going back to the most fundamental concepts in economics, supply and demand, one could say that this thesis is related to the supply side of agricultural goods, private as well as public. If there was no demand for these goods, the supply side would not be particularly interesting. Likewise, if there was no supply of the goods, little would it matter if there was a demand. Both sides are equally important, but the demand side is completely left to other researches, many of whom do not seem not to mind taking on the challenge of valuation of agricultural public goods.[2] In this thesis it is simply assumed that there is, or at least might be, a demand for certain agricultural public goods.[3]

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[1] Since there is no principal difference between the concepts 'goods' and 'services', both goods and services are ordinary outputs of the production process, the concepts will be used interchangeably throughout this thesis.

[2] See for example the following publications for discussions of values and valuation methods: Bishop, 1982; Brown and Mendelsohn, 1984; Diamond and Hausman, 1994; Fisher and Hanemann, 1983; Garrod and Willis, 1999; Hanemann, 1994; Hanley and Spash, 1993; Randall, 1991, 1994, 1998, 2002; Vatn and Bromley, 1994; Weisbrod, 1964.

[3] Indeed, much research has been devoted to the valuation of agricultural public goods in recent years and there does seem to a willingness to pay for some of these goods (*e.g.* Hasund, 1998; Drake, 1992; Hampicke, 1990; Pruckner, 1995).

The articles investigate different aspects of agricultural supply. To be more specific, three of the four articles are directly related to the concept of multifunctionality and the supply of landscape public goods. Article I investigates the costs of producing biological diversity on Swedish permanent pastures. Article II is also related to Swedish permanent pastures as it investigates the transaction cost determinants of a policy measure that aims to maintain the qualities of the pastures. Article III is a literature review, covering much of the multifunctionality literature that has been produced so far. Article IV diverges somewhat from the other articles and considers export supply of agricultural private goods. It investigates the competitiveness of ten Mediterranean countries' fruit and vegetable sectors.

The thesis consists of four chapters. Following this introduction, the theoretical framework creating the foundations for the articles will be presented in three subchapters. The first subchapter presents the complications of externalities and public goods, which are at the core of the multifunctionality problem, and thus serves as an introduction to primarily Article I through Article III. The second subchapter discusses another divergence from the perfect competition set up, namely the existence of transaction costs, which is an important part of Article II. In the third subchapter, some fundamental trade theories and the most important aspects of the Armington model are presented. Subchapter three thus introduces Article IV since the Armington model creates the theoretical foundation for the method used in that paper. In chapter three the articles that make up this thesis are summarized. The thesis ends with a concluding discussion and some suggestions for future research.

2 Theoretical framework

The purpose of this chapter is mainly to put the articles of the thesis in context and clarify some aspects that were not possible to include in the articles due to space constraints. It thus serves more as an introduction to the articles than functions as a presentation of the theories and methodologies utilized in the articles.

2.1 Externalities and public goods

In the introduction of this thesis, it was mentioned that the existence of public goods and externalities was at the core of the multifunctionality problem. Even though one sometimes might get the impression that the study of externalities and public goods is a rather recent phenomenon, it could in fact be traced back to the very origins of economic science. Even Adam Smith, the father of classical economics and usually considered a champion of laissez-faire both for reasons of economic efficiency and as a moral imperative, acknowledged the need for government interventions. In his *Inquiry into the Nature and Causes of the Wealth of Nations*, Smith claimed that under certain circumstances the market could not secure the optimal supply of goods or services. He divided the tasks of the government in three groups that all could be claimed to have public good characteristics: i.) The defense of the country; ii.) The protection of civil liberties and the administration of justice; and iii.) The construction of certain other public works and institutions. Regarding the third task, Smith wrote that the sovereign had the duty of:

> "…erecting and maintaining certain public works and certain public institutions which it can never be for the interest of any individual, or small number of individuals, to erect and maintain; because the profit could never

> repay the expense to any individual or small number of individuals, though it may frequently do much more than repay it to a great society."
> Adam Smith (1776, pp. 687-688)

Thus, interest in public goods has been present ever since the beginning of classical economics.

There is however some truth to the statement that the concept of public goods traditionally has been fairly ignored by economists to the advantage of a perfect competition setting. It was not until the 1950's after the publication of the seminal articles by Samuelson (1954, 1955), which provided a formal foundation of prior ideas, that research interest really started to grow. At first, the focus was on the two extremes, pure private and pure public goods, where the former could be efficiently handled by markets and the latter had to be supplied collectively.

The reason why pure public goods often are supplied collectively, if at all, is because they are characterized by perfect non-excludability and perfect non-rivalry. Perfect non-excludability implies that it is impossible to exclude anyone from benefiting from the good in question; perfect non-rivalry implies that additional consumption of the good in question does not dilute the benefit that already existing consumers might gain from their consumption. The deterrent effect of a defense system or the results of pollution controls are typical pure public goods. At the other extreme are private goods, goods such as food, drinks, fuel and clothes, where the benefits are perfectly rival and perfectly excludable. That a good is perfectly rival implies that any consumption of it completely and proportionally destroys the possibility of anyone else to consume it. Perfect excludability implies that the owner of the good costlessly can control the benefits. These classifications make it clear that pure private and pure public goods indeed are the extremes in a spectrum of characteristics.

