MTT SCIENCE 4

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Doctoral Dissertation

Sami Myyrä

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Academic Dissertation:
To be presented, with the permission of the Faculty of Agriculture and Forestry of the University of Helsinki, for public criticism in Lecture Room 13, Fabianinkatu 33 (3. floor), on November 20th 2009, at 12 o'clock.

ISBN 978-952-487-246-1 (Print)
ISBN 978-952-487-247-8 (Electronic)
ISSN 1798-1824 (Printed version)
ISSN 1798-1840 (Electronic version)
http://www.mtt.fi/mtttiede/pdf/mtttiede4.pdf

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Distribution and sale
MTT Agrifood Research Finland,
Media and Information services,
FI-31600 Jokioinen, phone +358 3 41881,
e-mail julkaisut@mtt.fi
Printing year 2009
Cover picture Riitta Myyrä
Printing house Tampereen
Yliopistopaino Juvenes Print Oy

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Land leasing, land degradation and agricultural productivity in Finland

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Abstract

This study analysed whether the land tenure insecurity problem has led to a decline in long-term land improvements (liming and phosphorus fertilization) under the Common Agricultural Policy (CAP) and Nordic production conditions in European Union (EU) countries such as Finland. The results suggests that under traditional cash lease contracts, which are encouraged by the existing land leasing regulations and agricultural subsidy programs, the land tenure insecurity problem on leased land reduces land improvements that have a long pay-back period. In particular, soil pH was found to be significantly lower on land cultivated under a lease contract compared to land owned by the farmers themselves. The results also indicate that land improvements could not be reversed by land markets, because land owners would otherwise have carried out land improvements even if not farming by themselves.

To reveal the causality between land tenure and land improvements, the dynamic optimisation problem was solved by a stochastic dynamic programming routine with known parameters for one-period returns and transition equations. The model parameters represented Finnish soil quality and production conditions. The decision rules were solved for alternative likelihood scenarios over the continuation of the fixed-term lease contract. The results suggest that as the probability of non-renewal of the lease contract increases, farmers quickly reduce investments in irreversible land improvements and, thereafter, yields gradually decline. The simulations highlighted the observed trends of a decline in land improvements on land parcels that are cultivated under lease contracts.

Land tenure has resulted in the neglect of land improvement in Finland. This study aimed to analyze whether these challenges could be resolved by a tax policy that encourages land sales. Using Finnish data, real estate tax and a temporal relaxation on the taxation of capital gains showed some potential for the restructuring of land ownership. Potential sellers who could not be revealed by traditional logit models were identified with the latent class approach. Those landowners with an intention to sell even without a policy change were sensitive to temporal relaxation in the taxation of capital gains.

In the long term, productivity and especially productivity growth are necessary conditions for the survival of farms and the food industry in Finland. Technical progress was found to drive the increase in productivity. The scale had only a moderate effect and for the whole study period (1976–2006) the effect was close to zero. Total factor

productivity (TFP) increased, depending on the model, by 0.6–1.7% per year. The results demonstrated that the increase in productivity was hindered by the policy changes introduced in 1995. It is also evidenced that the increase in land leasing is connected to these policy changes.

Land institutions and land tenure questions are essential in agricultural and rural policies on all levels, from local to international. Land ownership and land titles are commonly tied to fundamental political, economic and social questions. A fair resolution calls for innovative and new solutions both on national and international levels. However, this seems to be a problem when considering the application of EU regulations to member states inheriting divergent landownership structures and farming cultures. The contribution of this study is in describing the consequences of fitting EU agricultural policy to Finnish agricultural land tenure conditions and heritage.

Key words:
land tenure, insecurity, productivity, taxation

Pellon vuokraus, perusparannusten laiminlyönnit ja maatalouden tuottavuuskehitys Suomessa

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Tiivistelmä

Tässä tutkimuksessa tarkastellaan pellon vuokrauksessa esiintyvän pellon hallintaoikeuden epävarmuuden vaikutusta pellon perusparannuksiin. Tutkimuksen erityispiirteenä on suomalaisen kehittyneen teollisuusmaan, maatalouden kannalta pohjoisen sijainnin ja Euroopan Unionin yhteisen maatalouspolitiikan kombinaatio. Tulokset osoittavat, että tukijärjestelmän sekä pellonvuokralainsäädännön suosimat pellonvuokrauksen käteismarkkinat johtavat pitkävaikutteisten ja peruuttamattomien perusparannusten laiminlyönteihin. Ilmeistä on myös se, että pellonvuokramarkkinat eivät toimi. Toimivilla pellonvuokramarkkinoilla pellon omistajankin olisi kannattanut tehdä perusparannukset, vaikka he eivät viljelisikään peltojaan itse. Suomessa erityisesti vuokrapeltojen pH-taso on tilastollisesti merkitsevästi alempi kuin omistajan itse viljelemien peltojen vastaava.

Pellon vuokrauksen ja perusparannusten kausaalisuhteen selvittämiseksi vuokraviljelijän yli ajan ulottuvat kalkitus- ja fosforilannoituspäätökset ratkaistiin dynaamisen optimoinnin menetelmillä. Dynaamisessa optimoinnissa hyödynnettiin aikaisempaa tutkimustietoa satoresponsseista sekä maan helppoliukoisen fosforin ja pH:n kehityksestä viljelymaassa. Kalkitus- ja fosforilannoitussäännöt ratkaistiin kiinteille, viiden vuoden vuokrasopimuksille simuloimalla eri skenaarioita vuokrasopimuksen uusiutumistodennäköisyydestä. Vuokraviljelijän ennakoima vuokrasopimuksen uusiutumisen todennäköisyys osoittautui keskeiseksi muuttujaksi kalkitus- ja fosforilannoituspäätöksissä. Todennäköisyyden laskiessa myös kalkitus ja fosforilannoitus laskevat nopeasti, mikä kääntää pellon tuottaman sadon laskuun. Tulokset tuovat selvästi esiin pellonvuokraukseen liittyvän pellon hallintaoikeuden epävarmuuden ja perusparannusten välisen kausaaliyhteyden ja vahvistavat pellonvuokramarkkinoilta tehtyjä havaintoja.

Pitkällä aikavälillä pellon hallintaoikeuden epävarmuudesta aiheutuvat perusparannusten laiminlyönnit saattavat johtaa osan pelloista matalan tuottavuuden loukkuun, jossa ei vuokraviljelijällä eikä pellonomistajalla ole taloudellisia kannusteita pellon perusparannuksiin. Verotuksen kehittämistä tarkasteltiin eräänä vaihtoehtona näiden ongelmien ratkaisemiseksi. Verotuksellisina keinoina tutkimuksessa olivat mukana sekä pellon kiinteistövero että pellon myyntivoittoveron väliaikainen huojennus, joiden

molempien arvioitiin vaikuttavan maanomistajien päätöksiin myydä peltonsa. Perinteisillä logit-malleilla potentiaalisia pellon myyjiä ei pystytty kytkemään vahvasti mihinkään pellonomistajia kuvaavista sosiodemografisista taustamuuttujista. Tosin aikaisemmat pellon myyntikokemukset näyttivät olevan yhteydessä pellon myyntiaikomuksiin. Latenteista pellonomistajaryhmistä saatiin lisätietoa latent class -menetelmällä. Havaintojen perusteella ne pellonomistajat, joilla on myyntiaikomuksia, tarttuvat herkästi väliaikaisen pellon myyntivoittoveron huojennuksen kaltaisiin pellon myyntikannusteisiin.

Maatalouden myönteinen tuottavuuskehitys edistää Suomen elintarviketuotannon kilpailukykyä. Viljanviljelyn tuottavuuskehitys on ollut kuitenkin hidasta, ja se on edelleen hidastunut EU-jäsenyyden ja lisääntyneen pellonvuokrauksen myötä. Pitkällä aikavälillä viljatilojen tuottavuuskehitys on ollut 0,6–1,7 % vuodessa. Havaittu tuottavuuskehitys on aiheutunut lähes yksinomaan teknologisesta kehityksestä. Tuotannon laajuudesta aiheutuvilla mittakaavaeduilla on ollut vain pieni vaikutus tuottavuuskehitykseen.

Pellon hallintasuhteilla on keskeinen institutionaalinen asema maatalous- ja maaseutupolitiikassa niin kansallisella kuin kansainväliselläkin tasolla. Pellon omistus- ja käyttöoikeudet liittyvät perustavaa laatua oleviin poliittisiin, taloudellisiin ja sosiaalisiin kysymyksiin. Tulevaisuudessa oikeudenmukaisten ratkaisujen kehittäminen vaatii uusia innovaatioita. Näyttää kuitenkin siltä, että uusien kansainvälisten sopimusten ja säännöstöjen, kuten Euroopan Unionin yhteisen maatalouspolitiikan, soveltaminen laajenevassa unionissa on jäsenmaittain pitkälle eriytyneistä peltomarkkinoista johtuen entistä haastavampaa. Tämä tutkimus pyrkii osaltaan myötävaikuttamaan pellonhallintaoikeutta koskevien institutionaalisten kysymysten ratkaisemisessa ja yleisemminkin osallistuu keskusteluun yhteisen maatalouspolitiikan soveltamisesta suomalaisille pellonvuokramarkkinoille.

Avainsanat:
pellon vuokraus, epävarmuus, perusparannukset, tuottavuuskehitys, verotus

Acknowledgements

The research included in this thesis was carried out in the Economics unit of Agrifood Research Finland (MTT). In all my studies I have enjoyed the multidisciplinary cooperation and team work of people passionately involved in research. It has never been a question of organizational forms, but the dedication and passion of people who have carried out the research. I thank all the people working in the Economics unit for their skilful and generous help in numerous tasks. It has also been a pleasure to take part in academic as well as "coffeedemic" conversations, where we have reformed the agricultural policy so many times.

