Roles of Agriculture in the Rural Economy

An Exploration Exemplified by Austria

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Abstract

Agriculture is more than just the production of food and fibre. The topic of this thesis is to find evidence for this statement. There are no efforts made to describe the functions and roles of agriculture in an encyclopaedic manner. Pragmatic concepts as those proposed by OECD are applied to a small set of practical questions. The OECD suggested to identify commodity and non-commodity outputs of agriculture in order to make concepts like the multifunctionality of agriculture operational.

This approach is used as a guiding principle to explore four research questions: a) What are the roles of agriculture in the context of the rural economy, how can agriculture contribute to rural well-being and rural development? b) What are the commodity and non-commodity outputs of agriculture in Austria? c) Is it possible to establish empirical links between agricultural activities and (negative) agricultural externalities and does it matter if support for agriculture is granted with different instruments? d) What are the consequences and the effects of agricultural policy changes for rural and non-rural economies?

The thesis starts with exploring the role of agriculture in the rural economy in OECD countries. In the following chapters Austrian agriculture is taken as an example. A general notion of the thesis is that agriculture is not the only sector with substantial spillovers and external effects. Agriculture is 'multi-functional' in the sense that several outputs are produced intentionally but that unintended spillovers are associated with them as well. Positive and negative external effects are significant and agricultural outputs and spillovers affect the rural economy via direct and indirect channels. The thesis shows that some of the spillovers and effects can not only be identified but also quantified. Models need to be employed to make that possible in some cases. A model analysis shows that farmers in rural regions are the main beneficiaries of the Programme for Rural Development in Austria. But due to economic relationships other parts of the economy in non-rural regions benefit from the programme too. These results may contribute to a better understanding of the role of agriculture in the rural economy and help to better target policies that aim at improving the quality of life and well-being in rural regions.

Rollen der Landwirtschaft im ländlichen Wirtschaftsraum

Eine Erkundung veranschaulicht anhand von Österreich

Kurzzusammenfassung

Die Rolle der Landwirtschaft geht über die Produktion von traditionellen Agrargütern hinaus. Das Thema dieser Arbeit ist, die Aussagekraft dieser Feststellung zu erkunden. Es wird nicht der Versuch unternommen, die Aufgaben und Funktionen der Landwirtschaft enzyklopädisch zu erfassen. Im Gegenteil, eine kleine Zahl von pragmatischen Konzepten wird herangezogen, um die Rolle der Landwirtschaft zu beleuchten. Orientierung bieten die Vorschläge der OECD. Sie schlug vor, die Multifunktionalität der Landwirtschaft so zu untersuchen, dass Wirkungen und Produkte unterschieden werden.

Dieser Zugang wird in vier Abschnitten verfolgt in denen folgende Fragen behandelt werden: a) Welche Rolle kommt der Landwirtschaft im ländlichen Wirtschaftsraum zu und wie kann sie zum Wohlergehen der ländlichen Bevölkerung beitragen? b) Welche Produkte, welche Rollen, welche Funktionen werden mit der österreichischen Landwirtschaft in der sozio-ökonomischen Literatur in Verbindung gebracht? c) Besteht ein empirisch abgesicherter Zusammenhang zwischen Agrarfördermaßnahmen und Umweltwirkungen, und macht es einen Unterschied, welche Form der Agrarstützung gewählt wird? d) Welche Auswirkungen sind für die Wirtschaft in ländlichen und nicht-ländlichen Regionen zu erwarten, wenn sich agrarpolitische Rahmenbedingungen ändern?

Zunächst steht die Landwirtschaft im OECD-Raum im Mittelpunkt der Untersuchung. Am Beispiel Österreichs werden dort gewonnene Erkenntnisse vertiefend dargestellt. Die Multifunktionalität der Landwirtschaft rührt von den spezifischen Produktionsbeziehungen her. Im Zuge der Produktion kommt es zu beabsichtigten und unbeabsichtigten Nebenprodukten und Wirkungen; positive wie negative externe Effekte sind von besonderer Bedeutung. Diese beeinflussen und verändern die Wirtschaft im ländlichen Raum und darüber hinaus. Anhand von Beispielen wird veranschaulicht, dass zahlreiche Auswirkungen nicht nur identifiziert, sondern auch quantifiziert werden können. Vielfach sind dazu Modellanalysen erforderlich. Mit ihrer Hilfe wird gezeigt, dass das Programm zur ländlichen Entwicklung zwar vornehmlich an die Landwirtschaft im ländlichen Raum gerichtet ist, aber auch andere Wirtschaftsbereiche in nicht-ländlichen Gebieten stark profitieren. Die Ergebnisse der Arbeit können Anhaltspunkte für eine treffsicherere Politik liefern, die zum Ziel hat, die Entwicklung des ländlichen Raums zu fördern.

Roles of Agriculture in the Rural Economy

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1. Introduction

Agriculture is more than just the production of food and fibre. The topic of this thesis is to find evidence for this statement. Austrian agriculture is taken as an example. It seems that specific aspects of the way agriculture has been seen in Austria over decades have percolated through to the perception of agricultural policy makers throughout the EU. Whether Austria in fact is a frontrunner or not will not be investigated here. However, the fact that EU funds for the Austrian Programme for Rural Development are high compared to its share of agricultural production makes Austria an interesting special case. The topic here is to explore some of the distinctive features and specific characteristics of the agricultural sector and to shed light on various roles agriculture plays in the context of the rural economy. Many previous studies dealt with the role of agriculture in the economy as a whole. About a decade ago the Common Agricultural Policy (CAP) shifted its focus on rural development to concentrate more on territorial aspects of the agricultural sector.

Agriculture as such is a topic broad enough to fill libraries of studies that deal with descriptions and analyses of the structure of agricultural firms, the dynamic changes in the sector, the economics of agricultural production, innovations and technological change and the role of agricultural policies. Analysing all these questions in a rural development context, would be a daunting task. Therefore it is necessary to narrow down the specific questions analysed in more depth. A headline term, namely the "multifunctionality of agriculture" will be in the focus of this work. The term "multifunctionality" characterizes roles of a sector that go beyond its mere traditional production function.

One interesting question is whether multifunctionality of agriculture is a topic of scientific interest or not. Topics like structural change, competition and politics are equally of interest in the context of the second and the third sector of the economy. However, "multifunctionality" is discussed more broadly only with respect to agriculture and more recently also to forestry. There are three ways to deal with a term like "multifunctionality of agriculture". The first one is to simply ignore it, arguing that such a vague concept is not worth any further discussion and serious consideration. The second one is to make an attempt to develop a theory of multifunctionality and identify the specific aspects of the agricultural sector. The third approach is to make a vague and blurry concept more operational by pinning down those elements that are considered to have substance and separating out the other elements. This approach is taken in this analysis.

The term "multifunctionality" is widely used in agricultural policy debates. Frequently it is argued that public intervention in markets, regulations of agricultural production, support to special groups of farmers are necessary and justified because of the multifunctional roles of agriculture. Whether such claims are consistent with economic reasoning and empirical evidence or not is explored in the following chapters. The research questions of this thesis are:

- What are the roles of agriculture in a rural economy from a conceptual point of view? Rural viability, the well-being and quality of life of the rural population are affected by agriculture in different ways. What are the channels that convey the influence of agriculture to the rural society as a whole? Are there any indicators that help to understand the cause-and-effects relationships and are there measures to quantify targets of rural development and the outcomes?
- What are the aspects and facets of multifunctionality in Austria? Which authors contributed to this discussion and what are their major findings? Did these views and discussions have an influence on agricultural policies in Austria? Is there any empirical and quantitative evidence that a presumed positive role of agriculture actually materialises?
- Agricultural production processes take place mainly in the open space. Therefore its interaction with the environment is direct and the effect on environmental quality crucially depending on the ways production is carried out. Nitrate is essential for vigorous plant growth and therefore an input for agricultural production. Nitrate is also a significant pollutant in groundwater in Austria. One question is to what extent Agriculture is contributing to the level of nitrate pollution in Austria. A second question is whether different production activities are contributing to nitrate emission in different ways. A third question is whether agricultural policy has an effect on emission levels and if yes, in which way? The answers to these questions can provide insight on how to change existing policies in order to reach an important goal of rural development – to improve the environmental quality and thus the quality of life of the rural population.
- Agriculture plays only a minor role in the Austrian economy. Even in rural regions its contribution to the value added is relatively small. Is it therefore a sector that can be neglected? Would not the economy be better off if the subsidies that are flowing into this sector were discontinued? Is it possible to measure and to quantify the consequences for the rural economy if the level of support for the agricultural sector declines? What are the economic consequences for the rural economies and the national economy if the level of support for the agricultural sector drops?

The explorations of these questions are made in four distinctive chapters. In chapter 2 various roles of agriculture in the context of the rural economy will be analysed. This chapter will not be limited to the case of Austria, but refers to data from OECD and EU countries. The question whether agriculture is essential to rural viability or not is analysed using the approach proposed by the OECD to make the term "multifunctionality" operational for economic analysis. A reference is made to a conceptual model of rural development that is defining very broad elements that contribute to regional viability. Frequently used terms like "rural viability" and the "development of rural regions" are put into the context of a wider concept of regional development.

Chapter 3 provides a very detailed review of discussions on "multifunctionality of Austrian agriculture". The term "multifunctionality" is thereby reduced to the concept of commodity and non-commodity outputs and external effects. Many of the notions and connotations of "multifunctionality" can be made operational for economic analysis by thinking of positive and negative external effects. Such a reductionist approach definitively implies the danger of a narrow view. However, the cost must be compared to the gain, namely the possibility to discuss many aspects of agricultural multifunctionality without the load of ad-hoc value judgments.

Chapter 4 deals with external effects of agriculture in more depth. Nitrate concentration in groundwater is taken as an environmental quality indicator and the influence of agriculture on it is analysed in an empirical setting. Empirical findings from the early 1990ths are compared with recent evidence to show that some of the variance of the nitrate concentration in Austrian groundwater bodies can be explained by indicators measuring the specific types of transfers to the agricultural sector.

In the last chapter, findings of a collaborative study are reported. It deals with economic spillover effects of agricultural policy to rural and non-rural economies. The Austrian Programme for Rural Development is taken as an example. The currently implemented programme that spans over the period 2007 — 2013 is compared to a scenario in which fewer funds are available. This analysis shows whether rural and non-rural regions benefit from EU funds that are channelled through the agricultural sector into the Austrian economy.

The final chapter summarizes the findings of the research and gives some hints on topics for future studies.

2. Agriculture in the rural economy in OECD countries

2.1. The concept of multifunctionality

In 1998, at the Ministerial meeting of the Committee for Agriculture, OECD Agricultural Ministers acknowledged that the role of agriculture is going beyond the provision of food and fibre [...] by contributing to rural development and generating environmental and amenity services for which there are often no or very imperfect markets (OECD, 1998). The Ministers used the term "multifunctionality" to describe this role.

This term had been used already at the EU council meeting in Luxemburg when the European model of agriculture was presented. Apart from its production function, the agricultural sector must contribute to maintaining the countryside, conserving nature and making a key contribution to the vitality of rural life, and must be able to respond to consumer concerns and demands regarding food quality and safety, environmental protection and the safeguarding of animal welfare (Council of the European Union, 1997).

At a multilateral level, multifunctionality was discussed in the context of "non-trade concerns" of Article 20 of the Uruguay Round Agreement on Agriculture (discussed by Burrell, 2001 and Anderson, 2000). It is clear, however, that the meaning of this concept has changed over time. Originally, "multifunctional aspects" of agriculture addressed issues such as food security and sustainable development in the UN Agenda 21 (UN 2004). Multifunctionality seems to represent a set of issues (environmental and rural development concerns) that is understood to be a sub-set of "non-trade concerns" which encompass food security, environment, structural adjustment, rural development, poverty alleviation, and so forth (WTO, 2004).

Within the international scientific community the debate about multifunctionality has been controversial. Some authors warned against the abuse of the term before it was widely used (Bohman et al., 1999). By 2000, several research papers and conferences (reviewed by van Dijk, 2001) had already dealt with this concept.

An OECD study (2001) which built on expertise from outside the organization (e.g. Boisvert, 2001) placed multifunctionality within the context of external effects and market failure. According to this concept, agriculture produces two types of output: commodity outputs (food and fibre) and non-commodity outputs (NCOs) which represent various aspects of multifunctionality. A follow-up publication (OECD, 2003) provides a coherent framework to evaluate various types of multifunctionality outputs related to agricultural activities, including environmental benefits, food security, and rural viability.

This chapter applies the OECD methodology to analyse the effects of agriculture on rural development and rural viability. The term "development" and "viability" are most frequently used together. While "development" refers to an aspect that can be observed and measured, "viability" refers to an unobserved capacity that is a necessary condition of development. Both terms are linked very closely together and are treated together as well.

To narrow the scope of the analysis, some definitions are necessary. The starting point is to differentiate between two types of external effects; these are pecuniary and technological external effects (Scitovsky, 1954). A distinction is crucial because technological externalities may justify policy intervention from a welfare economic point of view, but pecuniary externalities do not. Pecuniary externalities affect prices and costs of other firms via markets. Technological externalities affect other firms via their production function and affect market outcomes only indirectly. By addressing technological externalities, policy intervention can correct market outcomes and contribute to a better allocation of resources.

Agriculture, as defined in the system of national accounts (NA), is the production of food and fibre. The system of economic accounts for agriculture (EAA), an ancillary system of the national account is covering activities beyond the production of food and fibre (European Commission, 2000, Appendix XI). EEA includes agricultural services other than contract work at the production stage (e.g. farm tourism). The present analysis focuses on a sector in which enterprises seek to make profits by selling food and fibre to the market and refers to the broader concept according to EAA as far as European farms are concerned. Subsistence farmers and hobby farmers involved in farming activities are not considered in this study.

Two factors make agriculture to a special case from the viewpoint of this thesis: demand for food is inelastic with respect to changes in income and technological progress the productivity of agriculture (Mundlak, 2005). If this observation from the last century holds for the foreseeable future, we have to expect that the level of non-commodity outputs (NCOs) will be affected by these two factors. The development of agriculture will have different consequences for NCOs depending on the way they are linked. NCO levels may either be dependent on the levels of commodity outputs or on the levels of factors used in production (OECD, 2001). Technological change will make it difficult to conserve a given mix of agricultural commodity outputs, the necessary inputs to produce them, and NCOs that are found optimal at a given point in time.

Multifunctionality in the context of rural viability has both a static and a dynamic component. Such a view is consistent with the objective of rural development: "an overall improvement in welfare of rural residents and in the contribution which the rural resource base makes more generally to the welfare of the population as a whole" (Hodge, 1986). Development and improvement means change. The consequences for rural development are "structural and institutional changes in the rural parts of the wider economy" (Thomson, 2001).

The analysis of rural development raises the question how to differentiate rural from non-rural areas. Without such a differentiation it would not be possible to make a distinction between the contributions of agriculture to the development of welfare in rural areas and the whole country. According to OECD definition, a region is "predominantly rural" if more than 50% of its population is living in rural communities, it is intermediate, if less than 50% and more than 15% of its population is living in rural communities and it is "predominantly urban", if less than 15% of the population is living in rural communities (OECD, 2005; see Annex I). There are many other possible ways to define rural areas and none of them is universally accepted, but two characteristics are relatively undisputed in the literature (Ward and Hite, 1998): rural areas are characterised by "remoteness" (distance to urban centres) and "low population density" (few inhabitants per square kilometre). Using such a definition helps to overcome "the difficulty of defining boundaries and reference systems" (Knickel and Renting, 2000) which became a major challenge in many studies on multifunctionality. The focus in this analysis is on rural regions while acknowledging that NCOs of agriculture are also relevant in non-rural regions.

The analysis is structured as follows. A short review of the literature on regional growth is presented in order to identify the factors that are considered to be relevant for welfare enhancing changes. In the spatial analysis which is then presented, an attempt is made to provide an overview of the links between the agricultural sector, the development of rural regions relative to other ones, and the level of supply of those NCOs which can bed directly observed on markets. A survey of studies dealing with NCOs which are associated with agricultural production is presented next. Only such NCOs which are considered to be relevant for rural development are covered in that chapter. Those NCOs that affect food security or environmental protection are only briefly mentioned. After establishing the set of NCOs relevant for rural development, the methodology developed by OECD (2002) is applied to identify the sources of jointness, to explore the possibilities of de-linkage, to identify the spatial factors associated with the supply side, to identify potential market failures and the characteristics of the goods in question. Finally, institutional arrangements that stimulate the production of NCOs and enhance internalisation of external effects are addressed. The findings are summarised along with conclusions at the end of this chapter.

2.2. Rural development, rural viability and non-commodity-outputs of agriculture

According to the OECD framework, rural viability is a function of agricultural employment and measuring its share in rural employment indicates whether there is jointness or not: "If that share is low, there is no jointness in practice" (OECD, 2003). There are many countries with farm employment in rural regions of less than 10%. Nevertheless, frequently the claim is made that the multifunctional role of agriculture is important. There is no consensus on what "low" actually means. One approach to specify threshold levels of low agricultural employment is therefore to measure the significance of rural employment for the rural economic performance in a dynamic context: Increased levels of productivity and falling agricultural employment "could be further evidence of weak jointness" (OECD, 2003).

From an economic perspective, rural productivity can be analysed in the context of "regional development". A starting point to understand factors affecting rural development is to analyse the factors affecting rural development, a special case of regional development.

Rural regions are special because of low population density and remoteness but the aim of rural and regional development is the same: economic growth and employment. Regions with a high growth potential have the ability to attract profitable firms that employ highly skilled workers with high incomes. The population in such regions has high living standards, a measure of its well-being. Programs addressing rural viability and rural development should aim at fostering such capacities.

How this can be achieved is not very clear because many factors are potentially important and since every region is different compared to others it is not easy to identify the characteristics that make one region successful while a similar region is not successful. In Figure1 a pyramid represents a conceptual model of regional development and its determining factors.

In Figure1 the target outcome of regional development is high quality of life and high standard of living of the population of a region. Both elements are determining the well-being of the people from a given region. These outcomes therefore at the top of the pyramid. There is no single measure or index that could be used to meter the level of well-being and its changes.

In order to compare regions or to measure whether the performance of a regions improved or not, indicators are necessary. Several of them can be used to identify the *revealed competitiveness*. There is a growing consensus that a single notion of competitiveness can be found to describe processes of the globalising economy for companies (microlevel), industrial sectors and regions (mesolevel) as well as for national economies (macrolevel). Competitiveness is intimately bound up with successful economic development (Lengyel, 2004). One important measure and an indicator of regional competitiveness is the regional gross domestic product which gauges the economic performance of a region. The regional GDP is an indicator of the well-being of the population and changes reveal how well a region is adjusting to the changing environment.

Productivity and the factors determining employment are indicators which can be measured on a regional scale and are the other measures of *revealed competitiveness*. The concept concentrates on very few variables and does not capture all the complexities of a given economic situation in a region. Factors of production other than labour are not accounted for directly, the flows of goods and capital are not considered, and net balances of commuting workers between regions are not calculated. The simplicity of the model has the advantage that data to describe the economic performance of a region in a longer term perspective are relatively easy to obtain.

Regional performance is a consequence of its productivity. It can be measured by two other indicators: labour productivity and employment. The first indicator is essential because "a country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker” (Krugman, 1992). However, labour productivity and employment rate must change in a balanced way in order to sustain a good regional performance.

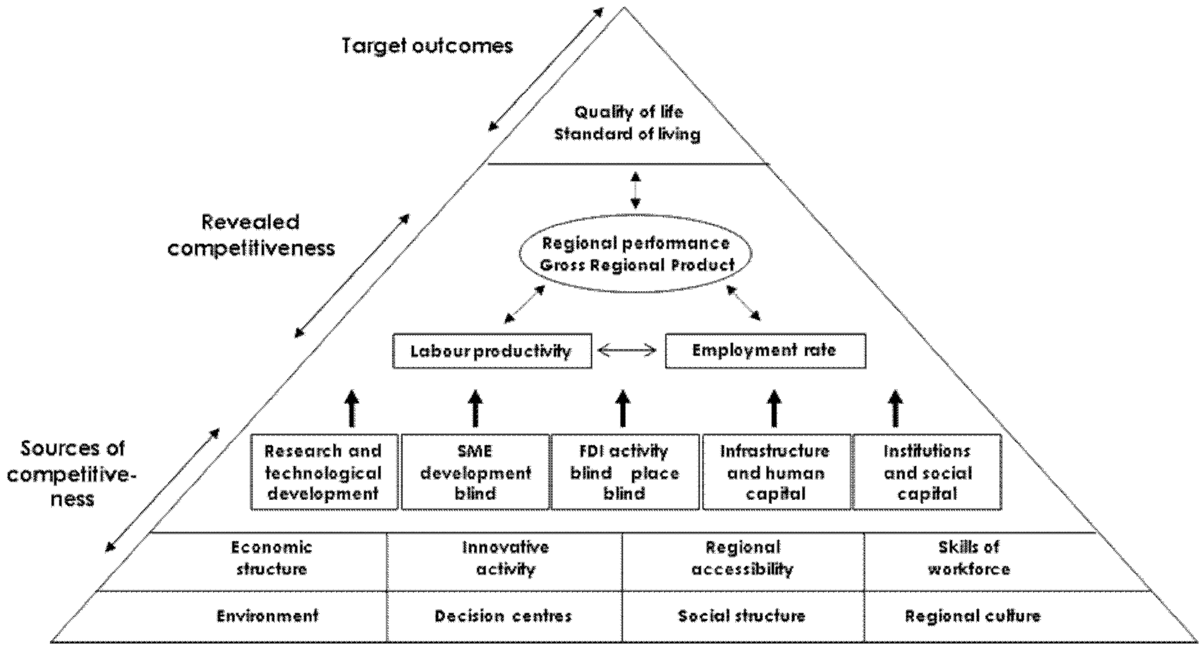

Figure1: A model of regional growth and competitiveness

Source: Gardiner, Martin, Tyler (2004) and Lengyel (2004).
Notes: SME small and medium sized enterprises, FDI foreign direct investments.

In a certain region where regional productivity (output per unit of labour) grows but where employment (hours of labour) drops because the least efficient firms close and workers are laid off, productivity growth may not be associated with any overall increase in output. Output matters because it determines the level of the living standard. In such circumstances, "employment reduction is a negative route to raising regional productivity, and is to be contrasted with regions that have both high productivity and employment" (Gardiner et al., 2004). Productivity measures the output per hours worked. Employment (the number of hours worked) is a function of the employment rate, the dependency rate and the work-leisure trade off of the population in a region (Gardiner et al., 2004; Lengyel, 2004).

There is not only one factor or process that determines the *revealed competitiveness* of a region but there are many *sources of competitiveness*. Some of them are good to measure and can be used in regional growth models as explanatory variables (e.g. direct investment, human capital, and infrastructure). The factors that are at the basis of the pyramid model of regional performance (environment, social structures, etc.) are known to have an influence but there is not yet a clear understanding how they affect the other processes.

Using this concept of regional performance, measuring the contribution of agriculture to rural viability and rural development can be conducted in a straight forward manner by measuring agricultural output, hours worked in the sector, the working population and the whole population of farm households. Evaluating the contribution of agriculture in such a way shows the significance of farming in a given region, but such a calculation is nevertheless not sufficient.

If agriculture enhances GDP in rural regions due to its multifunctional character, there must be at least two channels:

- Direct channels: Agriculture produces not only food and fibre, but also other outputs (products or services) which are a direct component of GDP of rural regions. Among these outputs are community services or farm tourism. Activities of farms have consequences on the profitability of other rural firms via input and output relationships. According to the definition presented above, such effects are pecuniary externalities.
- Indirect channels: Agriculture produces other NCOs that have an influence on the output of other sectors, the employment rate, the work-leisure trade off or the size of the population. They are either due to positive or negative technical external effects. They affect either production decisions of other firms or consumption choices of households.

The regional well-being (the quality of life, the standard of living) is determined by productivity and the level of employment. An unproductive farm sector with respect to food and fibre does not contribute in a positive way to rural viability. Maintaining farm employment at high levels diminishes rural development unless it is contributing to GDP of rural regions directly or indirectly. If that is the case, we should be able to measure this contribution because it materialises at the regional level. We would expect that regions with similar characteristics but different shares of agriculture have different levels of GDP or different growth rates.

To measure the contribution of agriculture that goes beyond commodity production may be relatively easy as far as direct channels of NCOs are concerned. But it may be very difficult, when indirect channels are the source of additional GDP. The difficulty arises because the pathway of influences has to be identified in the first place and its particular type (either a pecuniary or technical externality) has to be identified.

Figure1 presents a model of such pathways. It suggests that labour productivity and employment rate are determined by five factors. Only few farms are involved in research and development (R&D). The development of small and medium sized enterprises is concentrated on manufacturing and services and foreign direct investment (FDI) activities are generally not controlled by agriculture. Indirect channels therefore could come from human capital (spillovers from well educated farmers) or special roles farmers play in the formation of social capital.

Social capital can be defined as "the shared knowledge, understanding, norms, rules, and expectations about patterns of interactions that groups of individuals bring to a recurrent activity" (Ostrom, 2000). This is seen to be a prerequisite to solving social dilemmas or coordinating collective-action situations based on trust. Improving social capital in rural areas is viewed as one option to strengthen such positive effects for rural society as a whole (Ruben and Pender, 2004).

Indirect NCOs such as positive spillovers from agriculture to other sectors or to the well-being of the population in rural areas can be expected to come mainly from the base of the pyramid of regional growth, and its role of maintaining and providing an environment that attracts people to living in a given region (population), that helps people to stay healthier (total hours worked), or makes other sectors more productive (GDP/total hours worked).

A traditional cultural landscape provided by agriculture could be an important factor because productivity is not limited to just efficiency: "It depends on the value of the products or services that a region's firms can produce, as measured by the prices they can command, not just their efficiency in producing standard items" (Porter et al., 2004). For the tourism sector in rural areas, the characteristics of their environment may be the factor which allows differentiating from other destinations. For food processors, marketing food with regional attributes or special types of traditional processing can be important marketing attributes.

A government may be concerned by sparsely populated regions and try to maintain a given minimum level of population. Even under such a policy the framework of wealth creation in a region such as that outlined above will not change because the government would choose a targeted policy that obtained a given level of population while simultaneously trying to maximise regional GDP. In comparison to a situation without such a policy, relatively more agricultural activities can be a consequence.

2.3. Review of theories to explain regional development and clusters of economic activity and value chains in rural regions

There is no dominating theory in the economic literature which can explain the development process of regions. Consequently, no single "theory of rural development" provides a framework to analyse all existing phenomena (Ward and Hite, 1998).

One of the first authors attempting to explain the disparity between urban centres and rural areas was von Thünen (1826). His model explains how land rents are related to transportation costs. In the first half of the 20th century, Lösch (1940) and Christaller (1933) made important contributions to regional economics: the concept of central places and peripheral areas, explanations for factor mobility, migration, and international trade. However, these approaches cannot explain why economic structures like cities evolve in a market environment characterised by welfare maximising households and profit maximising firms (Krugman, 1998). Neoclassical theory, urban economics and new economic geography are the economic approaches that attempt to overcome this limitation (Martin and Sunley, 1998).

In the neoclassical growth theory regional differences in productivity are due to different factor endowments (differences in the capital/labour ratios) and prevailing technologies. Productivity growth (measured as output per unit work) depends on the accumulation of capital per worker and an – exogenously given – rate of technical change. In the standard neoclassical growth model technology exhibits constant economies of scale and diminishing returns to factors of production. An important assumption is that factors are free to move and the same technology is available in all regions. One theoretical result of this model is that lagging regions should catch up with highly productive ones. Regional convergence in productivity is therefore the outcome of economic growth. The fact that natural factors (like mineral deposits, transport conditions along rivers) are not the same everywhere can explain the concentrations of some industries. Empirical evidence does not support this theory unambiguously because one major result, regional convergence, is not observed everywhere. Policy conclusions derived from this model are that barriers to factor mobility should be removed, open access to markets should be guaranteed, and structural change should be facilitated. A necessary condition for an efficient flow of goods and services is an adequate transport and information infrastructure.

As the neoclassical growth theory, the endogenous growth theory also assumes that regional differences in productivity are due to differences in capital/labour ratios. But it takes account of the knowledge base and explains regional heterogeneity by different proportions of the workforce in knowledge producing industries. Technical change is considered to be subject to variations. Endogenous growth is a function of the number of persons working in human capital intensive industries (knowledge workers). Places with a large number of highly skilled workers benefit from concentration due to positive external effects of knowledge (Quigley, 2002). The development of regions with predominating low-tech industries depends on the ability to attract high-tech firms and high knowledge workers. Contrary to the neoclassical model, greater divergence may be an outcome of regional development. The more knowledge spillovers are localised, and the more knowledge workers move to leading technological regions the more productivity differences between regions will persist or even widen. Regions that have fallen behind will grow at slower rates or even lose population due to migration. Policy conclusions consistent with this model are that growth can be stimulated by investing in human capital and that knowledge spillovers are an additional growth stimulus. Evidence from Sweden where higher education policy has emphasized the spatial decentralization of post-secondary education suggests that there is a positive effect upon the average productivity of workers (Andersson et al., 2004).

The New Economic Geography is a relatively young branch of regional theory (Krugman, 1991). General equilibrium models are used to explain what factors lead to patterns of economic concentration similar to those that can be observed in the world. This theory attempts to discover factors that can explain why, for example, 19% of the French population live in the metropolitan area of Paris on 2,2% of the area of France and produce 30% of the national GDP. The same theory tries to explain why most of the population does not live in Paris.

Two important assumptions in such a model are technologies with increasing returns and imperfect competition. Spatial agglomeration (specialisation and clustering) is a source of externalities with increasing returns (due to knowledge spillovers and specialised suppliers). Factor flows and trade increase the tendency of spatial concentration of economic activities, leading to "core-periphery" equilibria of persisting regional differences in productivity (Fujita and Mori, 2005). Among the factors explaining such outcomes are transport costs, workers that are not equally mobile, and the fact that agglomeration allows specialised firms to attract workers with special skills. Producers of intermediate goods have an incentive to locate close to downstream industries where they have the largest market. Producers of final goods want to be close to their suppliers and close to high income consumers, those with high skills and high wages who work in specialised industries. However, agglomeration has not only benefits but also cost (e.g. congestions, high prices of land). Therefore centripetal and centrifugal forces are in balance and peripheral regions remain productive, however, at lower rates.

