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Farmland Conservation in The Netherlands and British Columbia, Canada: A Comparative Analysis Using GIS-based Hedonic Pricing Models

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Farmland Conservation in The Netherlands and British Columbia, Canada:

A Comparative Analysis Using GIS-based Hedonic Pricing Models

by

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Abstract

As a result of urban development farmland in many countries is under pressure. Reasons to preserve farmland are related to cultural heritage, food safety, open space, the environment, but also slowing and restricting development is a reason. To protect farmland countries use different land use policies. This paper will look specifically at two jurisdictions: The Netherlands and a particularly rich farming area in British Columbia, Canada. For these areas we will investigate how the institutions and laws present in these jurisdictions contribute to agricultural land preservation. We will analyse farmland values in a GIS-based hedonic pricing framework to answer this question. This combination enables us to analyse direct impacts of laws and regulations within the hedonic pricing framework. Moreover, we can use farm values to analyse farm survivability, and the level of speculation on farmland in the urban-rural fringe, where farmland is under urban pressure.

Key Words: Hedonic pricing models, zoning policies, Geographical Information System, agricultural land values at the urban fringe

Introduction

Many countries are concerned about the preservation of agricultural land and have a variety of programs in place to promote its protection. The reasons for preserving farmland are varied and multifaceted (Kline and Wichelns, 1996). People who live in areas with a rich, agricultural history may be primarily interested in safeguarding their rural identity and agricultural heritage, while others are concerned about food security, food safety or the adverse environmental impacts of buying food from other places. Apart from agrarian concerns, many also view local farmland preservation as important for the environmental amenities it provides, including open space, wildlife habitat, groundwater recharge and flood mitigation, and its role as a buffer against urban sprawl; indeed, some see farmland protection as a means to slow growth and restrict development (Bergstrom, 1985). Because agricultural land provides many externality benefits that are not efficiently transacted in existing markets, it is often undervalued and undersupplied. Meanwhile, the financial returns from development greatly exceed those from agriculture, which widens the gap between the marginal private benefit of farmland preservation and that of development. Not surprisingly, a range of regulatory and market-based policies are used to encourage the retention of land in agricultural activities, particularly near urban areas.

The primary regulatory approach is zoning, which legislates how land can be used. Where new zoning laws are passed without compensating current landowners, income distributional issues arise because zoning dramatically impacts property values (Hanna, 1997). Zoning can be at the national, provincial or local level and is usually accompanied by preferential farmland assessments for tax purposes. In some cases, land zoned as agriculture automatically receives tax concessions, but in others landowners must meet an income threshold to qualify for special tax consideration. In some areas, zoning and preferential taxes are largely

seen as incapable of impeding urban development because the returns from development are simply too large (Conklin and Lesher, 1977; Anderson, 1993; Plantinga and Miller, 2001). High returns to development create pressure on the government to change the zoning bylaws, which results in speculation in farmland (Nelson, 1992).

Market-based mechanisms for protecting agricultural land have gained prominence over time, especially in the United States (Brabec and Smith, 2002). With transferable development rights (TDRs), zoning is used to specify areas to be developed and preserved, with developers needing to buy rights from those zoned preservation in order to build. This exchange compensates landowners for the agricultural restrictions placed on their land (McConnell et al., 2005). In the case of a purchasable development rights (PDR) system, government or a non-profit conservation group will purchase the right to develop the land, attaching a permanent easement to the property title. This should lower the value of the agricultural land and provide landowners with investment funds, thus making farming a more profitable activity. However, empirical evidence suggests that land values are not significantly affected under either system, which may indicate that speculators believe they will be able to lift the development restrictions in the future or that hobby farmers and large rural estates are ratcheting up farmland prices (Nickerson and Lynch, 2001).

Finally, there is the effect of direct agricultural support payments. Farm payments benefit current producers, but often get capitalized in land values thereby increasing the actual or shadow rents. While we expect farmland prices to be higher as a result of farm programs, this may not be sufficient to overcome development pressure near urban areas.