I am grateful to my teacher, supervisor and co-author, Professor Kyösti Pietola, for his extensive scientific input as well as his administrative and practical help in all the work included in this thesis. Without his endless support, this thesis would not have achieved its current form. I also thank my other teachers and co-authors, Professor Matti Ylätalo, Dr Eija Pouta, Professor Markku Yli-Halla, Biometrician Elise Ketoja, Dr Timo Sipiläinen and Pekka Pihamaa, MSc, for their valuable contributions. During my studies I had a great opportunity to visit the University of Waikato Management School in Hamilton, New Zealand. For this opportunity I thank Professor Frank Scrimgeour and all the Kiwi people, who generously opened their friendship for me and my family.

I thank the reviewers of this thesis, Professor Jari Kuuluvainen and Professor Jack Peerlings, the language consultant Dr Roy Siddall and the research assistant Jaana Ahlstedt for their valuable comments and practical help in all stages of preparing the articles and/or the summary part included in this thesis.

In addition to the generous funding from MAKERA, Salaojituksen tutkimusyhdistys ry and Huoltovarmuuskeskus, my studies and this thesis were financed by the Kyösti Haataja Foundation, the Markku Nevala Foundation, the August and Aino Tiura Foundation, University of Helsinki Funds and the Finnish Cultural Foundation. I acknowledge, with deepest gratitude, all these organizations.

I am a happy man. I have shared my life with a woman who makes my life complete. Without your encouragement, dedication, warmness and love I would not have gone this far in my studies. Thank you Riitta! Hannes and Aino, your unquestioned joy of life is something that I should have learned better. Please keep on teaching me!

List of original publications

This thesis consists of the Summary and the following four articles.

I **Myyrä, S., Ketoja, E., Yli-Halla, M. & Pietola, K. 2005.** Land improvements under land tenure insecurity : the case of pH and phosphate in Finland. Land Economics 81(4): 557–569.

II **Myyrä, S., Pietola, K. & Yli-Halla, M. 2007.** Exploring long-term land improvements under land tenure insecurity. Agricultural Systems 92: 63–75.

III **Myyrä, S. & Pouta, E.** Farmland owners' land sale preferences: can they be affected by taxation programmes? Forthcoming in Land Economics.

IV **Myyrä, S., Pihamaa, P. & Sipiläinen, T.** Productivity growth on Finnish grain farms from 1976–2006: a parametric approach. Forthcoming in Agricultural and Food Science.

Authors' contribution

Articles I and II are based on a multidisciplinary research project including soil science, biometrics and economics. The development of the theoretical framework, the empirical approach and the data collection were mainly performed by Mr Sami Myyrä. Statistical methods were adapted and the actual model fitting was carried out by Ms Élise Ketoja. All authors contributed to the writing of the report, the first author contributing most and being most responsible for the text.

Article II is a pure numerical application performed under the framework of dynamic programming (DP). DP was introduced to the Finnish agricultural economists' toolbox by Dr Kyösti Pietola. This particular application was, nevertheless, designed, programmed and calibrated to the data by Mr Sami Myyrä with the guidance of Dr Pietola and Dr Yli-Halla. All authors contributed to the writing of the report, but Myyrä was responsible for the manuscript.

The first draft of Article III was written by Mr Sami Myyrä during his visit to the University of Waikato in New Zealand. Latent class methodology was introduced by Mr Sami Myyrä and further extended in collaboration with Dr Eija Pouta. Both authors jointly contributed to the final text.

The empirical approach and the data collection for Article IV were mainly performed by Mr Sami Myyrä and Mr Pekka Pihamaa. The model fitting and drawing of conclusions were mostly carried out by Mr Sami Myyrä. The theoretical foundation for the paper was clarified in collaboration with Dr Timo Sipiläinen. All authors contributed to the writing of the report.

Contents

1 Introduction

1.1 Background and literature

Agriculture is a long-term operation. A landowner has a planning horizon over generations when deciding on land improvements, but for a tenant the planning horizon may be short. It has therefore often been argued that tenants tend to overexploit the land. The question is how land tenure contracts should be formulated to avoid overexploitation. Also, are the agricultural markets efficient enough to transform incentives for a tenant to make land improvements that are necessary from the society's perspective?

Gradual land degradation may not imply an immediate or sudden loss of agricultural productivity. Moreover, technical progress, an increased scale and other improvements might have outweighed slowly proceeding degradation processes in agricultural lands. In addition to land tenure insecurity, land degradation might result from other causes. Poverty, population pressure, a lack of efficient markets for commodities, inputs, and externalities have been mentioned as factors causing land degradation, among others. Although the reasons for degradation vary significantly over international market regions, they may all be key factors behind the resulting low productivity trap, depending on the local land ownership structure, initial land rights as well as social structures and norms. The highly mechanised, market-orientated and developed conditions in Finnish agriculture are not typical for a low productivity trap in cases earlier described in agricultural economic literature. Therefore, the following sections describe in more detail the background and concepts in Finnish agricultural conditions, as a part of common agricultural policy (CAP) in European Union (EU).

The soils of Finland have been formed from acidic rock and pH values in agricultural soils in the country are commonly below the recommended level. Therefore, liming is one of the basic land improvements used to maintain good yields. Good yields also ensure an efficient harvest of nutrients and this way prevent their runoff, which is extremely difficult to capture later as nutrients are transported to watersheds. From the 1960s until the 1990s there was a slight but steadily increasing trend in soil pH, but particularly during the last decade liming has been practiced far less than recommended (Viljavuuspalvelu 2009, Yearbook of Farm Statistics). In order to maintain soil productivity, soil pH should be raised by liming.

Land improvements have generally declined and the demand for lime, for example, decreased by 49% between 1994 and 2004, even though the total arable land area slightly increased during this period. There are signals that the greatest declines in land improvements have been in land parcels that have been cultivated under lease contracts. Land improvements and land leasing in Finland have followed opposite trends, which indicates a potential land tenure insecurity problem (Yearbook of Farm Statistics).

Sustainable land management practises are most commonly constrained by lack of secure access to private property. The unrestricted access to commonly owned land recourses has also been noted, but this is a different phenomenon referred to as the "tragedy of the commons" (Hardin 1968). Such a problem does not currently exist in Finnish agriculture, because more than 97% of agricultural lands in Finland are privately owned.

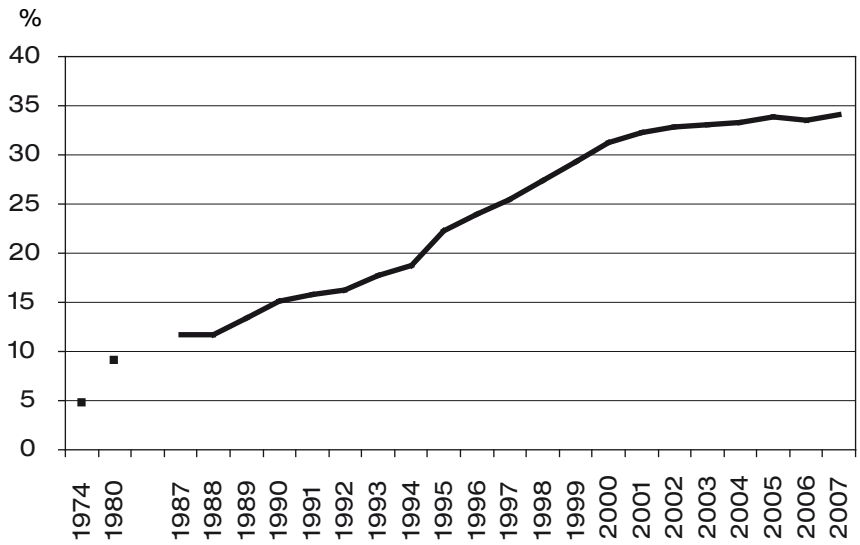

Figure 1. Development of land tenure in Finland (Yearbook of Farm Statistics).

In Finland, the share of agricultural land under lease contracts has doubled within the last 15 years (Figure 1). The standard land lease contract is a short-term contract with a fixed duration and a fixed cash lease payment per year and per unit of leased area. About 40% of all lease contracts have a duration of five years. With only a few exceptions, the annual cash lease payment is fixed per hectare of land when the contract is signed (Myyrä 2004). Under this contract the farmer supplies the optimal amount of inputs and has free access to the land's unprized attributes, i.e. productivity stock. Farmers do not face the full cost of usage of these attributes under fixed cash lease contracts (Allen and Lueck 2002). However, they own the entire crop. The socially optimal level of land improvements refers to a level that is reached at a competitive market with perfect information and perfectly defined property rights (Mas-Colell et al. 1995, pp. 325–328). The social optimum gives the maximum welfare for society as a whole, including landowners and tenants.

It is noteworthy that in well-developed rich countries, land tenure insecurity has received little attention in empirical studies and the economic literature[1] (Allen & Lueck 2002). Although land tenure insecurity is not yet a dominating problem in these countries, it may become such, particularly in Less Favoured Areas[2] (LFA), where production costs are high and yields are low. The trend towards a more liberalised food market and internationally harmonised agricultural policies has reduced the marginal value products (MVP) for agricultural inputs in LFA areas, where the possibilities of farmers to adjust to these trends are limited.

[1] Databases searched: Agricola, EconLit, Web of Science and Green file. Publications since 2007.

[2] Less favoured areas (LFA): These are areas, such as mountainous and hilly areas, within the European Union where farming is relatively difficult. In these areas farmers may receive compensatory allowances within the context of measures that are financed by the rural development policy (Axis 2). Scource: http://ec.europa.eu/agriculture/glossary/index_en.htm#lfa Accessed 7.9.2009 were searched. Accessed 5.3.2009 and 7.9.2009.