Highly stylised models of the New Economic Geography are capable of explaining economic phenomena which are relevant for agriculture. Murata (2005) showed that the theory is consistent with Engel's "law" (the demand shift from agricultural goods to other goods) and Petty's "law" (the reallocation of labour from agriculture to non-agricultural activities). The causes for such phenomena in Murata's model are 'substantial improvements in transportation technologies' which give rise to structural transformations that eventually 'create new varieties of manufactured goods'. Due to the complexity of the models of New Economic Geography there are only a few empirical studies that are specific to this theory (a survey is provided in Fujita and Mori, 2005). Empirical papers addressing various aspects of such models are difficult to compare (Head and Mayer, 2004). The existence of localised externalities and the limited geographical range of knowledge spillovers may be due to a range of factors. Owing to the lack of empirical findings, it is hard to derive concrete policy recommendations from the theory. Its value for policy analysis is identification of factors that matter in regional growth.

An alternative approach to describe the factors that have an influence on the productivity of regions is based on the analysis of clusters of firms and value chains (Bergman and Feser, 1999). Three recent studies (Munnich et al., 2002; Porter et al., 2004; and Feser and Isserman, 2005) used this approach to analyse U.S. rural regions. While Porter et al. (2004) did not account for the agricultural sector in rural areas; clusters that include agriculture and forestry are covered by the analysis of Feser and Isserman (2005).

Bergman and Feser (1999) see the value of the industry cluster concept in its capacity to assist analysts and policymakers to 'see the regional economy whole'. Industry cluster analysis is a comprehensive approach for understanding regional economic conditions and trends. Munnich et al. (2002) conclude that cluster analysis is an approach to learning from successful regional economies.

In their analysis of clusters in rural areas, Feser and Isserman (2005) aimed at separating two dimensions, the economic interrelationships between sectors and the geographical concentration of related sectors. They found that while rural economies specialise in natural resource- and agriculture-based economic clusters, they also play a significant role in a number of manufacturing and non-manufacturing clusters. According to their analysis, 14 of 15 geographic clusters of the motor vehicles value chain in the U.S. consist partly of rural and/or mixed rural counties. This result highlights the diversity of activities in rural counties. Agriculture and other resource based industries add only in a few clusters significantly to the value chains.

All three analyses on clusters in rural areas (Munnich, 2002; Porter et al., 2004; Feser and Isserman, 2005) draw the same conclusion: More research is necessary to better understand the determinants of rural economic performance. These conclusions suggest that the cluster approach has not yet provided sufficiently reliable results for well established policy conclusions (see also Martin and Sunley, 2003).

The long-run trends that the theoretical models imply are not simply of academic interest (Gardiner et al. 2004). The neoclassical model predicts that regional productivity (or GDP per person) should converge as integration proceeds. The endogenous growth and New Economic Geography models predict increasing regional specialisation and spatial concentration of economic activities. Convergence does not necessarily need to happen.

Empirical studies by Gardiner et al. (2004) on the process of convergence among regions in Europe provide non-conclusive results. Many low productivity regions have improved their relative position but the degree of convergence "has been disappointingly slow". Leonardi (2006) finds that the rate of convergence of the poorest regions (many of them rural ones) is acceptable and his results show that cohesion policy has "favoured the convergence of less-developed regions towards the EU mean." One conclusion of these findings is that policies aimed at improving regional productivity may work but there is no guarantee that the objective will be achieved quickly or at all.

2.4. The role of rural regions in countries and the role of agriculture for rural development – evidence from OECD and EU countries

Rural regions are characterised by remoteness and low population density. The OECD has developed a classification that takes account of both attributes (see definition in the Annex). This classification differentiates between predominantly rural, predominantly urban, and intermediate regions and is used in the remainder of this sub-chapter (most of the data presented are from 2001). By taking other attributes, adding more of them or delineating regions in another way, rural regions can be defined differently (an example is the ESPON classification; Bengs and Schmidt-Thomé, 2005). Therefore it should be kept in mind that "rural regions" according to one classification are sometimes 'non-rural regions' according to another classification. Depending on the territorial level, not all types of regions (predominantly rural, predominantly urban and intermediate) are present in all OECD countries. At a higher aggregated territorial level, there are no predominantly rural regions in the Netherlands, in Ireland no intermediate regions, in Canada no urban regions, and in Luxembourg there are only intermediate regions. In the remainder of this sub-chapter data will be presented that are based on the territorial definition of the OECD, however the terms "rural" and "urban" will be used instead of "predominantly rural" and "predominantly urban".

Statistics at the country level (Figure 2) show that the contribution of agriculture to national incomes (GDP) is relatively small in most OECD countries. The share of GDP of the food processing sector is similar to that of agriculture (on average agriculture accounts for 2% of GDP, food processing for 1.9%) in many countries. In almost all OECD countries the share of the agricultural workforce is larger than the share of GDP. Large discrepancies can be seen in Austria, Japan, Mexico, Poland and Turkey.

In OECD countries rural regions account for 13% of GDP, urban regions for 43% and intermediate regions for 44% (Table 3). In many small OECD countries rural regions contribute significantly larger shares to national GDP (Ireland and the Scandinavian countries). In two countries, Ireland and Finland, halve of national GDP is generated in rural regions (Figure 2). Austria is among the countries with rural regions contributing a large share of national GDP. In Table 1 the rate of regional growth within OECD countries differentiated according to the territorial units is provided.

The figures show that in most countries predominantly urban regions are those with the highest growth rates. This implies that predominantly rural regions are lagging behind. Austria is among the very few countries in which predominantly rural regions have been growing faster than the other regions during 1995 and 2003. Some explanations for this finding are provided in the last chapter of this analysis.

Table 2 shows basic statistics of the agricultural sector in OECD countries. The agricultural sector plays only a minor role in most countries as far as its share of GDP is concerned. The fact that a relative low share of GDP is combined with a relative high share of employment in all OECD countries indicates that value added per employed person in the agricultural sector is lower than the average in the economies.

In almost all OECD countries the level of GDP per person in rural regions is below the country average. In almost all countries, rural GDP is below average (Table 3). This does not necessarily mean that people living in rural regions are worse off, because they may have lower expenditures for the same standard of living. In OECD countries, 20% of the population, 19% of the labour force and 23% of unemployed persons live in predominantly rural regions. A lower level of labour market participation and a higher rate of unemployment (Table 3) are among the explanations why the regional per capita GDP is lower in predominantly rural areas than in other regions.

However, demographic factors, labour market participation and unemployment are not sufficient to explain why rural regions are lagging in many OECD countries. The following factors have an important influence on productivity: skills, infrastructure and — based on theoretical considerations — spillovers due to agglomeration. Analyses suggest that in several OECD countries agglomeration benefits are statistically significant (OECD, 2005).

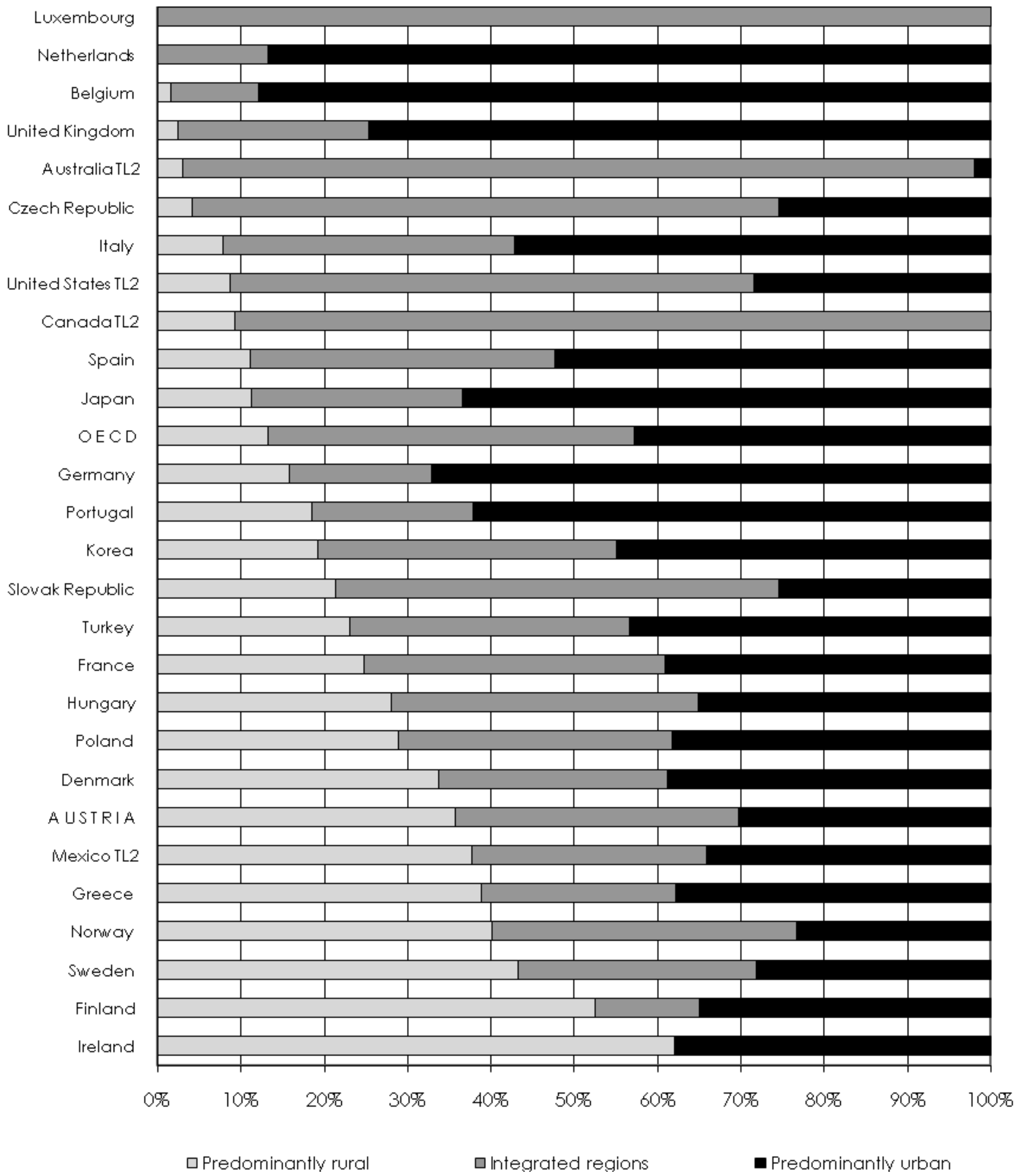

Figure 2: Territorial distribution of gross domestic product in OECD countries

Source: OECD, 2005a
Note: A definition of "predominantly rural", "integrated" and "predominantly urban" is provided in the Appendix.

Table 1: Average annual growth in % between 1995 and 2003 in predominantly urban, integrated and predominantly rural regions in the EU

Member States	predominantly urban regions	integrated regions	predominantly rural regions	all regions
EU 27	–	–	–	–
EU 25[2])	**+ 4.9**	+ 4.9	+ 4.5	+ 4.8
EU 15[2])	**+ 4.8**	+ 4.7	+ 4.2	+ 4.7
New Member States 10	**+ 9.2**	+ 8.4	+ 7.9	+ 8.5
Belgium	**+ 3.0**	+ 2.9	+ 2.8	+ 3.0
Czeck Republik	**+ 9.4**	+ 8.0	+ 9.3	+ 8.3
Denmark	**+ 4.4**	+ 3.9	+ 3.5	+ 3.9
Germany[2])	+ 1.4	+ 1.9	**+ 1.9**	+ 1.6
Estland	+ 10.4	**+ 14.4**	+ 12.4	+ 13.9
Greece	+ 6.8	**+ 7.4**	+ 6.4	+ 6.8
Spain	+ 7.0	**+ 7.1**	+ 5.9	+ 6.9
France	**+ 3.7**	+ 3.5	+ 3.4	+ 3.5
Ireland	**+ 13.3**	–	+ 13.3	+ 13.3
Italy	+ 5.6	**+ 5.8**	+ 5.5	+ 5.6
Cyprus	–	**+ 6.6**	–	+ 6.6
Latvia	**+ 13.2**	+ 12.5	+ 13.1	+ 13.0
Lithuania	–	**+ 17.8**	+ 13.6	+ 16.3
Luxemburg	–	**+ 6.3**	–	+ 6.3
Hungary	+ 10.3	**+ 11.3**	+ 8.5	+ 10.0
Malta	**+ 7.1**	–	–	+ 7.1
Netherlands	**+ 5.1**	+ 4.9	+ 4.8	+ 5.1
Austria	+ 2.7	+ 2.5	**+ 2.9**	+ 2.7
Poland	**+ 8.7**	+ 6.7	+ 7.4	+ 7.6
Portugal	+ 5.8	**+ 6.3**	+ 5.6	+ 5.9
Slovenia	–	**+ 6.5**	+ 5.7	+ 6.1
Slowakia	+ 8.9	+ 8.6	**+ 9.0**	+ 8.7
Finland	–	**+ 5.8**	+ 4.1	+ 4.9
Sweden	–	**+ 5.5**	+ 3.7	+ 4.4
United Kingdom	**+ 8.2**	+ 7.4	+ 6.3	+ 7.9
Bulgaria	**+ 9.4**	+ 6.5	+ 6.7	+ 7.4
Romania[1])	+ 0.0	+ 0.0	+ 0.0	+ 0.0

Source: Eurostat, NewCronos-Database, retrieved on 6.9.2006; EC, DG Agriculture, Rural Development in the European Union, Statistical and Economic Information, Report 2006, Bruxelles, 2006;
Notes: [1]) Between 1995 and 1998 several NUTS-Regions were missing. The assumption was made that during this period the regional share did not change within the countries under consideration.
[2]) In Germany: without regions with missing data.

Table 2: Main agricultural indicators for OECD countries in per cent

	Agriculture in GDP	Food processing in GDP	Agriculture in total civilian employment	Food processing in total civilian employment	Agriculture commodities in total exports	Agriculture processed products in total exp.	Agriculture commodities in total imports	Agriculture processed products in total imports	Food in total consumer expenditures	EAA share of NCOs relative to COs
Australia	3.4	.	4.0	2.1	12.7	4.2	1.3	2.8	10.5	
Austria *)	1.3	1.1	4.9	.	.	.	.	.	.	11.5
Belgium *)	1.0	0.8	.	.	.	.	.	.	.	1.2
Canada	2.3	2.0	2.9	1.6	3.9	2.2	2.9	2.7	9.9	
Czech Republic	2.8	3.5	4.5	2.6	1.4	1.7	2.2	2.2	17.5	4.4
Denmark *)	1.6	1.5	.	.	.	.	.	.	.	6.6
Finland *)	1.0	0.8	.	.	.	.	.	.	.	10.5
France *)	2.0	1.7	3.8	.	.	.	.	.	.	8.8
Germany *)	0.8	0.8	.	.	.	.	.	.	.	4.2
Greece *)	5.3	4.2	14.9	.	.	.	.	.	.	8.9
Hungary	3.3	3.2	5.6	3.3	4.8	2.3	1.6	1.5	19.0	11.7
Iceland	9.2	.	3.9	7.8	0.7	0.2	2.4	5.0	14.1	
Ireland	2.1	1.6	.	.	.	.	.	.	.	
Italy *)	2.3	2.0	4.8	.	.	.	.	.	.	7.8
Japan	1.3	2.3	4.6	2.8	0.0	0.2	5.7	2.5	14.4	
Korea	3.6	2.7	8.8	1.4	0.2	0.5	3.1	1.2	14.2	
Luxembourg *)	0.5	0.4	.	.	.	.	.	.	.	6.3
Mexico	3.8	5.0	15.8	4.1	3.0	2.3	4.6	2.3	21.1	
Netherlands *)	1.9	1.5	3.0	.	.	.	.	.	.	13.6
New Zealand	8.7	.	8.1	3.8	37.3	5.6	3.0	4.6	16.7	
Norway	1.4	1.5	3.7	2.4	0.3	0.3	2.8	3.2	12.5	
OECD	2.0	1.9	6.1	1.7	3.6	2.7	3.5	2.7	10.7	
Poland	3.0	3.6	18.4	3.4	3.7	3.6	2.4	2.4	19.4	4.1
Portugal *)	2.4	2.0	.	.	.	.	.	.	.	5.5
Slovak Republic	4.0	4.0	5.8	.	1.3	1.6	1.9	2.2	21.1	13.9
Spain *)	3.6	2.8	5.7	.	.	.	.	.	.	
Sweden *)	0.7	0.5	.	.	.	.	.	.	.	10.1
Switzerland	1.3	.	4.1	1.6	0.6	1.6	2.5	3.0	11.0	3.9
Turkey	11.9	4.8	33.8	.	4.5	4.6	2.2	1.5	.	
United Kingdom *)	0.7	0.6	.	.	.	.	.	.	.	11.4
United States	1.6	1.3	1.7	1.2	5.4	1.8	1.5	2.1	6.1	
EU-15	2.0	2.1	3.8	2.4	3.8	3.6	4.3	3.2	12.6	

Source: OECD, 2005a

Notes: *) Own calculations based on EUROSTAT New Cronos; employment measured in full time equivalents; EAA (economic accounts of agriculture) share of NCOs (non-commodity outputs) relative to COs (commodity outputs) measures the sum of 'secondary activities (inseperable), item 17000' and 'agricultural services output, item 15000' relative to 'agricultural goods, item 14000'.

***) % per cent of agriculture in GDP: National accounts gross value added for agriculture forestry and hunting as a percentage of Total Gross Domestic Product.*

Table 3: Regional GDP population, labour force and unemployment in OECD countries in per cent

Subregion	Distribution of GDP share of subregions relative to whole country			Population	Unemployment	Labour force	Per capita GDP
				in rural regions share of rural regions			relative to country
	pred. rural	pred. urban	integrated				
	1	2	3	4	5	6	7
Australia	3	2	95	24	25	22	86
Austria	36	30	34	46	42	44	77
Belgium	2	88	11	2	2	2	70
Canada	9	0	91	30	36	28	83
Czech Republic	4	25	70	5	4	5	82
Denmark	34	39	27	39	43	40	87
Finland	53	35	13	62	88	60	84
France	25	39	36	31	28	30	79
Germany	16	67	17	20	25	20	81
Greece	39	38	23	40	34	37	96
Hungary	28	35	37	39	49	37	72
Iceland	.	.	.	38	43	38	.
Ireland	62	38	0	71	75	68	88
Italy	8	57	35	10	10	9	83
Japan	11	63	25	13	11	13	87
Korea	19	45	36	17	12	19	111
Luxembourg	0	0	100	.	.	.	.
Mexico	38	34	28	37	29	34	80
Netherlands	0	87	13	.	.	.	.
New Zealand	.	.	.	.	.	.	.
Norway	40	23	37	50	50	48	81
OECD	13	43	44	20	23	19	69
Poland	29	38	33	38	56	50	76
Portugal	19	62	19	25	24	22	73
Slovak Republic	21	25	53	26	29	14	84
Spain	11	52	37	14	15	13	78
Sweden	43	28	29	50	54	49	87
Switzerland	.	.	.	6	47	6	.
Turkey	23	43	34	32	28	36	73
United Kingdom	3	75	23	4	5	4	68
United States	9	28	63	12	13	11	82

Source: OECD, 2005a, Tables 3 (col. 1-3), 1.4 (col. 4), 3.3 (col. 5), 4.3 (col. 6), 11.8 (col. 7).
Notes: pred. rural - predominantly rural, pred. urban - predominantly urban;

Table 4: Level of education, relative labour productivity and unemployment and share of agricultural workforce in rural regions in per cent

Subregion	Distribution of population by levels of education in rural regions				Labour productivity	Unemployment	Agricultural workforce
	tertiary	primary	secondary	tertiary	share of national level		share of total workforce
	share of whole country	share within pred. rural regions			in pred. rural regions		in pred. rural regions
	1	2	3	4	5	6	7
Australia	15	49	39	12	101	98	13
Austria	.	.	.	.	85	105	10
Belgium	2	42	32	26	89	84	6
Canada	23	29	40	31	102	108	10
Czech Republic	4	25	65	10	85	89	12
Denmark	30	33	47	20	92	107	6
Finland	55	29	42	28	92	104	9
France	23	35	51	14	83	96	7
Germany	9	19	62	19	82	122	5
Greece	25	61	27	12	109	97	30
Hungary	36	50	41	9	79	118	11
Iceland	.	.	.	.	.	112	0
Ireland	45	44	41	15	93	104	11
Italy	5	59	32	9	91	120	9
Japan	15	22	55	24	84	91	11
Korea	12	78	8	13	115	70	.
Luxembourg	.	.	.	.	.	.	.
Mexico	20	82	11	7	90	94	30
Netherlands	0	.	.	.	.	.	.
New Zealand	2	32	57	10	.	.	.
Norway	39	17	60	23	90	103	5
OECD	20	40	43	17	83	102	.
Poland	28	36	56	8	82	113	37
Portugal	24	74	17	9	85	108	25
Slovak Republic	11	19	69	12	92	115	9
Spain	12	33	46	21	87	97	17
Sweden	29	21	57	21	91	102	4
Switzerland	0	19	54	27	.	79	.
Turkey	17	77	15	8	64	84	64
United Kingdom	12	19	51	30	70	101	12
United States	11	11	64	25	64	105	4

Source: OECD, 2005a Tables 6.3 (col. 1), 6.8 (col. 2,3,4), 12.5, 12.6, 12.7 (col. 5; unweighted averages), 13.5, 13.6, and 13.7 (col. 6; unweighted averages); own estimates based on OECD Territorial Database and ST.AT (for Austria) in col. 7.

Notes: In Australia 15% of the population has a tertiary education; in predominantly rural regions in Austrialia 12% of the population has a tertiary education; labour productivity is 1 percentage point higher and unemployment is 2 percentage points lower in predominantly rural regions than in the whole country.

Table 5: Regional growth in OECD countries between 1996 – 2001 in per cent

Subregion	Average population growth 1996-2001			Average annual growth rate of GDP 1996-2001			GDP growth of fastest growing regions 1996-2001		
	pred. rural	pred. urban	integrated	pred. rural	pred. urban	integrated	pred. rural	pred. urban	integrated
	1	2	3	4	5	6	7	8	9
Australia*)	0.6	1.3	1.4	3.0	3.5	3.6	7.2	3.5	3.9
Austria	0.3	0.2	0.0	2.8	1.9	2.6	4.1	3.1	4.3
Belgium	0.6	0.2	0.2	1.9	2.7	1.9	1.9	5.0	2.6
Canada*)	0.1	1.3	0.4	3.1	0.0	4.3	6.7	0.0	7.3
Czech Republic	-0.2	-0.7	-0.1	2.3	6.4	1.1	2.3	6.4	4.1
Denmark	0.2	0.5	0.4	1.9	3.1	2.4	2.4	3.7	3.4
Finland	-0.1	1.3	0.2	3.0	5.8	4.4	5.2	5.8	5.4
France	0.3	0.3	0.5	2.4	3.2	2.9	4.9	5.9	4.5
Germany	-0.1	0.2	0.0	1.8	1.8	1.8	2.9	4.0	2.8
Greece	0.0	1.1	0.6	3.4	4.4	3.5	5.8	4.4	3.6
Hungary	0.2	-1.6	0.5	3.2	4.9	5.3	4.8	4.9	9.2
Iceland*)	-0.3	.	2.0	.	.	4.5	.	0.0	4.5
Ireland	1.1	1.2	.	9.6	9.2	.	11.7	9.2	0.0
Italy	0.0	0.3	0.1	1.9	2.2	1.9	4.1	3.2	3.3
Japan	-0.1	0.4	0.1	0.1	0.2	-0.1	1.1	1.1	1.4
Korea	0.0	0.2	2.4	4.4	2.3	8.2	7.2	5.4	11.1
Luxembourg	.	.	1.2	.	.	6.7	.	.	6.7
Mexico*)	1.0	1.6	1.3	3.9	4.2	5.3	7.2	6.5	9.4
Netherlands	.	0.6	1.0	.	3.5	2.6	.	4.5	6.7
New Zealand	.	1.3	0.2	.	.	.	.	.	.
Norway	0.3	0.8	1.0	-0.3	3.6	1.5	2.1	3.6	2.1
OECD	0.2	0.6	0.7	2.8	3.8	3.5	11.7	10.0	11.1
Poland	0.1	-0.4	0.1	4.9	6.2	4.9	8.1	10.0	10.1
Portugal	-0.2	0.6	1.3	2.8	3.4	4.3	4.8	4.2	5.8
Slovak Republic	-0.1	-0.7	0.2	3.0	4.0	2.9	3.4	4.0	4.3
Spain	0.0	0.5	0.5	2.8	4.1	3.9	3.8	5.6	5.7
Sweden	-0.3	1.0	0.2	1.7	4.7	4.0	4.3	4.7	4.2
Switzerland	0.1	0.7	0.4	.	.	.	.	.	.
Turkey	1.2	2.8	1.6	3.7	3.7	3.2	7.6	4.8	5.8
United Kingdom	0.4	0.1	0.4	0.6	3.4	2.0	3.7	7.9	5.9
United States*)	0.5	1.2	1.3	2.4	3.7	4.0	3.8	5.1	6.3

Source: OECD, 2005a, Tables 7.8 (col. 1,2,3), 8.8 (col. 4,5,6), 8.9 (col. 7,8,9). Note: In Australia the average growth rate of GDP in predominantly rural regions was 3.0% (col. 4), in the predominantly rural region with the highest growth rate, it was 7.2% (col. 7).

Notes: *) GDP growth measured at a higher aggregated territorial level than in the other countries.

A consequence of these agglomeration effects is that productivity in predominantly rural regions is below the country average in most OECD countries (Table 3). The relevance of human capital to development and growth emphasises the role of education in today's knowledge-based economies. Skills are generally measured in terms of attainment of tertiary level education (including university-level education from courses of short and medium duration to advanced research qualification). In 2001, from a working-age population of about 770 million, about 150 million, or about 19%, had a tertiary-level qualification. In most OECD countries people with high skill levels are concentrated living in predominantly urban regions and the relative share in predominantly rural regions is smaller compared to the share of labour force (Table 3). In countries like Finland, Canada and Belgium the shares of population in predominantly rural areas with tertiary education is high compared with the shares in other OECD countries (Table 3).

The share of the agricultural workforce in predominantly rural regions has been declining steadily in all OECD countries for which data are available (Bollman, 2006). Even in predominantly rural areas the share of agriculture in total employment is relatively low (Table 4; see also Figure 1 in Bollman, 2006). In most OECD countries, however, more than 50% of the workforce in agriculture is located in predominantly rural regions (Figure 2 in Bollman, 2006).

Population is growing in all types of regions, but predominantly rural regions are not developing in the same way in all OECD countries. In certain countries (Austria, Belgium, United Kingdom) population growth in predominantly rural regions is positive and higher than in the other regions (Table 5). In some countries, the rural population is declining in some regions while it is growing in others (in Scandinavian and Eastern European countries).

In some countries, the GDP of intermediate and some rural regions is growing considerably faster than in urban regions (Table 5). Therefore, not all rural regions are trapped in a low-growth path. Even if agglomeration economies are low in intermediate and rural regions, the growth potential of these regions remains significant.

OECD territorial indicators and results presented by Bollman (2006) indicate that rural regions are very important in many OECD countries. In some countries, rural population is declining and rural GDP growth is generally lower than in other regions. To attribute this solely to the decline of agriculture does not seem to be justified because in some countries rural regions grow faster even if the share of agriculture is declining.

For some OECD countries in the EU, sufficient data are available to compare growth rates of the agricultural gross value added (GVA) in rural areas with (nominal) growth rates of rural GDP. Comparing growth rates of nominal agricultural GVA and the respective regional GDP between 1995 and 2003 in 328 rural regions gives the following result (Figure 3):

- agricultural GVA grows and GDP of rural regions grows: 55% of all regions;
- agricultural GVA grows and GDP of rural regions declines: <1% of all regions;
- agricultural GVA declines and GDP of rural regions grows: 42% of all regions;
- agricultural GVA declines and GDP of rural regions declines: <1% of all regions.

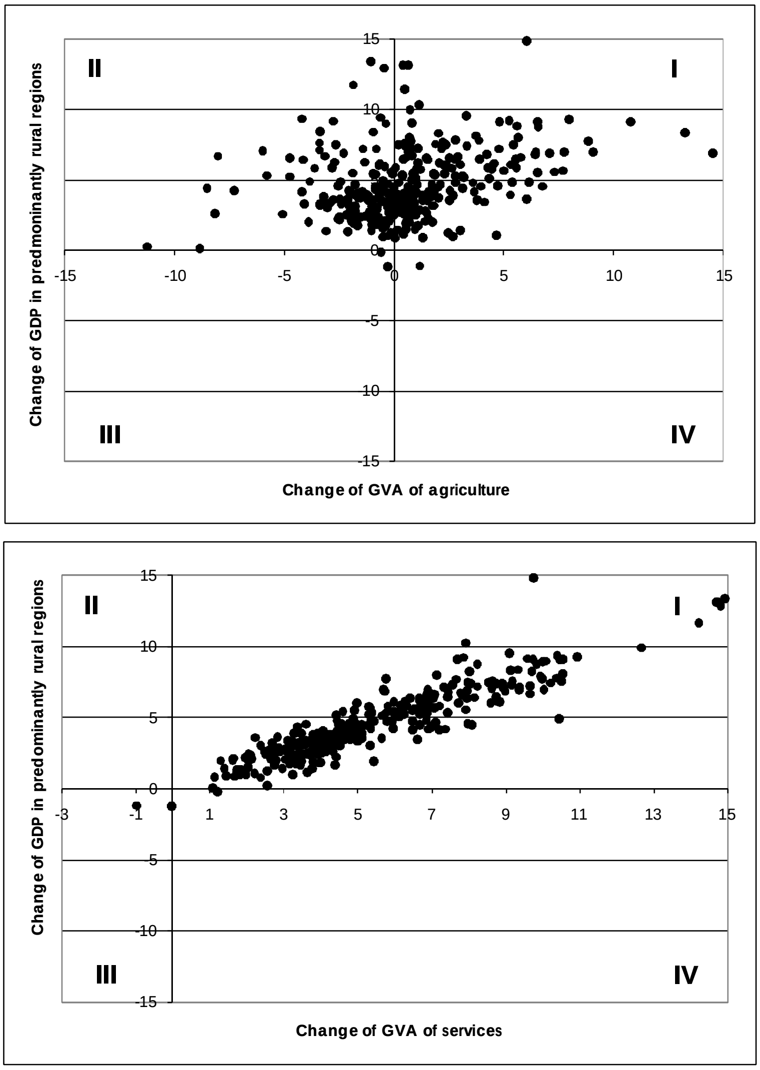

Figure 3: *Rates of growth of gross value added of agriculture, services and GDP in rural regions of the EU countries which are members of OECD*

Source: Own calculations based on nominal regional GVA and GDP data from Eurostat New Cronos, 2008.
Notes: In quadrant II there are regions with declining agricultural gross value added (GVA) and increasing regional GDP; in quadrant I are regions with increasing agricultural GVA and increasing regional GDP; in quadrant IV are regions with increasing agricultural GVA and decreasing regional GDP; in quadrant III are regions with decreasing agricultural GVA and decreasing regional GDP.