This paper will look specifically at two jurisdictions: The Netherlands and a particularly rich farming area in British Columbia, Canada. For these areas we will investigate how the

institutions and laws in these jurisdictions contribute to agricultural land preservation. We analyse farmland values using a GIS-based hedonic pricing framework, and thereby examine the direct impacts of laws and regulations. Direct impacts of laws and regulations on land prices can be analyzed because the hedonic pricing method assumes that property prices can be explained by the sum of the value of the individual characteristics. Characteristics include, for example, the size of the parcel and the distance to the nearest city, but also the regulations and restrictions that affect prices. By including laws and regulations directly into the hedonic pricing function, we can analyze the direct impacts of these regulations on the land prices. We also use the results of the hedonic farmland pricing model to make conclusions about farm survivability in the urban-rural fringe.

Farmland values do not only reflect the discounted value of all future agricultural income, but also the option value of converting the land at any time in the future to residential use (Isgin and Forster, 2006). These option values increase land prices. Because of the zoning systems that are in place in most countries, option values are really speculative values, because there is some chance that the zoning ordinance will permit residential use in the future. Speculation on agricultural land makes it difficult for new farmers to enter and for established farmers to expand, because the land prices are driven by the development potential of land and not its agricultural potential. If agricultural land prices are high as a result of nearness to urban areas, output is insufficient to ensure an adequate return to the land. The land input cost is directly related to the price of farmland, whether or not the current landowner incurred that cost or not. Further, in areas that assess estate taxes when assets move from one generation to the next, oftentimes the heirs of farmland need to sell it just to be able to pay the estate taxes.

Another negative effect of escalating farmland values near urban areas is the resulting

fragmentation of farmland. As subdivisions and highways are built, the landscape is partitioned into a patchwork of disparate properties that increases the costs of farming as it inhibits opportunities to take advantage of scale economies, especially as farmers are forced to buy or lease fields that are not contiguous to their existing land. Thus, they incur added costs of transporting equipment or are unable to 'package' fields together of sufficiently large size to take advantage of scale economies. As more agricultural land abuts residential areas, the potential for conflict also increases as neighbours complain about the odours and noise emanating from farms and farmers put up with trespass and vandalism (Ready and Abdalla, 2005).

We investigate these issues in greater detail using case studies of farmland prices in British Columbia and the Netherlands. Next we describe each jurisdiction's respective institutions and agricultural setting. We then provide background information on our methods, data and the hedonic models that we employ, and our estimation results. We end with a discussion of common features between the jurisdictions and the link between institutions and policy.

Laws and regulations

British Columbia

Zoning is delegated to municipal governments in BC as per the *Local Government Act* (1996). Municipalities can restrict land in any way including type of use, presence and position of buildings, density, and the configuration of parcels and how they might be subdivided. An exception is that municipalities may not prohibit or restrict agricultural activities in a farming area unless it receives approval from the minister responsible for administration of the *Farm Practices Protection* (Right to Farm) *Act* (1996) (Government of British Columbia, 1996).

To further protect agricultural land, the province created an Agricultural Land Reserve

(ALR) in 1973 that supersedes the local authority. The impetus for this was the rapid pace of urban development (an estimated 6,000 ha per year) encroaching on farmland (Runka, 2006), especially near the cities of Vancouver, Victoria and Kelowna. The ALR included all lands rated between classes one and four according to the CLI, those zoned as agricultural by municipalities, and those favoured with farm class status by BC Assessment, the provincial taxing authority. A parcel of land in the ALR may not be used for anything but agriculture without approval from the Agricultural Land Commission (ALC). It may contain one dwelling (a farmhouse) and other agricultural buildings and may not be subdivided.

The ALR and ALC have survived several changes in government and seem to be a permanent fixture, but they are not without controversy (Garrish, 2003). In recent years, there has been increasing public debate about whether the ALC is too lenient in approving exclusions (Green, 2006), which contributes to speculation on farmland. Concerned groups point to statistics showing that, although ALR area has increased since 1973, most of the exclusions have come from the urban fringe in the fertile south while most inclusions have come from the more arid and less populated northeast.