Furthermore, the tendency to decouple subsidies from production has been shown to increase the willingness of farmers to take risks in production (Kondouri et al. 2009). The risk-reducing aspect of land improvements is weakening because the connection between agricultural productivity and profitability is faded out by decoupled subsidies. Some fundamental land improvements such as drainage systems and developments in farm structure might be ignored as farmers become willing to take greater production risks. Because the pay-back periods of irreversible land improvements are longer, we may expect land improvements in the less favoured areas of northern Europe to decrease below the socially optimal levels if farmers are confronted with significant land tenure insecurity.

One exception in the current trend of agricultural economics literature on land tenure insecurity is the recognition of the soil erosion problem in the United States and Canada (Lee 1980, Soule et al. 2000, Fraser 2004). However, it has been a challenge to find empirical measures to connect land tenure and land degradation or best management practices (Prokopy et al. 2008). Like most empirical research, Soule et al. 2000 examined the adoption of conservation practices. They reported a decreasing influence of cash leasing over time, but found no connection between the top soil depth and the tenure system. This is important, because a cash lease contract might appear because of land quality and induce a self-selection bias (Allen and Lueck 2002, Huffman and Fukunag 2007). Lee (1980) compared the real rate of soil erosion between different tenure groups but observed no significant connection between land tenure insecurity and land degradation, even though the dataset contained 70 000 primary sampling units.

Most of the studies have used the number of land improvements, crop rotation, land improvement costs and other measures as proxies of ongoing developments in land fertility under different land tenure regimes. It is striking that, the differences in local soils and other conditions make it difficult to assess whether predicted causal connections between land management and land degradation / fertility are valid. For example, in Finland, potatoes and other intensively grown annuals are planted in owner-operated fields, whereas grassland, and fallow areas, occur in leased plots. However, this does not necessarily mean overexploitation of farmers' own fields and land improvements in leased plots, as it does, for example, in British Columbia (Fraser 2004).

From a statistical point of view, causal connections can be validly examined only by using corresponding control variables as indicators. The difficulty in Finnish data is that pure lease farming or lease farmers do not exist. Farmers always have some land of their own and the division of land improvements between owned and leased plots could not be tracked. Another typical feature is that some land improvements in Finland, such as liming, are carried out only once every five to ten years, thus causality between land tenure and land improvements is not always clear. In the early stages of this study it already became apparent that there are no valid data to indicate appearance of the land tenure insecurity in Finland based primarily on corresponding control variables for land degradation, but the lacking causality could be modelled and calibrated for Finnish conditions.

It is known that simple fixed duration and fixed cash lease payment contracts are not the most efficient in internalizing the externals caused by land degradation (Soule et al. 2000, Huffman and Fukunag 2007). However, they have remained persistent and popular in Finland for several reasons. First, fundamental co-operation, like sharecropping and share milking between a tenant and a landowner, is not recognised in the Common Agricultural Policy (CAP) of the European Union (EU) (Swinnen et al.

2009). Second, land leasing has been directly steered by a variety of policy regulations in Europe. Particularly in Finland, these regulations still favour short duration lease contracts. Third, landowners feel a sense of insecurity over the subsidy entitlements of decoupled subsidies. This is an essential and driving force towards lease contracts limited to the growing season only. Without the capitalisation of subsidies in land, land prices will significantly drop (Pyykkönen 2006). Fourth, cash lease contracts have low information requirements and may therefore result in a reasonable short-term outcome even if the market is informationally inefficient in the long term. In Finland, more than 40 000 people manage agricultural land acquired through inheritance, which accounts for one-tenth of the entire field area. Those inheriting land are not necessarily familiar with agriculture, and especially where siblings jointly inheriting land have to reach a united decision over its usage, they may aim for practical, but not long-term land management planning. Cash lease contracts are well suited to people whose aim is to transform fixed capital into cash. Fifth, the collateral value of agricultural land in Finland does not count for the land improvements i.e. in some cases land improvements could be reduced without reducing the collateral value of that land and increasing in the price of capital. Financial markets currently lack knowledge of the importance of land productivity to land prices (Ryan et al. 2001).

1.2 Framework of the study

A downward spiral including land tenure, disinvestments in land and decreasing or hindered productivity in agriculture also exist in developed countries. This situation is known as the low productivity trap[3] (Nkonya et al. 2008) (Figure 2). While the agricultural economics literature in well developed countries has not dealt with the low productivity trap, the literature on this problem from developing countries might provide suitable conceptualisation. The terms "welfare poverty" and "investment poor" are also appropriate in highly mechanized and well-educated production environments. This is due to the lack of economic incentives, complicated land ownership and leasing institutions and policy disincentives. Reardon and Vosti (1995) defined investment poor in the context of agricultural land investments as "a situation where farmers are not able to make minimum investments in the resource base to enhance the sustainable quality of agricultural land or are not able to reverse resource degradation." Poverty is usually associated with disability, but this is unlike the case in Finnish agriculture. This calls for a study of other reasons explaining the current trends in Finland. I propose that investment poorness is caused by a lack of economic incentives. Following Reardon and Vosti (1995), it could be argued that a household may choose to use the agricultural surplus for consumption, savings, or investments of other types than in the land due to external conditioning factors. When combined with substantial land tenure insecurity, investments elsewhere than in land improvement appear more attractive.

Undeveloped markets and a lack of incentives are comparable because they might hinder investments in land or the ability of households to convert one form of wealth into another. In Finnish cash lease contracts, land improvements are transformed into cash, because markets do not

[3] Certain other economic terms or processes such as the "lock-in effect" or "race to the bottom" could also be applied and examined. However, these are respectively related to taxation and competition between nations or states. The term "low productivity trap" is also associated with labour economics, but has continuously been used in the case of land tenure insecurity. The lock-in effect is referred to later when pathways out of the low-productivity trap are considered.

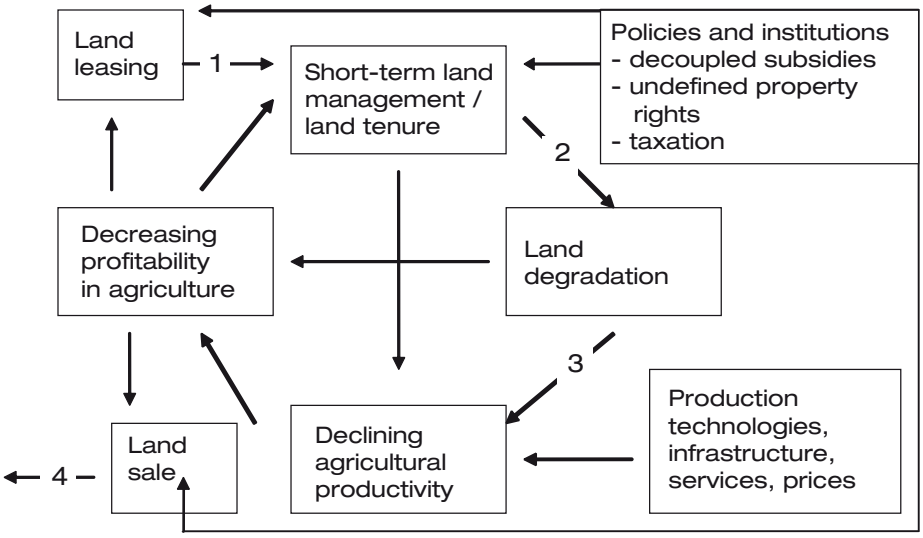

Figure 2. Low productivity trap. (Adapted from Nkonya et al. 2008).

provide long term incentives for land improvements. The penalising feedback from not investing in land improvement is also lacking. Because of these factors, agriculture is likely to face serious problems. Markets are not efficient enough to steer land asset prices to be determined by income-generating factors such as land productivity (Myyrä and Scrimgeour 2008). However, the debate over the connection between land productivity and land prices on agricultural lands is still open and shown to be very complicated (Gutierrez et al. 2007, Kataja 2008).

Incentives are not only limited in land sales, but also on rental markets. This is a largely accepted land tenure insecurity problem, which limits farm household net returns from land improvement investment by making the future income stream uncertain. A lower discount rate and a longer planning horizon are the key factors to encourage conservation decisions by increasing the present value of expected net revenues and by allowing sufficient time to pay back conservation investments.

The contribution of land leasing to poor land management and land degradation is implicitly assumed, but not often empirically illustrated, at least in rich developed countries. It is argued that well-developed institutional arrangements and efficient asset markets should solve problems caused by land tenure insecurity (McConnell 1983). Hence, economic literature analysing the implications of land tenure insecurity has for the most part focused on developing countries, where asset markets are likely to exhibit inefficiencies (Sjaastad and Bromley 1997, Li et al. 1998, Deininger 2003, Deininger and Chamorro 2004). In these countries, land tenure insecurity has significant implications, not only for land improvements but also for the welfare of households and society. Although the problems caused by land tenure insecurity are apparent, empirical studies have not been able to clearly identify and characterise their effects. The data have not been informative enough, because household access to farming inputs and markets in developing countries can be severely restricted by institutional, financial and economic

factors, as well as by land tenure insecurity. Thus, it has been difficult to isolate and identify the impact of land insecurity in statistical analysis (Holden and Hailu 2002, Lichtemberg 2007, Holden et al. 2009).

The links between land leasing and land degradation (links 1 and 2 in Figure 2) have also been questioned (Sjaasted and Bromley 1997, Allen and Lueck 2002, Lichtenberg 2007). The key point raised is that rental status is not an exogenous but an endogenous variable and the actions of landowners have been underestimated. In Finnish conditions this critique is not as valid as it is in the U.S., because the contract terms are limited by the government and the form of share cropping is unknown; thus, the contract terms are exogenous in Finland. In addition, the number of landowners exceeds the number of tenants by almost ten-fold, and furthermore, the competition between tenants is limited due to the sparsely populated rural areas. Rental prices of €0 /ha are not rare. The average landowner in Finland renting out farmland owns 3.35 ha, while his/her counterpart in the U.S. owns 109.35 ha (USDA, Myyrä et al. 2008). However, liming, the most important land improvement, is easily verifiable and the endogenous nature of land tenure contract termination could bee introduced. Finnish rental market conditions may imply the combination of maximizing the net value of production under the lease period, but the expected present value of land will only be partially achieved. The research problems are related to the levels of control variables deterring land productivity and the following stock levels of land improvements achieved when tenure contracts are short and the renewal of the contracts is uncertain and exogenously given. These questions were addressed in two articles. The tenant's problem of maximizing the net value of barley production in Finnish conditions is described in Article II and evidence of the land tenure insecurity problem based on the empirical foundation of stock variables of land improvements is presented in Article I.