About ten years after Samuelson's articles, Olson's (1965) "Logic of collective action" and Buchanan's (1965) "An economic theory of clubs" sparked extended research into impure public goods, *i.e.* goods that belong neither to the class of perfectly private goods nor the class of perfectly public goods. The category of impure public goods thus covers goods within a wide spectrum of characteristics. In this spectrum, a club good is a special example of a thoroughly studied type of good with particular characteristics. A club good is a good from which consumers can be excluded and that may or may no be congestible, *i.e.* possessing rivalry. Commonly mentioned examples of such goods are swimming pools and golf clubs, but schools, highways and national parks have also been suggested as examples of club

goods. A club good could be allocated efficiently by a group of individuals if the efficiency gains that are created are higher than the exclusion- and allocation costs. In addition, a sufficient share of those benefits has to fall upon the group members. The existence of club goods thus reduces the need for government intervention since these goods can be supplied by groups of individuals or by profit maximizing enterprises.

Another special type of impure public goods commonly mentioned in the literature is open access resources. The open access resources differ from the pure public goods through a higher degree of rivalry; if a person increases (decreases) his consumption of the open access resource, it will affect the utility of other users negatively (positively). That is, even though the individual consumer increases his own utility when consuming the good, that consumption has an external cost damaging other consumers. The open access resources are also called common property resources and could lead to the 'tragedy of commons', as described by Hardin (1968). The tragedy of commons implies that if there is a resource of economic value from which it is not possible to exclude consumers, and which is rival as described above, no individual user has an incentive to use the resource sparsely. This incentive problem is indeed as relevant today as ever with ongoing problems such as over-fishing, over-grazing and deforestation.

Both the club goods and the open access resources are examples of goods in the range of impure public goods. As mentioned though, they are just two particular examples: any good that is not at either of the two extremes and thus does not display the properties perfect excludability/rivalry or perfect non-excludability/non-rivalry, are impure public goods. Some specific examples have been presented above as being typically private or public goods. It is very important to remember though that it is not the actual physical goods or services that *per se* possess the specific degrees of rivalry or excludability. This becomes clear when considering the existence of technological advances that challenge current properties. Television and radio broadcasts, for example, used to be considered perfectly public within the range of the transmissions. Now, with access to electronic scrambling, the suppliers can choose whether to supply the transmission as a private or a public good.

In the literature, the concept of externalities is usually treated parallel to the concept of public goods. This approach is common not because the two phenomena necessarily appear together, but because they often do, especially when environmental problems are discussed. Like public goods, externalities may warrant government intervention. That is especially the case when externalities simultaneously are public goods. The externality rationale for

government intervention was first introduced by Pigou (1920) and refers to the situation when the action of one economic agent influences the utility or production of another, without any mechanism for compensation.[4] Usually, externalities are seen as unintended by-products of the products that actually were intended to be produced. One formal definition is presented in Meade (1973):[5]

> "An external economy (diseconomy) is an event which confers an appreciable benefit (inflicts an appreciable damage) on some person or persons who were not fully consenting parties in reaching the decision or decisions which led directly or indirectly to the event in question."
> Meade (1973, p. 15)

Thus, externalities may be positive or negative, *i.e.* creating benefits or inflicting harm.[6] The problem occurs by the fact that without an appropriate institutional framework, those that create the externalities may have no incentives to react to the existence of the externalities. That is, they will only take their own costs and benefits into account when making decisions, not the costs and benefits of those affected. By pure chance, it might be the case that the positive effects exactly outweigh the negative effects. Normally though, the private good could be expected to be either over-supplied (negative externalities) or under-supplied (positive externalities). This implies that there is a divergence between what would be optimal from the society's point of view and what the market generates: the socially optimal production of private goods and externalities is not equal to the spontaneously reached market outcome. One effective way to approach this divergence is through the concepts of private costs and social costs/benefits. The producers aim to maximize profits considering all relevant *private* costs while simultaneously ignoring the *social* costs and benefits resulting from the production. The resulting production level is usually inefficient from the

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[4] In the following, I will completely ignore the so-called pecuniary externalities.

[5] This is indeed a rather wide definition. An alternative formulation is presented by Arrow (1970), and discussions on definitions are provided by *e.g.* Baumol and Oates (1988), Buchanan and Stubblebine (1962) and Heller and Starret (1976).

[6] It should be noted though, that the decision of what is to be considered a positive or negative externality respectively is a normative issue and dependent on people's preferences. It is impossible to define on purely physical grounds when an externality is positive or negative (*e.g.* Vatn and Bromley, 1997). The question of what it is that should be protected in a certain situation can only be decided through the defining of rights to resources (Coase, 1960) and the distribution of rights is obviously a normative issue (Bromley, 1991).

society's point of view since optimality is reached only if *all* costs and benefits are incorporated in the production decision.

The difference between the socially optimal production level and the production level that occurs when only private costs are taken into account could be exemplified by a farmer that produces meat using grazing animals. The farmer has private costs of production, he has to pay for the land, care for the animals and so forth. The true costs of production, the total costs, are however lower than the private costs. The animals contribute positively to the biological diversity of the area and the total costs are the costs that remain after the social benefits have been deducted from the private costs. When the farmer aims to maximize his profit, he considers the private costs only and market equilibrium is reached where the demand curve crosses the private cost curve. The socially optimal production on the other hand would occur where the demand schedule crosses the total cost curve. The fundamental economic, and therefore environmental, problem with positive externalities is that the farmers do not become fully reimbursed for their production. In the case of negative externalities, the mirroring problem is that farmers do not have to carry the full costs of the damage they inflict on others

In this setting, the government could be viewed as an independent agent who could correct the production mix through an appropriate set of Pigouvian taxes and subsidies. If sufficient information is available to the policy maker, *i.e.* information on the marginal damages or benefits inflicted on the receiving parties, then a tax-subsidy system could be set up that made the social and private cost curves coincide.