Municipalities' largest source of revenue (about 40 percent of their budgets) comes from taxes on land and buildings. BC Assessment determines land values and preferential tax policies for agricultural land and those properties with farm class status. Farm status (and thus lower taxes) are determined by gross agricultural sales and the size of a property: parcels of less than 1 ha must have farm revenues of at least $10,000 (€7,000) per year, those between 1 and 4 ha must have at least $2,500 (€1,750) in gross sales, and those greater than 4 ha must have sales of $2,500 (€1,750) plus 5 percent of the land value. This threshold must be met every second year.

The Netherlands

Zoning and land use policy in The Netherlands are based on the *Spatial Planning Act* (WRO) (Van Geest and Hodl, 2002). As a result of the WRO, the organization of land use policy can be thought of as an onion, with layers of responsibility resting with the central government, the twelve provinces and the 483 municipal governments.[1] Development planning and spatial policy have undergone a transition over the past 15 years, resulting in more market-oriented land use policies based on public-private partnerships (Louw et al., 2003).

In the past, land use planning and land development was handled mainly at the municipal level since needs for residential development and industrial parcels are dealt with at that level. However, it is clear that local governments are losing their grip on land markets as market forces play an increasing role and municipal land ownership is no longer a given. The primary response to this new institutional environment has been for municipalities to form public-private partnerships, though participation in these is usually a defensive move as a result of landownership by developers. So-called 'red-for-green' projects are examples of public-private partnerships, where 'red' refers to the land in residential and industrial use, and 'green' to agriculture, nature, landscape, outdoor recreation and environment uses. 'Red-for-green' refers to the investment in the construction of public 'green' areas, using money earned with the development of 'red' areas by private organisations.

Provincial governments are an intermediary in the land development process, as their role has traditionally been more limited than municipalities. Their primary concern was the 'green' function of land. Provinces would handle the planning of these natural areas, but left the implementation to the central government's Rural Area Department (DLG) of the Ministry of Agriculture, Nature and Food Quality, which operated under its own guidelines (Louw et al., 2003). The DLG purchases land in order to complete the National Ecological Network (EHS)

introduced in 1990 (LNV, 1990).[2] The aim of the EHS is to connect nature areas in The Netherlands, so that these areas are not isolated and the survivability of animal and plant species is improved. Provincial governments play a key role in deciding which areas should be zoned as future nature areas. Provinces face ambitious targets in terms of the number of hectares that are to be protected; this task is increasingly challenging as land values rise (especially near the urban fringe) and speculation drives farmland values up in the hope of converting it to more lucrative 'red' function uses (Louw et al., 2003).

Initially, the selection of the EHS areas was based on Land Use Planning projects, which rearranged land use function within certain areas. About 70 percent of all purchases of land by the DLG was made within these projects. Land Use Planning projects are a result of the *Land Use Planning Act* of 1985 (Van Klaveren, 2005). Within these projects, the focus of land use planning takes into account agriculture, forestry, nature, landscape, recreation and cultural heritage. But infrastructural projects and water management can also be a part of Land Use Planning projects. Traditionally these projects focussed on the fragmentation issue by enabling voluntary exchange of parcels among farmers with financial government support. These projects could beneficial farmers as they could obtain parcels adjacent to their existing properties in exchange for parcels located further away. Nowadays, provincial governments are responsible for Land Use Planning projects. Some projects are voluntary as farmers do have a vote, but others are mandatory with farmers forced by law to meet the requirements resulting from the government's planning decisions.

As a result of the *Spatial Planning Act*, all land in The Netherlands is zoned, implying that all land currently in agricultural production is zoned as agricultural land. At the central government level, there is only one agricultural zoning category, but, at the municipal level,

specific regulations allow for particular types of agriculture in various areas. Residential buildings on farmland are not allowed in principle, although existing structures including residences are preserved. Additional farm buildings can only be built if the municipality in charge changes its zoning plan.

The Dutch agricultural sector is not only protected by zoning regulations, but also direct income support is received by farmers. This support is based on European legislation, such as the Common Agricultural Policy (CAP) (European Commission, 2003). However, the effect of direct income support on farm-survivability cannot be investigated within the hedonic price model as all landowners are affected similarly.