It is a challenging task to statistically demonstrate the impact of land management on the productivity of farmland at the aggregate level (link 3 in Figure 2). The effects of certain land improvements at the field plot level have been studied more frequently under Finnish farming conditions (Kemppainen et al. 1993, Saarela et al. 1995, Turtola and Ylivainio 2009). Documented effects can be used when optimal land management by tenants is pinned out (Article II). Nevertheless, on the aggregate level we do not know the actual differences in land management between leased and farmer-owned plots. A particular feature in Finnish agriculture is that farmers only lease additional land to expand the size of their farming operations. Because most of the accounts of farms are carried out at the aggregate farm level, we could not observe how farm inputs are allocated between farmer-owned and leased land. However, certain statistics describing land quality and fertility can be separately observed for each plot of the farm, and these data can be used to identify differences between owned and leased plots to justify the land tenure insecurity problem. This is a sum of links 1, 2, and 3 in figure 2.

To obtain aggregate-level measures of the effect of land tenure on farmland productivity, the productivity of Finnish grain farms between 1976 and 2006 have to be examined. Productivity changes could thereafter be compared to changes in land tenure. The observed gradual increase in productivity was associated with increasing land tenure insecurity in Finland (Article IV), and an emerging question is how pathways out of the low productivity trap can be found (links 4 in Figure 2). One might also argue that do we need to battle against the low productivity trap? As Pender (1998) pointed out, the downward spiral might be a natural shift from one type of capital to another to increase income and

welfare at the farm level. It is true that land leasing is economically rational for a farmer. In Finland, land rents have been moderate, and because the overexploitation of leased lands is not regulated, land leasing has become even more attractive. However, this does not maximize social welfare. Maximization of social welfare calls to address questions related to pathway out of land tenure insecurity problem. These questions are addressed by link 4 and the land sale box in figure 2. An empirical study is presented in Article III.

Linkages at the farm level are routed back to land tenure, because profitability at the farm level is determined by prices, subsidies and the productivity at which inputs are transformed to outputs. Prices and subsidies are to a large extent exogenous for farmers. However, farmers usually have the potential to improve productivity at the farm level if prices, subsidies and tenure-systems provide economic incentives to do so. Environmental regulations and an aid system based on positive externalities from agriculture can contribute to farm productivity and profitability. Internalizing the external benefits from agriculture will lead to higher long-term land improvements (Pender 1998) and thus positively break the linkage between land tenure and land degradation. Thus, findings in this thesis have relevance to the design of public policies and programmes, notably the importance of supplying information on the farm-level implications of land tenure and land degradation.

The existing literature presents sharecropping as one possibility to resolve the land tenure insecurity problem and escape the low productivity trap (Huffman and Fukunaga 2007). Sharecropped fields have been found to produce even higher yields than sharecropping tenants' own plots (Kassie and Holden 2007). However, sharecropping is not a part of agriculture or tradition in Scandinavian countries. It is also undefined who is the real holder of subsidy entitlements under the CAP in the EU when land is sharecropped (Swinnen et al. 2009). The landlord-tenant relationship is typically a complex informal contract conforming with expectations, trust and reputation based on local traditions. In some cases, contracts are also linked to a fear of eviction. Finnish land lease legislation reduces the possibility of eviction, but at the same time it reduces the possibilities of long-term contracting. In land leasing, land tenure contracts longer than ten years are prohibited by law (Maanvuokralaki). This law dates back to the Russian revolution, when Finnish crofters where freed from the dictating command of large landowners. To prevent landlordism, long-term land tenure contracts were then prohibited, and they still are.

Almost half of the farmland in industrialized countries is no longer owned by farmers (Ryan et al. 2001). As many landowners have given up farming, some of them have left their land idle, while others have leased their agricultural land to other farmers. These facts make presented framework of the study feasible also in other industrialised country conditions.

1.3 Objectives of the study

The overall objective of the study reported in this thesis is to empirically analyse the connection between land leasing and land degradation in a well-developed agricultural society. There has been considerable interest in studying linkages between natural resource management and poverty in developing countries. However, studies concentrating on interactions between institutional settings, natural resource management and agricultural productivity in developed countries are, with few exceptions, lacking. Moreover, mostly due to the lack of research based empirical evidence, there is currently no consensus on the impact of land tenure on land management and land degradation, or vice versa.

Agricultural and rural systems involve highly dynamic and complex interactions between people and soil, land management, and institutional and political components that are involved. Institutions and political components might conflict and hamper goals to improve land quality. In designing policies to concurrently achieve these objectives, a better understanding of their linkages is needed. Moreover, evidence on the context-specific nature of land tenure insecurity and its relationship with land degradation and productivity is required to guide policies. I hope that the results of this study can be of help for the policy planners in formulating policy options to resolve the land tenure insecurity problem in Finland.

1.4 Outline of the thesis

This thesis presents four different approaches, reported in four separate articles, to analyse the economics of land tenure insecurity and its implications. Both normative mathematical programming and positive statistical approaches are used. Normative modelling provided a better understanding of the economics of land tenure insecurity, while statistical approaches were used to test for the existence of these relations.

In the first article, the land tenure insecurity is analysed. The objective of this article is to find out whether tenure insecurity has lead to a decline in long-term land improvements (liming and phosphorus fertilization) under the Common Agricultural Policy (CAP) and Nordic production conditions in European Union (EU) countries such as Finland. Soil pH, in particular, was found to be significantly lower in land cultivated under a lease contract as compared to that owned by the farmers themselves. A large and unique dataset covering the years 1998–2000 was obtained from farms in the Farm Accountancy Data Network (FADN) and was complemented by information on land parcels and land quality. The data on land parcels and their ownership status were provided by the Information Centre of the Ministry of Agriculture (TIKE). Data on the indicators of soil quality, phosphorus (P) status and soil acidity (pH) were obtained from Viljavuuspalvelu Oy.

The second article examined the dynamics of liming and phosphorus fertilisation in Finland in order to maximize tenant's profits. The dynamic optimisation problem was solved by a stochastic dynamic programming routine with known parameters for one-period returns and transition equations (Bellman 1957). Empirical parameterisations of crop growth and carry-over functions represented Finnish soil quality and production conditions (Kemppainen et al. 1993, Saarela et al. 1995, Black 1993). The decision rules were solved for alternative likelihood scenarios concerning the continuation of the fixed-term lease contract. The results suggested that as the probability of non-renewal of the lease contract increases, farmers rapidly reduce investments in irreversible land improvements and, thereafter, yields gradually decline.

While articles I and II suggest that land tenure insecurity has resulted in the neglect of land improvements, the third article analyzes whether these challenges could be resolved by a tax policy that encourages land sales. A mail survey was used to acquire data on landowners' sale preferences, with a questionnaire being mailed to the final sample of 5 762 landowners. The data indicated that real estate tax and a temporal relaxation of capital gains taxation offer potential for the policies aiming at the restructuring of land ownership. However, a large number of landowners (84%) in the sample were unwilling to sell their land even as a response for temporary tax shields. Potential sellers who could not be revealed by traditional logit models were identified using the latent class approach (Vermunt and Van Dijk 2001).

Earlier studies have shown that Finnish agriculture is suffering from low productivity (Sipiläinen et al. 2008). To identify aggregate-level connections between the rapid increase in land tenure and changes in productivity in Finnish arable farming, the productivity trend of Finnish gain farms is analysed in article IV. The nature of grain farming in Finland challenges the methodology to simultaneously take into account the general trend and annual variation in total factor productivity (TFP). Our analysis applied production function approach and two different models to capture technical change. In the time trend model (TT), the trend variable was used as a regressor along with the input variables. It was a proxy variable representing the rate of technical change or the shift in the production functions over time, and produced smooth technological changes. In the general index model of Baltagi and Griffin (1988), the trend variable t was replaced by a vector of dummy time variables. A very long time series (30 years) of data was also used to avoid biased predictions from short-term changes in productivity trends.

2 Results and discussion

2.1 Land tenure insecurity in Finland

The effect of land tenure on stock variables describing the quality of land was tested in article I. Stock variables where used because the data on land improvements were unobserved as control variables so that they could be separately identified for farmer-owned and leased land. These stock variables were soil test P (STP) and soil pH. They were separately observed for each plot, either farmer-owned or leased. Other plot specific characteristics where also controlled.

The soil pH in Finland is higher in the South[4] than in the North, but the difference in mean soil pH between owned and leased land was found to be similar in both regions (Table 1). The mean soil pH was estimated to be 0.2 pH units higher for land owned by the farmer than that cultivated under a lease contract. In each soil group[5] in the two regions, the mean soil pH for the owned parcels was higher than that of the leased parcels. However, the endpoints of the 95% confidence intervals for the mean implied that the true means of both land tenure statuses could be within the satisfactory class[6].

[4] The South covers the CAP subsidy areas A and B; the North covers the CAP subsidy area C. See CAP subsidy areas ('tukialueet' in Finnish) on www.mmm.fi/attachments/maatalous/tuet/5l3gtq2oH/Paatukialueet__kartta.pdf

[5] Soils are classified according to the concentration of soil organic matter (SOM) and the particle-size distribution of mineral soils. Organic soils contain >20% of SOM and mineral soils contain < 20% of SOM. The textural class and the categories of SOM (SOM1 < 3%, SOM2: 3–6%, SOM3: 6–12%, SOM4: 12–20%) of mineral soil classes are determined by trained experts using finger assessment.