Agriculture is more important in predominantly rural regions than in intermediate and predominantly urban regions, but its share has been declining even in most rural regions. They are now characterized by activities of industry or the service sector. Nevertheless, effects of the farm population on regional viability seem to be most important in rural regions. Regional productivity is generally low in regions with a relatively high share of agricultural workforce. In a static framework, farm employment in such regions is therefore important and indicates that jointness matters but it is hard to quantify the degree of jointness at aggregate levels.

Statistics from OECD countries show that in a dynamic context many rural regions grow even if the share of agriculture is low. In EU member states rural regions in which agriculture is declining have high positive regional growth rates. According to the OECD framework (OECD, 2003) this is evidence of weak jointness, at least for the observed regions.

Regional growth is definitively positively affected by growing agricultural output because it is an element of overall output. How much agriculture is contributing to rural growth due to NCOs cannot be measured by comparing the performance of rural regions alone because many factors have an influence on growth differentials. But a declining farm sector does not prevent growth in many regions. Therefore, NCOs of agriculture do not seem to be a necessary condition for economic growth in rural regions.

2.5. Evidence of non commodity outputs of agriculture relevant for rural development

2.5.1. Direct and indirect growth drivers

A model of regional growth and competitiveness was presented in Figure1. Elements influencing the target outcomes (quality of life, standard of living of the population) can be differentiated into two categories:

- Effects via direct channels show up directly in indicators of the revealed competitiveness of regions. Some of them are due to pecuniary externalities. Activities in the market place of agricultural firms have consequences on other firms (increasing or lowering profits via price effects). From a welfare economic point of view, market outcomes need not be corrected if pecuniary externalities are present. Unlike technological externalities, they do not misallocate resources and are necessary for the market to work efficiently (Holcombe and Sobel, 2001).
- Effects via indirect channels that can be identified to exist but their significance is frequently not (yet) known in quantitative terms. They are consequences of either positive or negative technological external effects. Some authors claim that there are additional indirect effects that go beyond the concept of external effects.

The next two sub-chapters are organized according to this differentiation.

2.5.2. Non-commodity outputs affecting regional performance via direct channels

Several elements to measure regional performance are well covered in standard statistics:

- agricultural population and agricultural workforce;
- agricultural products in an input-output context;
- non-agricultural products provided by agriculture.

In the general literature on agricultural multifunctionality, these elements were identified to be related to NCOs of agriculture. The population of agricultural households and farm labour is measured in censuses in many countries. The share of agriculture in the workforce of OECD countries is provided in Table 1.

According to the OECD definition of multifunctionality, agricultural employment has potential positive effects on rural viability. However, NCOs related to population do not fit well into the conceptual framework. Farm labour is an input and cannot be viewed as a non-commodity output (OECD, 2002). Several potentially positive NCOs related to rural population were suggested to exist: lower congestion and pollution compared to urban centres and lower average cost of rural infrastructure (OECD, 2003; see also Abler, 2001 and Smith, 2006).

Viability of rural areas can also be defined in broader terms related to the "attractiveness" of life in rural areas. According to OECD (2001) income generation and the presence of rural amenities are frequently associated with the notion of rural viability. Some authors use rural viability in such a broad sense and claim that there are more types of potential NCOs associated with farm population that go beyond farm employment. According to their view:

- small farms tend to use more products provided by small local providers (Harrison, 1993);
- small farms use more labour per unit output (demonstrated for dairy farms by Flaten, 2002) and
- the same is true for organic farms (Fasterding and Rixen, 2005);
- in some countries farm families have more children than other families and therefore the farming community contributes to society in an over-proportional way (Mann and Erding, 2005, analyse the Swiss case); rural areas therefore can provide employees for high wage urban-oriented industries (Isserman, 2001).

Agriculture was defined above as producing commodities (food and fibre). It buys materials and services from the input providers, and supplies outputs to downstream industries as well. These relationships are recorded in input-output tables which are available for most OECD countries. Several studies refer to such statistics to quantify the importance of the agricultural sector:

- In a survey undertaken by OECD on evidence of jointness between commodity and non-commodity outputs, several country reports referred to the role of the agricultural sector for downstream and upstream industries (surveyed in Abler, 2001). The impact of agricultural production on other industries can be measured by input-output coefficients and inverse coefficients which measure the multiplier effects of changing outputs. A full accounting of all those linkages shows that agriculture is directly or indirectly responsible for about 23% of employment in non-metropolitan US counties (Gale, 2000).
- For the evaluation of regional policies input-output models have been developed for several regions (Ciobanu, 2004; Mattas et al., 2006 and Psaltopoulos et al., 2006). Such analyses show the consequences of different policies on the sector in question and its

upstream and downstream industries, but also on all other sectors (including households).

Many farms produce not only farm commodities for the market but other products as well. Among these outputs are food which is processed on farm like cheese or oil (examples from Norway are presented by Lyssandtræ, 2006) and services for elderly persons or persons with special needs, community services, or transport and machinery services for other farms or firms in the region and farm tourism (e.g. Park, 2006 for related activities in Korea). In many countries, the value of these outputs and services is measured by the economic accounts of agriculture (EAA). In some countries these outputs are more than 10% of the value of commodity outputs (see last column in Table 2).

2.5.3. Non-commodity outputs affecting regional performance via indirect channels

Agriculture generates environmental benefits that are well documented but not systematically measured. Since many studies have been carried out in this field and methodological advances have been made, the range of values of agricultural landscape attributes is well known (an extensive recent survey on valuation studies is provided in Idda et al., 2005). Open landscape is particularly highly valued close to metropolitan areas (Boulanger, 2004). Providing access to land (Marsden et al., 2002) is an important precondition for the consumption of such environmental benefits and countries have different rules on access to open land. Therefore not only the output levels and technology determine the agricultural NCOs, but also institutional arrangements and property rights matter.

Environmental amenities provided by agriculture as well as services related to flood prevention (Nakashima, 2001) are directly consumed by residents and visitors of rural regions. The rural population grows if more people become residents attracted by the amenities of cultural landscape — consequently indirect channels of NCOs have measurable outcomes. In such cases positive external technological effects are causing the social benefits. When technological external effects are present, markets do not provide the price signals reflecting social opportunity costs. Policy intervention may enhance resource allocation in such situations.

The agricultural community and other inhabitants of rural areas are considered to contribute to rural growth via additional indirect channels which seem to go beyond the concept of external effects:

- the social capital of rural societies (Léon, 2005 and Mugler et al., 2006);
- the cultural heritage and traditional villages and architecture (Hediger, 2004 and Ohe, 2004);
- the territorial image of regions (Vollet, 2006);
- the social coherence of their communities and their traditional activities (Lim, 2005; Saika, 2006; Mann and Wüstemann 2005).

During the last ten years, the concept of social capital has been an ever expanding field of social science research. It has been used to explain a wide range of phenomena (political participation, institutional performance, health, corruption, performance of public services) and was found to be an explanation for regional growth (Helliwell and Putnam, 1995). Most analyses which focus on agriculture and rural social capital are dealing with developing economies and countries in transition. How agriculture contributes to the social capital in OECD countries is therefore not yet well understood. One reason for such a lack of evidence could be that measuring "social capital" is very difficult (Durlauf, 2002; Sabatini, 2006).

Two proposals are found in the economic literature to evaluate the benefits the society gains from agricultural NCOs. In both proposals, the authors suggest taking all elements together and identifying the value of a bundle of NCOs. The first approach is to consider that existing farming systems are formed by farm policies based on deliberate public choices as opposed to measure the value in monetary terms. For the case of Switzerland, Mann and Wüstemann (2005) reported on a referendum of a farm bill in 1996 as an example of public valuation. An alternative to referenda are valuation studies similar to those carried out by Bennet et al. (2004). They estimate a willingness to pay for the maintenance of rural population levels in Australia by employing methods to measure environmental benefits. They did not distinguish between farmers and other citizens in remote areas and therefore the NCOs related to Australian agriculture are unknown.

2.6. Evaluation of the degree of jointness between agricultural production and non-commodity outputs that contribute to rural viability and rural development

2.6.1. Non-commodity outputs affecting regional performance via direct channels

In OECD countries, the share of the agricultural population has been declining over the last decade, while the economies as a whole have been growing. Most rural regions in these countries have a growing population, although there are several rural regions where the population, and particularly the agricultural population, is declining.

This problem is not associated with the agricultural sector alone. The number of people living in a specific region will determine the average cost of infrastructure services. Thus, where there is a declining population, the people who use existing infrastructure will have to pay higher costs per user if costs have to be borne by the population in the region. Concerning infrastructure, it is necessary to distinguish between investment costs and maintenance expenses. Investments for infrastructure such as streets, sewers, or telephones should be treated as sunk costs once the infrastructure is finished. They should not be accounted for in decision-making and therefore it is not economical to attract more people into regions to lower the average sunk costs of existing infrastructure. Preventing the population from dropping below a certain minimum is only relevant for maintenance expenses. Statistics on maintenance costs of infrastructure in rural areas at OECD level are not available.

There are several options to prevent certain services being shut down in rural areas. One is to increase competitiveness and review potential limitations on businesses (e.g. the operation of postal services by monopolies). Community services can be provided collaboratively by co-operation between villages and not necessarily by each village. Such strategies help to keep average maintenance cost down.

Is there a benefit if people from rural areas do not move to urban centres and contribute to the problems of metropolitan areas (negative environmental effects, congestion)? To answer that question it would be necessary to estimate net welfare losses because residents in rural areas generate externalities as well. The first best approach to address environmental problems and congestion is to internalise external cost (by taxes or regulations). According to the theoretical models presented above, such a strategy can make rural areas more attractive because it introduces friction in the process of agglomeration. However, unintended side-effects may also result.

Equity concerns during the phase of policy reforms have to be considered as well. Blekesaune (2001) analyses such a scenario in Norway. He concludes that "if the subsidies are going to be more orientated to payments for rural settlement and landscape care, and less orientated towards farm production, it is more likely that farmers in urban areas will derive benefit from this arrangement because they are more likely to maintain farming." He also mentions that specific regulations of the land market aggravate the problem of rural depopulation. Brunstad et al. (2005) analyse the same situation not from a sector specific perspective but in a general equilibrium framework. Their suggestion is to address multifunctionality attributes with targeted instruments that focus on specific problems that may vary between rural regions. Using such instruments, equity concerns can be directly addressed.

2.6.2. Agriculture as a supplier for downstream industries

Is agriculture contributing to rural viability because of the production effects in upstream and downstream industries? Multiplier effects clearly indicate that this is the case. But in a dynamic context upstream and downstream linkages cannot be used as an argument to justify the maintenance of a given output level of an industry. As the I-O import tables of most countries show, domestic food processors use a considerable amount of imported farm commodities to produce food and other products.

In a dynamic context, food processors would expand the share of imported commodities if there were fewer domestic supplies. The example of Austria shows how fast and flexibly firms adjust to new situations (Hofreither et al., 2006). After Austria's accession to the EU in 1995, prices of agricultural commodities dropped by 21%. Austrian firms in the food processing could buy agricultural inputs much cheaper and became more competitive because they also could choose between a larger variety of inputs. Ten years later, the value added in the food industry has increased considerably and employment levels are rising again after a transition period of several years. However, the transition was not successful in every case. The fact that ten percent of firms in the downstream sector had to close shows that there were not only winners. However, the remaining firms are now more competitive and have better business opportunities.

2.6.3. Non-commodity outputs sold on the market

In many cases agricultural enterprises produce not only food and fibre but also services. Some of them are directly linked to farming (e.g. machinery services for other farms), many others are not (e.g. farm tourism). Economies of scope can be an explanation for the fact that farmers offer such services. Economies of scope arise when a single firm can produce two outputs cheaper compared to a situation in which each output is produced by two separate firms. They can arise when indivisible inputs are used in the production of more than one good.

Community services which can be carried out with farm machinery (like clearing streets of snow in winter) give rise to economies of scope because fixed costs can be spread over more services. In this particular case, farmers are competing with firms from other sectors with adequate machines (like trucks) which are not operated at full capacity during winter. In many cases farmers are owners and operators and therefore can supply these services very flexibly and probably cheaper if they need not to hire workers. Communities in rural areas definitely benefit if they get the service cheaper.

Many consumers have a preference for goods and services which are provided by local farmers. Farm tourism and food processed on farms are typical examples (several case studies are provided in OECD, 2005b). The production of such goods and services is typically on a small scale. Many consumers prefer this to industrial products. Unit production costs are relatively high because of scale economies. Nevertheless many consumers are paying the premium price for the attribute "made on a small farm." One important reason why consumers pay premium prices is that they can directly check the credibility of the attribute either because of direct sales or – in the case of farm tourism – because the good is consumed where it is produced.

Many farmers produce commodities and highly differentiated products, because of economies of scope. If farming is no longer profitable this may disrupt the other business as well, farm tourism can only be offered as long as a farm is operated. Closing the farm and giving up both product lines is only one alternative. The other is to expand the branch with the highest margin and the best opportunities to reap economies of scale. This actually happened in many tourist regions in Alpine regions in Austria, where many hotels emerged from farms.

2.6.4. Non-commodity outputs affecting regional performance via indirect channels

It is very hard to quantify the factors which are at the basis of the pyramid of regional competitiveness (see Figure1). We know very little on how social capital, regional culture, social structure and the other factors contribute to the economic performance of regions. To quantify these factors is very difficult in any region, not only in rural regions. The question therefore is whether it is worthwhile to analyse the factors that affect rural growth with a special view on agriculture.

Concerning environmental amenities which are linked to the production of agricultural commodities, it seems worthwhile to promote research with an agricultural focus, because we know relatively little about how institutional arrangements can contribute to the stimulation of these outputs and the technology of providing landscape amenities separate from agricultural outputs (e.g. the case studies on tourism in OECD, 2005c).

Concerning the other elements listed above, it is necessary to increase the knowledge as well. However, it does not seem promising to focus on agricultural NCOs alone because the whole rural population (including non-farm households, small medium sized firms, and local non-governmental groups) has some spillovers to other agents in the region and on the well-being of rural communities.

In a comparison of successful communities versus less successful ones, Mugler et al. (2006) found some factors which contribute to fostering job creation and growth in rural communities: adequate infrastructure, good governance of regional policy, accountability of local public decision-makers, a climate of competition and innovation, no subsidies for the prolongation of uncompetitive operations, local institutions for the creation of trust and networks, and a unique regional vision which allows firms to differentiate their traded products. Some of these factors are just good governance, others are very closely related to the NCOs discussed above. Using such studies and approaches like those proposed by Feser and Isserman (2005) or Porter et al. (2004) may contribute to a deeper understanding of NCOs in rural communities.

2.7. Concluding remarks on rural viability, rural development and agricultural multifunctionality

Rural viability and rural development are considered to be one of the major elements of agricultural multifunctionality. In this chapter an attempt was made to apply the method developed by the OECD to evaluate the degree of jointness between agriculture and elements that contribute to rural viability and rural development.

Theory of regional development suggests that several key factors and indicators are important for the growth of regional GDP: infrastructure, population, labour market participation, hours worked, skill level, mobility of goods and factors, economies of scale and scope, and agglomeration forces. Factor mobility, openness to trade, a flexible and skilled labour force, the rapid adoption of new technologies, investments in human capital and high quality infrastructure contribute to regional growth. These factors are relevant for any type of region, rural regions are no exception. However, empirical results on theories of regional growth provide ambiguous results. Neoclassical growth theory would imply that regions converge, but observations indicate that this is not always the case. Other theories (endogenous growth theory and New Economic Geography) show that regional divergence may happen and urban centres may grow faster than other regions due to factors like localised knowledge spillovers and agglomeration effects. According to these theories not all lagging regions will necessarily catch up even if other conditions listed above are met.

Rural regions are characterized by remoteness and low population density and many rural regions face specific problems like out-migration and slow growth. The objective of rural development policies is to improve the well-being and standard of living of its residents. A multifunctional agriculture is supposed to contribute to this objective not only by providing food and fibre. Non-commodity outputs (NCOs) contribute to rural GDP via direct channels (e.g. services) and other factors (e.g. the provision of landscape amenities) foster rural growth via indirect channels. NCOs affecting the rural standard of living directly contribute to rural economic performance in a straight forward manner. NCOs affecting regional welfare indirectly are not evident and can be identified only by evaluating the outcomes. From an economic perspective, direct links are the consequence of pecuniary external effects, whereas most indirect links are the result of technological external effects.

The performance of regions can be measured by the regional GDP. If agriculture provides NCOs related to rural viability and development, their effects should have a positive impact on rural GDP. In the case of direct effects, NCOs are components of observable indicators of regional growth (population, workforce, working hours, gross value added of goods and services). In the case of indirect effects of NCOs, their influence cannot be tracked directly. However, the effect should be measurable by revealed indicators (e.g. population growth or more productive local firms due to attractive cultural landscapes or higher productivity due to social capital).

Regional statistics published by the OECD provide an extensive overview of the performance of rural regions relative to urban and intermediate regions. In many OECD countries rural population is high and rural regions contribute a significant share of the overall GDP. The GDP per person is lower in rural regions than the national average in most OECD countries and many rural regions are growing slower than urban or intermediate regions. Agriculture is an important activity in most rural regions; however, even there its contribution to the regional labour force rarely exceeds 20% or 30%.

At country and regional levels there is little evidence that the decline of agriculture (measured as gross value added) has diminished growth. Evidence from European countries suggests that there are very few regions in which both agricultural value added and regional GDP declined during the last years. Many European rural regions had a growing GDP despite a declining agricultural value added. These findings are not a proof that NCOs of agriculture are irrelevant for rural viability. If they exist, their effect on growth in rural regions does not seem to be very large.

Agriculture produces food and fibre. Thus downstream and upstream industries are linked to agricultural production. In a static framework these direct links can be analysed by input-output models. Using multipliers, it can be shown how changes in the level of agricultural activities change output and input levels in other sectors. Such results underline the importance of agriculture for the economy at a given point in time. An attempt to measure the effects of a policy experiment using Austria as an example is provided in the last chapter of this thesis. In a dynamic framework it has to be considered, that many domestically produced outputs can be substituted by imports. If domestic supplies are not sufficient, down-stream industries will import the necessary supplies to supply their markets. Therefore strong direct linkages between agriculture and upstream and downstream industries in a static view may turn out to be weak from a dynamic perspective.

Economies of scope are an explanation why the agricultural sector produces not only commodities but also other marketable and non-marketable goods and services. The provision of community services using agricultural machinery and farm tourism are two important examples of such services. The economic accounts of agriculture (EAA) measure these outputs in many countries, however these activities are not attributed to the agricultural sector but to the service sector in the system of national accounts (see European Commission, 2000).

NCOs produced by agriculture apart from farm tourism and community services is food processing and catering on the farm. These activities represent a value of ten per cent and more of total sector output in many countries. They contribute directly to rural GDP and are therefore important for the living standard of the rural societies. The supply of these goods and services may shift if prices for agricultural products decline. If there are no farms, farm tourism is no longer an option. But even in such an extreme scenario, rural GDP does not necessarily need to be significantly negatively affected. Very similar services can be provided by specialised firms which are competitive without economies of scope. Direct NCOs of agriculture may be essential for the typical character of rural regions; however they are not indispensable when close substitutes exist. A policy aiming at a diverse business structure in rural areas contributes to lessening the regional consequences of shocks that affect only one sector adversely.

The literature suggests that there are further elements of multifunctional agriculture. Such NCOs contribute to rural development in an indirect manner: social capital, regional innovation, social coherence, rural culture, and other factors. However, there is only scant empirical evidence that would support such considerations and more research seems necessary in this field.

Every region develops in a special way and therefore NCOs play specific roles. This is true not only for rural regions but for other regions as well. In some regions NCOs may be important foster for rural development and the approach taken in this study could show a pathway to identify them. In many rural areas basic services are underprovided because of low population densities and low purchasing power. Specific programs, fine tuned to the regional setting, are a precondition of targeted policy interventions. Such programs should focus more on providing the necessary services at risk and the people living in the region rather than addressing specific sectors. Since most farm households live in rural areas, they would be beneficiaries of such policies.

The analysis in this chapter has shown that there is a large diversity among rural regions even within small countries. Any policy aimed at stimulating regional growth and rural development should therefore be well targeted to addressing the specific growth drivers. The agricultural sector can be among them, depending on its contribution to rural viability. Focusing on those NCOs with a direct effect on regional growth seems to be a good option. The general rule is to address specific problems with the appropriate instruments. If, for example, rural employment is at risk, labour market policies should be adopted to enhance the competitiveness of the rural work force. Policies stimulating the output of a particular sector are not an adequate instrument in such a case. If, in another example, positive or negative technological external effects of agriculture are affecting the well-being of rural communities, the set of instruments which addresses them in the best way, should be adopted.

3. Aspects of agricultural multifunctionality in Austria

3.1. Chapter Overview

This chapter reviews literature and research results on external effects of Austrian agriculture using the approach developed by OECD (2000), which refers to a wider concept, namely non-commodity outputs. The material used for this review comprises journal articles from reviewed journals, articles from not reviewed journals, research reports, papers presented at workshops and conferences, working papers, unpublished manuscripts and personal communication, as well as internet resources. With very few exceptions, the literature cited deals with the Austrian situation. Most studies covered in this survey are from the last decades of the 20th century. The reason is that during this period multifunctionality, external effects, environmental effects of agriculture were new topics. After the establishment of the Programme for Rural Development and after the wide scale efforts of the OECD to measure environmental indicators, many scientists lost their interest in describing effects of agricultural production. The focus changed from description towards prescription and evaluation of policies in place that were put in place to correct market outcomes.

Work on multifunctionality has been carried out in Austria mainly on behalf of the Federal Ministry of Agriculture and Forestry, primarily for internal use. Large parts of these efforts were published, but not many publications have undergone the scrutinising process of international peer-reviewing. This does not imply that weaker quality standards applied to such research and that the results are of less significance. However, it makes it more difficult to separate reliable findings from less reliable ones.

The literature reviewed here covers economic analyses and analyses of other disciplines ranging from the agronomy of grassland farming over rural planning to integrated landscape perception and also refers to political statements. The large number of disciplines reflects the wide scope of 'multifunctionality research' in Austria. Such a multi-disciplinary comparison becomes problematic in a few situations. The first situation is where similar findings lead to different conclusions depending on the discipline. For example, a meadow with many plant species may be valuable from a nature conservation point of view, whereas the same meadow may be of low value from a livestock nutrition point of view. Such differing views can be resolved from an economic perspective by comparing social marginal values. Another situation arises when different views are taken within a discipline. This actually occurs when experts come to contradictory conclusions on the environmental benefits of organic farming. The approach taken in this review is not to take position, but to leave the issue until further research eventually leads to more widely accepted conclusions.

This review is structured as follows: in the next sub-chapter a list of non-commodity linked outputs of Austrian agriculture viewed to be positive for society is presented. In the following sub-chapter, non-commodity outputs regarded to be negative external effects are dealt with. Finally, conclusions and proposals for future research are presented.

Readers should not expect to find detailed research results on monetary values of positive or negative external effects associated with non-commodity output generated by Austrian agriculture. There are only a few empirical studies that deal with external benefits associated with agricultural production in monetary terms. There are few Austrian authors that have made attempts to measure the positive external effects (Hackl and Pruckner, 1995a, 1995b, 1996). The results of such rare examples of economic valuations are at a highly aggregated level. To derive values of marginal external benefits from these studies for a particular region or a positively valued non-commodity output would be heroic but futile. One very specific analysis is an exception (Hackl, Halla and Pruckner, 2007). This case study could be the starting point for a targeted approach to stimulate positive agricultural external effects. The situation is even worse with respect to negative external effects of Austrian agriculture. Only a few attempts were made to estimate the monetary value of environmental harm due to agriculture. Therefore quantitative results in many studies are referring to changes of levels of indicators, while in most studies results remain at a qualitative level.

Another issue is that different authors often implicitly make assumptions on the distribution of property rights of a given resource that are deviating: For example, author A takes the view that a farmer has the right to use groundwater as a pool for nutrient residues within the limits defined by regulation X, whereas author B assumes that the right for pure groundwater lies with the public based on law Y. It may be the case that the legal sources X and Y are contradictory at a first glance and that courts did not clarify the actual property rights situation. In such situations where assumptions about the actual distribution of property rights needed to be made, the Polluter-Pays-Principle as established by the OECD in 1971 was taken as a reference.

In many cases, as soon as a technical externality has been identified, authors make the assumption that an externality is Pareto-relevant and that a market failure exists. In addition, the (implicit) assumption is often made that a given non-commodity output has the characteristics of a pure public good where in fact this assumption does not seem to be justified. Both issues can only be clarified in empirical investigations. The position taken in this review is to challenge statements which are not based on observations and to point out any conclusions that are based on empirical evidence.

3.2. Research on multifunctionality and agriculture in Austria — topics and definitions

Systematic research on topics related to multifunctionality in Austria is carried out mainly in three institutions: the Federal Institute of Agricultural Economics (BAWI, a research unit of the Federal Ministry of Agriculture, Forestry, Environment, and Water Management), and economic departments at Universität für Bodenkultur Wien. Pevetz, until recently a researcher at BAWI, is the author of a monograph entitled The multifunctionality of Austrian agriculture and forestry (Pevetz, 1998).

The influence of this work on the arguments in popular articles on agriculture, official statements of policy makers, and mission statements of various rural initiatives is eminent. A look at part of Pevetz' work gives a good overview of the development of arguments concerning non-commodity output in Austria: 43 years ago Pevetz (1966) analysed the links that exist between agriculture and tourism. One of the conclusions was that both agriculture as well as tourism enterprises benefit from each other. Two years later, Pevetz (1968) argued that farmers should be compensated for their countryside-stewardship services in intensive tourism regions where visitors enjoyed landscape amenities provided by agriculture. One of his conclusions was that farmers actually producing public goods should be compensated via direct payments for such services in a way not linked to farm-output. The funds should be allocated by the communities. In 1971 Pevetz presented at an international congress (probably the first) list of non-commodity output of Austrian agriculture: countryside stewardship services, infrastructures also used by tourists (roads, electricity lines), and a flexible pool of labour for the tourist industry to smooth out seasonal demand fluctuations. The benefits for agriculture from tourism were acknowledged as well, e.g. additional sales opportunities for agricultural products and opportunities to offer beds.

Three years later, Pevetz (1974) developed a methodology to quantify the social services of agriculture and forestry. The argument was explicitly based on welfare-economic reasoning: 'agriculture is providing external value added'. Elements provided by the farm sector which are not covered by the price of commodities are: the production of 'domestic' food, direct effects on local labour markets, and the contributions for tourism. Other services for which Pevetz used the term 'meta-economic' are: the stewardship of the rural countryside which is used by city-dwellers for recreation, and the conservation of soil and water. By multiplying the cost to mow a hectare of extensive grassland Pevetz finally estimated "the cost of landscape stewardship". He was well aware, that this "is not its value — the quantified benefit" (Pevetz, 1974, p. 414). Basing the estimates on the cost of providing the services (a methodology that was applied again by Pevetz et al., 1990) was the only possibility available because Pevetz obviously was not aware about methods for demand-side evaluations of non-market goods.

Over the next fifteen years that were characterized by agricultural price support policies, border protection measures and direct aid for farms in disadvantaged regions the discussion on non-commodity output was suspended. At the end of the 1980s environmental issues related to agriculture became a topic. In Austria, Haimböck (1988) was the first to look at environmental problems relevant for agriculture from an economic perspective. During this time agriculture was mainly seen to be adversely affected by emissions from industry and traffic. However it was already widely accepted that agriculture was causing environmental problems as well and the economic factors causing them were identified (Wytrzens and Reichsthaler, 1990; Hofreither, 1990; Wytrzens, 1991; Hofreither and Sinabell, 1994).

At the same time, the issue of 'meta-economic' services of agriculture surfaced again. Kromka (1989) argued that a market economy benefits from farmers' virtues that can be regarded as a positive external effect. However, one can argue that residents of rural areas derive utility from living there and not because they are sacrificing their lives for providing public goods. Such a perspective was taken by Puwein (1992) who argued that the primary beneficiaries of landscape amenities are people living there, among them farmers.

By the end of the 1980s, the first maps of 'cultural landscapes' and a typology of Austrian landscapes was published (Fink et al., 1989). Further steps to analyse the determinants that form landscapes, the interaction between men and landscapes, were launched following the initiative of Smoliner (1992). The initiative eventually became a research programme under which landscape related research continues to be carried out. Puwein (1993) who analysed the economic instruments available to promote the provision of landscape amenities argued that the character of landscape is changing continuously (e.g. forty years ago arable crops where grown in regions where today only grassland can be found). What is now perceived as a 'traditional cultural landscape' may have looked quite differently forty years ago. He further took the position that subsidising farming could not be justified on economic grounds in regions where there is no demand from visitors for landscapes that are 'produced' by agriculture.