Upon comparing land use policies between these jurisdictions, we conclude that different strategies are used to prevent 'scattered' landscapes. In contrast to the ALR's objective of protecting farmland, Dutch policy is focused more on the preservation of 'green' areas, with less emphasis on agricultural use and more on nature reserves and parks, even though land is zoned for agriculture and there is a desire to support farming.

Agricultural Background

British Columbia

Only three percent of British Columbia's land is suitable for agriculture, and only 0.6 percent of this is classified as prime farmland (or class one land) according to the Canadian Land Inventory (CLI) soil and climate classification system (Runka, 2006). Although BC's class one land is some of Canada's most fertile, it is chiefly located in three areas – the Fraser Valley (near Vancouver in the southwest), southern Vancouver Island (near Victoria, the capital city), and the Okanagan Valley in the south-central interior. Thus, the best farmland is coincident with the largest and fastest growing urban areas, putting strain on the farm economy.

In terms of cash receipts, BC's major crops types are floriculture and nursery, potatoes and vegetables, and dairy products, followed by poultry and eggs, calves and cattle, and greenhouse vegetables; berries and grapes, tree fruits, and grains and oilseeds contribute much less (MAL, 2006). The province's cropping regions are segregated by climate, with hay, grains and oilseeds constituting the major crops in the northeast, which is part of Canada's grain belt and thus benefiting most from Canada's agricultural support programs and falling under the jurisdiction of the Canadian Wheat Board. Cattle and livestock dominate the north and central interior; the south-central Okanagan Valley is the centre of BC's rapidly growing wine industry and produces large quantities of fruit; the Fraser Valley in the southwest produces a large variety of crops, including field crops, berries and greenhouse products; and, finally, southern Vancouver Island can grow any non-tropical crop (MAL, 2006). Unlike the northeast, these areas generally do not benefit from direct forms of farm subsidies, although milk, egg and poultry producers throughout the province participate in Canada's supply-management (quota) regimes and livestock producers benefit from transportation subsidies that lower feed costs.

The focus in our study is the Saanich Peninsula, near the provincial capital of Victoria on southern Vancouver Island. The peninsula contains three municipalities (Saanich, Central Saanich and North Saanich) and has climate capable of supporting a large variety of crops. The distribution of land use on the Saanich Peninsula is indicated in Figure 1.

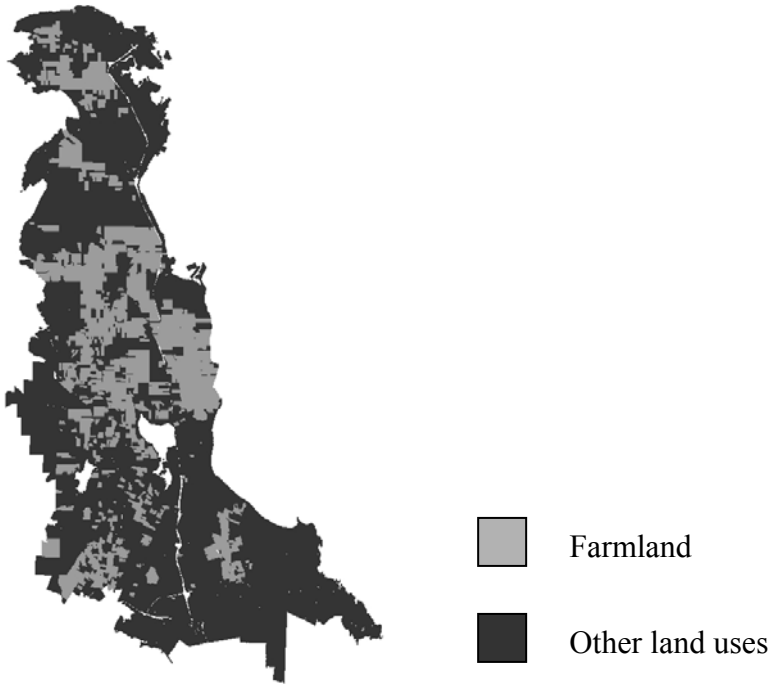

Figure 1: *Distribution of land use on the Saanich Peninsula*.
(Source: Ministry of Agriculture and Lands and the Capital Regional District, edited map)

The Netherlands

The Netherlands is quite flat with most of its area suitable for agricultural production. More than 46 percent of total land area is under seasonal or permanent crop production (Statistics Netherlands, 2003). Grasslands account for about 51 percent of all agricultural land, much of which provides forage for the country's dairy cows. Because of its large claim on land, dairy farms have a profound effect on the country's landscape. A variety of other crops are also grown, including sugar beet, potatoes, wheat and bulbs. The distribution of farmland and other land uses is indicated in Figure 2.