[6] Soil characteristics are used in the interpretation of soil *pH* and *STP* results. This means that a given *pH* or *STP* value, measured in the laboratory, can result in different fertility classes, depending on the soil class and the content of SOM. The results of both *pH* and *STP* are divided into seven classes as follows: poor, rather poor, fair, satisfactory, good, high and excessive. These classes guide farmers in farming practises.

Table 1. Comparison of parcels cultivated by landowners and tenants with respect to covariate-adjusted mean soil pH in the South and North. [a)]

Region / Tenure		Number of parcels	Adjusted mean	95% confidence interval for the mean	Difference between the means	Standard error of the difference	P-value
South [b)]							
All soils	Own	210	6.2	(6.1–6.4)	0.22	0.05	< 0.0001
	Leased	101	6.0	(5.9–6.2)			
North [b)]							
All soils	Own	198	6.0	(5.9–6.2)	0.20	0.06	< 0.005
	Leased	129	5.8	(5.7–6.0)			

[a)] The adjusted means are predicted values obtained from the estimated model evaluated at the two hectare parcel level, located at a distance of one kilometre from the compound.

[b)] South covers the CAP subsidy areas A and B; North covers the CAP subsidy area C.

There was no evidence that the observed difference in pH would depend on parcel size, parcel distance from the compound of the tenant, or on any farm characteristic available in this study. Nevertheless, the soil pH was predicted to increase as parcel size increases and to decrease with parcel distance, independently of the land tenure status. As earlier pointed out, liming, which increases soil pH, is one of the most important long-term investments in sustainable agricultural production in Finland. This is also supported by the results. In the South, which is the most productive region for arable cropping, the best field plots i.e. the largest parcels, close to the farm compound have highest pH values. In earlier studies, field plot size and distance from the compound have been shown to be the most critical measures of the productive value of a field plot in agricultural production.

Above signals that leased field plots are not considered as important in long-term production plans as owned field plots, and uncertainty over land tenure has significant implications for the management of leased plots. From a statistical point of view, the above-mentioned relationships between soil pH, parcel size and parcel distance from the farm compound are challenges to be considered when outcomes from land tenure insecurity are measured. Because of the lack of data, these challenges are typically ignored in studies on land tenure insecurity and effects of land tenure insecurity could not be revealed. Holden et al. (2009) presented one of exceptions to this baseline.

We obtained slight evidence of a difference in mean (STP) between owned and leased parcels such that soil test P values where higher on farmer-owned plots than on leased plots. The evidence was somewhat stronger in the North than in the South, where in each soil group the mean STP of the owned parcels was higher than that of the leased parcels. However, in the South the estimated means for both land tenure statuses were within the satisfactory fertility class, i.e. in the target range. Lichtemberg (2007) used our result for STP in the South to argue against the hypothesis of land tenure insecurity. This is not exactly correct, because the findings from the North indicate interaction between land tenure status and production line. This signals that the difference be-

tween owned and leased parcels is smaller in livestock production than in crop production. The results suggest that P supplied in manure is quite evenly distributed on owned and leased parcels. More land may have been leased on livestock farms in the South, where pig farming is concentrated, particularly to obtain a sufficient land area for manure management. In these cases, the excessive amount of manure and phosphorus contained in it becomes a waste product, and livestock production farms seem to equalize the STP values between leased and owned land in the South.

The results indicate that a delay in land improvements, as indicated by the suboptimal stock variable values unobservable for non-agricultural landowners, does not yet show in the yield potential of land to the extent that it can be visually detected, even though the effect is statistically significant. This provides an opportunity for lease farmers to continue the overexploitation of leased lands. However, the productivity of arable farming might be hampered.

2.2 Lease holder's profit maximization and land tenure insecurity

The Finnish application of the tenants' dilemma concerning land improvements using a recursive dynamic programming algorithm method in the context of grain farming is presented in Article II. This methodology is strongly based on local norms and yield responses, which have been extensively studied in field trials in Finland.

The optimisation problem faced by lease farmers in liming and phosphorus application was formulated as a recursive finite-horizon dynamic programming problem that was numerically solved by iterating Bellman's equation (Bellman 1957). Spring barley was used as an example, because it is the most widely cultivated arable crop in Finland. The optimal value function was constrained by transition equations, which were a function of the amount of lime or phosphorus used. Transition equations determined the connection between the current state and the control and the state in the next period. The optimal solution was estimated as a function of the initial state. This specification generalised the models presented in Kennedy (1986), where the initial state (as a proportion of the earlier period's application) and current application have a unique yield response. The model also exhibited the feature of stochastic renewal of the leasing contract. This is to my best knowledge a new feature, and implies the exogenous nature of the renewal of land lease contracts.

Land tenure insecurity constrains farm households to increase net returns through investment in land improvements by making the time horizon and, thus, the future income stream uncertain. The length of the lease contract clearly has a direct effect on the net present value of land improvements for the farmer in the case of a fixed probability of contract renewal. However, we adopted a more realistic approach in which the volatility of renewal probabilities was taken into account.

Liming is to some extent lumpy as it is expensive to distribute a small amount of lime. Furthermore, farmers usually do not have the necessary equipment and contractors are used to spread the lime on the fields. Thus, if the initial soil pH at the beginning of a five-year land lease contract is within the biological target range (5.8), which was the case in the simulations, land tenure insecurity does not make a difference in the optimal liming rules within such short lease contracts. It does not pay to apply lime on land with a pH level exceeding 5.4, except when the access of the farmer to the land is certain to continue, either through repeated and secure contract renewals or land ownership. In this case, the decision rule converges with the optimal behaviour around the long-run

equilibrium without land tenure insecurity, which is also optimal from the society perspective.

If land sale does not occur and land leasing continues, the initial pH level at the beginning of the upcoming land lease contract decreases. The decisions to lime then vary according to the uncertainty over lease renewal. As usually noted, the duration of the contract also plays an important role in the liming decision, but this was not explicitly examined in Article II. In Article II we concentrated on the sequence of fixed-duration, five-year land leasing contracts and the consequences of the renewal probability. If lease contracts are longer, the farmer can collect a larger income from the land improvements, and the threshold level determining the liming decision of landowners and tenants does not decrease to as low a level as in the case of five-year contracts. See Myyrä and Pietola (2005) for complete results from the comparison of five- and ten-year contracts.

If the contract is going to expire with certainty, it pays to lime at the beginning of a five-year contract if, and only if, the soil pH is below an extremely low value of 5. If the odds are slightly in favour of contract renewal (P = 0.6), it pays to lime at the beginning of the five-year contract if the soil pH is below 5.2. The risk-free long-term equilibrium is to maintain soil pH above 5.4, representing a "fair" soil pH status in the soil type studied. When contract renewal is likely, e.g. P > 0.5, it is still advantageous to maintain the soil pH above 5.2. Optimal timing is to apply lime immediately after the new contract is signed. Nevertheless, when the likelihood for contract renewal decreases and the odds are in favour of contract termination (P < 0.5), the soil pH is allowed to decrease below 5.2, which most commonly represents the fertility class "rather poor" or "poor"[7].

[7] The class limits depend on the particle-size distribution and the organic matter content of the soil.

The study of phosphorus application under land tenure insecurity in Article II focused on the difference between two steady state equilibriums. The first represented the case where no land tenure insecurity exists, i.e. the land is owned by the farmer or the lease contract is repeatedly renewed with certainty. The steady state equilibrium for phosphorus application in barley production was estimated at 18 kg/ha, which is slightly exceeds the environmental recommendations, implying that environmental regulations limit phosphorus application by owner farmers. The likelihood for the non-renewal of the lease contract has a considerable effect on the optimal phosphorus fertilisation, particularly when the contract is approaching the renewal date. If, for example, the odds are slightly in favour of contract renewal (P = 0.6), the optimal phosphorus application was found to remain between 10 and 11 kg/ha until the third year before the renewal date. This level of application is as much as 39 to 44% lower than the long-term equilibrium without land tenure insecurity. Thereafter, and towards the end of the current contract, the phosphorus application drops to 8–9 kg/ha. If the contract is to expire with certainty, phosphorus application rapidly declines towards 2 kg/ha as the expiry date approaches. Clearly, the environmental regulations do not hinder annual phosphorus fertilization decisions by lease farmers, particularly when the contract is approaching its renewal date.

The key interest in Article II lay in the long-term effects of the current land tenure system, which is characteristic of the Finnish agricultural sector. The case of pH was discussed above, and the details of the phosphorus stock measured as soil test P (mg/l) on farm land are described in Figure 3. Due to continuous lease farming, a gradual decrease in soil phosphorus stock has occurred. When there is no land tenure insecurity, the steady state for soil phosphorus, i.e. the long-term equilibrium that maximises the value function, is 8.5 mg/l,

which is substantially below the amount needed to produce the maximum yield (13 mg/l). If uncertainty over the continuation of each five-year contract is large (the probability of contract renewal, P = 0.2), the steady state soil phosphorus is estimated at 5.5 mg/l, which definitely represents a lower soil phosphorus status than that required for the maximum yield. This extremely low level of soil phosphorus describes the overexploitation of land by tenants.

The economic loss due to a decreased pH and STP stock arises from several reasons. First, liming is a necessary land improvement in Finnish conditions to maintain the soil pH. A decrease in pH impedes the uptake of almost all nutrients needed by grain (Kemppainen et al. 1993). Second, changes in the phosphorus stock have implications for the fertilising behaviour of tenants. Under a decreased phosphorus stock, annual phosphorus fertilization by lease holders becomes a difficult decision and even more dependent on the probability of contract renewal. Because of the low phosphorus stock there is an incentive to use high levels of phosphorus fertiliser at the beginning of the lease contracts. Third, as our results from the liming and pH model show, lime is applied at the beginning of every second or third lease contract and the overall productivity of the land declines. The yield potential is no longer large enough to transform these phosphorus fertilization peaks at the beginning of the lease contract to improved yields. Furthermore, some of the yield potential might become underutilized because of the low levels of phosphorus fertilization at the end of lease contracts. This type of phosphorus fertilization peaking at five-year intervals is not efficient from an environmental perspective.