However, in order to develop efficient policies when multiple externalities are present, it is important to take all externalities into account (OECD, 2001). This leads to the question if it ever could be conceivable to create an economy wide system of externality correcting taxes and subsidies. Since ultimately most private activities that change the status quo create external effects at some level, a full scale externality correcting system would take on information requirements of Herculean proportions. Thus, the Mises-Hayek (*e.g.* Hayek, 1945) argument against full scale planning also has validity in the more restricted setting of externalities. Notice though, that the Mises-Hayek argument in this setting is not an argument against Pigouvian taxes *per se*, but it is an argument that one should consider twice before attempting to apply the system on activities where the benefits are likely to be marginal.

The problem with information requirements leads to another line of inquiry into the externality problem, created by Coase (1960) with the

publication of "The problem of social cost". After the publication, it became clear to economists that the pure existence of externalities does not necessarily warrant government intervention. An alternative solution is to assign entitlements and let those that create the externalities and those affected by them bargain over the allocation. In the absence of transaction costs, such a procedure would lead to an efficient allocation and remove the need for further government intervention. This has come to be known as the Coase theorem. In essence, what the assignment of rights does is to expand the private markets to intangible commodities that previously were not subject to transactions.

According to OECD (2001), it may sometimes be useful to differentiate between externalities depending on if they are produced with or without opportunity costs. The opportunity costs are in this case related to the extra costs the producers face when producing the externalities. They may for example stem from extra costs for the inputs needed for the production of the externalities. This kind of production of externalities with opportunity is essentially equivalent to joint production of two or more goods constrained by allocable fixed factors. A farmer may for example divert from common techniques and utilize more labour in order to increase the supply of positive externalities, intentionally controlling the amount of externalities provided.

It is arguably so that it may be useful to include the intended externalities when discussing multifunctionality because it might simplify discussions: if farmers respond to *e.g.* new support systems and increase the amount of landscape amenities they produce using extra resources, it could be referred to as an increased supply of externalities. If, on the other hand, externalities are defined as *unintended* side effects of activities (*e.g.* Dorfman, 1993), intended outputs could of course not be classified as externalities. Externalities without opportunity costs, *i.e.* unintended externalities, are the form of externalities that is more commonly discussed; they are generated automatically without consuming any extra resources. Although there is a point to it that the inclusion of intended outputs in the concept of externalities sometimes could facilitate discussion, on a grander scale it probably complicates it. There is simply no need to blur the distinction between externalities and joint production. Referring to Mishan (1971), Baumol and Oates (1988) and how the concept traditionally has been treated in economics, an externality is the *unintended* product produced jointly with another product; if the product is *intentionally* produced, then it is not an externality.[7] Although it may be impossible for an external spectator, or even

[7] It should be pointed out that not all economists agree with this statement (*e.g.* Vatn and Bromley, 1997).

for the producer, to spot clearly the point when marginal production is produced jointly rather as an externality, it is still important to keep the concepts separated.

As mentioned previously, the concepts of externalities and public goods are at the core of the multifunctionality problems. At the most fundamental level, if there are neither externalities nor public goods associated with a certain type of production, it can not be argued from a welfare perspective that policy measures are necessary. In conclusion, a necessary criterion for the implementation of policies for multifunctional agriculture is that production is characterized by externalities and that the resulting products are public goods.

2.2 Transaction costs

Although all too often neglected in economic analyses, most, if not all, economic transactions include some form of transaction costs. Broadly defined, they include all costs that are not specifically a part of the physical production process. Coase (1937) argues that firms are created as means to lower transaction costs. The basic reason is that even at the most fundamental level, there are costs attributable to the utilization of the price mechanism; it is costly to discover the relevant relative prices. In a similar vein of argument, one could claim that the creation of institutions aims to lower transaction costs (*e.g.* Williamson, 1985; Bromley, 1989; Hodgson, 1988). Following Coase and Williamson, a large literature has since demonstrated that transaction costs to some extent can explain industry structure and decision making (Globerman and Schwindt, 1986; Pittman, 1991; Leffler and Rucker, 1991; Lyons, 1994). Most of the transaction cost literature has so far focused on transactions in the market.

When externalities were discussed previously, it was simply assumed that they exist and create suboptimal allocations, but it was not discussed why they exist. It could be claimed that the problem leading to market equilibriums that diverge from the Pareto optimum is the presence of transaction costs (*e.g.* Calabresi, 1968). If transaction costs were sufficiently low, it would always be possible for those that produce the externalities and those affected to negotiate and internalize the externalities. The externalities would cease to exist and a Pareto optimal resource allocation would be formed. This is basically the essence of the Coase theorem (Coase, 1960). Consequently one could claim that defining some goods as externalities is not necessary: there is no special kind of market failure associated with

externalities, they are simply normal goods with the exception that the costs of organizing market exchange are too high.