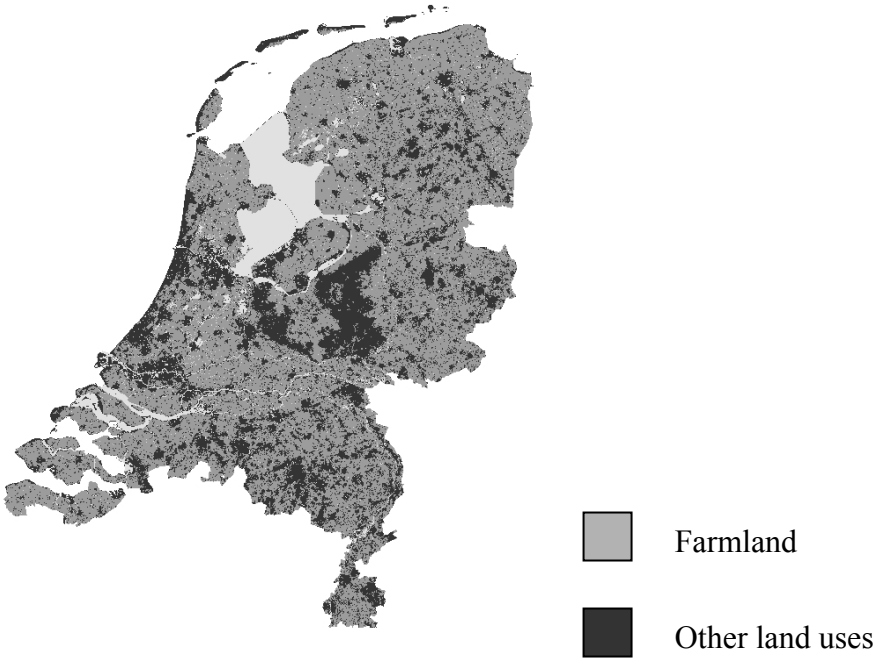

Figure 2: *Distribution of land use in The Netherlands.*
(Source: Statistics Netherlands, edited map)

Although the situation in each of these jurisdictions appears very different, British Columbia is significantly larger (94.78 vs 3.39 million ha) and much less densely populated (4.5 vs about 400 people per km^2). Yet the same threats apply to farmland in both jurisdictions and farmers face similar challenges. Although BC is about 28 times as large as The Netherlands, it has only 2.5 times more land in agricultural use because, while nearly all land in The Netherlands is suitable for agriculture, BC's mountains and climate (rainfall on the west coast, extreme cold in the north) restrict crop and pasture area. Urban pressures are, surprisingly, comparable in both jurisdictions. In The Netherlands urban and agricultural uses everywhere compete for land, while prime farmland in BC is located mainly close to the three major and rapidly-growing cities (Vancouver, Victoria, Kelowna). These urban pressures result in similar land conversion patterns. During the period 1975 to 2003, total farmland in The Netherlands

declined by 158,880 ha to 1,923,084 ha; in BC over a similar period, land excluded from the ALR amounted to 137,271 ha compared to a total in 2007 of 4,759,668 ha. (Although the ALR does not represent all the agricultural land in BC, it is a pretty good proxy.)

Hedonic Price Model, Data and Variable Specification

To investigate the impact of farmland characteristics on agricultural land prices, hedonic pricing models (Rosen 1974) are specified for the Saanich Peninsula of Vancouver Island, BC, and The Netherlands. These models are specified as:

$$P = X\beta + \varepsilon \qquad \text{Equation (1)}$$

where P is a vector of property prices, X a matrix of property characteristics, β a vector of associated parameter coefficients to be estimated, and ε the vector of error terms.