Three interesting phenomena could be identified from the above results. First, current cash lease contracts give a clear incentive for a tenant to transform land capital, i.e. land fertility stock to other forms of capital. Second, cultivation practises are significantly driven by the economic and institutional settings. This might lead to major insufficiencies in plant nutrition and thus hinder the productivity of leased land.

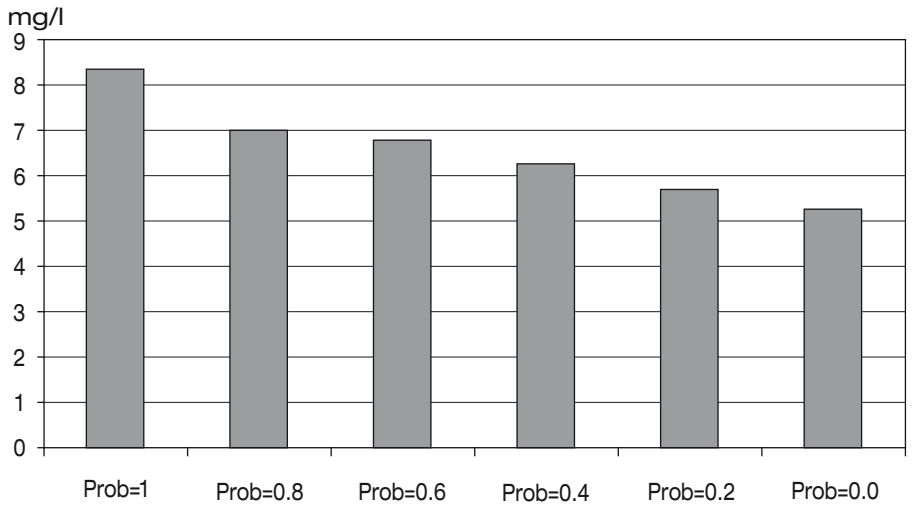

Figure 3. Converged values of easily soluble P, conditional on the probability (Prob) that the five-year leasing contract is renewed. If prob = 1 (Prob = 0), the contract is renewed (terminated) with certainty.

Phosphorus fertilization is just one example of these trends. Third, the productivity of farmland is reduced and maintenance of the food supply through high yields is jeopardized. This also hampers the goals of environmental programmes, because the yield is the only positive way to collect nutrients from agricultural soils and prevent runoff.

2.3 Taxation and land sale

In Article III possible effects of taxes as policy instruments to promote farmland land sales is studied. From the land sales statistics and studies we find that only 1.8% of the total field area is traded annually (Pyykkönen 2006). This raises an important question concerning how tax policies, for example, could be used to encourage land sales to solve the problem of the low productivity trap. Some earlier studies have also confirmed that the land use intentions of landowners can be affected by policy instruments. However, earlier studies have also demonstrated that landowners may be reluctant to sell their agricultural land. Numerous reasons have been presented, but in many respects the type of landowner and the property characteristics associated with unwillingness to sell remained unknown.

In Finland, some institutionally available policy instruments could be used to enhance land markets. Temporary relaxation of taxation on the proceeds of a farmland sale (TTF) would be one equitable option, because it is open to all landowners and quite light taxes are currently collected from capital gains in land sales. Another alternative is to introduce a real estate tax (RET) on farmland. RET affects all landowners, but it could be conjectured to trigger[8] land sales amongst landowners whose land use does not generate land rent that exceeds the tax. A prerequisite for successful policies is a thorough knowledge of landowners' preferences and willingness to take part in markets because of these types of tax programmes. However, such knowledge is currently lacking.

To study landowners' preferences over land sales, a large survey was conducted on a sample of landowners, including both active farmers and passive landowners, in 2006. The sample was selected from the register of the Finnish tax administration based on the data for 2004. A questionnaire was mailed to the final sample of 5 762 landowners and a total of 2 684 observations were obtained. The questionnaire focused on a single holding of farmland owned by the responding landowner. All land sale models, including past sales, sales under TTF and RET as well as classification of land owners to sellers and less probable sellers, were fitted to this dataset.

Based on past sales, the standard logit model identified only some landowner characteristics related to sale. Unsurprisingly, unemployment explained past sales. The acute need for income from land sale for consumption was a logical and plausible explanation. A somewhat unexpected result was the finding of regional differences in past sales. The probabilities for past sales were higher in the western part of Finland and lower in the northern part. However, these patterns could be related to cultural differences, and to general expectations concerning agriculture and land markets, which are decreasing in the north and increasing in the west.

Although we lost a large number of observations because landowners found it difficult to report their future intentions to sell their land, the logit models performed somewhat better when future land sale intentions were investigated. We observed that earlier sales were the dominant predictor of future sales and that 5.8% of land

[8] Holt, C. and Shelton, J. 1962. The lock-in effect of the capital gains tax. National Tax Journal 15: 337–352.

owners had an experience of earlier land sales. This result was consistent with previous studies (Ajzen 2002) and confirmed that the same factors explain both past and future sales. However, the logit models indicated that these factors are rare and difficult to identify. We found some evidence of a connection between female gender, a higher age and lower education, as well as landowner objectives[9] in selling land.

Despite the association between certain socioeconomic variables and the probability of future land sales, the power of the logit models to correctly predict actual sellers was weak. Using a cut-off point of 0.50, as in standard in computing predictions in these types of probability models, the number of correctly-classified sellers was under 20% of all observed sellers within the sample. By lowering the cut-off point the sensitivity could be improved, but a loss of specificity was inevitable. This result inspired us to try some new methodologies not yet applied in this field of economic analysis.

To gain a further insight into the selling intentions we applied a latent class model. An interesting feature of latent class modelling is the ability to use statistical criteria to measure the number of underlying latent groups. An example of latent groups could be those value-based objective groups that we used earlier. The series of fitted latent class models and the applied Bayesian information criterion (BIC) confirmed the presence of two classes of farmland owners concerning land-sale preferences. Class 1 consisted of owners who were less probable sellers in the coming five-year period. This class comprised 84% of all landowners. Class 2, comprising 16% of landowners, had future intentions to sell land, particularly if a tax policy would be implemented. At this point it has to be mentioned that the number of classes in our model is not necessary limited to two. Behind the observed variables, a number of unobserved variables may exist and parameters of the regression model explaining land sale decisions differ across unobserved classes. If these underlying landowner classes are not recognised, serious problems due to omitted variables are faced.

The effect of the studied policy measures (TTF and RET) differed significantly between the observed landowner groups. In the model containing the dichotomous RET variable, higher tax levels were associated with higher sale preferences, but the effect was stronger in the class of landowners with intentions to sell land (class 2). The difference between the landowner classes was even stronger on the case of TTF. In class 1, sale intentions were not significantly affected by the TTF policy, but in class 2 TTF had a positive and significant effect on sales.

The introduction of substantially high RET levels (from €10 per ha to €70 per ha) was found to increase the selling probability in Class 2 from 17% to 70%. Almost the same increase in selling intention could be achieved by TTF, which increased the selling intention by 53% in class 2. Based on these results, TTF was concluded to be a more attractive policy if an increase in land sales was seen as one possible solution to the current land tenure insecurity problem in Finland.

Some of the observable land owner's characteristics where connected to fitted latent classes. However, the earlier sale behaviour remained as the best predictor for the future sales. Characteristics like land ownership objective group, the region of the farm and the perception of the field prise gives tools for future research to predict farmland markets. But, it is not possible to dif-

[9] Five value-based objective groups (agricultural earners, indifferent owners, immaterialists, part-time farmers and agricultural earners) were constructed in a paper by Pouta, Myyrä and Hänninen. The paper has been submitted to the journal Society and Natural Resources.

ferentiate the taxation between land owners based on these results.

2.4 Long-term productivity changes in grain production

Changes in agricultural productivity have been of continuous interest to agricultural economists in Finland (Ihamuotila 1972, Hemilä 1982, Ylätalo 1987, Ryhänen 1994, Sipiläinen 2008). The first studies on TFP changes in Finland by Ihamuotila (1972) indicated a rate of growth of TFP between 2.5–2.7% per year from 1950–1969. Ylätalo (1987) estimated the annual TFP change in Finnish agriculture from 1961–1984. The results indicated TFP growth between 2.9% and 1.5%, depending on the income shares of labour and capital. The rate of increase in TFP improved towards to the end of the research period, being 3.8% from 1975–1984. Sipiläinen (2008) showed that productivity growth on Finnish cattle farms faced a slowdown in the mid-1990s at the time of EU accession, but have accelerated since then. During the 1990s the average increase in productivity on cattle farms was estimated at 1.0% per year. Long term productivity development is studied in last study of this thesis, Article IV.

In Article IV, the average production function is estimated. By assuming allocative efficiency the estimation of production function can be concentrated to derive technical change and the scale effect on productivity growth. By this technical decomposition, no detailed price information is needed, although it is assumed that farmers face equal prices in order to be able to estimate changes in TFP. The main challenge is thus to estimate a suitable production function. The simultaneity problem caused by the used endogenous explanatory variables in the production function could not be avoided. The one way to go around the simultaneity problem could have been the usage of dual approach, but for that there where not enough farm specific price information.