Clearly, transaction costs do exist and they may make up a substantial fraction of the total transaction value (*e.g.* Falconer and Whitby, 1999a, 1999b, 2000; Rorstad *et al.*, 2007). The sources of transaction costs vary but they could in general terms be described as costs that are linked to activities that are associated with exchange. According to Dahlman (1979), the fundaments of transaction costs are linked to the temporal stages of transactions and include: i.) Search and information costs; ii.) Bargaining and decision costs; and iii.) Policing and enforcement costs. Market transactions can be expected to take place when the resources that must be spent on those activities are lower than the expected gains from the actual transactions. Even if it may be useful to differentiate between these classes for analytical purposes, Dahlman also shows that the three classes of costs boil down to one single source; in all stages, resources are lost because of imperfect information. In addition to Dahlman, a rather large literature deals with factors that influence the level of transaction costs (Coase, 1960; Williamson, 1985; North, 1990; Griffin, 1991; Easter, 1993; Stavins, 1995; Challen, 2000; Vatn, 1998).

According to Williamson (1985), there are three principal dimensions through which transactions ought to be analyzed and described. The dimensions are *frequency, uncertainty* and *asset specificity*. High asset specificity implies that the good involved has few alternative uses or buyers. Recurrent transactions with low uncertainty and low asset specificity generally have lower costs than transactions where the dimensions are reversed. These dimensions are highly relevant when analyzing agri-environmental policies for multifunctional production. Many of the goods that are of interest for the society to promote are characterized by high asset specificity and low frequency in transactions. In some cases there is also a high degree of uncertainty. A study of the Swedish agri-environmental program that is clearly influenced by Williamson's thoughts is Eklund (1999). According to the study, five principal factors influence the level of transaction costs: i.) The character of the good; ii.) The design of the measures; iii.) Administrative institutions; iv.) The type and degree of uncertainty; and v.) The frequency of transactions. The factors that seem to have the most substantial impacts on the level of transaction costs in the case of the Swedish agri-environmental program are the complexity of the kind of goods the government intends to promote and the complexity of the design of the policy measures, but the other factors may also be important depending on circumstances. There may for example be high start up costs

that fall over time once the policy is in place, the decline being due to the recurrence of transactions and diminishing information needs. This latter point has been supported by Falconer and Whitby (1999a, 2000) in their study of the transaction costs incurred in the public sector due to the introduction and existence of agri-environmental policies. They conclude that not only are transaction costs often ignored when policies are developed or evaluated, they also tend to be of significant value. An important point is that substantial transaction costs do not necessarily mean that there has to be a waste of resources, the efficiency might still be high. However, the substantial amount of resources spent on transactions point to the need for thorough investigations of the administrative efficiency. The authors stress that transaction costs and their implications should be considered to be of major importance in public policy decision making.

The importance of striking the right balance between transaction costs and precision is stressed by Romstad *et al.* (2000). Just because transaction costs absolutely, or as share of expenditures, are higher for some policies than other does it not mean that the more expensive ones are less efficient. General payments directly related to acreage would clearly have low transaction costs in absolute numbers as well as share of total payments. Such policies are however, due to the weak precision, unlikely to be suitable for the goods that are of interest to promote. Using more specific instruments and policies are likely to involve higher transaction costs, but the better precision might lower total costs and create environmental gains that far outweigh the transaction costs.

The number of theoretical and empirical papers examining the size and impact of transaction costs for agri-environmental policy measures have increased substantially, although from a very low level, in the last couple of years. For example, Vatn *et al.* (2002) and Vatn (2001, 2002) try to clarify what it means that an agricultural production system is multifunctional but the focus is on the implications of transaction costs for agricultural policies. Although the complexities of transaction costs are thoroughly discussed, transaction costs as a specified function of some factors is not included in the model. The authors settle with the statement that the transaction costs will increase the higher the precision of the policies. The main conclusions is that it may be optimal to pay for the public good via an associated private good, depending on the type of production relationships, if transaction costs are positive. A trade-off has to be made between transaction costs and precision if the production relationships are not perfectly joint.

Rorstad *et al.* (2007), investigate the differences between the transaction costs of various Norwegian agricultural and agri-environmental policy

measures through interviews with stakeholders. The policies cover the entire range from low asset specificity and high frequency to high asset specificity and low frequency. Clearly, the level of transaction costs varies significantly depending on the point of application, asset specificity and transaction frequency, where very specific, low frequency measures carry relatively high costs. In a study that explores the transaction costs of agri-environmental policy schemes based on management agreements, Falconer *et al.* (2001) show that there are efficiencies of scale with respect to the number of agreements formed within an area as well as to scheme experience. The data also show that the administration costs as share of total costs decline over time, although still remaining substantial. Falconer and Saunders (2002) investigate the public and private transaction costs of management agreements on 'sites of special scientific interests', including those under the English Wildlife Enhancement Scheme. The study was confined to the direct costs related to concluding and operating the management agreements. The absolute level of negotiation costs was significant, as were the costs as share of compensation payments, especially for the wildlife enhancement schemes.

One of the most extensive studies of transaction costs and agri-environmental policy measures in the European context is Falconer and Whitby (1999b) where the transaction costs of 37 schemes in 8 countries are estimated. The focus of the study was on the public sector and the direct organizational costs of the schemes. The scale and objectives of the measures are very diverse and it is therefore not surprising that the magnitude of transaction costs varies substantially. However, in general transaction costs seem to decline with time and fixed initial costs may be very important and make up a large share of total transaction costs.

Although the number of articles investigating the transaction costs of agri-environmental policy measures has increased in recent years, there is still a lack of empirical knowledge about the determinants that cause the transaction costs. Article II in this thesis attempts to remedy some of that lack.