Data

The data consist of 932 farmland parcels that were sold in the period 1974 to 2006 on the Saanich Peninsula. Observations begin with the introduction of the ALR. All 'single cash' transactions that took place within the farming sector in the specified period were taken into account. Transactions that included more than one parcel were discarded. Further, only parcels that could be linked to all other datasets were selected, so that for each observation all explanatory variables were available.

For The Netherlands, a sample of 947 transactions that took place in 2003 was used in the analysis. For all transactions, both sellers and buyers were farmers. Similar to the Saanich Peninsula, no buildings were present and parcels were only selected if all explanatory variables were available (Cotteleer et al., 2008). In the Dutch sample, it was possible to include transactions that consisted of more than one parcel because of the way the transaction database

was constructed. Because regional differences are expected to drive transaction price due to different motives for selling and buying land in different areas, the sample of 947 sales was split into transactions that occurred in urban, rural and semi-urban farmland areas.[3] The division between urban and rural areas was based on the level of urbanization of the area in which a parcel is located. This level was based on the Reilly index (Shi et al., 1997).

The Reilly-index for parcel *i* is given by

$$R_i = \sum_{k=1}^{K} Pop_k \big/ d_{i,k}^2 \,, \qquad \text{Equation (2)}$$

where Pop_k is the population of urban area *k* and $d_{i,k}$ the distance between parcel *i* and the k^{th} urban area. All urban areas within 100 km of the parcel are taken into account.

In The Netherlands, transactions in a single year were selected, whereas sales over a period of more than thirty years were used for the Saanich Peninsula. The reason for this is that the Saanich Peninsula is smaller in area and population, so fewer transactions take place in a given year. The time series poses an additional challenge with respect to controlling for inflation of prices over time.

Variable specification and functional forms

For both study areas, many different data bases were collected from several government and private sources; these were then used to construct the dependent and explanatory variables. ArcGIS was used to link data sources and construct distance and other location variables. In both studies, the price of farmland per hectare (ha) was used as the dependent variable. For Saanich, the dependent variable was obtained from LandCor (a private company) and BC Assessment; for The Netherlands, it was obtained from DLG's Cadastral Land Sales Database.

In order to analyse farmland values on the Saanich Peninsula, the following explanatory

variables were defined: parcel size, indicators of the profitability of land (e.g., dummy variables for fruit trees, cows, poultry), ALR designation, exclusions from the ALR, elevation levels, presence of buildings on the lot, hobby farmers and macroeconomic variables, such as mortgage rates and GDP. The ALR-dummy variable only represents the situation in 2006, so the number of hectares excluded from the ALR each year was also included as a regressor. Using ArcGIS, we calculated a variety of distance measures, including distance to Victoria and the major highway that transverses the peninsula, and created an index of fragmentation for each parcel. The fragmentation index was specified as the percentage of the perimeter bordering other farmland multiplied by the size of the total farm block of all the farmland that was adjacent to the parcel.

In the Dutch farmland model, some indicators of the agricultural profitability of land, such as standard size units per ha (NGE per ha), soil type and a dummy for livestock grazing were specified as explanatory variables. GIS was used to determine distances to residential areas, industrial areas, recreational areas, (wet) nature areas, greenhouse horticulture, fresh water and the nearest highway. Zoning indicators were specified, such as the dummy variables for land within the National Ecological Network (EHS) and land within Land Use Planning projects, though indicators for agricultural zoning schemes are not included in the model as all farmland is also zoned as agricultural land. Land Use Planning projects are divided into projects where farmers participate voluntarily and those where participation is mandatory. Parcel size and the level of urbanization represented by the Reilly index (equation 2) were taken into account as well as rented land. (In The Netherlands, lessees are protected by law, resulting in low lease prices and leaseholders cannot prematurely abort leaseholds without the lessee's consent.) Furthermore, a dummy variable was specified for transactions between family members and an indicator of

market power of either buyers or sellers was specified. This indicator was specified as (*number of sellers – number of buyers*)/(*number of sellers + number of buyers*). Market power supposedly influences prices because farmers do not wish to purchase land too distant from their existing lands, which results in a localized market for farmland with few participants and significant market power effects.