With two separate models we showed that the annual variation in TFP growth rate in Finnish grain farms was large and captured by the general index model (GI), because this model allows more flexibility with respect to year-to-year changes in productivity. However, it might be impossible to capture the general trend in TFP based only on general index model results. To test larger trends we used the time trend model (TT). This issue was topical during the first years of EU membership, when land leasing rapidly increased. As Figure 4 illustrates, the 1994 harvest year was reasonably good. However, during the following years from 1995 to 1999, the first five-year period under the CAP, weather conditions were poor and TFP collapsed.

At time of accession to the EU, there was considerable debate over quasi or apparent farming. This was because of the sharp decrease in the marginal product value (MPV) and increasing land leasing, both of which reduced the incentives for input usage. Despite clear changes in the operating environment in farming, it still is difficult to find changes in the productivity trend, even if we have such a long time frame and advanced econometric methods.

Our results from article IV indicated that total factor productivity (TFP) increased in 1976–2006 by 0.6% per year in the GI model and 1.7% per year in the TT model. Results from the TT model also evidenced that the increase in productivity was hindered by increasing land tenure and the policy changes introduced in 1995. The cumulative increase in TFP indicated by TT model over the study period was at the same level as the largest yearly changes in TFP estimated by the GI model. The results are presented in Figure 4.

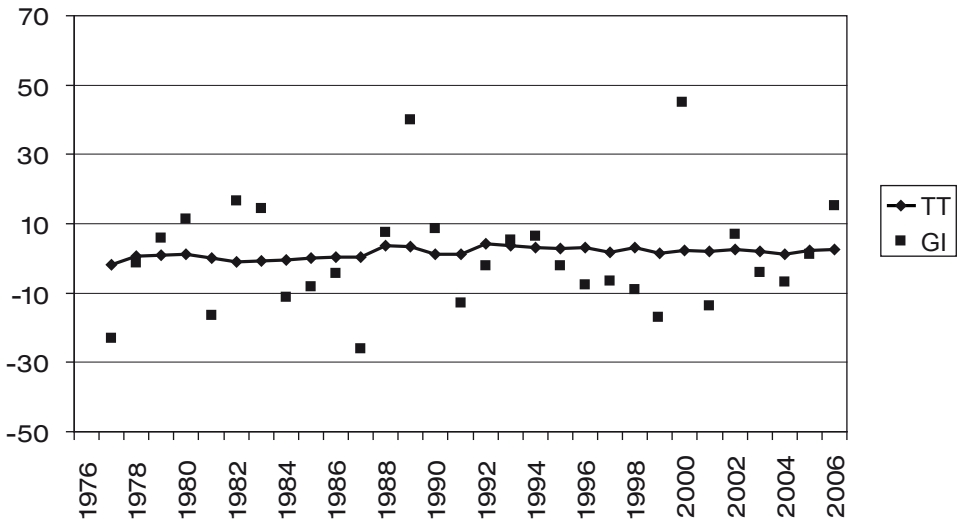

Figure 4. Annual change in total factor productivity. TT = Time trend. GI = General index.

Based on our experience, the time trend model is not flexible enough to capture the annual variation in Finnish grain farming, and in this sense results gained from the general index model are preferable. Baltagi and Griffin (1988) also preferred the GI model, since it closely follows the changes in Divisia indices. Kumbhakar et al. (1999), however, presented some contradictory views on the TT model.

Farming is a long-term operation and land improvements have a long payback time. Consequently, it is natural that sharp economic changes generate only gradual changes in land productivity. However, it could be argued that the increase in TFT of grain farming could have been faster without combined effects from land tenure and changes in policy regime.

According to Fuglier (2008), agricultural productivity increased in Western Europe by 1.6% per year on average from 1970–2006, while it increased in Eastern Europe by only 0.6% per year. This is interesting, because property rights and land reforms are known to be among the major questions in Eastern European agriculture. A slow privatization process prolongs the uncertainty of property rights. As long as property rights are uncertain, markets cannot develop and the disinvestments in agriculture continue, including a reduction in investment in land (Macours and Swinnen 2000).

3 Conclusions

Property rights are fundamental to economic performance and efficiency analysis. Land improvements are necessary, but an insufficient condition in arable farming to improve performance. These fundamental phenomena are combined in this thesis. Certain conditions of land acidity, measured by pH, and availability of phosphorus, measured by STP, are essential to obtain maximum crop yields. This study described how these conditions are most unlikely to be met under the current land tenure system in Finland, where farmers are confronted with substantial land tenure insecurity. The results underline that the low productivity trap caused by land tenure insecurity, land degradation and declining productivity can also occur in highly modernized, developed and rich countries. Under these conditions, the main driving factor for the low productivity trap is uncertainty. Uncertainty over the continuation of short-term cash lease land tenure contracts restricts farmers in their ability to discount future income streams from current land improvements. Both the soil pH and STP were shown to be lower on leased land than on the land owned by the farmer in Finland.

The limitation of the data set to cross-sectional observations of plot characteristics and stock measures of soil pH and STP limits the ability to assert and explicitly test for the causal relationship between land tenure and land improvements, i.e. corresponding control variables which in this case are liming and P fertilization. Nevertheless, I refer to the observed statistical relationships as "causality". Obviously, a causal relation could be only justified based on time series data. However, such a data set was unavailable for this study. The causal relationship was analysed in a separate economic optimisation model, constructed in a dynamic programming framework. Thus, the lacking causality was modelled and calibrated to Finnish conditions.

The tenants' dilemma over land improvements is important and a concern of the increasing field area in Finland. The most important new feature in the dynamic programming application was the recognition of the stochastic nature of the duration of lease contracts and explicit modelling of the probability of renewal of land lease contracts. The results suggested that uncertainty over the renewal of the lease contract sharply reduces incentives for farmers to invest in maintaining pH and STP. Because soil pH and STP are necessary factors to obtain good yields, the yields and land productivity gradually decrease when these soil improvements are not carried out.

The results signal that in Finnish land tenure market conditions, where land tenure contract terms are limited, the reputation of farmers gained through land improvements does not resolve the problem of land tenure insecurity. It does not pay to make land improvements to build up a long-term land tenure relationship with the landowner. The reasons for this remained unclear, but it could mostly be because landowners are no longer attached to agriculture and the productive value of agricultural soils. If there is no possibility or legal incentive to establish conditions for long-term planning by giving farmers and landowners possibilities to make arrangements longer than ten years ahead, and thereby to reduce uncertainty, it might be beneficial for society to relax land market constraints, and the possible lock-in effect, through other policies such as taxes.

One pathway in agricultural policy might be to encourage landowners to take full advantage of the market value of agricultural land. Relaxation of the capital gains tax on land sales showed some potential along these lines. However, 86% of landowners did not consider the sale of their land as a plausible option.

It is evident that the productivity of leased land in Finland is declining. In future years the land productivity will decrease to a point where we will have to consider if it is feasible or beneficial for society to try to maintain the entire field area under agricultural production. This is especially so in those areas where land leases have reached the level of 0 €/ha or markets are expecting land to be converted to some other usage than agriculture. Because landowners are not willing to sell land to active farmers, other interests of the landowner as well as society at large have to be accounted for. A change in land usage of fields with the lowest productivity is one of the fastest ways to improve the general productivity of Finnish agriculture. This study revealed that land tenure and low productivity could be connected, and potential areas for new agricultural policy indicated by the history of land tenure. The possibility to reallocate subsidy entitlements for the most productive farm lands might be one direct way to improve land allocation and productivity.

The decreasing trend in productivity on leased land is natural and occurring under current and well-established land tenure contracts. Connected to the market environment, these contracts provide incentives for farmers to transform land improvements, i.e. inbuilt productivity stock, to cash. The markets do not penalise farmers if they do not invest in land and this way try to ensure the continuum of the land tenure contract. Although natural, this trend is alarming from the perspective of productivity development in arable crop farming. Agriculture is a long-term operation, and the current, partially "home made" land tenure institutions in Finland are hindering the survival of Finnish agriculture under international competition.

Land institutions and land tenure questions are essential in agricultural and rural policies on all levels, from local to international. Land ownership and land titles are commonly tied to fundamental political, economic and social questions. A fair resolution calls for innovative and new solutions both on national and international levels. However, this seems to be a problem when considering the application of EU regulations to member states inheriting divergent landownership structures and farming cultures. The contribution of this study is in describing the consequences of fitting EU agricultural policy to Finnish agricultural land tenure conditions and heritage.

4 Yhteenveto (summary in Finnish)

Maatalous on pitkäjännitteistä toimintaa. Pellon perusparannuksia suunnittelevan maanomistajan suunnittelujänne on pitkä, jopa yli sukupolvien ulottuva. Sen sijaan vuokraviljelijän suunnittelujänne on perusparannusten osalta lyhyt. Usein väitetäänkin, että vuokraviljelijöillä on taipumus perusparannuksia rapauttavaan viljelyyn. Perusparannusten huomioonottaminen antaa haasteita vuokrasopimuskäytäntöjen kehittämiseen. Vuokrasopimusten ja tukijärjestelmän sekä maatalousmarkkinoiden yleensäkin tulisi olla riittävän tehokkaita antaakseen vuokraviljelijälle mahdollisuuden ja kannusteet myös vuokrapeltojen pitkäjänteisen sadontuottokyvyn ylläpitämiseen. Peltojen hyvä sadontuottokyky ja maan tuottavuus ovat koko yhteiskunnalle monestakin syystä tavoiteltavia asioita. Vuokrapeltojen hallintaoikeuden epävarmuuteen keskittyvä tutkimus on juuri nyt erittäin ajankohtainen, sillä pellon vuokraus on yleistynyt 1990-luvulla ja sen jälkeen nopeasti. Toisaalta maatalouden tuottavuuskehityksen, ja erityisesti kasvinviljelyn tuottavuuskehityksen, on havaittu olevan hidasta. Epäillään kin, että osa vuokrattuina viljellyistä pelloista on ajautumassa matalan tuottavuuden loukkuun, jossa sekä maanomistajan että viljelijän kannusteet pellon kasvukunnon parantamiseen ovat alenevat.