2.3 Some trade aspects

Early trade theory had a problem dealing with bilateral trade due to the assumption of homogeneity among commodities. Prior to Armington (1969), nearly all focus of trade theory was on comparative advantages that foresaw complete specialization except for under very special circumstances. David Ricardo was the first to clarify that all countries gain from trade

because what determines the efficient allocation is comparative advantages, not absolute advantages. Focusing on labor productivity, the theory foresaw that countries would export products where the utilized labor was relatively efficient compared to labor in other countries. Subsequently, Heckscher (1919) and Ohlin (1924) improved the theory by developing a model with both industry and agriculture that included the productive factors land and capital in addition to labor. The Heckscher-Ohlin model focused on how the variation in availability of the factors impacted specialization and trade patterns. Subsequent mathematical improvements by Samuelson led to the notion of the Hecksher-Ohlin-Samuelson trade theory that foresees that a country will specialize in the production of commodities that use the factors with which the country is relatively well endowed intensively. This implies that rich, developed countries like Germany or the USA should export capital intensive products and poor countries like Morocco should export labor intensive products. Even though being much refined over Ricardo's approach, it still does not account for variations in demand since the model assumes that consumer preferences are identical and homothetic and that products are homogenous.

Clearly, countries do not specialize completely and products are not homogenous. Likewise, particular countries both import and export certain commodities, *i.e.* there is intra industry trade (IIT).[8] One of the first extensive empirical attempts to estimate the extent of IIT was performed by Grubel and Lloyd (1975). Their empirical results sparked much interest and led to substantial theoretical improvement by Lancaster (1975) and Dixit and Stiglitz (1977).[9] Some years later, Helpman and Krugman (1985) showed that the Heckscher-Ohlin trade theory and the 'New Trade Theory' were complementary in nature. Focusing on the demand side and trade in agricultural products, Armington (1969) acknowledged that consumers might not find the origin of commodities irrelevant. Removing the assumption of homogenous products, he treated commodities of different origins as different commodities; *i.e.,* an Israeli orange is not identical to a Moroccan orange, they are two different commodities. To facilitate estimation, Armington suggested that demand could be modeled in two stages. In the first stage, the consumer chooses between 'aggregate' goods given his income, *i.e.* the consumer simply considers oranges to be oranges no matter the origin. Then, in a second stage, the consumer can direct his

[8] For a recent overview of the IIT literature and trade in agri-food products, see Sarker and Surry (2006).

[9] And subsequently Lancaster (1979, 1980), Krugman (1979, 1980) and Helpman (1981), among others.

consumption to oranges of different countries, thus capturing the aspect that consumers might have preferences both for domestic and various foreign oranges. The Armington model has since its introduction been frequently used by agricultural economists to model intra industry trade in agricultural products (*e.g.* Thursby *et al.*, 1986; Babula, 1987; Johnson *et al.*, 1979; Alston *et al.*, 1990).

The major share of Article IV is devoted to a Constant Market Share analysis (CMS) of Mediterranean fruit and vegetable exports. Despite the frequent utilization of the method in analyses of trade patterns (*e.g.* Rigaux, 1971; Bowen and Pelzman, 1984; Brownie and Dalziel, 1993; Hayward and Erickson, 1995; Juswanto and Mulyanti, 2003; ECB, 2005), the CMS methodology has been criticized on the grounds that it should lack a theoretical foundation (*e.g.* Houston, 1967; Richardson, 1971a,b). Although that used to be true, there is now a solid theoretical foundation. Merkies and van der Meer (1988) have successfully linked the CMS that is due to Leamer and Stern (1970) to a two stages Armington model. Furthermore, following the suggestion by Ahmadi-Esfahani (2006) and complementing the CMS results with those generated by other methods, conclusions from the analysis can be strengthened further.

3 Summary of articles

3.1 Article I: Biodiversity on Swedish pastures: Estimating biodiversity production costs.

The agricultural landscape provides both private goods, for example food and fibers, and public goods such as biodiversity. There is however a substantial variation in the impact agriculture has on the biodiversity. The variation depends to a large extent on historic management and the type of agricultural practices employed. Whereas agriculture's ability to produce private goods clearly is important from the society's point of view, the quantity and quality of biodiversity produced is also important for the society. A multitude of factors influence the level of biodiversity in the agricultural landscape, and one can conclude that the common misunderstanding that human activities necessarily have a negative effect on biodiversity simply is flawed. Some of the most interesting areas in the landscape, from a biodiversity point of view, are those that have a long history of human interactions with the natural environment. Most notably, meadows, pastures and their relics are important habitats for many red-listed species (Swedish Environmental Protection Agency, 1997).

In this article, the production costs of biological diversity on Swedish semi-natural and cultivated pastures are estimated. If policy makers aim to develop efficient policy measures, it is important to know both the costs of production and the values of the public goods resulting from the production. This paper improves the knowledge of biodiversity production costs in the pastoral landscape insofar as it provides a link between the costs of managing pastures and the biological diversity that is the result of that management. The costs of producing biodiversity are the additional costs

that result from keeping livestock on pastures rather than utilizing the alternative, most profitable, methods to produce milk or meat.

The specific costs for each pasture have been calculated and rely on the essential assumption that a specific level of grazing pressure is upheld on all well maintained pastures. Since the costs are simulated, this paper uses a semi-economic engineering approach. In a pure economic engineering approach, the entire production process leading to the final product is described and calculated (French, 1977). In this study, one crucial step in the production process is lacking, namely a model of nature's process where the inputs land and grazing pressure are transformed into the final product biodiversity. Consequently, it is not a pure economic engineering study since the cost calculations are combined with collected data for the final product.