The reason for specifying different variables for the two hedonic pricing models is that different factors influence transaction prices of farmland in theses two jurisdictions. The Saanich Peninsula is a well-defined hilly area, surrounded by ocean and affected only by the city of Victoria. The Netherlands is a larger area where elevation plays no role because of the flatness of the countryside, and a greater number of factors affect farmland prices. There are also many more urban areas exerting influence on farmland prices. Another reason for using different explanatory variables is simply due to available data.

In the Saanich model many of the explanatory variables are inherently highly correlated. For example, the fragmentation measure is related to the ALR designation because farmland within the ALR is less fragmented than farmland outside the ALR. The variable indicating soil quality is correlated with the ALR-dummy because only lands with a high soil quality were included in the ALR. By definition one expects correlation between these variables. Furthermore, elevations are correlated with distance to the highway because the highlands are located in the western part of the peninsula whereas the main north-south highway runs along the lower eastern part. Finally, distance to the Swartz Bay ferry terminal (to Vancouver) and distance to Victoria are almost perfectly correlated as the ferry terminal is situated on the northern tip of the peninsula while the city of Victoria is located at the southern end. Multicollinearity is addressed by leaving some of the explanatory variables out of the regression model (Wu et al.,

2004). The reason why multicollinearity is not a major concern in the Dutch farmland model is that not all the explanatory factors are so dependent on one another – the area is larger and not isolated as with a peninsula.

Different functional forms are used for the study regions – a double-log functional form was specified for the Saanich Peninsula and a linear function for the Dutch data. The former is generally preferred because linear functional forms have the disadvantage that they suggest that parcel characteristics can easily be repackaged, so that nonlinearities will not exist as a result of arbitrage (Rosen, 1974). In the Dutch model, a linear functional form was chosen to focus on the symmetric results of market power. However, nonlinearities in the form of inverse transformations were allowed for explanatory variables related to distance.

Empirical Results

Hedonic pricing results for the Saanich Peninsula

The regression results for the Saanich Peninsula are reported in Table 1. About 76 percent of the total variation in the logarithm of sales prices is explained by the model. Land located within the ALR sells at a significantly ($p<0.10$) lower price than that outside the ALR. This corresponds with the idea that prices in different submarkets are related to the profitability of the permissible land uses, with land in agriculture having lower value than that used for commercial and residential purposes (Cotteleer et al., 2008). Indeed, the statistical significance for the ALR dummy variable might even be higher except that on some parcels there is speculation that land in the ALR might be removed at some time in the future (Shi et al., 1997). We do not find a significant effect of the number of hectares excluded from the ALR in each year on farmland values. This means that we do not find evidence for an increase in the speculation on farmland as a result of the exclusions of ALR land that take place.

Table 1: *Hedonic Regression Results for Farmland on the Saanich Peninsula (n = 932), robust standard errors*

Dependent variable: Price per ha	Parameter estimates	Probability
Land use policy indicators		
ALR (= 1 if parcel is located within the ALR, 0 otherwise)	-0.1128**	0.035
Excluded number of hectares in the transaction year	0.0015	0.497
Distance to ALR boundary in km (distance is negative if the parcel is located within the ALR, and positive otherwise)	-0.1473**	0.048
Fragmentation index ((proportion of perimeter bordering other farmland × size of total farm block of all adjacent farmland in metres) / 100000)	0.0112*	0.077
Land use indicators		
Log of distance to Victoria city centre (City Hall)	-0.0842*	0.090
Log of distance to highway	0.0170	0.120
Profitability of farmland indicators		
Log of parcel size (ha)	-0.7109***	0.000
Tree fruit (=1 if tree fruits are grown on parcel, 0 otherwise)	-0.0294	0.856
Cows (=1 if farm is beef or dairy farm, 0 otherwise)	0.0321	0.631
Poultry (=1 if farm is poultry farm, 0 otherwise)	-0.1857*	0.056
Vacant land (=1 if land is vacant, 0 otherwise)	-0.4749***	0.000
Hobby farmers (=1 if farm is a hobby farm, 0 otherwise)	-0.0560	0.256
Macro economic indicators		
Log of GDP	1.0249***	0.000
Log of mortgage rates	-0.2361***	0.007
Constant	-0.2162	0.804
R-squared	0.7561	

Note: ***significant at the 1%; **significant at the 5%; and *significant at the 10% critical levels.