Up to the 1980s nature conservation was focused mainly on rare species and the most frequently used instrument was to designate nature protection areas in a command and control way (Tiefenbach, 1993). Networks of linked habitats became a new objective for nature conservation authorities when the paradigm of nature conservation to focus only on rare species was overcome and the focus changed to an integrated eco-system management. This new objective only could be achieved with farmers' co-operation by managing part of their land according to nature conservation requirements. Pevetz (1989) saw opportunities for farmers co-operating with nature conservation authorities or conservation trusts by arguing that farmers should welcome this new demand and provide the services to diversify the sources of land-related income.

During the following decade Austrian research initiatives took two directions: one branch of research has focused on measuring, quantifying and monetizing external effects (both positive as well as negative), empirically identifying multiple uses of agricultural land and quantitatively analysing the factors determining environmental behavior of farmers. Part of this research has been carried out in international and interdisciplinary teams and a major topic has been the evaluation of the environmental effects of the Austrian agri-environmental programme that was launched in 1995. Most of these studies and major findings are presented in the second and third sub-chapter of this chapter.

The second branch of research, represented by the work of Wohlmeyer (1999) and Neunteufel (1992 and 1997) has focused on methodological issues and attempts to show limitations of the standard neo-classical model of economic reasoning. Both authors build on the concept of sustainability. Neunteufel, argues that standard economic analyses does not (yet) have the adequate tools to analyse the complex interdependencies of economic and natural systems: "In summary it can be established that the issue of the quantification of (economic) values of the external services of agriculture leads to the problem of valuation of (renewable and non-renewable) resources. This cannot be solved by the available tools in economics, at least not at the moment" (1992, p. 67). Following the methodology of OECD (2000) in which it is argued that sustainability issues should be regarded in another context, literature on this topic was not dealt with in this paper.

Background information on Austrian agriculture

Austria is a member of the European Union and therefore the Common Agricultural Policy provides the regulatory framework for the farm sector. The 1% to 2% rule of thumb is a good approximation for estimating the relevance of Austrian agriculture within the EU farm sector. Output of major crops and livestock, as well as the share of utilised land lie within this bandwidth.

Most Austrian farms (70%) are run on a part-time basis and the average farm size is relatively small. This shows up in aggregated figures: the number of farms is equivalent to over 3% of the EU, whereas the number of labour units is only 1.9%.

Less than half of Austrian agricultural land is located in regions with favourable climatic and topographic conditions. Farmers in this part of the country can effectively compete in the Single Market and the value of output of vegetables, fruits and wine exceeds the value of commodities like cereals. The other part of agricultural land — dominated by grassland farming — is situated in the Alps and other mountainous areas. Conditions for farming are comparably harsh: in the production region 'High Alps', e.g. which accounts for 30% of utilised agricultural land, the median of altitudes of parcels is 1 300 m and the median of steepness is 30% (Wagner et al., 2000). In some of these regions (both winter, as well as summer) tourism is the dominant economic activity.

Many farmers are owners of forests and forestry is an important source of income for family farms in mountainous areas. An additional important source of income is the renting of beds. In tourist regions many farmers offer tourist services under the label 'holiday on a farm'.

A prominent policy goal is to keep agricultural production viable in less-favoured regions. The most important instrument to achieve this objective is a non-output linked transfer to farms according to the severity of topographic disadvantages. Austria accounts for approximately 8% of total EU payments for less-favoured areas.

Apart from such natural conditions that explain a special situation in Austria, the political commitment of Austrian agricultural policy makers to integrate environmental concerns into agricultural policy making is remarkable. During 1995-2005 approximately 15% of European funds earmarked for agri-environmental programs have been allocated in Austria. This strong emphasis on environmental programs as part of agricultural policy that can be explained by the tradition of an 'eco-social market economy model' developed by Riegler (1990, 1993).

This separation of research directions shows up in different approaches how to deal with non-commodity output of agriculture. One group of authors is mainly working on definitions of multifunctionality. A set of functions is offered and it is argued that agriculture (frequently in combination with forestry) is providing services to society. This is similar to a textbook on plant production where the different crops, how to produce them and how they can be used are described. A typology of non-commodity output is presented, and the links between agricultural production and the benefits society are explained. On the one hand there are functions technically linked to agriculture, like the production of water: on average, more water is filling a groundwater reservoir under agricultural land as compared to forests or urban areas. On the other hand there is a description of social functions of farm family members who offer services such as taking care of the elderly, participating in the political system or local folklore clubs. Other authors (among them policy makers) offer very short definitions or state the term multifunctionality assuming that the reader knows how it is defined (Eßl, 1999; Klasz 1999, 2000; Molterer, 1999; Riegler, 1993, 1999). An inductive approach to identify elements of multifunctionality by using data-mining procedures was taken by Baaske et al.,1991. Current research following this last approach is focussing on exploring the technical relationships and finding evidence for functions of family-farms that have positive effects for the society.

3.3. Positively valued non-commodity outputs of Austrian agriculture

In this sub-chapter, positively valued non-commodity outputs of Austrian agriculture are reviewed. The outputs that will be analysed are taken from the list elaborated in more detail in the next sub-chapter, which summarises the studies on multifunctionality by Austrian authors. Before going through these outputs individually, it is necessary to determine which items defined as constituting elements of multifunctionality actually fit the definition of non-commodity output by OECD (2000).

According to the literature reviewed, the following functions are associated with Austrian agriculture in general and agricultural land in particular:

a) production (food, feed-stuff, raw material);

b) rural employment (direct and indirect employment function, buffer function on labour market);

c) spatial aspects (road infrastructure, buffer of land, open space);

d) management of rural ('cultural') landscapes;

e) natural hazard / damage control services (e.g. flood discharge zones, particularly in the Alps);

f) ecology (habitats of species, filter of depositions, water protection);

g) recycling and waste management (compost, sewage sludge, water purification);

h) culture (farmers being part of the rural culture);

i) food security;

j) agro-tourism;

k) social services;

l) water management (water conservation zones, water reserves, water management restriction);

m) nature and landscape conservation (rare species / landscapes in designated zones with restrictions);

n) recreation and tourism (hiking, riding, panorama point, ski slope, picking flowers, etc.);

p) hunting;

q) military (in designated zones with restrictions, used for military exercises, etc.);

r) special land uses (restrictions on land: hazard zones, green belts, overhead power lines, protection zone along national roads, underground power lines or water pipes, etc.).

The production function describes the same as farm commodities, item a) therefore will not be analysed here. The recycling function and waste management g) are classified to be private goods, as well. The services provided with these functions are not typical farm commodities but there is no reason to assume that price signals on private markets deviate from social marginal cost. These functions therefore will not be treated in this chapter. One could argue that a particular farmer may have an attitude towards risk that leads him to surplus application of non-farm organic waste, but no empirical study backing such a view was found. Actually, it is the case that the application of non-farm waste is heavily regulated and society is well aware of potential hazards. Concerning the function "water purification" (see item g) the view is taken that water is not a scarce good in Austria. Of course, clean water is scarce in some regions but, particularly in these regions there is no evidence that agriculture is actually purifying water but that the opposite is the case (BMLFUW, 2001).

The functions agro-tourism and social services, item j) and k) are assumed to have rather similar characteristics like commodities. There is no evidence that these services are not private goods (both excludability and rivalry in consumption are given). This does not mean that the social value of these services is zero (Wiesinger, 1991, reported examples of integrating mentally challenged persons on farms). Such a categorisation only implies that the view taken by the author of this review is that market prices are not systematically wrong. Other aspects of social services mentioned by Pevetz (1998) like "learning efficiency" are neglected here because it is hard to fit them into a commodity- and non-commodity-output framework.

In the context of the rural employment function, b) the private good argument cannot be applied because a factor is regarded. Every person participating in the labour market is a benefit for society but it is hard to argue that other sectors are affected by positive external effects from the farm sector if labour that was used in agriculture is allocated elsewhere, or if farmers' children take a non-farm employment opportunity. Apart from that, Weiss (1997) showed empirically for an Austrian region that people leaving the farm sector frequently "come back again". Therefore, if argument b) was valid, agriculture would benefit from other sectors as well. Since workers are insured against unemployment the buffer function that may have been relevant 40 years ago can be regarded to be obsolete.

Another argument in the context of the rural employment function is that people in downstream and upstream industries or other parts of the rural economy depend on farmers. Two studies (Baaske, 2000 and Schneider, 2001) show that spillover effects to other sectors exist and quantify them in form of multiplicators.

Baaske (2000) investigated effects of public investment support measures (for agriculture, food processors, forestry, avalanche and torrent control, rural infrastructure, and renewable energy) in a kind of input-output tables analysis. He found that one million euros in subsidies triggered two additional million euros in private investment and "(moved) 5.5 additional [million euros] in production, households, and capital-cycles" (Baaske, 2000, p. 343). He further estimated that one million euros of investment support leads to additional employment of 117 persons (of which 53 are employed in agriculture or forestry). These figures are surprisingly high.

Steininger (1999) is the only author to estimate such effects in a study analysing the general equilibrium effects of two trade liberalisation scenarios. Steininger's model has been used for various analyses and its results are widely accepted. According to his results, farm employment would decline by 33 900 to 84 300 persons and farm output would be reduced by 20% to 49% depending on the extent to which agricultural trade is liberalised. The net gain to the Austrian economy would be the additional employment of 7,000 to 25,000 persons and a GNP-increase of 0.18% to 0.69% depending on the scenario. The findings are obtained at the aggregate level, therefore no conclusions can be drawn with respect to the spatial dimension.

Farmers are integrated members of the rural society and participate actively in local political decision making and public services (like working for the fire brigade, or the Red Cross without monetary compensation). Since there is nothing special about this, functions related to the role of farmers in the rural society will not be reviewed.

Most of the items l) to r) seem to be neither private goods nor non-commodity linked outputs. In the case of hunting p) compensation agreements exist that are established on the basis of hunting-laws. The same is probably true in most cases of the categories l), m), and q) water management, nature conservation and military uses. As noted by Pistrich (2001), general statements should not be made in this context, there is empirical evidence that in many cases, contracts exist defining property rights and compensations.

Finally, restrictions on the use of land are defined in the context of r) regional planning and where landscape protection areas are designated (part of m). Agriculture could be viewed as a special case because the factor land has a spatial dimension. However, all other land owners are treated similarly and people planning to build a house have to take notice of regional planning restrictions as well.

Some authors (Wohlmeyer, 1999; or Heissenhuber and Lippert, 2000) take the position that such restrictions (as well as restrictions due to environmental regulations) should not be seen in a national context but in an international one. The argument is that the production cost of local farms are increased and they therefore cannot compete effectively on international markets. This view is not shared here because it is a national concern to regulate national problems and in the context of spatial planning an international spillover-effect can hardly be identified.

3.4. Jointness between commodity and non-commodity outputs

3.4.1. Technological characteristics of agricultural production

By definition agricultural production in open space is associated with ('cultural') rural landscape. Different agricultural technologies and intensities will result in a different type of landscape. The nature of a particular landscape, however, does not seem to be linked to the level of output if technology and cropping patterns remain unchanged. Inventories and maps exist in which the technical relationships that lead to particular types of landscape are described (Dollinger, 1988; Fink et al., 1989, and Jeschke, 1999). To date, very little is known about the spatial dimension. In an analysis carried out by the Austrian Federal Environment Agency the need for protection in Alpine regions, with a focus on biodiversity, was investigated (UBA, 2000). A synoptic approach was used for this study so as to integrate characteristics of rural landscapes like "closeness to a natural steady state", "age of a semi-natural landscape", "number of small (closed) habitats", "rareness of species", and "representativeness of the landscape". A map presenting some results has been published showing that approximately 20% of the Austrian Alpine territory falls into the class "highest level of protection required". The methodology on which this map was developed and the detailed results have not yet been published, therefore the significance of agriculture in this context is not yet known to the general public. The extent to which the provision of rural landscape is linked to commodity output has not yet been analysed in a systematic way.

Ecological functions seem to have very similar characteristics. The set of species (both fauna and flora) is contingent upon the type and technology of production and any change will have an impact on the number and spectrum of species. In sensitive areas, such as Alpine meadows and pastures, this interdependency is very high. The type of grazing animal and its characteristics like its weight have an influence on plant societies (Brandl, 1994; Schwabe-Braun, 1988).

As far as grassland is concerned, the link between intensity and biodiversity (plant species) is empirically well analysed. Buchgraber and Sobotik (1995) report findings of an ongoing field experiment in Gumpenstein (Styria) which started in 1961. In a split-plot experiment with four repetitions in which different levels of intensity are compared (2 different levels of fertilisation and 5 types of cuts), the number of species is observed over time. The absolute number of species is very similar when the high-intensity experiments are compared with low-intensity ones; however, the spectrum of plant species is changing considerably. The highest number of plant species (39) is observed in the experiment in which nitrogen, phosphate and potassium fertiliser is applied and in which 2 cuts are followed by a grazing period. The lowest number of species (30 and 31) was observed in the experiments with 6 cuts and 2 cuts (without grazing). Obviously, the number of species is maximised when a semi-intensive use of grassland takes place. The absolute number of species is only one criterion; another one is whether the number of rare species is linked to intensity or not. According to Bohner (1998) and Wytrzens et al. (2000) red list species are more frequently observed on grassland that is managed at very low-intensity.

In regions where arable farming prevails, the relationship between intensity and the number of species seems to be weaker. According to German studies, the frequency of species is slightly higher in organic farm fields (Freyer, 2001). However, there are no results for arable land from experiments comparable to the intensity trials in Gumpenstein. If a link between the number of species and organic farming actually exists, then a link between output levels and biodiversity can be established as well. Eder et al. (2000, Chapter 6) and Salhofer and Streicher (2000) empirically show that yields of cereals in Austria are 11% lower if organic farming practices are adopted.

Several types of semi-natural areas across the country are considered to be of high ecological values according to a survey of Lughofer et al. (1999). They found that agricultural production is a precondition for achieving conservation goals in 60% of the habitats of the Austrian Natura 2000 network ('Habitat Directive' 92/43/CEE), which — among others — comprises semi-natural areas. In which regions this is actually the case and how many hectares of agricultural land are concerned is a topic of ongoing research.

The functions related to natural hazard control and damage prevention have a clear spatial component. The services of agriculture in this field are limited to Alpine grassland and few retention zones along rivers. Depending on topographical conditions some authors (Lichtenegger, 1992) take the view that the abandonment of Alpine grazing may cause avalanches. Such hazards can be prevented if young trees are planted. The author of this survey is not aware of a systematic analysis of this issue.

There is evidence that tourists and visitors are aware of how a landscape looks like and what technology is adopted (they notice whether cattle is grazing or not, etc.). Obviously visitors perceive a different picture of the same landscape during winter when snow changes the character completely.

Food security is linked with output and depending on the technology chosen. Austrian self sufficiency rates in 1998 were reported to be 102% for cereals, 57% for fruits, 64% for vegetables, 124% for oil-seeds, and 110% for meat (141% beef) (BMLFUW, 2000a, p. 186), ten years later the figures are 95% for cereals, 66% for fruits, 59% for vegetables, 100% for pork and 146% for beef (BMLFUW, 2008a, p. 29).

Spatial functions (infrastructure, open space, buffer of land) seem to have similar characteristics as the management of rural landscape. These functions do not seem to be linked to production levels of commodity output.

3.4.2. Cost of changing current farming practices to preserve non-commodity production following a change in commodity production

A landscape dominated by a managed forest is a 'cultural' landscape as well, however the character changes completely when compared with a landscape characterised by agriculture. No attempts were made to 'produce' a rural landscape with other technologies apart from small plots in educational or amusement parks up to now. But there are privately funded programs that stimulate the 'production' of a certain type of landscape tourists expect in Alpine ambience (Hackl et al., 2007).

Ecological functions can partly be de-linked from agricultural production. Species can be kept in zoos or botanic gardens or essential parts can be stored in gene banks. However, ecologists take the view that such alternatives cannot fully replace all functions of an eco-system.

There is evidence that Alpine grassland is very sensitive to changes in management. Where grazing is suspended for several years, a given pasture becomes worthless from an agricultural point of view and it would be costly to re-establish the previous condition. There are different views whether this is a problem from an ecological point of view or not (Grabherr, 1988). In this context the role of livestock threatened by extinction also becomes relevant (Schachl et al., 1993). Some varieties of cattle seem to be better adapted to grazing in the mountains and the weight of animals is reported to play an important role to prevent erosion (Schwarzelmüller, 1995). Such cattle varieties produce less milk and meat (Wiesböck, 1998).

The cheapest technology available to maintain the ecological functions of Alpine grassland (to prevent that it becomes overgrown with shrubs and eventually a kind of forest) seems to let livestock graze there. The Austrian agri-environmental programme offers grazing premiums for Alpine grassland. Land-owners holding more than 0.5 ha land can participate in the agri-environmental programme and may qualify for such payments if Alpine land is managed according to certain criteria. Horses that are not used for meat production graze on several Alpine pastures — this has been and is also promoted by the agri-environmental programme (BMLFUW, 2000b, Section 9.8.2.18.3 and BMLFUW, 2007b, p. 330).

Hazard control and damage prevention functions can be de-linked from agricultural output by switching to forestry or by technical constructions. The author is neither aware of any study analysing the cost if Alpine grassland was no longer managed by farmers nor of any study analysing alternative ways of hazard control that could be adopted. The direct cost of avalanche and torrent control measures are approximately 120 million euros per annum (BMLFUW, 2008, p. 121); it is not reported how much of these expenses are due to the abandonment of farming in sensitive areas.

Currently, visitors have the choice either to find recreation in regions dominated by forests or by agriculture. The area of forest is increasing continuously in Austria to the detriment of agricultural land. The rate of change is highest in the high mountain area (Zanetti, 1999, reports almost 1% loss of agricultural land per year). Depending on local situations this process happens naturally or trees are planted. Cede (1998 and 2000) describes in detail this process and the change in the character of the landscape. Open space is a prerequisite for many recreational activities and alternatives to agricultural land could be parks. There is no systematic analysis as to the costs of alternatives to provide open space with a similar character.

There is no evidence that spatial functions like infrastructure depend on agricultural production. Open landscape requires some kind of land management that prevents forests which could be achieved by a low intensity agriculture. Depending on the kind of management which needs to be defined in a regional context the cost of such management can be estimated based on existing data catalogues. It should be noted that once land is covered by trees a license is required in case the land is used for agricultural purposes again.

There exists an extensive body of international literature on how to achieve food security goals best. Some Austrian authors (e.g. Wohlmeyer, 1999) oppose to such findings. However, the author of this survey is not aware of an Austrian publication in which this topic was treated rigorously.

3.4.3. Delinking agricultural output from non-commodity outputs in Austria

Pevetz (1997) compared two types of regions: one with a large share of Alpine grassland, the other with a large share of forests. Employment is much higher in the sample regions with a higher share of grassland. He is aware that this observation does not imply causality. There are several regions in Austria with a high share of agricultural employment (over 20% in 10% of Austrian districts). Even pluriactivity could not prevent that such regions would be adversely affected if agricultural incomes declined (Qendler, 1999). In the previous and the current Programme for Rural Development (BMLFUW, 2000b and BMLFUW, 2007a) novel instruments are used that are aiming at stimulating additional sources of income.

Some tourists expect an open landscape and signs of agricultural activity. Other groups of tourists are looking for other kinds of recreation (playing golf, rafting, etc.). Edinger (1998) takes the position that tourists will not be interested as much in a rural countryside as previous generations have been. His argument is that farmers offering products to tourists (beds or food or entertainment) need to adapt to changing preferences. From contingent valuation method studies (Hackl and Pruckner, 1995) we know that (potential) visitors have a positive willingness to pay for Alpine agricultural landscapes. Such demand needs to be accounted for and local scarcity should be addressed.

With respect to ecological functions, jointness could be weakened by adopting less intensive production methods. However, adopting less intensive methods is not always possible.

Consider Alpine grazing: intensity cannot be reduced significantly because generally mineral fertilisers or other inputs are not used there. The only way to reduce intensity is to reduce stocking rates or to shorten the grazing period. But less intensity may have adverse effects concerning the ecological functions (Cernusca and Tappeiner, 1998; Moser, 1999).

Marginal land in mountainous areas is used for grazing (according to the shadow values on different land categories obtained by a Positive Mathematical Programming (PMP) model developed by Röhm and Sinabell, 1999). In case of significant price drops of agricultural outputs, land which now is used to produce cattle or sheep would be taken out of production. Consequently the output of mutton, wool, beef and milk would decrease. Currently Austria is producing 140% of domestic demand of beef and veal. Therefore food security does not seem to be impaired by a significant decline of grazing on marginal land.

The spatial functions do not seem to be affected in cases where agricultural output is decreased significantly or if production becomes less intensive. However, in this context too little information is available concerning the natural hazard and damage control function of agriculture.

3.5. Evidence for market failures associated with the non-commodity outputs of agriculture

Rural landscapes influenced by agriculture can be used for recreation by anyone and have the character of a (local) pure public good. A dense network of roads, paths and trails allows visitors and local residents to access land by foot, bike or car with few restrictions. The (use) value of landscapes being influenced by agricultural activities was estimated in several studies that are reported in detail at the end of this sub-chapter.

There are widely accepted arguments that the ecological functions provided by rural landscapes have the character of pure public goods as far as species are concerned that are of national significance. In designated nature conservation areas the most stringent restrictions on land use are applied. Other types of protection relevant in this context are listed in Table 6. The designation of such zones can be interpreted as a definition of property rights which was done in order to avoid or reduce market failure. Approximately 5.5% of the Austrian territory is protected according to strict regulations (national parks and nature conservation areas — see Table 6).

For one of the national parks (Kalkalpen) an economic evaluation using direct methods was carried out (Hackl and Pruckner, 1995). The results show that depending on the frequency of visits the annual value of this national park is 4 to 8 million euros. Agricultural production still takes place in this park and the interaction of natural processes with low intensity agricultural use is forming a complex ecosystem of obviously high value. Details of the management contracts between the park authorities and farmers are reported in Moser (1999) and a critical evaluation of these contracts is provided by Seher (2000). Marginal values of non-commodity outputs associated with changes in commodity prices have not been measured.

Table 6: Protected zones in Austria relevant for nature conservation, landscape protection, and public access

	1992	1997	2009	2009	2009
type of protection	km²	km²	km²	% of territory	number
National parks, IUCN category II	1,965	2,299	2,353	2.8	6
European protection areas Natura 2000			10,244	12.2	148
Nature conservation area	2,403	2,455	2,979	3.6	441
Landscape conservation area	13,596	13,616	12,696	15.1	247
Nature-landscape conservation area			506	0.6	4
Nature parks	866	1,489	4,030	4.8	47
Protected landscape elements	50	66	96	0.1	448
Plant- and wildlife protection area	358	361	2,617	3.1	41

Source: ÖROK (1994, 1997), UBA (2009).

Concerning the spatial function as far as roads are concerned excludability is given (some roads can only be used by people having a key that opens a gate or if a duty has been paid). Many roads in rural areas (as well as telephone lines or cable lines) were built with public subsidies and therefore may be used by visitors (Hovorka, 1999, gives a detailed overview of such public investments in mountainous areas). In regions with intensive tourism land owners are compensated if previously existing property rights are extended (e.g. horse riders are using trails that in the past were used only by hikers) or where another sport infrastructure is using land that has commodity output functions as well. The existing legal system seems to provide the necessary prerequisites that land owners can prevent harm from being done to their property. It must be reiterated here, however, that numerous legal provisions limit private property rights. To what extent this is causing market failure from a welfare economic perspective has not been analysed. As brought forward by Pistrich (2001), the actual situation can only be observed at a very local level.

Concerning protection against natural hazards there is strong evidence that institutions exist that prevent market failure. Public authorities (avalanche and torrent control units) are designating protection zones and deal with constructions that contribute to the prevention of damages in co-operation with local authorities (Sinabell et al., 2009). Natural risks are therefore controlled mainly by the public and private persons that contribute to that control. A market failure therefore does not seem to be relevant because public agencies are established to control these risks.

According to the reasoning above farm tourism can be viewed to be very similar to a standard commodity output of farms. Some authors (including Pevetz, 1998) have a different point of view. Edinger (1998) however, points out that farmers offering beds in tourist regions are benefiting from the infrastructure provided by commercial tourist enterprises as well. A golf course, tennis court or a cheerful nightlife (facilities not provided by farmers) make a tourist destination attractive for those who spend their holidays at farms. Basically, the argument is that there are both reciprocal and mutual positive external effects. Of course, not all farmers are able to capture such positive external effects because not all of them are offering beds. Up to now, however, no study has analysed these issues or identified relevant market failures.

No study exists in which positively valued non-commodity outputs as listed above are weighed against negative external effects (see next chapter). A model presented by Sinabell and Schmid (2003) can be used to quantify the trade-off between indicators of positive and negative external effects at the provincial level. However, a systematic analysis that would allowing conclusions — even if based only on indicators — has not yet been carried out. Austrian research on this topic currently does not provide reliable estimates about the marginal effects on social benefits or costs associated with agricultural production in case commodity prices are declining.

Only with respect to the provision of rural landscapes do studies exist that attempt to monetize the demand of non-commodity outputs of agriculture. The aggregate willingness to pay of summer tourists for a landscape that is characterised by agricultural activities was estimated to be EUR 51.6 millions per year (Pruckner, 1995b). This result shows that there is a positive monetary value associated with 'rural landscapes'. However, there was no estimate of the marginal cost of the provision of 'rural landscape', and therefore a market failure was not empirically verified. Hackl and Pruckner (1995b) used the same method to estimate the willingness to pay for a national park (with open access) in which Alpine farming plays a significant role. The situation in Hackl and Pruckner (1995b) is different from the one analysed in Pruckner (1995b) because the benefit-cost context in the case-study on the national park. Since the annual costs of providing the national park are similar to the willingness to pay it was recommended to carry out the project.

In another study, Baaske and Villani (1996) made another valuation. The objective was to estimate the use value local residents obtain from open landscapes and unspecified other non-commodity output of agriculture. Based on the responses to the question "what would you be willing to pay for agriculture in your neighbourhood", Baaske and Villani obtained an aggregate estimate of EUR 1.3 billions.

Concerning other non-commodity outputs, no studies exist that would allow to draw conclusions in the context of an over- or under-supply based on demand side estimate. There are numerous studies with a natural and social science background that establish a 'threat of extinction' or a ‘threat of loss’ and basing such conclusion on criteria that are not compatible with the definition of’ market failure'. The reliability of the results of studies which deal with the value of rural landscapes depends on the methods used. The studies by Pruckner (1995) and Hackl and Pruckner (1995b) used the contingent valuation method (CVM) to derive their results. These were published in refereed journals and are frequently quoted in scientific papers. CVM is a widely accepted method for direct valuations and the method was applied in a very careful way in these studies, therefore the results obtained by the authors are reliable. The situation is different concerning the study of Baaske and Villani (1996); their results seem to suffer from a design bias because no provisions were made to guarantee that the budget constraint was taken into account by respondents. The authors report about the puzzling result that people without labour income had the highest willingness to pay: "In this context we have to acknowledge that the potential payments from students and respondents working in households probably may not materialise". It should also be acknowledged that the authors warn the reader that their figures concerning the willingness to "pay for agriculture in the neighbourhood" may be overestimated.

3.6. The role of non-governmental market creation

Concerning ecological values rivalry in consumption does not seem to occur because existence values may exceed use values.[1] In small nature conservation areas congestion problems may occur. The other non-commodity outputs analysed here do not seem to be affected by congestion. There are no Austrian studies that analyse these issues.

Concerning ecological values mainly the command and control approach has been taken (as far as the implementation of nature conservation laws is concerned). In agri-environmental programs experts are defining the amount of a given non-commodity output related to ecological functions to be supplied by farmers. In the case of grazing on Alpine meadows farmers are offered a standard premium and the number of heads of livestock is limited based on a coefficient related to the area. Only land-owners having registered rights to use Alpine meadows qualify for that premium. The author of this survey is aware of only one case (the national park Kalkalpen) where benefit-cost-criteria were used during decision making.

In many areas, private contracts have been established as part of the Austrian agri-environmental programme. The objective of such management agreements is to a) prevent negative external effect as listed in the next sub-chapter, b) to promote the upkeep of agricultural production, and c) to improve the ecological quality of habitats (covering approximately 40,000 ha, mostly grassland). Farmers participating in category c schemes receive special training and negotiate contracts with nature conservation authorities for a period of five years. Responsible for the designation of zones and defining management practices are provincial governments. A co-financing agreement for the premium exists with the Federal Government and EU institutions. Therefore provincial governments pay only part of the premiums but must cover the full cost of planning, administration and contracting.

Conservation clubs are also addressing ecological values in rural areas and an overview of public support for their activities is presented in Parlamentarische Materialien (2000). The criteria as to which pieces of land qualify for enrolment in the programme are defined by nature conservation experts and landscape planners (Suske, 1999). The author of this survey is not aware of any demand-side-valuations or cost-benefit assessments of such projects.

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[1] Existence values are reflecting the benefit people receive from knowing that a particular environmental resource, such as an Alpine meadow or an endangered species exists. Existence value is a prominent example of non-use value. Existence values do not require that utility be derived from direct use of the resource, like hiking on a trail on an Alpine meadow. In the case of existence values the utility comes from simply knowing the resource exists. The idea was first introduced by Krutilla (1967), though he used the term 'sentimental value'.