Biodiversity is a quantitative measure of the biological diversity that incorporates two relevant factors into one measure. The area of the pasture is multiplied by a joint indicator for the absolute biodiversity quality of the pasture. The joint indicator is constructed by summing four sub-indicator values for type of land, vascular plant species, bush diversity and maintenance. The sub-indicators have different weights according to the influence they are considered to have on biodiversity in pastures. Box-Cox transformations are used to estimate the functional form of the cost function. To get the most general shape, the combined Box-Cox (Box and Cox, 1964) and Box-Tidwell (Box and Tidwell, 1962) function is used, allowing all variables, dependent and independent, to be transformed by different lambdas. The data are characterized by heteroscedasticity which is handled by using variances as functions of the biodiversity quantity.

The main result is that biodiversity production costs differ between geographical areas of Sweden. For low levels of production, the marginal costs are lower in the Selaö area than in the Vetlanda area. When production increases though, the situation is reversed and marginal costs are higher in the Selaö area than in the Vetlanda area. This is an important result since it implies that policy makers should consider the differences between different areas when developing policy measures. Spatially homogenous payments may result in a situation where producers in high cost areas are not paid sufficiently and valuable areas are lost. Alternatively, producers in low cost areas are paid a premium and make an economic rent. An excess burden is thus created through the collection of taxes. In either case, it implies an inefficient use of resources. This paper also makes two other contributions to the literature: it develops and tests a method of estimating costs for

production of biodiversity on permanent pastures and it illustrates biodiversity supply functions.

3.2 Article II: Transaction costs and agri-environmental policy measures: are preferences influencing policy implementation?

The agri-environmental policy measures are of increasing importance. That is especially the case in the European Union with the ongoing transfer from commodity related support to decoupled area payments complemented by payments for non-commodity outputs. When agri-environmental policy measures increase in importance, transaction costs become increasingly important to study if efficient policy measures are strived for. This paper aims to increase the understanding of what determines the level of transaction costs by analyzing how economic and political factors influence it. In the paper, the transaction costs of the Swedish agri-environmental policy measure that aims to support the qualities of semi-natural pastures are investigated. This particular measure has been chosen because of its resemblance to measures in other European countries and the results are thus applicable to not only the Swedish context. More specifically, the paper investigates the determinants of the county authorities' costs for setting up maintenance plans for the permanent pastures that participate in the system. Although to some extent fulfilling an educational function, the costs of creating the maintenance plans could essentially be classified as pure transaction costs.

The costs per plan vary substantially between the 21 Swedish counties. Since no apparent reason for these cost variations can be easily found, the challenge is to investigate if the variations can be attributable to reasonably objective economic factors, such as pasture density or distances, or if other factors, such as preferences and political attitudes at the county level, influence the costs. The paper contributes to the literature by empirically investigating the determinants of transaction costs for the implementation of agri-environmental policy measures, or more precisely, compensation schemes for preservation of semi-natural pastures in Sweden. It also applies the extreme bounds analysis (EBA) methodology to a new area, investigating the robustness of political and economic influences on the transaction costs of a European agri-environmental policy measure. The utilized EBA method is due to Leamer (1978) and it is a suitable method to check if the independent variables are robustly related to the dependent variable or if they are fragile and depend on certain specifications to be significant.

Another contribution is that is summarizes the existing literature that estimates transaction costs of agri-environmental policy measures.

In the analysis, the transaction cost determinants are split into two groups. In the first group, all factors that reasonably should affect transaction costs are included. Examples of such factors are the size and number of pastures in a county, the quality of pastures and the number of years that has passed since the introduction of the measure. This group of variables is called 'economic variables'. The other group includes all variables that on pure economic grounds reasonably should not affect the level of transaction costs. This group of variables is called 'political variables' and includes factors such as membership in lobby groups, political preferences, income- and education levels.

A preliminary analysis is performed by utilization of pooled data and ordinary least squares regressions. The results of that analysis show that five of the economic variables are significant. The variables have the expected signs and it appears that the size and number of pastures increases transaction costs, whereas a high general quality of pastures decreases transaction costs. There is also a significant learning effect as costs decrease with time. In addition to the economic variables, four political variables are significant. The results indicate that a high preference for the Christian democrats, the left wing block or the right wing block increases transaction costs, whereas a high preference for the Green party decreases transaction costs. Although the results are interesting, not particularly inconclusive and the regressions evidently capturing a large share of the variability, it is necessary to strengthen the results further. Since the paper is exploratory, it is desirable to establish if the parameters are robust with respect to model specifications. Therefore, in order to improve the strength of the results and establish if the political variables indeed are robust, an extreme bounds analysis is performed.

The extreme bounds analysis does not verify the robustness of all the variables that came out as significant in the initial analysis. Indeed, all the political variables are fragile according to both the strong and weak EBA criteria. Only the relatively fundamental economic variables, such as the number of plans created and the size of the pastures, pass either of the EBA criteria. Thus, it appears as if level of the transaction costs investigated in this paper are not related to political factors but only to economic factors and that administrators at the county levels are not unduly affected by local politics and public preferences.

3.3 Article III: Multifunctional agriculture – what does the literature tell us?

Given the width of recent research that concerns the multifunctionality of agriculture and associated policies, the main purpose of Article III is to survey the multifunctionality literature that has been published up to date.