Tässä tutkimuksessa tarkasteltiin vuokraviljelystä johtuvan pellon hallintaoikeuden epävarmuuden vaikutusta viljelijän tekemiin pellon perusparannuksiin. Kahdessa ensimmäisessä artikkelissa tutkittiin peltojen vuokrauksen vaikutusta niiden kalkitusten ja fosforilannoitusten määriin ja kannattavuuteen. Kolmannessa artikkelissa keskityttiin havaitun pellon hallintaoikeuden epävarmuudesta johtuvan ongelman ratkaisuvaihtoehtoihin verotusjärjestelmää kehittämällä. Neljännessä artikkelissa peltoviljelyn tuottavuuskehitystä tarkasteltiin pitkällä, yli 30 vuoden mittaisella paneeliaineistolla. Käytetyt ekonometriset menetelmät ja tuotantotaloudellinen lähestymistapa kytkevät tutkimuksen maatalouden tuotantotaloudelliseen viitekehykseen.

Pellon hallintaoikeuden epävarmuuden lisäksi pellon kasvukunnon rapautumista on selitetty kansainvälisessä kirjallisuudessa monilla tekijöillä. Köyhyys, asutuksen paine, huonosti toimivat tai olemattomat markkinat panoksille, tuotteille ja maatalouden ulkoisvaikutuksille ovat tekijöitä, joita pidetään syynä pellon sadontuottokyvyn alenemiseen. Näiden tekijöiden merkitys vaihtelee voimakkaasti eri alueiden välillä, mutta mikä tahansa niistä voi laukaista matalan tuottavuuden loukun. Edellä mainittujen tekijöiden vaikutuksen eroja voidaan selittää esimerkiksi maanomistuksen rakenteella, alkuperäisillä tai ikiaikaisilla maaoikeuksilla sekä sosiaalisilla rakenteilla ja normeilla. Suomalaiset olosuhteet ovat erikoiset verrattaessa niitä aikaisempaan kansainväliseen kirjallisuuteen matalan tuottavuuden loukusta, sillä toimivien markkinoiden ja kehittyneiden sopimuskäytäntöjen on arvioitu ratkaisevan nämä ongelmat. Tulokset kuitenkin paljastavat, että vuokrapeltojen sadontuottokyky on Suomessa jäämässä jälkeen muiden maiden peltojen vastaavasta.

Aiempi tieteellinen keskustelu matalan tuottavuuden loukusta painottuu kehitysmaihin. Ehkä juuri tästä johtuen riittävän informatiivisen kvantitatiivisen empiirisen aineiston käyttö tutkimusaiheen tutkimuksessa ei ole lopultakaan ollut kovin yleistä. Välillisiä perusparannuspäätöksiä, kuten eroosiota estäviä toimia, on tutkittu paljon, mutta todellisia omistajan ja vuokraviljelijän viljelemien peltojen sadontuottokyvyn eroja ei ole useinkaan tilas-

tollisesti testattu. Poikkeuksen tästä päälinjasta tekee Yhdysvalloissa ja Kanadassa havaittu eroosio-ongelma. Suomessa käytettävissä oleva aineistokaan ei mahdollista satotasoerojen selvittämistä vuokra- ja omistajapeltojen välillä, sillä meillä ei ole puhtaita vuokraviljelijöitä. Käytettävissä oleva aineisto kuitenkin mahdollistaa sen, että peltojen sadontuottokykyä pellon viljavuudella mitattuna voidaan vertailla. Tämä vertailu tehtiin artikkelissa I, jossa tärkeimpänä tavoitteena oli selvittää, onko vuokrapeltojen sadontuottokyky jo jäänyt jälkeen omistajapeltojen vastaavasta.

Artikkelin I tulokset osoittavat, että viljelijän omien ja vuokrapeltojen pH:n tasoero on nyt ½ viljavuusluokkaa ja helppoliukoisen fosforin tasoero ⅓ viljavuusluokkaa viljelijän omien peltojen hyväksi. Peltojen kasvukunnon ollessa kohtalaisen hyvä ei viljavuuden tasoero aiheuta kuitenkaan vielä merkittävää eroa omien ja vuokrattujen peltojen satotasojen välille. Keskeisin tulos piileekin juuri tässä. Viljavuuden tasoeron kehitys on niin hidasta, että markkinat eivät pysty reagoimaan siihen ja vuokramiehet voivat jatkaa vuokrapeltojen perusparannuksia rapauttavaa viljelytapaa. Tästä syntyy matalan tuottavuuden loukku, johon reilusti yli ⅓ Suomen pelloista on luisumassa.

Artikkelissa II keskityttiin siihen, ettei kausaalisuhdetta pellon vuokrauksen ja havaitun viljavuuseron välillä ei voitu tilastollisesti vahvistaa Artikkelissa I käytetyn poikkileikkausaineiston perusteella. Kausaalisuhteen talousteoreettinen perusta rakennettiinkin Artikkelissa II dynaamisen ohjelmoinnin menetelmin. Rakennetut dynaamisen ohjelmoinnin mallit ovat maatalouden liiketaloustieteen ja erityisesti tuotantotalouden keskeisimpiä menetelmiä. Viljelijän toiminnan rationaalisuuteen, kuten voiton maksimointiin, nojaavat mallit rakennettiin aikaisemman tutkimustiedon varaan viljelysmaan pH:n ja fosforilannoituksen vaikutuksesta satoon. Mallien uutuutena ja samalla poikkeuksena oli vuokrasopimuksen jatkumiseen liittyvän epävarmuuden huomioiminen ulkoa annettuna eli eksogeenisena. Tämä lähestymistapa lisää kansainväliseen kirjallisuuteen aivan uuden näkökulman, sillä aikaisemmin vuokraviljelijän perusparannuskannusteiden on nähty osittain rakentuvan viljelymaineen rakentamisen varaan. Vuokrasopimuksen jatkumisen todennäköisyyttä on siis pidetty endogeenisena. Vuokrapeltojen ja omien peltojen viljavuuseron perusteella väitteeni kuitenkin on, että vuokrasopimuksen jatkumisen todennäköisyyden tarkastelu eksogeenisena muuttujana kuvaa paremmin pellonvuokramarkkinoita Suomessa.

Mallin tulokset osoittavat, että vuokrasopimuksen uusiutumisen todennäköisyyden laskiessa vuokraviljelijät vähentävät nopeasti sekä kalkitusta että fosforilannoitusta. Tästä seuraa satotason asteittainen aleneminen.

Artikkelien I ja II osoittaessa vuokrapeltojen sadontuottokyvyn olevan jäämässä jälkeen viljelijöiden omien peltojen vastaavasta artikkelissa III tarkastellaan keinoja ongelman ratkaisuksi. Artikkelissa tarkastellaan erilaisten verokannusteiden vaikutusta pellon myyntihalukkuuteen. Kaikkiaan 5 762 pellonomistajalle lähetetyllä kyselyllä kartoitettiin pellon myyntihalukkuuteen vaikuttavia tekijöitä. Aineiston perusteella näyttää siltä, että pellon kiinteistövero sekä väliaikainen pellon myyntivoittoveron huojennus tarjoavat mahdollisuuksia peltokauppojen volyymin lisäämiseen. Aineisto osoitti kuitenkin myös sen, että 86 % pellonomistajista ei myy peltoa ehdotetuista veromuutoksista huolimatta. Potentiaalisia pellon myyjiä ei voitu paljastaa perinteisellä logit-mallinnuksella, mutta myyntihaluiset saatiin esiin Latent Class (LC)-menetelmällä. LC-menetelmä osoittikin selkeää potentiaalia tutkimusmenetelmänä tarkasteltaessa omistajien käyttäytymistä, jota ei voida kytkeä helposti mihinkään omistajia kuvaavaan sosiodemografiseen muuttujaan.

Artikkelissa IV viljatilojen tuottavuuskehitys vuosina 1976–2006 estimoitiin kannattavuuskirjanpitotila-aineistosta maatalouden tuottavuuskehityksen ja pellonvuokrauksen välisen yhteyden selvittämiseksi. Suomalaisen kasvinviljelyn erityispiirteet ja erityisesti tuotannon voimakas sääriippuvuus haastavat tuottavuuskehityksen mittausmenetelmät. Menetelmän pitää olla riittävän joustava huomioidakseen vuotuisen vaihtelun, mutta toisaalta taustalla olevat hitaasti muuttuvat ilmiöt eivät saisi jäädä vuotuisen vaihtelun alle. Käytetyssä analyysissä nämä seikat otettiin huomioon käyttämällä kahta eri tavalla teknologista kehitystä kuvaavaa mallia. Mallit perustuvat tuotantofunktion määrittämiseen ja siitä johdettuihin tuloksiin. Tulokset osoittavat, että viljatilojen tuottavuuskehitys on hidastunut vuonna 1995 tapahtuneiden maatalouspolitiikan muutosten myötä. Tämä tulos oli tilastollisesti merkitsevä, mutta todelliselta merkitykseltään melko pieni. Tulos kuitenkin vahvistaa käsitystä siitä, että EU-jäsenyyden myötä voimakkaasti lisääntynyt pellonvuokraus on osaltaan hidastanut maatalouden tuottavuuskehitystä.

Hyvin järjestetyt tuotantovälineiden omistussuhteet luovat kannusteet pellon perusparannuksille. Pellon perusparannukset ja hyvä kasvukunto ovat välttämättömiä, mutta eivät riittäviä ehtoja kasvinviljelyn tuottavuuden parantamiseksi. Tässä opinnäytetyössä saadut tulokset osoittavat, että Suomessa käytössä olevat vuokrasopimuskäytännöt, vuokrasopimusmallit sekä pellonvuokraukseen liittyvä lainsäädäntö eivät pysty ratkaisemaan vuokrapellon hallintaoikeuden epävarmuudesta aiheutuvia ongelmia.

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