There are several strategies to internalise the benefits of public goods. In quite a few cases visitors must pay a fee if they want to use a road that brings them to a beauty spot or visitors must pay a parking fee. Farm tourism is another way to internalise external benefits by those farms who partly generate them. The role of public authorities is to establish the legal basis for such activities. In Austria additional involvement from public bodies comes from investment aids (Hovorka, 1999; Baaske, 2000). Another way farmers internalise part of the external benefits they provide is facilitated by theme and panorama streets (wine streets, apple wine street, apple street; Dietrich, 2001). A considerable share of the wine produced is sold via direct sales to the consumer. At the 'Heurigen' the producers offer wine (or apple wine) and small snacks to visitors. Visiting such places is a popular recreation in Austria. Further initiatives concern local traditional markets or vertical integration efforts: e.g. the high-priced luxury resort Harbach, where a co-operation experiment started in the 1990s and in which contracting farmers get premium prices for organic food of excellent quality (Neumayr, 2001). Moder (1997) reports about innovative marketing initiatives in mountainous areas and the role of labels specifying the regional origin is analysed in Ankers (1997).

From a conceptional point of view contracts between enterprises in the tourist business and farms could be an adequate way to deal with positive external effects generated by agriculture in tourist regions (Hofreither, 1993). In some regions, this is actually happening. Resch (1995) reports that farmers in 20 communities in the Central Alps receive premiums financed from local taxes (a total of 145,000 euros have been paid annually for 10,000 hectares). Hackl, Halla and Pruckner (2007) explore in detail local compensation payments for agri-environmental externalities. According to the authors such payments result from political bargaining at the municipal level. The probability of introducing compensation payments depends positively on the benefits of landscape amenities. Compensation payments mainly occur in communities where the provision of agricultural landscape services is perceived as relatively low and the diversity of the countryside seems to be endangered. In some instances, there is farmer-consumer co-operation providing local environmental goods in the form of clubs (Schlederer, 1995). There is evidence that ecological goods are provided by private clubs as well (e.g. World Wide Fund for Nature). However, only on survey of such initiatives exists (Tiefenbach, 1993). The club Alpenverein (270,000 members) offers recreational services to its members by providing shelter in mountainous areas. It maintains trails in Alpine regions and is involved in nature conservation activities (among others, it is a founding member of the national park Hohe Tauern). Other nature conservation clubs (e.g. Naturschutzbund Österreich) lease farm land and/or negotiate management contracts with farmers. An up-to-date analysis of such activities is not available, but the list of initiatives reported in ÖKOBÜRO (1995) suggests that private conservation clubs actually play a role. According to Lughofer (2001) no Austrian conservation club has the ambition of becoming a big land-owner; one of their major activities lies in lobbying for publicly provided nature conservation activities.

Hofreither (1999) presents some innovative approaches that would allow for a more efficient provision of public goods offered by farmers. For several non-commodity outputs of agriculture, public auctions could be an appropriate way to obtain a given quantity at the least cost. Another way to increase efficiency would be to establish contracts with farmers that are goal- and outcome-oriented as opposed to a measure-oriented way which dominates at presents. Whether such approaches — if employed by private parties — would lead to private co-operation, or if such mechanisms could stimulate private demand, is an issue that should be investigated.

Vogel (2000) looks at this issue from a different perspective: he analysed the factors determining innovations in rural areas. He also identified several reasons that contribute to projects to fail: free-rider behaviour in groups; external opposition against new, innovative ideas; heterogeneous interests within groups; and incompatible strategic goals of farm households. The initiatives from which Vogel obtained his findings were producing private output but it seems that the same or rather similar reasons might prevent private co-operation.

Before private arrangement can be made, property rights need to be allocated. This is a distributional and thus an equity issue. Sinabell et al. (1999) point out that depending on how property rights are actually distributed, efficient policies may have quite different outcomes. The conceptual example given is the following: in country A the land owner has the right to use the land in an unrestricted way, while in country B restrictions on land use exist because of nature conservation laws. To provide a certain level of conservation it may be optimal to pay a premium to the farmer in country A, while the farmer in country B cannot claim such payments. The authors did not analyse such a situation empirically.

3.7. Evidence for negative externalities of Austrian agriculture

Early overviews of negative external effects of Austrian are provided in Hofreither and Sinabell (1994) and Sinabell (1995). Only a few articles exist on estimates of monetary damages due to negative externalities of Austrian agriculture. No attempt was made to analyse a problem in such a way as to identify a point of "optimal pollution". Therefore little can be said whether a given external effect actually is causing damage or not from a Pareto-efficiency point of view. To obtain such results would not be easy because of the second-best situation in the current state. However, something can be said about the likely direction of change in case prices for agricultural output decrease or increase.

Readers who compare the elements listed in Table 7 with those in the original sources will notice that some negative external effects are missing (e.g. environmental damage done due to drainage or emissions due to the burning of straw on the fields). There are several reasons for assuming that the situation has been improving during the last decade:

- several environmentally counter-productive subsidies no longer exist and environmental regulation has become more stringent in some cases (output linked direct payments have been abolished in the EU CAP reform of 2003; the Nitrate Directive limits the use of fertilisers);

- prices for agricultural products generally decreased, which has brought about a decrease of input intensity (the EU accession brought about a drop of 21% for agricultural products);
- crop protection substances that may be used today have smaller environmental impacts and the number of substances has decreased significantly;
- agri-environmental measures aiming at extensification have been adopted at a large scale by farmers since 1995 and quantitative analyses based on models capturing causal relationships indicate positive effects of the environmental programme (Hofreither et al., 2000).

In order to back the assumption by empirical evidence it would be necessary to compare time-series data on environmental indicators over a longer time period or to have models at hand that are able to capture causal relationships between economic activity and environmental outcomes. Data are available only for the case of nitrate in water (see below) over a longer time period, but efforts are underway to regularly measure a diverse set of indicators in Austrian sample regions (BMLF, 1998a,b; BMLFUW, 2004).

In Table 7 small arrows indicate the likely direction of change of the external effect in question if prices for agricultural products decline. The indicated directions are best guesses and not backed by empirical studies in Austria or by model results for the Austrian farm sector. One underlying assumption is that only output prices change while other variables are kept constant, in particular technology. This is a crucial assumption because model results obtained by Hofreither et al. (2000) for a region in Austria show that choices about tillage practices (technology) have an important effect on environmental outcomes.

The studies listed above observe and/or analyse physical linkages and technological interdependencies between agricultural activity or current farming practice and the given external effect. In the following situations, the listed studies show that a correlation between output levels (crop yields per hectare, or heads of livestock per unit land) and a negative externality exists:

- in the case of gaseous emissions due to livestock production (methane of ruminants, compounds of nitrogen and bad smells of manure; in the studies mentioned, an average technology and a reference diet for livestock is used),
- in the case of eutrophication, water pollution and groundwater depletion due to irrigation (although there is no direct link with output, the studies show that more extensive ways of production as well as more adequate equipment and management cause less environmental harm);
- in the case of overuse of marginal land and grazing in forests (the damage done is proportional to the heads of livestock).

Table 7: Early literature on negative external effects of Austrian agriculture, affected parties, and likely direction of change in case of lower prices for agricultural commodities

item	likely direction of change	external effect	technical relationship (examples)	affected party	representative source(s)
1	↑	loss of landscape elements	land use (with machines)	visitors, local residents	Liebel *et al.*, 1986
2		loss of species	pesticides, loss of habitats	society (global), hunters	Liebel *et al.*, 1986; Onderscheka, 1978
3	↓	soil erosion	inadequate tillage, some crops	hydropower producers	Aichberger, 1999; Klaghofer, 1997; Summer, 1989, UBA, 1988
4	↓	CO_2-emission	turn grassland in arable land	society (global)	Sinabell, 1996; Kopetz, 1997
5	↓	other gases and bad smells	livestock production	society (global; neighbours)	Klaasen, 1994; Knoflacher et al., 1992; Orthofer, 1988; Schütz and Steinmüller, 1997; Womastek, 1992
6	↓	eutrophication, water pollution	runoff of nutrient, emission of nutrients and pesticides into groundwater	water users (local and down-stream)	Hofreither, 1996*b*; Hofreither *et al.*,2000; Hofreither and Sinabell, 1998; Gerhold, 1990; Gerhold, 1993; Götz, 1998; Schweiger and Brandstetter, 1993; Sinabell, 1999; Wagner, 1998;
7		accumulation of heavy metals	fertilisers, use of sewage sludge	farmer, society (option value)	UBA, 1988; Blum and Wenzel, 1989
8		damage of archaeological objects	fertiliser use, tillage	society (global)	Blum and Wenzel, 1989
9		animal welfare	livestock production	consumers	Konrad, 1993
10	↓	depletion of groundwater	Irrigation	water users (local)	Hofreither *et al.*, 1996
11		separation of habitats - loss of species	ways, streets	society (global)	Liebel *et al.*, 1986
12	↓	over-use of marginal land	Alpine grazing	society (local; global)	Moser 1999; Spatz, 1988
13	↓	grazing in forests	Alpine grazing	forest owners	ÖROK, 1993

Several studies analysed negative external effects directly or indirectly linked to the use of inputs. How these inputs are linked to outputs is not analysed in these studies but a positive correlation is generally assumed. Onderscheka (1978) reports on negative effects of pesticides with respect to the loss of species; Womastek (1992) analyses drifting herbicides that may cause damage in neighbour fields. The accumulation with heavy metals in soils is linked with the use of mineral fertilisers and / or sewage sludge (UBA, 1988). In the Austrian agri-environmental program, there are several measures that aim at preventing such effects.

Farming technologies and practices have also an impact: The loss of landscape elements may be due to mechanisation; the loss of species may depend on the kind of pesticides used, minimum tillage systems help reduce erosion, constructions and special machinery help reduce gaseous emissions and nutrient runoff, efficient irrigation technologies reduce water demand. Concerning grazing of Alpine grassland, grass could be mown by hand or special equipment. The type of land-use (and not yields) plays an important role in the context of global warming; if grassland is converted to arable land, a considerable amount of CO_2 is released into the atmosphere (Sinabell, 1996). Participants of the 'elementary support' scheme of the Austrian agri-environmental programme introduced in 1995 committed themselves not to turn grassland into arable land. In the meantime this restriction on the use of land has become an element of very specific measures in the Programme for Rural Development (BMLFUW, 2007a).

In the literature the argument is brought forward that small-scale agriculture (as opposed to large farm units) is positively linked to the existence of landscape elements and structures. Some structures (bushes, stone-walls) are seen essential for species, others (like wooden fences as opposed to wire-fences) are elements of a picturesque rural landscape.

Numerous attempts have been made to reduce negative external effects, frequently as command-and-control measures and design standards. In Austria, there is no study that estimates the cost farmers incurred to adopt more adequate production technologies in order to comply with environmental standards. However, such estimates can in principle be obtained relatively easy (by collecting market prices of machinery and buildings). Other measures include the leasing or the purchase of land for use as a natural reserve by public authorities or conservation clubs. Estimates for such costs do not exist. The actual expenditures could be obtained by analysing public budgets or asking representatives of private initiatives.

Low intensity agriculture (meaning fewer inputs per unit output) reduces not only crop yields but also the total amount of nutrients lost in the case of plant production. However, a failed harvest (e.g. due to hail) may in fact increase nutrient losses because the damaged crop cannot use the minerals. Reducing the output of milk per cow may increase the gaseous emission per unit milk. The extreme form of low-input agriculture, organic farming, frequently requires to change the whole process of plant and livestock production. While the use of non-farm inputs (pesticides, many fertilisers) definitely is reduced to zero in this kind of farming many other side-effects have not yet been investigated.

The only indicator for which sufficient data are available in this context is nitrate in groundwater. A monitoring programme exists with sample plots all over the country and samples were taken before and after 1995, the year when substantial price drops were observed. According to current data (BMLFUW, 2006) the average nitrate content is relatively stable. A downward trend as indicated in Table 7 could not be verified for all regions. Two explanations can be found (Eder et al., 2000, Chapter 8): the time span for less polluted percolation water to reach groundwater is too short and/or the fact that prices for fertilisers dropped as well left fertiliser consumption unchanged. A further explanation could be an inelastic demand for mineral fertilisers (Hofreither and Sinabell, 1998). Even if nitrate concentrations in most places are relatively stable, changes took place. The share of sampling plots with nitrate concentrations above 45 mg/l declined from 18.2% in 1995 to 13.7% in 2004 (BMLFUW, 2006). This progress probably is due to several factors including nitrate related measures in the programme of rural development.

The spatial dimension and the degree of excludability and rivalry is indicated in the column "affected party" in Table 7. The underlying assumption was made that as far as the loss of rare species is concerned society as a whole might be negatively affected (items 2 and 11). This actually may not be true because even if a species is lost in Austria in another country the risk of extinction may be small for the same species. However, if the so called "red lists" are accepted as an indicator for the threat of extinction, then there is evidence that such an externality actually exists. Other effects of global concern comprise gaseous emissions (some of them are only regionally relevant, bad odour only locally) and the loss of cultural heritage (archaeological objects; singular landscapes). Empirical studies verifying that Austrian cultural heritage (items 1 and 8) is part of the existence value of global citizens are not known. The fact that some regions and sites are inscribed in the UNESCO List of World Heritage (e.g. the valley Wachau along the river Danube to the West of Vienna) may be an indication that it is actually the case.

Other negative external effects are affecting users of the same resource (item 6 as far as a common pool resource is concerned or 12 and 13 which is a common property) or downstream users (items 3 and 6).

Institutions for voluntary agreements to reduce the external effects have been established in the case of grazing in forests. In this case, the number of parties involved is small and therefore chances to find optimal agreements are good from a theoretical point of view. Other kinds of non-governmental agreements over the reduction of external effects concern co-operations between farmers and hunters (e.g. in a club called Distelverein).

Other measures implemented to reduce the amount of negative external effects are advice and information. Information about environmental problems is part of the training of young farmers and the code of good agricultural practices and recommendations for adequate fertilisation are communicated by authorities and advisory staff. A research project on the effect of intensive advice for farmers in nitrate vulnerable zones shows that changing traditional behaviour by means of information and demonstration is very costly (as reported in Eder et al., 2000, Chapter 7). Such initiatives were extended in the Programme for Rural Development for the period 2007 – 2013.

Agri-environmental measures that form the basis of private contracts between farmers and bodies responsible for carrying out a specific measure can be viewed as belonging here. This kind of co-operation is of major importance in Austria (70% of all farms are participants in one or the other scheme). However, listing this form of co-operation here may be challenged on the ground that it is actually public money that is offered to farmers to reduce a negative external effect.

The Austrian agri-environmental programme offers several measures that are focused on reducing negative external effects. Participants of the scheme 'basic support' may not remove landscape elements, other measures are aiming at the reduction of inputs, the adoption of soil conservation practices, the management of habitats, and limits on livestock densities. More details on this programme are presented in Annex II.

3.8. Making multifunctionality operational in a non-commodity output framework

Very few studies reviewed in this sub-chapter attempt to estimate the economic value of positive as well as negative non-commodity outputs of Austrian agriculture. No study exists showing what the likely net-welfare effect would be in case agricultural prices were lower. No study could be found in which the marginal cost of providing a positively valued non-commodity output is compared with its marginal social benefit. There is also no study comparing the marginal abatement cost of negative externality with the marginal social costs of the externality. In only a few cases are indicators of social benefits quantified empirically and linked to farm activity (but not directly to the level of output or prices). There is some empirical evidence that indicators of environmental damage are linked with agricultural output and in several cases the conclusion can be drawn that lower prices will result in less environmental harm. There is no study that systematically analysis the effects of commodity price changes on indicators of negative and positive external effects.

Concerning positively valued non-commodity outputs, the review of the literature presented in the second sub-chapter shows evidence of market failures. Various mechanisms and arrangements are in place to internalise positive external effects provided by agriculture and to stimulate the production of outputs that have the character of local or pure public goods. Public authorities are demanding ecological services in greater quantity, mostly financed by the programme of rural development. Thus market failures are (partly) corrected. Whether the quantity demanded is 'right' from a welfare economics point of view has not yet been analysed. There could be an over- as well as under-supply. Up to now, benefit-cost-analyses are not a standard tool for decision-making in the field of nature conservation policies in Austria.

In several cases, agriculture seems to be the only activity available for the provision of specific ecological services. Such a strong relationship exists where there is a technical link between specialised species and certain (mostly extensive) agricultural practices. Several studies show that in many situations (in particular on Alpine pastures) a delicate balance must be found to choose the right level of intensity. Other positively valued non-commodity outputs (like the provision of open space) do not seem to be likewise closely linked to agricultural production. A systematic analysis on how the provision of such outputs is linked with the intensity of production has not yet been carried out.

There is evidence that several negative external effects can be reduced if commodity output declined and others no longer existed if land was used for forestry or other purposes. There is no systematic analysis that would allow conclusions as to whether potential negative external effects of other activities would cause more harm than agriculture or not. Lower prices are likely to have an effect not only on the intensity of farming, but also on the technology that would be used. Literature shows that landscape elements and small habitats are removed as a consequence of mechanisation. A change of prices might further induce such pressure and cause social cost. Evidence on this issue was found during the period of increasing farm commodity prices in Austria. If the same effect turns up in case of falling prices has not yet been analysed but it might indeed be the case.

The effects of lower prices for agricultural commodities are not easy to analyse because the interactions with existing agri-environmental measures have to be taken into account. Currently, a majority of Austrian farmers is participating in schemes which prevent the removal of landscape elements or the destruction of habitats. The existence of an agri-environmental program, therefore, may prevent potential environmental damage induced by lower prices. If it is true that some negative external effects are reduced when prices are lower (as some studies suggest), then other measures of agri-environmental programs aimed at preventing negative externalities may become obsolete. Some evidence on this issue is provided in the next chapter.

Summing up, a market failure linked with non-commodity outputs likely exists in the following cases: management of rural (open) landscapes, ecological functions, and natural damage and hazard control functions. In many cases research results suggest that a less intensive agricultural production would not impair some of these functions. However, this is highly dependent on spatial conditions. Alpine grassland, in particular, seems to provide many positively valued functions that probably cannot be supplied economically by using alternative technologies or less intensive practices. The literature suggests that the same is true in the case of semi-natural lands that are the habitat of rare species. The survey also showed that the Austrian agri-environmental programme is addressing many of these issues by promoting extensive farming practices on marginal land and by offering contracts to farmers for the management of semi-natural land. Results from studies evaluating the agri-environmental programme (BMLFUW, 2005) are not very conclusive. Most indicators used in the evaluation are not related to the environmental outcome but to the programme participation. There is one robust result: during the programme period groundwater quality improved slightly. However the causality is not very clear because agricultural output prices dropped also during the same period. further research — in particular economic valuations of marginal benefits and the marginal cost of the provision of positively valued non-comedy outputs at a regional level — is necessary to evaluate the tentative conclusions on empirical grounds.

4. An exploration of agricultural policy support and its impact on nitrate concentration in groundwater in Austria

4.1. Chapter overview

In the previous chapter negative external effects of agriculture were addressed and discussed. In Austria, one of the major pollutants is nitrate which is leaching into groundwater. Considerable efforts have been made in Austria to analyse the potential causes of this pollution and to identify policy options to reduce them (see Hofreither, Pardeller, Sinabell, 1996 and Hofreither and Sinabell, 1996 for early studies on this topic).

Regional nitrogen balances are an analytical tool that were developed in the 1990s. The reasoning is that there is a causal relationship between nitrogen surpluses and nitrate in the groundwater. The OECD publishes national nutrient balances for OECD member states as part of the environmental indicators of agriculture. Such balances are useful tools as far as whole countries or single farms are concerned. At other regional levels the information on the use of mineral fertiliser is generally missing and therefore balances have to be based on assumptions that may or may not be close to reality.

Given that there are no statistics on the use of mineral fertiliser and the level of manure application at regional and municipality scales, it is not at all straight forward to explain a given level of nitrate pollution in a spatial context. Hofreither and Rauchenberger (1995), Hofreither and Pardeller (1996), and Pardeller (1996) developed an econometric approach to overcome such data limitations by identifying a number of variables that are correlated with observed nitrate concentrations in groundwater.

These efforts show that nitrate concentrations in groundwater could partly be explained by soil and groundwater characteristics, by the level of rainfall during winter and by agricultural activities like maize cultivation. This general approach was the inspiration for this chapter. The idea is to use on the one hand variables that are fixed and not influenced by agricultural activities to explain nitrate pollution and to add variables describing agriculture to find econometric models with a better fit to observed data of nitrate in groundwater.

The reminder of the chapter is structured as follows: In the next sub-chapter, a simple analytical model is presented that shows how a causal relationship between a production activity and a negative external effect can be conceived. Then previous studies that attempted to specify econometric models to explain nitrate pollution in Austria are reviewed and a short description of the current state follows. Next, an empirical model is presented that shows that both variables describing site conditions and variables describing agricultural activities are contributing to explaining the variance of nitrate in groundwater. A short discussion of the results and proposals for future research are closing this chapter.

4.2. Farm policy and negative external effects — a conceptual approach

The market price of an agricultural commodity should reflect its social opportunity cost. In practice, market prices are frequently different mainly due to market imperfections, the most important of which is government intervention (Saunders, 1996). The most frequently used indicator to measure market imperfection is the nominal protection coefficient (NPC) which is calculated by dividing the domestic price through the world market price of a given commodity. A NPC>1 indicates that there are distortions on the domestic market of this product. An approach to measure the social costs of agricultural output is to estimate the effective rate of protection (ERP) based on the concept of effective protection developed by Corden (1966). ERPs assume that the trading status of a country would be unchanged given no support, changes in domestic supply will not influence world market prices, and that there are fixed input/output coefficients. It is further assumed that there are no significant impacts on exchange rates, no transportation costs, no external effects of production, that there is homogeneity of production, and full employment of production factors. All these assumptions also underlie the concept of PSE (producer subsidy equivalent). The PSE was proposed to measure the income transfer to producers in a protected sector by Josling (1973).

Several authors deal in depth with this measure (among Tsakok, 1990; O'Conner et al., 1991) and show that policy measures with quite different effects on trade or production may have similar PSE values (Schwartz and Parker, 1988, Cahill and Legg, 1990) or investigating the influence the underlying assumptions have on the ranking of countries (Masters, 1993; Bureau and Kalaitzandonakes, 1995). Guyomard and Mahe (1993) analyse the effects production quota in combination with price support measures have on that indicator. None of these authors took account of the presence of external effects. In the next paragraphs a graphical model is used to demonstrate how this indicator is affected if external effects are no longer negligible.

PSE in its simplest form (the product specific market price support element of the producer support estimate, a measure developed by OECD) is frequently termed Subsidy Equivalent (SE) in the literature. The SE is calculated by multiplying the quantity of a good produced in a country where there is a tariff on imports times the difference between domestic and world market prices. In OECD-terminology, the subsidy equivalent is called market price support. All the information required to calculate the value of SE for a given period can be observed quite easily on markets (see Vousden, 1990, 32pp for an extensive treatment).

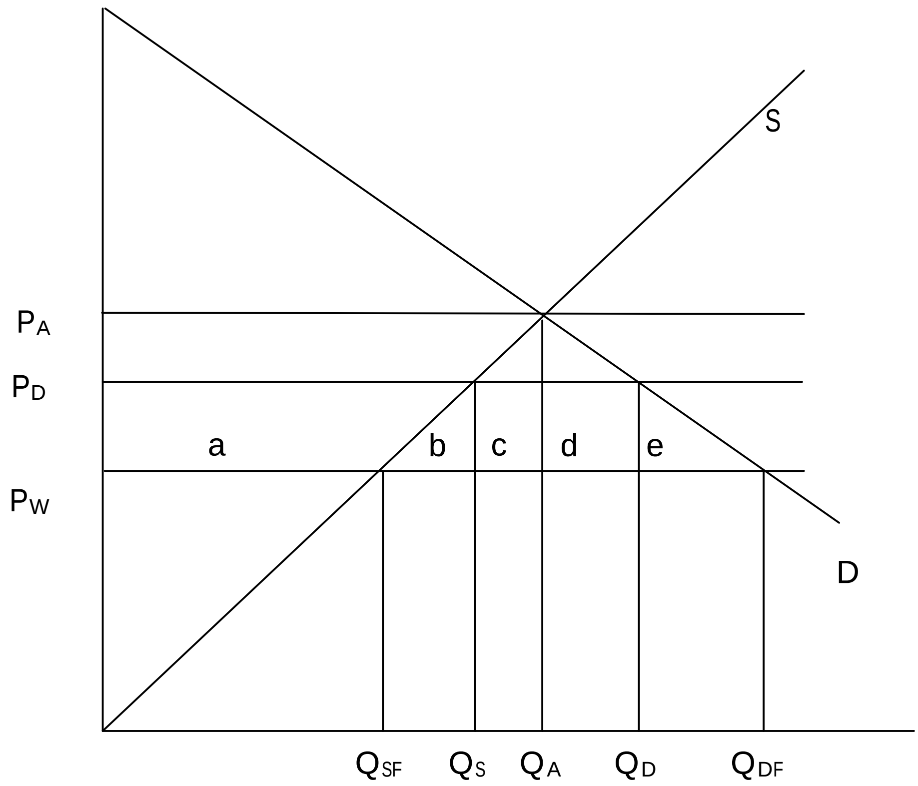

Figure 4: The Subsidy Equivalent SE in a partial equilibrium model

Source: Own construction based on Anderson, 1992.

Figure 4 shows the market situation of a small country. S and D are the supply and demand schedule. In autarky the market is cleared at a price P_A in which case the quantity Q_A is produced and consumed domestically. If world market price P_W is below the autarky price P_A the country can gain from trade. When trade is not restricted consumption increases to Q_{DF} and production declines to Q_{SF}. The benefit for the consumers is exceeding the loss of producer surplus and thus there are net welfare gains from trade.

The introduction of a trade restriction by a tariff reduces the benefits from free trade and part of the welfare losses can be measured by the Subsidy Equivalent (SE). The price for domestic producers and consumers after introducing a tariff is P_D. The SE is equal to area a+b which is equivalent to the market price support for producers (domestic production Q_S times tariff rate P_D-P_W). SE represents the transfer from consumers to producers a, and includes the social costs b which arise because of the additional production costs (for allocating resources to produce too much of the commodity in question). Summing up, SE is composed of both, transfers from consumers and social costs (SE=a+b). The loss of welfare resulting from this protectionist policy is illustrated by the triangles b and e. While b represents the additional production costs (also called 'production loss'), e is the consumer loss. The revenues of the tariff on the imports (Q_D minus Q_S) are equivalent to c+d.

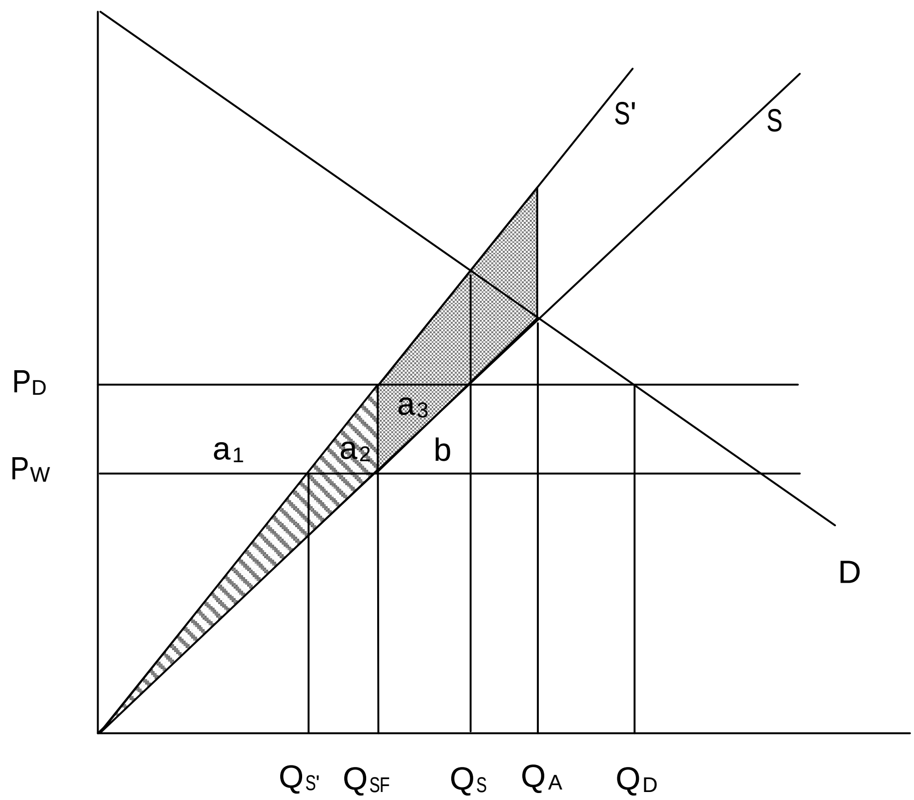

Figure 5: A partial equilibrium model with a negative external effect of production

Source: Own construction based on Anderson, 1992.

The relationship between a protection coefficient like the SE and a negative externality of production in the same market setup is shown in Figure 5. As in the previous example, the country is small and therefore its policies do not affect world market prices. Production (but not consumption) of this good is pollutive. The marginal social costs of production are represented by S'. In practice, social and private costs may not diverge until the level of production has passed a certain threshold, and may not diverge increasingly over all output ranges, but the exposition is simpler and loses no generality by depicting all curves as linear with the divergence beginning with the first unit of production (Anderson, 1992).

Given these assumptions Q_A would be the equilibrium level of production and consumption in the absence of both a pollution tax and international trade. Compared to the situation in Figure 4 net social welfare is reduced by the additional social costs equivalent to the grey area and the grey shaded area because of the external costs.

Liberalizing trade in this good whose production is pollutive improves the small country's environment and welfare if, following the policy change, the country imports this good. The improvements have two components: the gains from trade (the net benefit of consumer surplus and the loss of producer surplus) and lower external costs because production is reduced from Q_A to the Q_{SF}. The reduction of social costs due to smaller external effects is shown in Figure 5 as the grey area to the right of Q_{SF}.

Compared to the free-trade scenario, restricting trade by a tariff raises prices from P_W to P_D. This leads to the social costs (b and e as discussed before). Another source of social costs are those induced by the production expansion and its external effect (the grey area between Q_{SF} and Q_S). A comparison between the two models shows that the SE (SE=a+b in Figure 4 and SE=a_1+a_2+a_3+b in Figure 5) includes part of the social costs of the negative external effect (a_2 and a_3 in Figure 5) and part of the social costs due to the tariff (b).