At the core of the problem is the fact that multifunctionality, at one level or another, necessarily implies that there is some form of relation between different goods or values, relations that sometimes may be difficult to notice or clarify. One of the most obvious types of relations that could be present is a physical joint production between private and public goods, *e.g.* the joint production of biological diversity and extensive farming. However, the objects in an area, or the general appearance of an entire area, may affect the values of another area even if they have no physical relation or effect on each other. For example, if the quality of a certain field is degraded over time due to the absence of grazing animals, it could affect the values of nearby fields that still are identically the same as previously. Consequently, different areas or objects can be relational even if there is no actual physical joint production taking place.

One necessary condition for efficient policy measures is that it is possible to estimate the values of the public goods in question. It follows from the difficulty of identifying the different production and value linkages between various objects that it also is problematic to estimate the values correctly. There are various methods available for value estimation purposes, but unfortunately, none of them is flawless. Furthermore, even if it is possible to estimate the values of one specific area correctly, one can not necessarily use those estimates on a different, physically identical area. One of the main reasons for this is that the use values that people attribute to an area depend on the geographical location. It should also be remembered that the values of one area might change when the quality of adjacent areas are modified. This implies that it is a difficult and costly process, if at all possible, to get the values absolutely correct everywhere.

The policy makers should probably not strive for perfect estimates as that is likely to result in excessively high transaction costs for the policy measures. Optimal policy measures have to strike the right balance between transaction costs and effectiveness in order to achieve efficiency. One way of approaching efficiency with lower information requirements is to utilize indicators as information carriers. The presence, or absence, of indicators may be used to estimate the type and extent of the biological diversity or other values in an area. Efficient policy measures should then reimburse the farmers for their production of public goods up to the point where the

marginal benefit equals the marginal costs, taking transaction costs into account. That is, if correct estimates are attained for the values of the public goods in an area and the farmer is paid in accordance with those values, then profit maximization will ensure that the efficient production level is reached. Other considerations may of course influence the farmer's production decision but generally and in the long run, efficient allocations will be reached.

If a single country was to succeed in developing efficient policy measures that enhance the welfare of that country, the policy measures could still be controversial as they may affect trade flows. Trade flows that are diverted away from their free trade equilibrium will lead to diminished welfare in at least one country. For that reason are in the current world trading system only those agricultural policies that are not at all or at most minimally trade distorting deemed completely acceptable. Since many efficient policies will not be perfectly decoupled from production, they are likely to be looked upon with suspicion from the trading partners. However, if it can be shown that the policy measures indeed are efficient, that the global benefits outweigh global costs and that the measures only affect trading patterns slightly, then it should be possible for trading partners to accept the policies. A main issue in order to gain acceptance for efficient measures would be to clearly demonstrate and prove the above mentioned properties to trading partners.

One can conclude that substantial work remains to be done if efficient policy measures are to be developed for the provision of landscape public goods. On the demand side there is a potential for improved valuation methods that could be used to get more precise value estimates of the services the agricultural landscape produces. Additional valuation studies probably have to be performed using the best methods available in order to get a more complete picture of how the society values the different attributes of the landscape. As for the supply, further research is needed on the design of efficient policy measures. What form should the measures take in order to improve welfare at the lowest possible cost? Well functioning indicators that are able to present complex information cost efficiently in a comprehensive form need to be further developed. Politically, there is a need to clarify for the electorate the different costs and benefits that current and alternative payment systems imply. On the international level, nations have to agree on rules for trade in agricultural products that make it possible to use efficient policy measures even if they to some extent may divert trade from the free trade equilibrium. Even if much remains to be done, research in the area is progressing fast and the knowledge today is much more

substantial compared to a decade ago. If the research continues to be developed at this pace, the goal of efficient policy measures for the production of landscape public goods may be reached within a reasonable amount of time.

3.4 Article IV: Are the Mediterranean countries competitive in fresh fruit and vegetable exports?[10]

For the countries surrounding the Mediterranean Sea, trade has often been an important wealth-creating vehicle. The ongoing liberalization process in the world brings opportunities to the region and is especially important for the agricultural sector. Since large parts of the Mediterranean economies depend on agriculture, freer trade could be a stimulus to the region. Although trade in horticultural products has increased substantially over the last decades, trade could increase further if the protective measures of major trading partners were reduced (Huang, 2004).

Article IV investigates the competitiveness of the non-processed fruit and vegetable sectors of ten Mediterranean countries. The analysis is based on two foundations. Firstly, the importance of the sectors for the economies and their exports is assessed through the presentation of a set of indicators such as Relative Unit Values (RUV) and Revealed Comparative Advantage (RCA). Additional information, including sector shares in national exports and per capita exports, is presented in order to give a broader picture of the importance of the sectors to the economies. Secondly, the trade performance of the fruit and vegetable sectors in the countries is analyzed through a constant market share (CMS) analysis.