The model presented in Figure 5 describes a situation in which an agricultural policy (a tariff on imports) leads to social costs which are proportional to SE. If production is associated with a negative external effect as shown in Figure 5, the SE is proportional to the social cost. In this model a smaller difference between P_D and P_W reduces not only the SE but also the social costs due to the negative external effect. But there is not a one-to-one relationship between the SE and the social costs in the presence of external effects of production. If SE is zero (when $P_D = P_W$) one part of social costs – induced by the tariff – would vanish but there would still remain social costs associated with the external effect of production (equivalent to the shaded grey area which spans from the origin to Q_{SF}). Internalising the social costs of the negative external effect would require to shift production to S' which could be induced by an environmental tax. In this case production would further decline to $Q_{S'}$ and the imports would further increase.

The SE can be observed relatively easily by calculating the price difference between international and domestic prices and multiplying it with the output (Q_S), thus calculating the market price support according to the OECD PSE calculation procedure. If the real situation is similar to the simple model shown in Figure 5, the relationship between the SE and the external effect could be estimated in an empirical setting. This would allow the evaluation of benefits from liberalizing trade including the reduction of external costs. However, given the imponderabilia of the actual situation in the real world one has to be aware that the a proportional relationship between the SE and the total social costs may not be given. The actual relationships between production and external damages (measured in terms of social costs) are likely far more complex than in the model of Figure 5 which was chosen because of its simplicity.

The argument of Maier and Steenblik (1995) is that an abolition of the tariff on imports could already lead to a dramatic reduction of social cost: The only source of inefficiencies remaining would be the environmental costs. If the environmental damage was proportional to output, a tax on production could reduce it even further to a socially optimal level left of $Q_{S'}$. Empirical estimates of the relationships are necessary to quantify the benefits and the necessary tax rates. In the next sub-chapter first steps of such an undertaking are presented.

4.3. Farm support and environmental outcomes – groundwater quality in Austria in the 1990s

In this sub-chapter a simple model is presented that establishes a link between an indicator of environmental outcomes and social costs: If we assume that polluted drinking water can be blended with unpolluted water and blending is the cheapest option, then social costs are linear to the nitrate concentration in the polluted water:

(1) $SC = a * NO_3conc.$

SC is the social cost of one litre polluted water. Blending it with unpolluted water until the drinking water standards are met is depending on its NO_3 concentration and the linear term a. The difficult task is to obtain a good model which explains the level of nitrate concentration in a given region. A model consistent with Figure 5 could look like this:

(2) $NO_3conc = f(SE, x_1 \ldots, x_n).$

This model links the SE, the measure of agricultural market price support, and other explanatory variables $x_1 \ldots, x_n$ in a straight forward manner with the environmental indicator nitrate in groundwater. SE is not a perfect measure of the external effect. It is zero in case that domestic and reference prices are identical but social costs are present if there is a negative external effect of production as indicated in Figure 5. Equation (2) states that nitrate pollution will increase the higher the difference between domestic prices and reference prices is, which can be tested empirically.

The data for the empirical case study are from Austria in the mid 1990s when domestic prices were considerably above reference prices (like in Figure 5). A regional transfer indicator 'rti' was estimated for each municipality (Hofreither and Sinabell, 1994). This was constructed by dividing the national PSE by the level of each activity (crop production and livestock products) in all the municipalities and by adding non-product related transfers ('neutral rti') for each hectare of agricultural land. The crop and livestock specific regional transfer indicators and the non product related transfers can be divided by the the agricultural land per municipality to show different levels of support at a sub-national level.

The variables x_n of equation (2) are describing the natural environment. Hofreither and Rauchenberger (1995), Hofreither and Pardeller (1996), and Pardeller (1996) developed a model with a small number of variables to explain nitrate concentration in groundwater in Austrian municipalities. Two of these variables which turned out to have consistently good explanatory power are used in the model listed below: the redox-potential of ground water and precipitation during the winter period. The regional nitrogen balance contributed to a lesser extent to explain the observations.

In an analysis presented by Hofreither and Sinabell (1995) the nutrient balances are substituted by regional transfer indicators which measure product specific market price support of crops ('mps-crops') and non-product specific PSE like support for mountain farming or advisory services ('rti-neutral') per hectare agricultural land. The log-linear model and its parameter estimates are:

$$NO_3conc = 104 - 5.02 \ln\text{-redox} - 11.07 \ln\text{-precip} + 2.29 \ln\text{-mps-crops} - 6.2 \ln \text{rti-neutral}$$

$$(4.9) \quad (-3.5) \quad (-3.6) \quad (3.8) \quad (-2.8)$$

These are the results of a model implementing (2) in a log-linear form. The figures in the line beneath give the t-values of the parameters. A total of 432 observations (municipalities for which observations were available) were included. The transfer indicators are an average of the year 1990 to 1993, groundwater data are from 1991. The corrected multiple correlation coefficient of the model is 0.45 which seems to be satisfactory given the simplicity of the model.

The positive regression coefficient of mps-crops indicates that higher nitrate concentrations are observed in municipalities where the crop specific market price support is high, whereas non-product related support (rti-neutral) tends to diminish nitrate concentrations. The parameters of redox potential and precipitation are both negative. Certain environmental conditions captured in the two variables therefore contribute to the decomposition or the dilution of nitrate in groundwater.

Several aspects have to be kept in mind when using an approach as the one presented:

- finding a model that explains nitrate concentration in groundwater using variables collected in a territorial context is a tedious task (approximately 2 person years were spent in collecting data and specifying models used in the analysis reported above);
- regional nitrogen balances turned out to be bad predictors of nitrate concentration in groundwater in Austria because in several models not reported here, the coefficients were not significantly different from zero;
- the lack of farm management variables (e.g. are there winter cover crops) is one explanation why the constant has such a large value in the estimated model;
- the lack of site specific information in the vicinity of the sampling plot is another explanation for the large value of the constant;
- the mineral nitrate content in autumn in top soils is a good predictor (see Hofreither, Pardeller and Sinabell, 1996) – however, this information is not available in Austria.

4.4. Agricultural support and nitrate concentration in groundwater — empirical findings

Nutrient balances have shown that there have been considerable nitrogen surpluses in Austria over long periods (Figure 6). Some of these nutrients percolated into the groundwater and polluted it. Nitrate concentrations in groundwater have been measured since the start of the sampling in the 1990s owing to the great public interest in water quality and the fact that the Water Framework Directive requires an improvement of polluted groundwater sources.

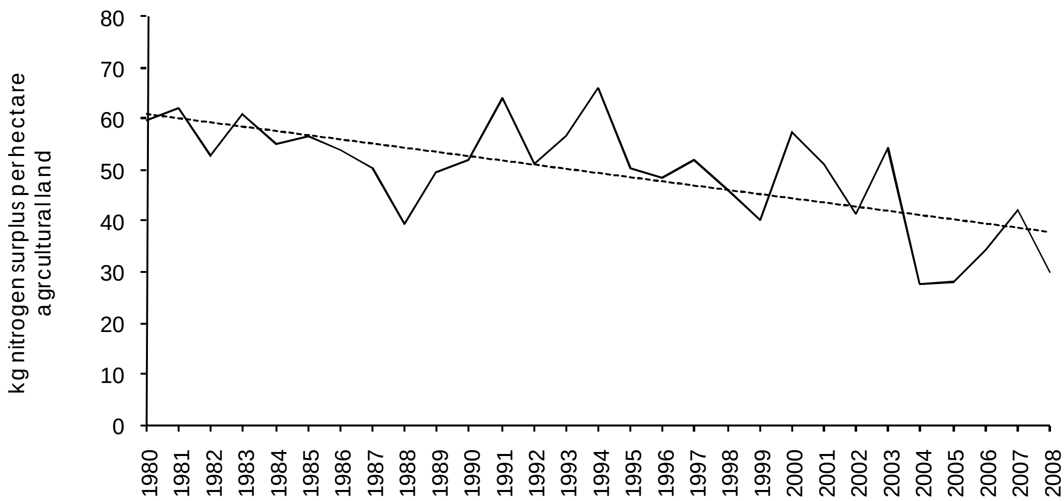

Figure 6: Nitrogen surplus in Austria (kg per hectare agricultural land) 1980 — 2008 and its trend

Source: Own calculations based on OECD-Nitrogen-Balances (http://www.oecd.org/document/29/0,3343,fr_2649_33793_1890205_1_1_1_1,00.html)

An updated data set was used to measure the change in nitrate pollution. Data from 2,738 sample plots were available; however only in very few cases data from a single sample plot were observed of a period of 18 years (1991 to 2008). Frequently it is the case that samples are taken from a given plot only for three to five years.

Aggregating these data is therefore difficult because not every sample plot offers the same quality of information. For the analysis presented below a subsample was drawn. Those sample plots were included in the analysis for which at least one observation was available during the first and the last five year period. Finally 1,226 sample plots could be used and for 667 municipalities a long term comparison was made. In 445 municipalities an improvement could be observed, on average nitrate concentration dropped by 5.8 mg/l. In the other 222 municipalities deterioration was observed (on average +9.7 mg/l; see Figure 7).

There are several possible explanations for an improvement of groundwater quality:

- farmers use less and less mineral nitrogen fertiliser, they are becoming ever more efficient because agricultural output has remained more or less constant during the last decades - one consequence is that the nitrogen surplus per hectare agricultural land according to the national nitrogen balance has been improving consistently over the last decades (Figure 6); the surplus is the difference between all sources of nitrogen inputs (atmospheric deposition, mineral and organic fertilizer, legume accumulation) and the withdrawals of crops;

- starting in 1995, an agri-environmental programme has been put in place that grants support for farmers who reduce the nutrient input and who implement best nutrient management practices on their farm;
- the EU nitrate directive (Council Directive 91/676/EEC of 12 Dec. 1991) was implemented in Austria regulating the minimum manure storage capacity, and time restrictions for the application of manure (BMLFUW, 1999);
- in several regions with high pollution levels, provincial governments have implemented regulations that contribute to a reduction of nitrate emission into the groundwater (Philippitsch and Grath, 2006);
- parallel to the efforts to make agriculture a more clean industry, great efforts have been made to reduce pollution by municipal sources, in particular by supporting the construction of sewers in rural regions with considerable public investments.

Data on the situation of groundwater pollution in the year 2004 were used for the application of the method described in the previous chapter (see Figure 8). The structure of the empirical model is very similar to the one described in the previous sub-chapter but another set of explanatory variables was chosen.

The nitrate concentration per municipality observed during winter 2004/2005 was put on the left-hand-side into a regression equation as introduced in (2). The data were provided by Umweltbundesamt. In municipalities with more than one sampling plot and in the cases with more than one observation during winter, the means of the observations were taken.

Given that not all variables used in the regression analysis presented in the previous sub-chapter were available, a new model had to be specified. The explanatory variables are described in more depth in the sources listed there. They are used in the model to explain the differences in variation between nitrate concentration at the level of municipalities in the winter 2004/2005.

The variables in the estimated models are

- the precipitation sum during the month October to March (long period averages) ;
- a soil quality index used by the financial administration (*Bodenklimazahl*) ;
- a dummy variable (1 if precipitation during winter is below 270 mm and 0 if it is higher);
- compensatory payments for less favoured areas (mainly mountain regions) in EUR/km^2;
- premiums of the measure 31 of the Austrian agri-environmental programme which compensates farmers who adopt water quality improving measures in EUR/km^2;
- market price support of various crops and livestock products in EUR/km^2 (the regional average yield per crop in tons is multiplied by specific market price support as published by the OECD);
- coupled direct livestock and crop payments in EUR/km^2;
- the withdrawals of nitrate from soil by agricultural crops (this is one side of the nitrogen balance of Austria — the inputs of nutrients are neglected);

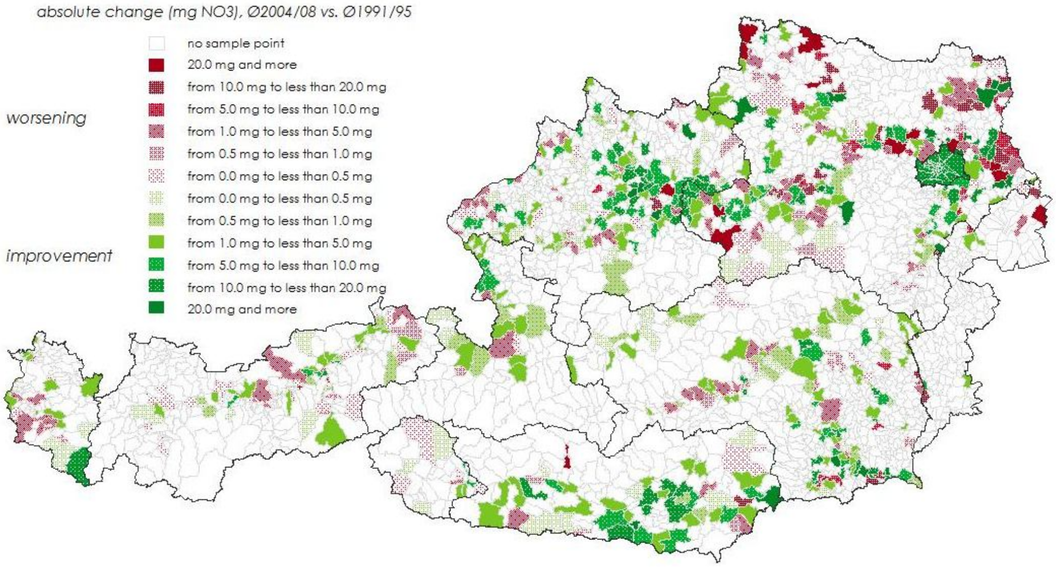

Figure 7: Improvement and deterioration of nitrate pollution of groundwater in Austria

Source: See below.

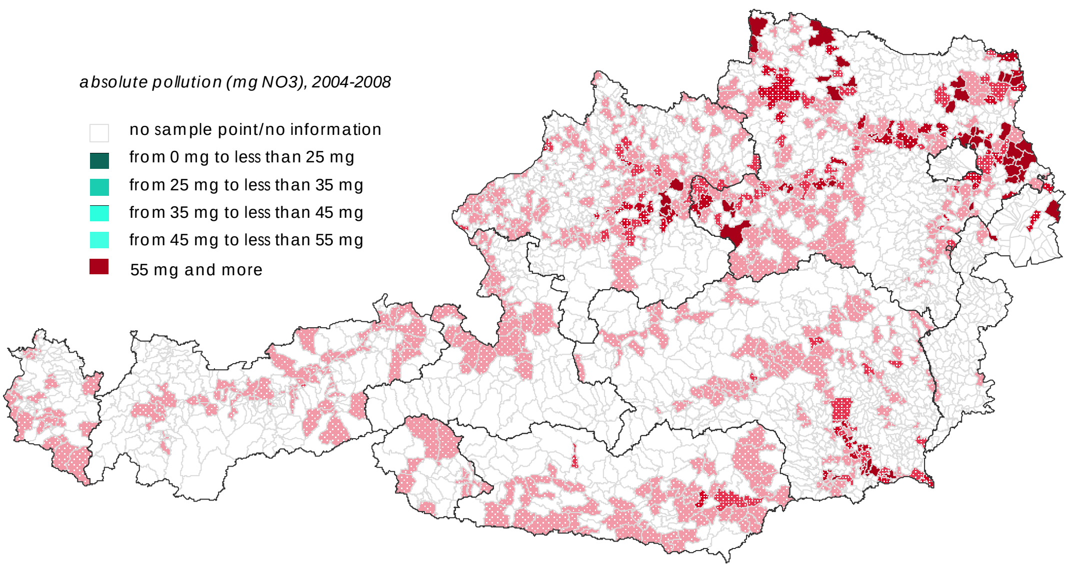

Figure 8: Nitrate pollution of groundwater in Austria, 2004-2008

Source: Erhebung der Wassergüte in Österreich gemäß Hydrographiegesetz i.d.F. des BGBl. Nr. 252/90 (gültig bis Dezember 2006) bzw. Gewässerzustandsüberwachung in Österreich gemäß Wasserrechtsgesetz, BGBl. I Nr. 123/06, i.d.g.F.; BMLFUW, Sektion VII/Abteilung 1 Nationale Wasserwirtschaft; Ämter der Landesregierungen. Umweltbundesamt 2009; own calculations.

Table 8: Estimates of a cross-section regression model to explain the variance of nitrate concentrations in Austrian municipalities in 2004

Variable	Coefficient	Std.error	t-statistics	p-value	Significance
Constant	-21.9515	16.346	-1.343	0.180	
Variables not affected by agricultural activities					
precipitation Oct. to March	-0.0087	0.005	-1.822	0.049	5%
ln soil quality (Bodenklimazahl)	5.8000	2.747	2.111	0.035	5%
dummy variable precipitation < 270 mm	9.3321	2.414	3.865	0.000	5%
square of population density	0.0000	0.000	2.280	0.023	5%
Variable related to agricultural nitrogen balance					
square of nitrogen withdrawal of crops / km^2	-0.1290	0.042	-3.057	0.002	5%
Support: not product and not output specific					
agri-environmental measure 31 EUR/km^2	0.0029	0.001	4.208	0.000	5%
compensatory payment EUR/km^2	0.0005	0.000	1.690	0.091	10%
Support product specific but not output specific					
coupled livestock payments EUR/km^2	0.0001	0.000	0.300	0.764	
coupled crop payments EUR/km^2	0.0011	0.000	5.250	0.000	5%
Support product and output specific					
mps grains without maize	-0.0031	0.010	-0.318	0.750	
mps maize	-0.0004	0.000	-0.797	0.426	
mps sugar	0.0002	0.000	2.447	0.015	5%
mps potatoes	0.0019	0.001	1.555	0.120	
mps pork	0.0005	0.000	2.796	0.005	5%

Source: Own calculations; mps = product specific market price support; significant variables at 5% level indicated in the last column; the multiple correlation coefficient r of the model is 0.62, the coefficient of multiple determination r^2 is 0.37, number of observations 662 (municipalities with average nitrate concentrations exceeding 150 mg/l were eliminated).

In the course of the analysis, several more variables were used in more extended versions of the model but did not turn out the have explanatory power (e.g. nitrogen surplus). Variables related to the level of production (e.g. number of livestock units) were not used because of multicollinearity concerns (premiums and thus market price support are directly related to the activity levels of crop and livestock production). All variables used in the analysis are at the level of municipalities. The major sources are public authorities (Ministry of Finance and Ministry of Agriculture and Forestry, Environment and Water Management), Statistik Austria (the Austrian statistical office). The two most important data sources are IACS-data from 2004 which where aggregated at the municipality level and data from the 2001 agricultural census.

Several models consistent with (2) were estimated. In a first round, variables were included that are not specific to agriculture like the quality of soil (measured by the *Bodenklimazahl*), precipitation and population density. Models with such variables can explain more than a third of the variance of nitrate in groundwater.

The idea to include variables that are specific to agriculture is to obtain a better model fit and by this to demonstrate that agricultural activities actually have an impact on the level of nitrate in groundwater. Details of the estimated parameters of the models and test statistics are reported in Table 8 which summarizes a model with an acceptable fit. This model has a multiple correlation coefficient r of 0.62 with a coefficient of multiple determination r^2 of 0.37.

The results show that site specific factors like soil quality and long year average precipitation are excellent explanatory variables. This confirms the findings of previous analyses.

Interpretation of the results

a) Variables that are not affected by agricultural activities explain approximately 25% of the variance of nitrate concentrations in Austrian groundwater at municipality level:

- precipitation during the winter period is significant — the more rain or snow falls, the lower is the concentration of nitrate in groundwater, this seems to be a diluting effect due to rainfall and snow; given that only one year was analysed the consequences of frost periods are not accounted for;
- soil quality (measured by *Bodenklimazahl*) is significant, by using the logarithm (indicated by ln), the significance was improved — it seems that better soils make it worthwhile to use nitrogen more intensively and thus increase the risk of nutrient losses;
- a dummy variable that is 1 in municipalities with precipitation during winter lower than 270 mm indicates that dry regions are specifically different from other regions; the positive sign of the coefficient indicates that drier regions are more prone to nitrate emissions;
- population density matters, the more people live in a region, the higher is nitrate pollution — however the very small coefficient is an indicator that there is only a very weak link; the hypothesis is that more people generate more waste water and leaking sewage pipes may release nutrients into the groundwater;

b) Variables that are linked to the national nitrogen balance:

- regional nitrate balances were estimated by making several assumptions: a) the same technical coefficients (e.g. nitrogen content of manure and production of manure per livestock unit) in all municipalities; b) withdrawals of nutrients by crops are based on average yields per crop in 2004; c) the level of organic fertiliser per municipality is given by the number of livestock (accounting for different types of animals); d) the level of mineral fertiliser per municipality was determined by the remaining nutrient deficit e) the sum of deficits over all municipalities is far less than the amount of mineral fertiliser bought in 2004 – this surplus was equally distributed depending on the assumed nutrient uptake of crops; these balances did not yield any significant coefficient;
- the only explanatory variable with a significant coefficient is the withdrawal of nitrogen from soil by agricultural crops (the square of the variable improves the significance level); per hectare outputs are not observed at the level of municipalities — instead the per hectare yields of provinces were used to estimate the harvest per municipality;

- nitrogen balances therefore may be an important source of information at national levels where aggregate information is available and it may also be useful in a farm specific context, but it seems that regional nitrate balances that are based on estimates using uniform technical coefficients do not have much explanatory power;

c) Variables of agricultural support measures that are neither output nor product specific:

- one variable that is consistently significant in any model is the premium of the agri-environmental measure 31 that is support for farms to adopt nutrient management practices that go beyond the obligations of the nitrate directive;
- the fact that the coefficient is positive should be interpreted that this measure is in fact targeted to the regions with high concentration levels — whether it is effective or not can only be judged in a pooled-data analysis where the time domain plays a role;
- compensatory payments for farms in less favoured areas are a large expenditure of the Programme for Rural Development in Austria — the fact that the coefficient is not significant is an indication that this type of support is not correlated with nitrate pollution; one explanation is that this support is not output linked (but requires minimum stocking rates of livestock per hectare) and therefore not contributing to potentially environmental side effects, another explanation is that site characteristics (e.g. the large share of grassland) compensate any production related effects;

d) variables of agricultural support measures that are product specific but not output specific:

- coupled livestock premiums (mainly for bulls, suckler cows, heifers, sheep and goats) are not significantly correlated with nitrate emission;
- coupled crop premiums (for cereals, pulses, oilseeds) are significantly and positively correlated to the level of nitrate in groundwater — this indicates that even if there is no incentive on the level of output, that the production incentive as such has an impact on agricultural intensity and the external effect;

e) support that is product and output specific — market price support (introduced as SE in at the beginning of the chapter):

- the SE measures the product specific support due to differences between domestic prices and reference prices;
- the results show that for two products (sugar beet and pork) market price support indeed is significant and positive; the reason may be that pig fattening requires feed concentrates that are not produced on farm and part of the nutrients finally ends up in the manure that is spread on local fields;

- market price support of other products is not significant; in most cases product prices in the EU were very close to international reference prices, therefore the market price support was very small;
- other products with high market price support like milk did not turn out to be significant, probably owing to the fact that milk production is not a groundwater polluting activity in Austria given the specific technology.

4.5. Conclusions and directions of future research

Estimates of regional PSEs have been used in several studies (Hofreither and Sinabell, 1995; Anders et al., 2004, Harsche, 2006) to show the regional consequences of agricultural support measures. These studies show that sub-national PSEs can be estimated in a straight forward manner if some assumptions are made. If an indicator is explained by PSEs it has to be kept in mind that widely used indicators (like nutrient balances) may turn out to be poor explanatory variables for a given environmental outcome (e.g. nitrate in groundwater in Austria) if they are not based on observations but on estimates with uniform coefficients for heterogeneous regions.

Finding relations between various measures of support and environmental outcomes as presented here is not unproblematic. Correlations with plausible but nevertheless somewhat arbitrary variables cannot be a substitute for a detailed, spatially diversified, and integrated model (see e.g. Hofreither et al, 2000). The best option is probably a combined approach which uses the strength of both approaches: the empirical evidence of models that are similar to those presented here and integrated bio-physical models that describe the flow of nutrients in a detailed manner (e.g. Schmid, Sinabell, and Liebhard, 2004).

The approach presented here seems to be very promising if it is possible to address spatial issues in a coherent manner. It is very likely that samples that are taken from the same groundwater body have similar nitrate concentrations. To control for heterogeneity of the explained variable when heterogeneity is correlated with the explanatory variables, a fixed effects model should be analysed. Another approach would be to employ spatial econometrics models.

Even if the approach presented in this chapter has several limitations, one advantage over alternative approaches is that conclusions can be drawn for whole countries or regions. Another further step to enhance the analysis could be pooled data analysis that addresses the levels of change of nitrate pollution. However, the construction of detailed data sets that cover a whole period is very resource intensive and eventually does not overcome the principle problem, that complex natural processes can only partially be analysed by the types of models employed here.

The results presented in this chapter provide significant evidence that nitrate concentration in groundwater was and is correlated with the level of support to particular agricultural activities. This conclusion holds for the analysis in both periods for 1990 (which was analysed by Hofreither and Sinabell, 1996) and for the more recent year 2004. The fact that the level of pollution was declining in most municipalities is an indicator that something has changed in these regions in a favourable way. Further research is necessary to identify the concrete reasons. This would allow addressing this issue in an even more targeted way then previously possible.

5. The Programme for Rural Development in Austria: modelled impacts in regional economies

5.1. Introduction

In May 2006, the decision making institutions of the EU reached an agreement on the financial perspective for the period 2007 — 2013. The EU Council, Parliament and Commission decided to allocate EUR 371 billions for Common Agricultural Policy (CAP) measures. Of this amount EUR 293 billions will be used for market related instruments (e.g. single farm payments which were introduced in Austria in 2005). The rest, EUR 78 billions, will be spent on the Programme for Rural Development (PRD), dubbed the 'second pillar' of the CAP.

In this chapter, an ex-ante analysis of the inter- and intra-regional consequences of the PRD in Austrian regional economies is presented. The 'Green Pact' scenario, the programme submitted for approbation to the Commission in 2006 is one scenario and it is compared to an alternative scenario in which less money would have been available for the Programme for Rural Development in Austria. The results obtained are for the country as a whole and for rural and non-rural sub-regions at NUTS-2-level.

The objective of the analysis is to evaluate the economic consequences of the Programme for Rural Development for rural (PRD) and non-rural regions. Inter-regional spillovers and their impact on the development of the two types of regions are taken into consideration explicitly. Austria is chosen because of the eminent role of this programme for the agricultural sector. Austria accounts for 1.7 % of total agricultural output in EU-27 but will get 4.4% of the total PRD funds until 2013.

There are several general equilibrium models analysing CAP issues which are available at national or EU levels (e.g. GTAP). Most regional models for agricultural policy analyses are either limited to the agricultural sector (e.g. CAPRI) or to a part of the country in which agriculture plays an important role (Psaltopoulos et al., 2006). Here, a multi-regional input-output model of the whole Austrian economy is presented which captures both, the agricultural sector and agricultural policies in a very detailed manner. The study attempts to evaluate the regional consequences of a rural development policy experiment for the whole country as Kilkenny (1993) did for the US. Kilkenny has used a computable generel equilibrium (CGE) model of the US economy. In this case, an econometric model of nine Austrian subregions will be used to aggregate results on rural and non-rural regions. The most important measures of the PRD are accounted for explicitly and the model is calibrated to data observed during the previous PRD (2000 — 2006).

The rest of this chapter is structured as follows:

- Firstly, a framework of rural development from a territorial perspective is presented and key indicators showing the performance of rural regions compared to other ones in Austria are reviewed.

- Secondly, a regionally differentiated model of the Austrian economy is presented which represents the downstream and upstream linkages of the agricultural sector in a very detailed manner. This model is linked to an agricultural sector model which includes most measures from the Austrian PRD.
- Thirdly, a review of major elements of the PRD introduced in Austria in 2008 is given and the major differences to the previous programme are identified.
- Finally, economic consequences of the programme in rural and non-rural regions consistent with the OECD terminology are presented.

5.2. Rural development in Austria from a territorial perspective

The objectives of rural development policies were set out by the European Council of Göteborg (15 and 16 June 2001). The CAP should, among its objectives, contribute to achieve sustainable development by increasing its emphasis on encouraging healthy, high-quality products, and environmentally sustainable production methods. These principles were confirmed in the Lisbon strategy conclusions of the European Council of Thessaloniki (20 and 21 June 2003). According to it, the reformed CAP and rural development can make a key contribution to competitiveness and sustainable development. Economic growth and the creation of jobs in rural areas are among the key objectives of the Programme for Rural Development as laid down by the Community strategic guidelines for rural development for the programming period 2007 to 2013 (Council Decision 2006/144/EC).

Rural regions are usually characterized by low population densities and remoteness (see OECD, 2005). The consequences of these characteristics on regional growth have been a topic in the 'regional development' literature. The objectives of policies addressing rural and regional development are the same: high rates of economic growth and employment. Regions with a high growth potential have the ability to attract profitable firms that employ high skilled workers with high incomes. The population in such regions has high living standards and the regional performance can be measured by its GDP and job creation potential. Programs addressing rural viability should aim at fostering such capacities (Gardiner et al., 2004).

The regional GDP and the number of jobs created are well established indicators for the standard of living in a region and changes reveal to what extent a region is adjusting to or affected by a changing environment. Economic growth and employment are therefore the most important horizontal indicators of the evaluation process which are an integral part of the PRD (see Appenix F, DG Agriculture and Rural Development, 2006). Looking at both measures simultaneously is essential. If regional productivity (output per unit labour) grows but employment (hours of labour) drops because the least efficient firms close and workers are laid off, productivity growth may not be associated with any overall increase of output. Output matters because it determines the level of the living standard and the well-being of the population. In such circumstances, 'employment reduction is a negative route to raising regional productivity, and is to be contrasted with regions that have both high productivity and employment' (Gardiner et al., 2004).

Productivity and employment are indicators which are measured at regional scales and are therefore measures of 'revealed competitiveness' of regions. These variables do not capture all the complexities of an economy in a region: Factors of production other than labour are not accounted for directly, the flows of goods and capital are not considered, net balances of commuting workers between regions are not calculated and the quality of the environment is not measured directly. However, focussing on the growth of regional value added and on employment has the advantage that data are relatively easy to obtain and the two variables are sufficient to describe the economic performance of a region in a longer term perspective.

The OECD classification of regions differentiates between predominantly rural, predominantly urban, and intermediate regions. EU institutions adhere to this classification (see e.g. Council Decision 2006/114/EC). By taking other attributes than population density and remoteness, or delineating regions in another way, rural regions can be defined differently (an example is the ESPON classification; Bengs and Schmidt-Thomé, 2005). Therefore, it has to be kept in mind that 'rural regions' according to one classification are sometimes 'non-rural regions' according to another classification.

Depending on the territorial level, not all types of regions (predominantly rural, predominantly urban, and intermediate) are present in all OECD countries. In many EU member states, rural regions account for a considerable part of national value added. In many small EU countries rural regions contribute significantly larger shares to national GDP (Ireland and the Scandinavian countries) than in larger ones like Germany, United Kingdom, or Italy. The development – the rate of change – of key variables shows that rural regions are lagging behind compared to other regions in many countries (OECD, 2005). Rural population is declining in countries like Czech Republic, Finland, Germany, Sweden while it is faster growing in relatively densely populated small countries like Austria and Belgium. In almost all countries, rural per capita GDP is below country average. Addressing the development of rural regions in a tailored programme can therefore be justified by equity concerns.

The development of regional GDP in Austria is shown in detail in Figure 9. The graph in the left panel of the top row shows the variance of growth rates between the Austrian NUTS-3 regions. It shows that predominantly rural regions (diamonds) are both, among the slowest and the fastest growing regions. The growth rates of the different sectors of in the regions are shown in the other panels of Figure 9. The graph for the primary sector shows that in a considerable number of Austrian NUTS-3 regions it is the case that the primary sector is shrinking (quadrant II above horizontal axes) while the other sectors contribute to growth. Mainly rural regions are among them. — This situation is typical for many European regions and rural regions in OECD countries.

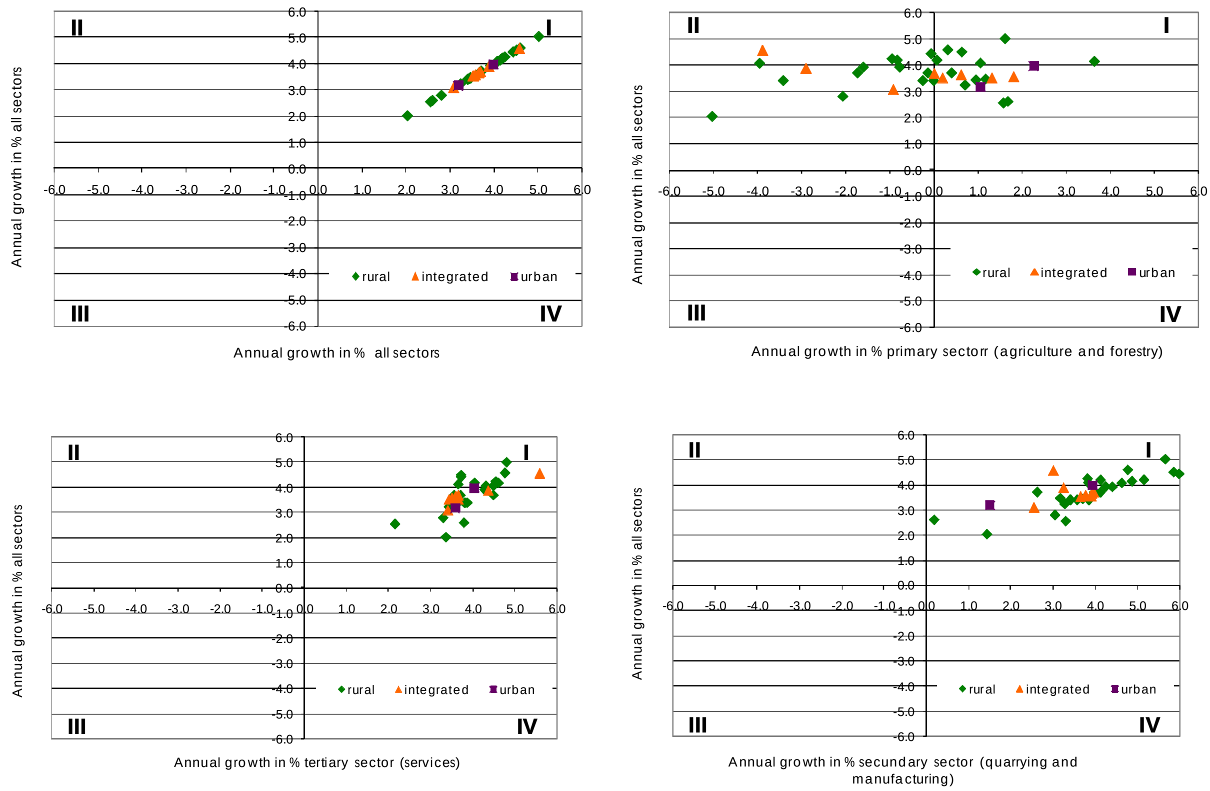

Figure 9: Annual growth rates in gross value added for all sectors, for agriculture and forestry, the secondary and tertiary sector in Austrian regions between 1995 and 2006 (nominal values)

Source: Statistik Austria regional statistics, 2009. Notes for the upper left panel: In quadrant II there are regions with declining agricultural gross value added (GVA) and increasing regional GDP; in quadrant I are regions with increasing agricultural GVA and increasing regional GDP; in quadrant IV are regions with increasing agricultural GVA and decreasing regional GDP; in quadrant III are regions with decreasing agricultural GVA and decreasing regional GDP.

In Austria the majority of regions have a (nominally) growing primary sector (the majority of diamonds is in quadrant I in the upper right panel of Figure 9). The other two panels (for the secondary and the tertiary sector) show that rural regions benefit because the non-primary sectors expand and are driving regional growth. The development of the secondary sector is particularly strong in rural regions. Some rural regions are among the fastest growing regions. On average, integrated regions are not growing at an equal pace in the secondary sector as the rural regions do. To sum up, growth in rural regions mainly comes from the secondary and the tertiary sector of the economy. Regions with a thriving primary sector are a minority. The territorial differentiation of Austria in rural regions, integrated regions and predominantly urban regions at the level of NUTS-3-level is presented in Figure 10.

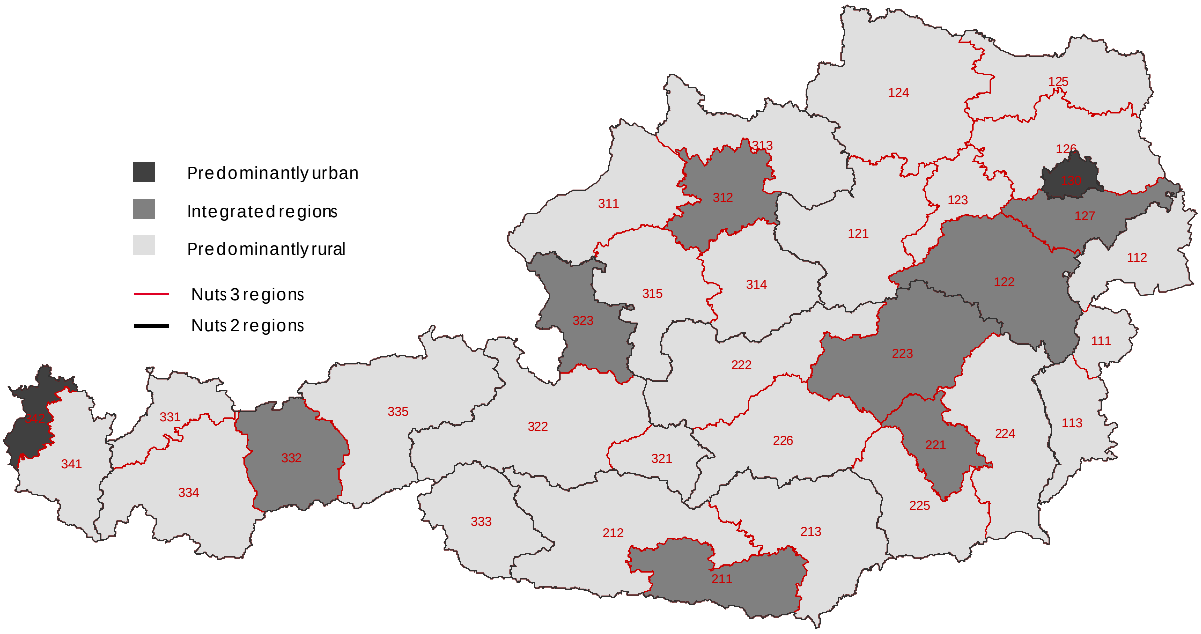

Figure 10: Classification of rural and non-rural regions based on NUTS-3 regions

Source: Bundesanstalt für Agrarwirtschaft, WIFO.
Note: The numbers indicate the NUTS-identifiers.

5.3. The Austrian Programme for Rural Development and the scenario description

5.3.1. The Austrian implementation of the Programme for Rural Development (PRD)

Starting with the McSharry reform in 1992, the EU took several steps to change the agricultural policy approach from the ground up. In the CAP reform in 2003 the decisions were made to separate the attainment of agricultural policy objectives as far as possible from the intervention in agricultural markets. This process is not yet finished but underway by reforming one commodity policy after the other. It will come to an end by the abolition of the milk quota system in 2015. The objective to support farm incomes has been addressed by decoupled direct payments from 2005 on. Other objectives like rural development, competitiveness of the farm and food sector, improvement of the environment are covered by the PRD.

The current PRD puts in place a strategic approach to rural development through the definition of three core objectives and a reorganisation of sub-objectives and measure objectives (see Council Regulation (EC) No 1698/2005 of 20 September 2005). The programme is objective rather than measure led and gives member states considerable leeway to reach the stated objectives.

Compared to the previous program, a thorough simplification of policy implementation is reached through the introduction of a single funding system, the modification of programming, financial management and the control framework for rural development programs.

There are three core objectives for rural development measures (see Article 4 Council Regulation (EC) N° 1698/2005 of 20 September 2005):

- improving the competitiveness of agriculture and forestry by support for restructuring, development and innovation;
- improving the environment and the countryside by supporting land management;
- improving the quality of life in rural areas and encouraging diversification of economic activity.

The programme is structured according to thematic axes that correspond to each core objective. A fourth axis is dedicated to the mainstreaming of the LEADER approach. LEADER stands for 'Links between actions of rural development' (EC, 2006). It is a method of mobilising and delivering rural development in local rural municipalities, rather than a fixed set of measures to be implemented. LEADER initiatives can play an important role in encouraging innovative responses to old and new rural problems, and are a sort of 'laboratory' for building local capabilities and for testing out new ways of meeting the needs of rural municipalities.

Member states had to identify the strategic objectives of their national program(s) before knowing how much funds would be available. This preliminary plan was dubbed 'the Green Pact' in Austria. It was the basis of the Austrian PRD and was published in early 2006. EUR 1 billion p.a. were planned to be spent for the following purposes: EUR 276 millions on support for farmers in mountain areas (EUR 257 millions in the previous period), EUR 524 millions on the agri-environmental programme (EUR 610 millions in the previous period), EUR 96 millions on investment aids in rural areas (EUR 37 m in the previous period) and a large number of other measures (details are provided in Lebensministerium, 2006).

The Council Regulation on the PRD had been published in 2005 but the total volume of the funds available for the PRD was not known until 2006. This fact created considerable uncertainty about the future of the programme.

According to the financial framework which defines the long term budgeting of the European Union, 34% of all expenditures will be allocated for direct payments of farmers. For the PRD 9% of the EU budget is allocated which is equivalent to EUR 88 billions (Fritz and Sinabell, 2006).

Before this decision was made in December 2005, a compromise agreement was worked out by the Luxembourg Presidency in mid 2005. According to this proposal, the volume of the PRD would have been considerably smaller than finally agreed upon. This proposal is the basis for one of the scenarios analysed in detail.

The proposal of the Luxembourg Presidency was finally overturned and more funds were allocated to the PRD. According to the final decision, Austria will get a total of EUR 3.9 billions of EU funds for the national PRD over the period 2007 to 2013. The national and the provincial governments are co-financing the programme at a rate of 50%. Therefore the total programme volume will be EUR 7.9 billions. Given that the output of the Austrian agricultural sector was EUR 6.7 billions in 2008, it is evident that the programme has a major impact on the agricultural sector because farmers will be the main direct beneficiaries. Approximately 80 per cent of total programme funds will be allocated for measures for which only farmers can qualify (see Mang, 2007). In the year 2007 EUR 0.92 billions were spent for the Austrian agriculture and EUR 1.06 billions in 2008 (BMLFUW, 2009).

5.3.2. Scenario description

In the policy experiment, the unmodified continuation of the 2000 – 2006 PRD (funds and scope of measures) until 2013 will be the reference scenario (with a budget of EUR 970 millions p.a.). It will be compared with two variants of the new PRD. Ongoing policy changes of the CAP reform of 2003 (relevant for milk) and later reforms (relevant for sugar) are implemented in all scenarios in order to isolate the effects of the new PRD. The most important measures of the old and new PRD (support for farms in mountainous regions, for agri-environmental payments and for investments) are modelled explicitly.

In the new PRD the volume of agri-environmental payments will be cut. The consequences have already been analysed in Schmid and Sinabell (2006) who found that organic farming will become more attractive for farmers because support levels for this measure will be maintained while they will be cut for other ones. The focus of this analysis will be on the effects of the expansion of investment aids. Other and new measures, in particular support for training, education and LEADER initiatives are treated as lump sum payments, assuming that the 50% of these funds will flow into the agricultural sector, while the rest goes to the other sectors according to their share of value added.

Two scenarios which are very similar but differ from one another by the budget of the PRD are compared to a baseline scenario:

- The **baseline scenario** is a business as usual situation: The assumption is made that the previous PRD with a volume of EUR 970 millions p.a. would continue unmodified until 2013.
- In the **Green Pact scenario** the volume of the PRD is EUR 1.0 billions per year. Compared to the baseline scenario – apart from the slight expansion of the programme volume – some of the funds are rearranged.
- In the **Luxembourg 2005 scenario**, the volume of the PRD is EUR 849 millions per year. It simulates a situation of a programme cut which seemed likely when the Luxembourg presidency did not reach an agreement on the financial framework in mid 2005.

In the **baseline scenario** ongoing policy changes of the CAP reform of 2003 (relevant for milk) and later reforms (relevant for sugar) are implemented in order to isolate the effects of changes in the PRD. The simulations cover the programme period from 2007 to 2013. It is therefore necessary to make assumptions on exogenous parameters. Those relevant for the Austrian economy (interest rates, inflation rate, government expenditures, foreign trade balances, exchange rates) were derived from medium term forecasts on the Austrian economy by WIFO (Kaniovsky and Baumgartner, 2007). The assumptions on prices of inputs and outputs of the agricultural sector are based on forecasts of OECD and FAO (2007). In this publication prices are listed only for the EU. To derive prices for Austria historical data (1995 – 2005) were used to estimate price wedges between Austria and the EU. These differences were assumed to prevail until 2013.

In the **Green Pact scenario**, more funds are available than in the reference scenario. The additional share financed by the EU (EUR 15 millions p.a.) is treated as 'manna from heaven'. It comes at no additional costs for the Austrian economy, the net-payer position of Austria is therefore improving. The necessary complementary national funds (EUR 15 millions p.a.) have to be offset by lower government support elsewhere.

In this scenario, investment aids and support for training and education measures will be expanded. The additional investments induced by the new programme will stimulate the demand for construction and manufacturing goods. Given the lack of knowledge on the adoption of investment measures among farmers, the assumption is made that part of public funds offsets planned investments (65 per cent for small and 25 per cent for large projects). The share of realised investments between construction and machinery is assumed to be the same as it was observed during the previous programme period. The relevant shares are derived from international (Dirksmeyer et al., 2006) and national (Lebensministerium, 2005, chapter 11) studies on the effects of investment support programs. A further assumption is that these investments do not make the agricultural sector more productive (justified by the lack of empirical evidence which would challenge this view; see Sinabell and Streicher, 2003).

In the **Luxembourg 2005 scenario** the PRD budget is smaller by EUR 121 millions p.a. compared to the reference scenario. The structure of this scenario is very similar to the 'Green Pact' scenario with the main difference being the lower budget, assuming that all measures of the programme will be funded at a lower rate by the same percentage.

For the purpose of the analysis, the assumption is made, that all other aspects of the two alternative programme scenarios are the same with one notable exceptions: the percentage allocation of total funds to the various axes of the PRD is conforming to the plan published by the ministry of agriculture in 2006 (for details see Lebensministerium, 2006). The only support measure that is held constant in the two scenarios is the support for farms in less favoured areas. This is motivated by the understanding that farming in these regions is very special and that there is a broad consensus to maintain support for this group of farmers even if total farm expenditures are cut down.

5.4. An ex-ante evaluation of effects of the Programme for Rural Development

5.4.1. The Programme for Rural Development and the evaluation problem

Even if not explicitly stated, the principal problem in any evaluation is the question of "what if". This question is most intuitively asked from a participant's point of view: what would have been the post-programme state of some target variable, if this participant had not been part of the programme under consideration. Of course, this state of the world is not directly observable; it is called the counter-factual. For any meaningful evaluation, it is however necessary to estimate this counter-factual value: the effect of the programme is nothing else but the difference between the (observable) actual and the (unobservable) counter-factual value of the target variable.

Not being directly observable, the counter-factual has to be estimated. Numerous approaches exist, ranging from more qualitative to expressly quantitative methods. In Figure 11 the different approaches are graphically presented. An assessment of their relative position along the two dimensions "level of detail" and "statistical rigour" shows the relative position of each approach.

In the diagram, "level of detail" pertains to the kind of questions which can be answered: the higher up on this axis, the more questions can meaningfully be answered without pushing the inherent limits of each approach too far. "Expert judgment", can go a long way in answering all sorts of questions. Its main drawback is a lack of "statistical rigour": it is, after all, *only* expert judgment, possibly reflecting nothing else but beliefs. A survey of participants, using questionnaires, can add some statistical rigour while probably losing some attainable level of detail.

To score higher on "statistical rigour", mathematical methods are called for. We can envisage at least three basic approaches: a "dedicated panel survey", which presents a standardized questionnaire to both participants and non-participants (probably a full survey, but more likely a randomized survey), both before and after the implementation of some programs. Such dedicated surveys are expensive. If, however, existing data, which are probably collected for some completely different reason, can be harnessed, a more cost-conscious approach can be pursued: statistics from the farm accountancy data network (FADN) might constitute just such a data base. The attainable level of detail is typically more limited, as FADN data do not contain all the relevant variables and the farms in the sample are not necessarily statistically representative for all farms. The fact that FADN data are collected for different purposes might eliminate (or, at least, mitigate) one potential problem with a dedicated survey, namely strategic answering. If farmers perceive a survey as "supervision" they might be tempted to (probably unconsciously) tailor their answers somewhat to better conform to expectations of the evaluators.

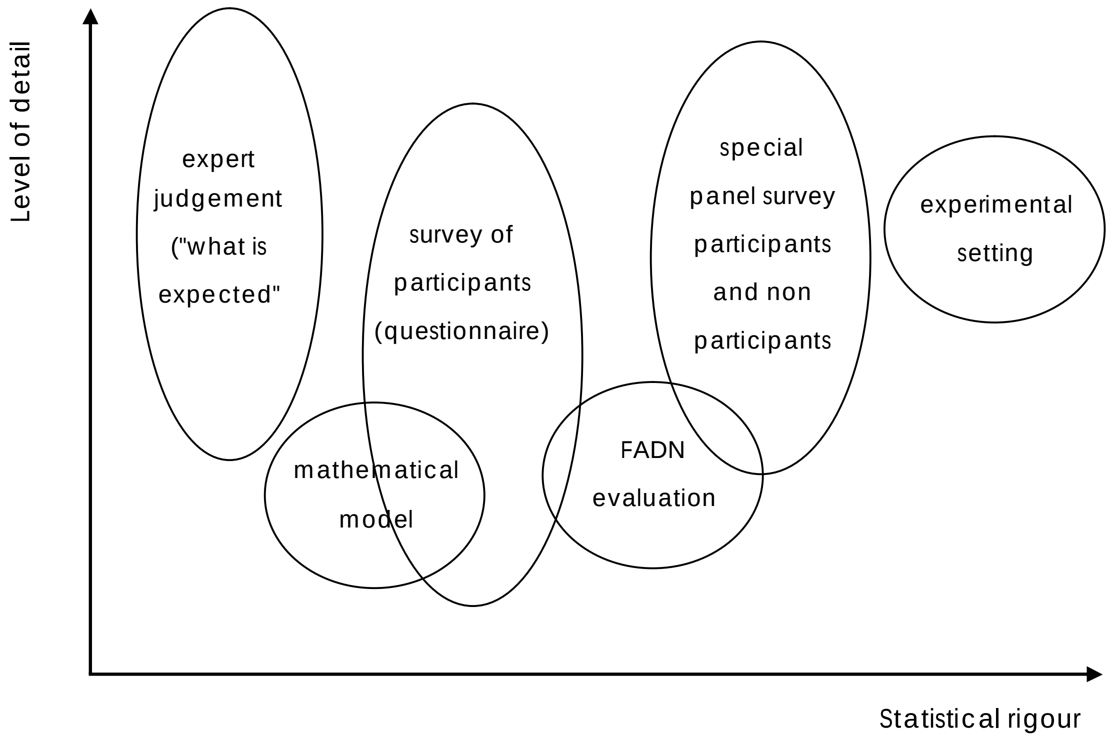

Figure 11: Comparison of evaluation strategies of rural development programs

Source: Own construction.

Frequently, in policy evaluation analysis, mathematical models are used. Their limitations are set by their mathematical and statistical foundations: optimizing models share with expert judgement a low score on statistical rigour, whereas econometric models are probably rather limited in the scope of questions they can be analysed. It might however be argued that the mathematical models have advantages over many alternatives: their ability to model reactions to external stimuli should lend itself to ex ante-evaluations of proposed programme schemes.

Mathematical models share with expert judgment a probably important drawback: their reliance on "what should be the case”, i.e. their leaning towards a normative approach. In estimating a program’s effect on some target, they are based on the assumption that the rules of the programme lead to predictable changes in behaviour and outcome. Another assumption is the full compliance with the rules which may not necessarily be the case.

The topic of this chapter is to make an ex-ante evaluation of the likely effects of the PRD in Austria. For this purpose a modelling approach is the best alternative. The tools used for the analysis are described in more detail in the next two sub-chapters.

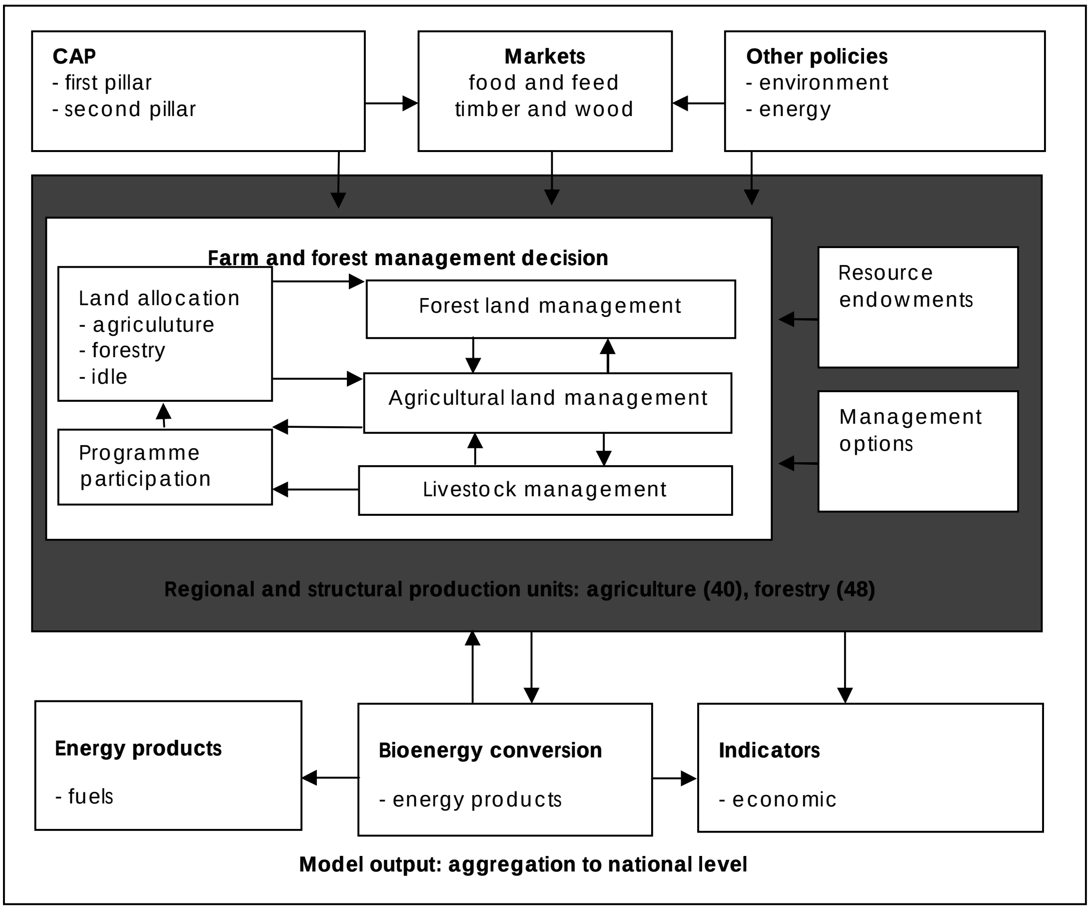

Figure 12: Model structure of PASMA

Source: Sinabell and Schmid, 2008.

5.4.2. PASMA — a regionally disaggregated model of the Austrian agricultural sector

An overview of the model structure

PASMA (positive agricultural sector model of Austria) is a tool that has been developed for policy analysis (Sinabell and Schmid, 2006). It is a formal representation of the Austrian agricultural sector. It is an alternative to single farm models (e.g. Kirner, 2002) because its results hold for the whole sector, not just a representative number of farms. For Austria, there exists another farm sector model, FAMOS (Schmid, 2004). The difference between the two models is that in PASMA regions are modelled as a representative farm whereas in FAMOS different farm types are aggregated to the regional level.

The core of PASMA is the decision module (see Figure 12). A representative farmer decides on the production activities in a region by allocating land to various crops, setting the level of livestock activities and deciding on the type of management. The decisions are constrained by the available management options (those observed and in the region) and the resource endowments (based on census data and administrative data). In the scenario module of the model various variables affecting the decisions can be set: prices of products and costs of factors, premiums of agricultural programs and restriction on the use of resources.

PASMA represents the agricultural sector in a very detailed manner. This is possible because it employs the method of positive mathematical programming (Howitt, 1995a, and 1995b). This modelling strategy avoids the limitations of linear programming while employing some of its strengths. PASMA is capable to estimate production, labour, income, and environmental responses for each single regional unit. The model considers conventional and organic production systems (crop and livestock), all other relevant management measures from the Austrian agri-environmental programme ÖPUL, and the support programme for farms in less-favoured areas (LFA). Thus the two most important components of the PRD are covered on a measure by measure basis. Apart from major components of the PRD the complete set of CAP policy instruments is accounted for, as well. Both, the set of instruments before and after the 2003 reform are modelled explicitly.

An overview of the method

The model maximises producer surplus (the aggregate gross margins of farms in a given region) and is calibrated to historic crop, forestry, livestock, and farm tourism activities by using the method of Positive Mathematical Programming (PMP). Howitt (1995) has initially published PMP and since then it has been modified and applied in several models e.g. Lee and Howitt (1996), Paris and Arafini (1995), Heckelei and Britz (1999), Cypris (2000), Röhm (2001), Röhm and Dabbert (2003). This method assumes a profit-maximizing equilibrium (e.g., marginal revenue equals marginal cost) in the baseline and derives coefficients of a non-linear objective function on the basis of observed levels of production activities.

Howitt's method is based on two major conditions: (i) the marginal gross margins of each activity are identical in a baseline, and (ii) the average PMP gross margin is identical to the average of the gross margin of each activity in the baseline Linear Programming (LP) model. These conditions imply that the PMP and LP objective function values are identical in the baseline. Another important assumption needs to be made by assigning the marginal gross margin effect to either marginal cost, marginal revenue or fractional to both. In PASMA, the marginal gross margin effect is completely assigned to the marginal cost and consequently coefficients of linear marginal cost curves are derived.

As an extension of the original model proposed by Howitt, in PASMA, linear approximation techniques are utilised to mimic the non-linear PMP approach (Schmid and Sinabell, 2005). Thus large-scale models can be solved in reasonable time. In combination with an aggregation procedure, i.e., building convex combinations of historical crop and feed mixes (Dantzig and Wolfe, 1961; McCarl, 1982; Önal and McCarl, 1989, 1991), the model is robust in its use and results.

PASMA is a set of three almost identical LP models. The purpose of the first one is to assign all farm activity levels i.e., crop, forestry, livestock, and farm tourism, and remaining cost shares from feed and manure balances. For instance, the area of meadows is recorded in various data sources listed below. However, information on which activities are actually carried out and to what extent are not available (e.g., grazing, hay, silage, or green fodder production activities). In the model, these activities and remaining cost shares (i.e., fertiliser and feed) are accordingly assigned using historical livestock records and detailed feed and fertiliser balances (phase 1). Phase 2 is the second LP in which the perturbations coefficients (Howitt, 1995) are incorporated to compute the calibration coefficients of a linear marginal cost curve primarily following the approach of Röhm and Dabbert (2003). The third LP (phase 3) is the actual policy model. Calibration coefficients are built in using linear approximation techniques that allow calibration of crop, forestry, livestock, and farm tourism activities to observed and estimated shares. Other model features such as convex combinations of crop and feed mixes, expansion, reduction and conversion of livestock production, a transport matrix, and imports of feed and livestock are included to allow reasonable responses in production capacities under various policy scenarios.