The RCA measure is one indication of a country's specialization with respect to specific commodities and provides useful information about trade prospects. The RUV indicator measures the average unit value of a country's exports in relation to the world average unit value. When commodities are heterogeneous, a high RUV indicates superior quality and thus can not be viewed as a sign of poor price competitiveness. The CMS analysis is a traditional tool, first used to analyze international trade by Tyszynski (1951), that often has been used to deal with structural effects. The CMS analysis has since been applied, in various versions, on many regions and periods. In this paper, the method chosen to decompose the development of trade is based on Leamer and Stern (1970). At the basis of the CMS analysis is always the

[10] Please note that the first line of equation 6 in Article IV should read:
$\Delta X_C \equiv \sum_i \sum_j \left(V'_{ij} - V_{ij} \right)$.

assumption that a country's share of exports in world imports should be constant. If the share in world imports changes, there is a difference between the constant market share norm and the actual export performance. The actual export performance could then be disentangled into four components: a market size effect, a commodity composition effect, a market distribution effect and a competitiveness effect. The analysis covers ten years. The first period covers 1992/1993 to 1997/1998, the second period covers 1997/1998 to 2002/2003 and the final period covers 1992/1993 to 2002/2003.

The most striking result of the constant market share analysis is that all countries, for both types of commodities in all periods, perform poorly with respect to competitiveness. The competitiveness effect is always negative, but the variation between countries, time periods and commodities is substantial. Despite the negative competitiveness effect, most countries are doing well in the second period, increasing exports of vegetables much faster than the constant market share norm. The negative competitiveness effect is attributable to the market distribution effect: Although the countries grew faster than the world average, they should have increased exports even faster in order to keep up with the markets and commodities they were exporting. Contrasting to the initial period, the export improvement is obvious: in the first period, none of the countries grew faster than the world average. The recovery in the second period secures that three out of eight countries manage to grow faster than the world over the ten year period.

The fruit sectors of the countries do not perform as well as the vegetable sectors. Furthermore, the fruit sectors generally do better in the first rather than the second period. In the second period only three of the countries display a positive growth in absolute terms. Those countries manage to grow much faster than the general world growth though. Despite that, the competitiveness effect is negative for the same reasons as it was for the vegetable sectors. They perform well but not as well as they should have, the market distribution effects outweigh the absolute increase in exports.

The results of this study are somewhat surprising since at least some countries would have been expected to display a positive competitiveness. One reason relevant for the non-EU countries is the fact that the EU demands high sanitary standards on producers that wish to export to the union. This may be costly for exporters (Muaz, 2005) and could be one reason why the Mediterranean countries do not succeed as well in exporting as they should be expected to. In addition, Grethe *et al.* (2005) find the value of the preference margin for several Mediterranean countries' exports to be substantial: the value of the preference margin amounts to a significant

share of the agricultural exports value to the EU. This indicates that these countries, due to the preferential trade agreements with the EU, may succeed in their exports of fruit and vegetables despite not necessarily being competitive. The relatively poor competitiveness of the European Union member countries Spain and Greece could possibly be attributable to the very favorable treatment they have by being members of the EU. Given the very positive influence access to the EU is bound to have on the countries, beating the market size and market distribution effects may be difficult. Further studies are necessary though, to safely assess the basis of the low competitiveness factor.

To conclude, it appears as if most of the Mediterranean countries perform less well than they should, given their potentials. Although quite some countries manage to increase their export shares in world imports, that is largely due to positive market distribution effects. Apparently, most of the countries depend on favorable historical export patterns for their successes in recent years. Without such an advantage, it is likely that the deterioration of the competitiveness would have led to less advantageous export changes.

4 Discussion

This thesis includes four articles that all are related to supply of agricultural private or public goods. They do however cover different topics and utilize different methods and it is therefore not possible to draw any conclusions that are relevant for all articles. Article III has some relevance for the other articles though since it surveys the bordering literature. In a sense, it frames the other articles and facilitates interpretation.

One important contribution of Article I is that it displays a novel approach to estimate the production costs of biological diversity on permanent grasslands. A caveat with the procedure followed in the article is that farmers currently do not receive payments that are strictly related to the level of biodiversity they produce. If a payment system was introduced that reimbursed farmers strictly for the biological diversity they produced, marginal lands would probably be used to a larger extent. Likewise, farmers would be more inclined to devote additional resources to pasture management for the purpose of increasing biodiversity. Both factors would change the shape of the supply function. A further implication is that costs are not static. In the long run, technological advances and improved knowledge of biological links are likely to decrease production costs. Thus, the cost functions estimated in Article I should be seen as short- and possibly medium-run cost functions. Given these aspects, an evident suggestion for further research would be to set up a test system where farmers that participate are paid according to the level of biodiversity they produce. The targets, linked to payment levels, could very well differ from the measurement used in this article, but it would be advisable to survey the participating pastures utilizing the same measurement as in this article. That should preferably be done both before and after the system is active, this in order to make comparison with the supply functions in this article possible.

Article II investigates the transaction cost determinants of an agri-environmental policy measure. The preliminary ordinary least squares regressions indicate that political factors have an impact on the level of transaction costs, but the extreme bounds analysis shows those results to be fragile. A given suggestion for further research would be to include the actual size of the pastures, rather than proxies, in the analysis. If data on area per maintenance plan were accessible it would be possible to give a better estimate on how transaction costs vary per managed hectare. Likewise, as mentioned in the article, the entire chain of transaction costs would preferably be included.

The literature survey in Article III shows that although substantial work already has been performed for the development of efficient multifunctionality policy measures, additional research is necessary. One suggestion for future research is to focus on the impact that policies promoting landscape public goods might have on trade patterns. Although such policies could affect trade, little is known as to what extent that is the case in practice.

The article that diverges the most from the others is Article IV. Utilizing the constant market share analysis and various trade pattern indicators, it shows that the investigated Mediterranean countries have performed poorly in fresh fruit and vegetable exports. Since these results are somewhat unexpected, future research could preferably focus on the underlying structures that are the cause of these results.

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