Data sources and representation of the agricultural sector

PASMA is employed to estimate the effects of PRD on farm income (accounting for the following revenue streams: crop and livestock, direct payments, agri-environmental payments, less favoured areas payments, agro-tourism, machinery services), crop and livestock production, and farm labour at regional and national scales. Data from Allgemeines Land- und Forstwirtschaftliches Informationssystem (ALFIS), the Integrated Administration and Control System (IACS), the regional Economic Agricultural Account (EAA), the latest agri-structural survey, the standard gross margin catalogue, and standard farm labour estimates provide necessary information on resource and production endowments for 40 regional and structural production units. Data of the rural development programme period 2000 to 2004 were used to calibrate the model.

PASMA is capable to estimate production, labour, and income responses for each single unit. Such a broad regional differentiation allows flexible aggregation in the model and its results (e.g. federal states or major production regions, and Alpine farming zones).

Total producer surplus from crop and livestock production and policy payments is maximized subject to regional resource endowments (i.e. land, livestock, and farm labour). PASMA differentiates production activities with respect to:

- 19 land categories (arable land, alpine pastures, forests, etc.) and 36 cash crops (wheat, corn, vegetables, etc.);
- conventional and organic production systems (crop and livestock), and information on management practices at farm level;

- 32 management measures from the Austrian Agri-Environmental Programme ÖPUL (organic farming, reduction of agri-chemicals, cover crops, etc.);
- 29 livestock categories (dairy, suckler cow, pigs, sheep, etc.), 34 livestock products (milk, meat, wool, eggs, etc.), 48 feeding activities and crops (grazing, silage, hay, etc.);
- all CAP and agri-environmental premiums.

All these activities are available in each of the 40 regional and structural production units. Feed and fertiliser balances assure transfers between crop and livestock activities within each production unit. Separate feed balances are available for forage and concentrates, winter and summer rations, as well as for organic and conventional farming systems. Similarly, manure from livestock production and commercial fertiliser are transferred to crop activities. A comprehensive transport matrix allows transfers of crops (concentrates, hay etc.), and animals (piglets, calves, heifers, etc.) between all 40 regions. In addition, imports of feed (e.g. soybeans) and animals (e.g. heifers, calves) are also considered in the model. Product prices and other model assumptions are referenced in Sinabell and Schmid (2003a, 2003b, 2003c).

5.4.3. A multi-regional, multi-sectoral model of the Austrian economy

Austria is a small open economy and some of its regions are characterized by a high degree of openness. This limits the usefulness of single region models (e.g. the rural economy) since economic impacts from changes in policy or public investment projects mostly emerge not within one region, but also in other regions due to factor and trade flows.

The quantitative assessment of the scenarios of the PRD is carried out by coupling the agricultural sector model PASMA with MultiREG, a multi-regional model of the Austrian economy. It differentiates between 32 activities and commodities and has been frequently applied for regional impact assessments (Fritz et al., 2005). Agricultural commodities are among the commodities covered by MultiREG, but for the purpose of this study, PASMA, was used to assess the changes of agricultural output and factor demand. MultiREG is a set of modules that are structurally linked together:

- for each Austrian province input-output tables are integrated in the model; they represent the flows of goods between the sectors of each province;
- an inter-regional trade matrix represents the flows of goods and services between the provinces; exports and imports to foreign countries are included in this module, as well;
- parameters of behavioural equations for consumption, household income, production, employment are based on empirical estimates.

The model structure of MultiREG is illustrated in Figure 13 with the arrows indicating monetary flows. The model starts out with solving total final demand, which is composed of private and public consumption, investment, and regional and foreign trade. This demand can be met either by importing commodities from other regions in Austria, by commodities produced by firms in the region or by imports from abroad.

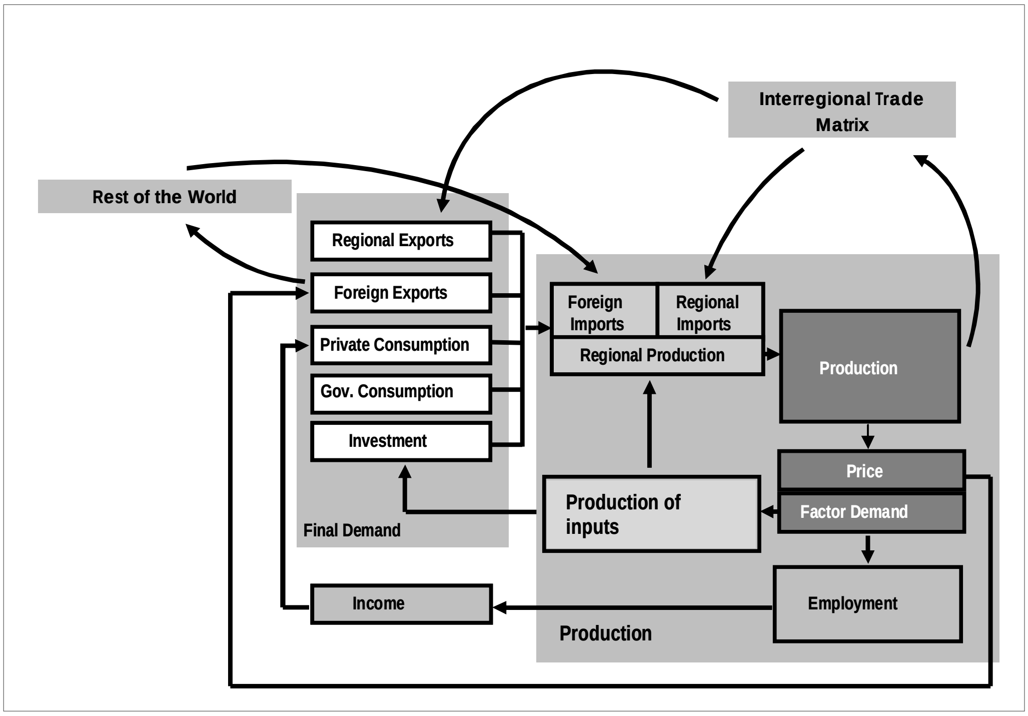

Figure 13: The structure of MultiREG, a multi-regional and multi-sectoral model of the Austrian economy
Source: Fritz et al., 2005.

The demand from the world market is exogenously given and determines the level of foreign exports of the regions. Imports from the world market as well as exports to other regions in Austria are determined in the interregional trade block of the model.

Regional production is simulated in the output block, where output prices and factor demand are derived based on cost functions. Factor demand has two components, intermediate inputs and labour. Total regional demand is linked to factor demand in the production block of the model. The level of labour employed determines income generation and influences private consumption and thus final demand. Another feedback channel operates via output prices. If relative prices change, changes in the demand for foreign exports (and foreign imports) are triggered. Finally, changing regional production patterns also lead to changes in regional trade patterns. Applying the OECD classification on the Austrian provinces gives one predominantly urban region (Vienna), three integrated regions (Vorarlberg, Oberösterreich and Salzburg) and the other regions being classified as predominantly rural (see Figure 14).

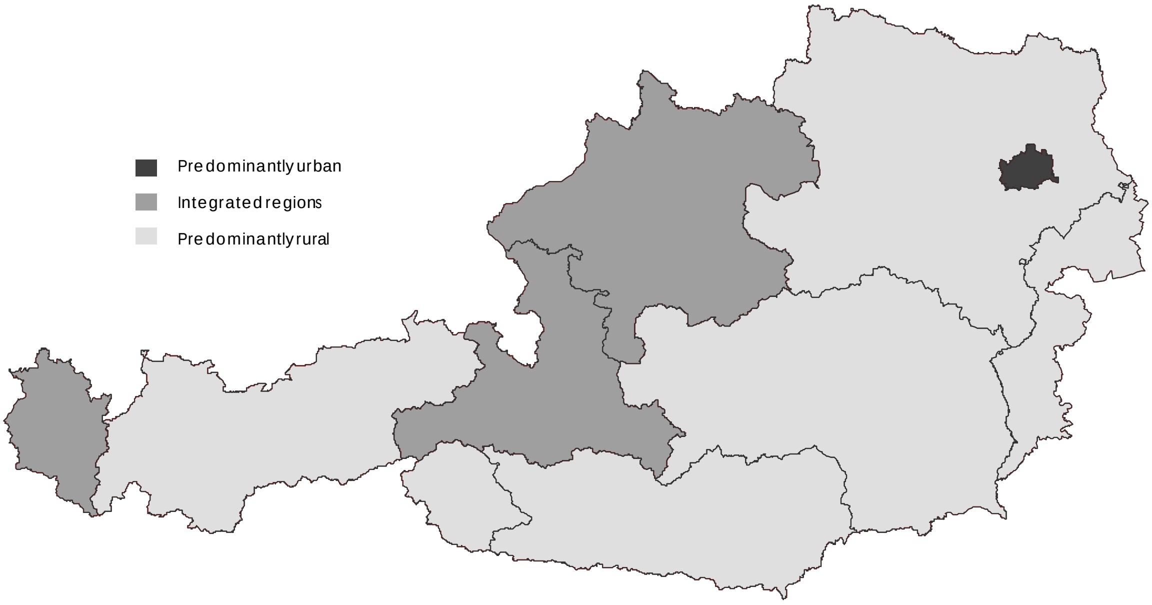

Figure 14: NUTS-2-level classification of rural and non-rural regions in Austria

Source: Bundesanstalt für Bergbauernfragen and WIFO.

5.5. Implementation of the model link and selected results

The quantitative tool for the analysis is an integration which combines PASMA and MultiREG, a multiregional input-output model of the Austrian economy. The two models are linked via output-, input- and price vectors at regional scales representing the economies of nine Austrian provinces aggregated to rural and non-rural regions.

The two models, PASMA and MultiREG, are not solved simultaneously but sequentially in an iterative manner.

- In a first step, baseline scenarios are defined. The agricultural sector model is calibrated to reflect the production and policy situation after the CAP reform in 2003 and before the implementation of the new PRD in 2007.
- The baseline of MultiREG reflects the Austrian economy during the period 2000 to 2005. Based on forecasts about the economic environment, results for 2008 and the following years are derived.
- In the second step, the policy scenarios are implemented in each model.

Due to the small size of the Austrian economy, changes in many prices are taken from external sources (derived from OECD and FAO, 2006). In the simulation runs, MultiREG treats agricultural activities as external data, level changes of output and input vectors are imported from PASMA, feed-backs to the agricultural sector are accounted for in several iterations until a state of equilibrium is approximated. The regional scale of interaction between the models is NUTS-2. The results of the scenarios are presented as deviations from the base line solutions.

In Table 9 major results of the two scenarios are presented. The major difference between the two scenarios is that in the Green Pact scenario the volume of the PRD is EUR 1.0 billions p.a. while it is EUR 849 millions p.a. in the Luxembourg 2005 scenario. The outcomes of these scenarios are compared to the baseline scenario with a PRD volume of EUR 970 millions.

One important feature of the model analysis is that any additional funds for the agricultural sector have to be offset by savings of public expenditures elsewhere in the economy. For this purpose the assumption was made that a proportional reduction takes place for all other budgets.

The baseline situation is a business as usual scenario. Based on previous studies (Sinabell and Schmid, 2005) forecasts were made for the development of the agricultural sector until 2020. In these scenarios the assumption was made that the agricultural policy did not change beyond those reforms that have already been agreed upon in the EU-CAP-reform of 2003. By the time of making these forecasts, the health check reform of 2008 could not yet be anticipated, therefore this recent reform is not reflected in the results. The base-line situation is compared to the two simulation scenarios and deviations from it are reported in Table 9.

The 'Green Pact' scenario shows positive effects for the whole of the Austrian economy. This result does not come at a surprise because additional funds which need not to be offset elsewhere are injected into the Austrian economy by the EU (EUR 15 millions p.a.). The largest share of this sum (EUR 10.44 millions p.a.) is spent in rural regions but also non-rural regions receive a significant share.

EU-funds have to be co-financed by national sources. With the complementary amount of the Austrian federal and provincial governments a total of EUR 30 millions is available; as most of this money is used to finance investments in buildings, the main beneficiary of this is the construction sector. The construction sector has a comparatively low propensity to import compared to private consumption. The effect on the Austrian economy is therefore larger than would be the case if the money was an income transfer to farmers.

In the 'Luxembourg 2005' scenario, the Austrian economy would be worse off. In such a case, less EU funds (EUR 61 m) would be transferred to Austria via agricultural policy expenditures. According to the assumptions mentioned above, the complementary domestic savings are distributed in an aliquot manner for other government demand. Nevertheless, annual value added would be approximately EUR 81 m less (19 EUR millions in rural and 62 EUR millions in non-rural regions. Employment would decline accordingly, with a loss of 760 jobs (most of them in non-rural provinces).

Table 9: Two alternative scenarios of the new Programme for Rural Development in Austria in 2007-2013 compared to a business as usual baseline scenario

			Green Pact		Luxembourg 2005	
			rural	non-rural	rural	non-rural
			model-input: difference to baseline per annum			
Agriculture	all inputs	mn EUR	-8.20	-8.01	-22.14	-12.11
	output	mn EUR	-8.83	-24.08	-29.85	-35.66
	construction investments	mn EUR	57.14	26.00	-6.64	-3.02
	machinery investments	mn EUR	1.98	0.68	-0.23	-0.08
	additional demand education	mn EUR	2.34	1.02	-0.52	-0.23
PRD funds	financed by the EU	mn EUR	10.44	4.56	-42.18	-18.44
	national co-finance	mn EUR	10.44	4.56	-42.18	-18.44
			scenario-results: difference to baseline in 2013			
Employment	total of persons employed	persons	1,255	725	-122	-646
Output	total output of all sectors	mn EUR	111.7	60.7	-57.7	-102.0
Value added	primary sector	mn EUR	-0.1	-15.9	-7.9	-23.6
	secondary sector	mn EUR	36.4	22.3	-11.5	-11.5
	tertiary sector	mn EUR	32.4	26.6	0.5	-26.7
	all sectors	mn EUR	68.7	33.0	-18.8	-61.9

Source: Sinabell et al., 2007
Notes: Rural and non-rural regions according to OECD (2005) territorial classification at NUTS-2 level; monetary values are given in real terms (in 2000 prices); the GRP of Austrian regions was EUR 235 billions in 2004 (40 % in rural regions), total employment was 3.8 million (mn) persons (46 % in rural regions); the annual volume of the PRD is assumed to be EUR 970 millions in the baseline scenario, EUR 1 billion in the Green Pact scenarios, and EUR 850 millions in the Luxembourg 2005 scenario.

The reason why non-rural provinces are affected more strongly in this scenario comes mainly from the production response from the agricultural sector that is affected more severely in the non-rural regions in such a scenario. This is mainly due to the assumption that support for farmers in less favoured areas is the same in both scenarios. Rural regions are therefore relatively less affected in a situation where total programme funds are reduced.

5.6. Agricultural support and its effects on rural and non-rural regions in Austria — conclusion and discussion

This analysis reports a modelling approach that is capable to evaluate the economic consequences of the PRD for the whole economy and its rural and non-rural regions in a regionally differentiated integrated macro-micro modelling framework. The two models employed in this study represent the structure of the Austrian economy with respect to the spatial dimension and the sectors that are linked via down-stream and up-stream relations. Being a first attempt, it is obvious that a long way lies ahead to further improve the analytical tools. A very obvious limitation of the model link presented here is that rural and non-rural regions are differentiated only at NUTS-2 level (provinces) which is a very crude approximation to the actual situation.

Another limitation is that the models are certainly not general equilibrium models, thus criticism might arise with respect to the validity of the econometrically estimated behavioral equations (especially as far as MultiREG is concerned; PASMA's parameters are based on observations and derived according to the PMP approach). But this is a minor concern because shocks are very small relative to the size of the whole regional and national economies as a whole,

Another important aspect is that a combination of sector models like PASMA with regionally differentiated sector models like MultiREG can be done in a straight forward manner with relatively small adjustments. An important precondition is that the models are consistent with the system of national accounts. Another aspect that was helpful in the case study presented here was that both models use the same software.

The model results show that rural regions will benefit more than non-rural ones in a 'Green Pact' scenario. Approximately two thirds of additional employment and value added will go to the rural economy. In the 'Luxembourg 2005' scenario less money is spent for the programme. In this scenario non-rural regions would suffer relatively more than rural ones. This result can be explained by the fact that output- and input-responses of the agricultural sector to the respective policy shocks are not symmetric. In both scenarios agricultural output and input will be reduced compared to a business as usual scenario according to PASMA results. Funds for the agri-environmental programme will be cut in both scenarios considerably. The production stimulating effect of this programme that was already observed in previous studies (e.g. Sinabell and Schmid, 2003) is therefore alleviated.

Austria seems to have found a good tap of EU funds for rural regions. Being a very rich country there are not many ways to get back funds from the EU. The only two candidates are agriculture and research. Rural regions definitely benefit more than non-rural ones, mainly due to the transfers that go directly to the agricultural sector. As the model results show not only rural but also non-rural regions are affected in a positive way because of the direct and indirect links to upstream and downstream industries.

Future research efforts will be necessary to improve the modelling approach presented in this paper. It seems to be true that future policies will be more regionally targeted. Therefore, it will be necessary to further differentiate in the spatial dimension. Rural and non-rural regions are far from being homogeneous. Differentiating regions at the level of NUTS-3 should be a long term goal of regional modelling, although this will not be an easy task due to a quantitative and qualitative lack of data (especially for MultiREG).

A second direction of future work will be the tighter integration of the two models. In its current state the iterative process to implement forward and backward linkages between the models is cumbersome and should be improved to speed up the scenario analysis.

The most important research topic however is the question whether it is the best option for the growth of a country or the growth of rural regions to spend public funds in a way as presented in this case studies. It could definitively be the case that regions would prosper more if taxes were lower or if support was channelled to other activities.

6. Summary and conclusions

"Agriculture is more than just the production of food and fibre" is the opening statement of this thesis and the promise was made to present the reader evidence for this statement. The choice was made to employ pragmatic concepts as those proposed by OECD. The OECD suggested identifying commodity and non-commodity outputs of agriculture in order to make concepts like the multifunctionality of agriculture operational. This concept was used as a guiding principle to explore four main research questions:

a) What are the roles of agriculture in the context of the rural economy, how can agriculture contribute to rural well-being and rural development?

b) What are the commodity and non-commodity outputs of agriculture in Austria?

c) Is it possible to establish an empirical link between agricultural activities and (negative) agricultural externalities and does it matter whether support for agriculture is linked to outputs or not?

d) What are the consequences and the effects of agricultural policy changes for rural and non-rural economies?

Austrian agriculture is taken as an example for the last three questions, agriculture in OECD countries is considered in the first question. Various roles of agriculture in the context of the rural economy were analysed in chapter 2. The question whether agriculture is essential to rural viability or not was analysed by referring to a conceptual model or rural development that is defining very broad elements that contribute to regional viability. Rural viability and the development of rural regions are identified as special cases of regional development. The analysis shows that agriculture definitively has a special role because it affects factors of rural growth in special ways. However, agriculture is not more special than other sectors are. Agriculture produces both market and positively valued non-market outputs simultaneously. It shares these characteristics with several other sectors of the economy.

In the third chapter a detailed review of discussions on "multifunctionality of Austrian agriculture" was presented. The term "multifunctionality" is thereby reduced to the concept of commodity and non-commodity outputs and external effects as proposed by the OECD. Many of the notions and connotations of "multifunctionality" can be made operational for economic analysis by thinking of positive and negative external effects. The focus of the review is on early analyses and it may contribute to the understanding of policies and programs to promote environmentally friendly farming practices that are currently in place.

Negative external effects of agriculture are analysed in more depth next. Nitrate concentration in groundwater is taken as an environmental quality indicator and the influence of agriculture on it is empirically analysed. Findings from the early 1990ths are compared with recent evidence to show that some of the variance of nitrate concentrations in Austrian groundwater can be explained by measuring various types of transfers to the agricultural sector. Discussions on multifunctionality and the role of agriculture in the rural economy often are reduced to the claim of support for the sector. The results show that different ways to support agricultural producers have different environmental outcomes.

In the last chapter of the thesis, results of a collaborative study are reported that deals with economic spillover effects of agricultural policy to rural and non-rural economies. The Austrian PRD is taken as an example. A scenario that captures the major elements of the currently implemented programme that spans over the period 2007 – 2013 is compared to a scenario in which fewer funds are available. The model analysis shows that in Austria not only rural but also non-rural regions benefit considerably from EU funds that are channelled through the agricultural sector into the Austrian economy.

In the introduction to this thesis several research questions were raised that were grouped in four sets. The first set of questions referred to the role of agriculture in the rural economy:

- What are the roles of agriculture in the rural economy from a conceptual point of view? A conceptual model was presented that brings together the elements that have an effect on the performance of a region in a coherent manner. The goal of regional (and rural) development is to improve the wellbeing, standard of living and quality of life of its population. Agriculture is one sector in (rural) regions that can contribute in attaining these objectives. Given the structural change its weight is continuously diminishing.
- Rural viability, the well-being and quality of life of the rural population are affected by agriculture in different ways. What are the channels that convey the influence of agriculture to the rural society as a whole? Agriculture contributes directly by producing commodities and offering services like farm tourism. Agriculture contributes indirectly by provided positive external effects like an open landscape that tourists find attractive. However, agriculture also impairs regional wellbeing by negative external effects like nitrate emissions. Some of the roles of agriculture are difficult to evaluate and probably impossible to quantify like the role farm households play in the social structure.
- Are there any indicators that help to understand the cause-and-effects relationships and are there measures to quantify targets of rural development and the final outcomes? A benchmark to measure whether the objectives outlined above are attained is the regional product and value added. There are other competitiveness indicators like labour productivity which can be readily used to measure the contribution of agriculture to the rural economy. To measure other factors relevant for the wellbeing of the (rural) population like environmental quality, indicators must be used that have to fit into the conceptual framework.

The second set of questions refers to the aspects and facets of multifunctionality of Austrian agriculture:

- Which authors contributed to the discussion on it and what are their findings? To answer this question a survey of socio-economic publications was carried out. The discussion on multifunctionality dates back until the late 1960s. At that time it became evident that uninhibited structural change could bring about negative consequences for other sectors of the rural economy. About 20 years later negative external effects and environmental degradation due to agriculture were widely discussed. Around that time Austria became an EU Member State and quantitative and sometimes monetary estimates of the negative and positive external effects were published.

- Did these views and discussions have an influence on agricultural policies in Austria? Policy makers frequently made reference to the concept of multifunctionality in order to justify policy intervention. In Austria it is the PRD that addresses a wide range of multifunctional roles like environmental quality, maintenance of open landscape and rural employment directly and with an elaborate set of instruments and measures.
- Is there any empirical and quantitative evidence that a presumed positive role of agriculture actually materialises? Compared to the number of publications dealing with various aspects of multifunctionality in a descriptive manner, the number of empirical studies is still very low.

Agriculture is a special case because its production is taking place in the open space. Therefore its interaction with the environment is direct and the effect on environmental quality crucially depending on the ways production is actually carried out. The third set of questions focuses on nitrate pollution in Austria:

- Nitrate is a significant pollutant in groundwater – to what extent is Agriculture contributing to the level of nitrate pollution? A large data set that included observations of nitrate in groundwater in more than 650 Austrian municipalities was used for a cross-section analysis. The results show that agricultural variables can explain some of the variance of nitrate concentrations in groundwater but not all. A general finding is that the better the quality of agricultural soil, the higher is the nitrate concentration in groundwater. Precipitation also has a large influence. Other variables like population density explain only a very small part of the variance.
- Are different production activities contributing to nitrate emission in different ways? The findings of the analysis do not give a clear picture. One reason may be that the regional specialisation is too low. In many municipalities many different production activities are observed simultaneously (intensive livestock production, organic farming, crop production, etc.). More data on land uses and land cover and other methods than linear OLS could probably provide more conclusive results.
- Has agricultural policy an effect on emission levels and if yes, in which way? To analyse this question two types of policy variables were developed: measures of output linked support and support measures that are not directly linked to output. Generally, in regions where support is directly linked to agricultural output, the level of nitrate pollution is significantly but only slightly higher.
- How should policies change in order to reach an important goal of rural development – to improve the environmental quality and thus the quality of life of the rural

population? The econometric analysis of nitrate pollution in Austria supports the view that product specific support should give way to alternatives that are better targeting the goals agricultural policy is aiming at.

Agriculture plays only a minor role in the Austrian economy. Even in rural regions its contribution to the value added is relatively small. The fourth set of questions refers to the agricultural sector being part of the regional economy:

- Agriculture plays only a minor role in the economy – is it therefore a sector that can be neglected? Even if the contribution of agriculture to the GDP is small it should not be neglected. On the contrary, it is worthwhile to analyse the development of the agricultural sector very carefully. In this thesis the regional aspects were analysed in a detailed manner. A comparison of the rates of change of the agricultural value added in NUTS-3 regions of Austria showed that there is not a uniform pattern of change. Contrary to the development in other OECD and EU countries, the average growth rate of rural regions in Austria is slightly higher than the average of non-rural regions. In some regions agriculture is growing against the general trend of declining rural economies. To better understand the factors that drive growth in the one or the other direction is on the agenda for future work.
- Would not the economy be better off if the subsidies that are flowing into this sector were discontinued? This question was not analysed in this thesis in a rigorous quantitative manner. For such a scenario special tools need to be developed that are capable to analyse longer term structural adjustment. The tools presented in the last chapter could be used for such an analysis after substantial modifications.
- Is it possible to measure and to quantify the consequences for the rural economy if the level of support for the agricultural sector declines? First of all, a classification of rural and non-rural regions is a precondition for such an analysis. There is considerable disagreement on what actually is a "rural" region in the literature. A widely accepted definition is provided by the OECD which classifies regions in predominantly rural, integrated, and predominantly urban. In the last chapter of the thesis two analytical models were presented that can be used to answer this question when they are linked together. The models are specifically designed to represent the spatial and regional structure of the Austrian economy. Tools like these can be used to answer a wide range of questions of regional (and rural) development.
- What are the economic consequences for the rural economy and the economy as a whole if the level of support for the agricultural sector drops? Three scenarios were developed in order to analyse the consequences of an agricultural policy change in Austria. The example is the Austrian Programme for Rural Development. The major finding of the model analysis is that support for the agricultural sector induces significant effects throughout the whole economy. Even if the major share of programme funds is spent in rural regions, non-rural regions are affected as well because of strong spillover effects.

The findings of this thesis therefore support the view that agricultural policy has significant repercussions in the other sectors and that the Programme for Rural Development could be one factor to explain why Austrian rural regions are catching up while the opposite is true in most other OECD and EU countries.

Building on the findings here, future research should cover the following issues:

- to gain a better understanding on the causes of nitrate pollution it should be analysed which factors (e.g. soil type, livestock density, land use, crop and manure management) explain an improvement or a deterioration of nitrate pollution of groundwater;
- to better understand the role on non-agricultural activities explaining groundwater pollution it would be necessary to develop a broader set of explanatory variables (e.g. land cover, land use and management) for a cross-section analysis similar to the one presented here;
- the results on the effects of the Programme for Rural Development were based on a model that differentiates between provinces (NUTS-2) — a disaggregation to lower territorial levels (NUTS-3) would provide better insight into the heterogeneity of rural and non-rural regions;
- to improve the wellbeing of the population (in rural areas) is an important policy goal, however there is not yet a consensus how wellbeing should be measured (Stiglitz, Sen and Fitoussi, 2009); further efforts to improve our understanding of this issue are therefore necessary.

The results presented here are only a glimpse on what is actually happening in rural and non rural regions in Austria. This thesis may contribute to a better understanding on the roles of agriculture in a rural economy. But many questions are still open. In particular there is a lack of understanding how agricultural policy and rural development programmes could be harnessed to (further) improve the quality of life and wellbeing in rural and non-rural regions. Further explorations on this topic therefore seem to be justified because too little is known about how to improve the wellbeing of the population in a sustainable way in general.

Annex: OECD Regional Classification

The OECD has classified regions within each member country. The classifications are based on two territorial levels (TLs). The higher level (Territorial Level 2) consists of about 300 macro-regions while the lower level (Territorial Level 3) is composed of more than 2,300 micro-regions. This classification – which, for European countries, is largely consistent with the Eurostat classification – facilitates greater comparability of regions at the same territorial level. Indeed, these two levels, which are officially established and relatively stable in all member countries, are used by many as a framework for implementing regional policies [...]

The OECD has established a regional typology according to which regions have been classified as predominantly urban, predominantly rural and intermediate. This typology, based on the percentage of regional population living in rural or urban communities, enables meaningful comparisons between regions belonging to the same type and level [...]

The OECD regional typology is based on three criteria. The first criterion identifies rural communities according to population density. A community is defined as rural if its population density is below 150 inhabitants per square kilometre (500 inhabitants for Japan to account for the fact that its national population density exceeds 300 inhabitants per square kilometre).

The second criterion classifies regions according to the percentage of population living in rural communities. Thus, a region is classified as:

- Predominantly rural (PR), if more than 50% of its population lives in rural communities.
- Predominantly urban (PU), if less than 15% of the population lives in rural communities.
- Intermediate (IN), if the share of population living in rural communities is between 15% and 50%.

The third criterion is based on the size of the urban centres. Accordingly:

- A region that would be classified as rural on the basis of the general rule is classified as intermediate if it has a urban centre of more than 200,000 inhabitants (500,000 for Japan) representing no less than 25% of the regional population.
- A region that would be classified as intermediate on the basis of the general rule is classified as predominantly urban if it has a urban centre of more than 500,000 inhabitants (1 million for Japan) representing no less than 25% of the regional population.

Source: OECD (2005a), Regions at a Glance, Paris, pp. 177-178.

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