Although we hypothesized that farmland values are determined by the ALR, one could argue that causality is the other way around – farmland prices increase because of urban pressure and, as a result, it is excluded from the ALR. If this argument is true, our ALR variables would be endogenous and our empirical findings would be biased. Thus, we tested for endogeneity using the Hausman test, and included indicators about the party in government as an instrument for the ALR variable. The indicators were the percentage of votes garnered by the four largest

parties (New Democratic Party, Social Credit, Liberals and Greens) and dummy variables for the parties that formed the government. These indicators were used because we assumed that exclusions from the ALR depend on the political climate. Given that these indicators were the right instruments, we found no evidence for endogeneity in our model.[4]

We found a significant ($p<0.10$) negative effect for distance to the ALR boundary. Because this variable takes on negative values within the ALR and positive values outside the ALR, this implies that the closer a parcel is to the centre of the ALR, the higher its price. As land closer to the centre of the ALR is less fragmented, this supports our finding for the fragmentation variable. Parcels that are less fragmented, and often located closer to the centre of the ALR, sell for significantly ($p<0.10$) more than parcels that are fragmented and probably closer to residential and commercial properties. This finding also suggests that externalities caused by nearby residences and other non-farm uses lower farmland values.

Parcel size also plays an important role in the determination of price. The log of the lot size is highly significant ($p<0.01$) and has a negative effect on the log of prices. This is contrary to the expectation that farmers seek to acquire large properties to realize economies of scale, because with respect to agriculture, larger parcels should have higher productivity levels than small ones (Cavailhes and Wavresky, 2003). However, Colwell and Munneke (1997, 1999) point out that when parcels are purchased for development purposes, prices are negatively correlated with increasing parcel size due to subdivision costs of parcels if the land would ever be excluded from the ALR and used for development purposes. Further, since ALR land is difficult to subdivide, larger properties would be a deterrent to those wanting rural estates or hobby farms, although, as noted above, there are some tax advantages to having parcels greater than one ha (Dove, 2007). Hobby farmers do indeed buy smaller lots then regular farmers. On average hobby

farmers buy parcels of 1.91 hectares, whereas regular farmers buy 3.75 hectares.

Macroeconomic variables are important in the model because the data span a period of more than 30 years. Prices are expected to rise and fall jointly with macro-economic changes. For example, we find that farmland prices rise significantly ($p<0.01$) with increasing GDP. As the country's GDP increases, people are wealthier and able to spend some of the additional income on land purchases, increasing the demand for land and its price. Furthermore, as interest rates increase, borrowing is less affordable and demand for property decreases (and property prices fall). This is in line with the significant ($p<0.1$) negative impact of mortgage rates on farmland prices.

Finally, vacant land is significantly ($p<0.01$) less valuable, indicating that structure add to the value of a property, ceteris paribus. The presence of poultry farms also decreases land values significantly ($p<0.10$), perhaps because poultry farms do not need high quality land, which is usually more valuable. Further, poultry farms would be less appealing for people purchasing farms for other purposes (residence, hobby, agro-tourism) and they would be more costly to develop.

Hedonic pricing results for The Netherlands

With respect to the Dutch model, we provide only the key results (Table 2). Some non-significant control variables, such as soil variables and variables related to the personal characteristics of buyers and sellers are not presented. For a discussion of the full model, see Cotteleer, et al. (2008). Separate regression results are provided for farmland in more rural and more urban areas. The model for the more urban areas explains about 76 percent of the total variation of farmland prices. In these areas, prices are mainly driven by the level of urbanization as represented by the Reilly index ($p<0.01$). The nearer that parcels are to urban areas, or the

larger the nearby urban area, the higher are farmland prices, indicating that speculation is taking place even though agricultural zoning is in place. With respect to zoning schemes, only the obligatory Land Use Planning projects have a significant ($p<0.01$) negative impact on prices. Within these projects participation is obligatory for farmers, so land use must be changed within these areas. Other characteristics of farmland only explain a small amount of agricultural land prices. For example, family relationships between buyers and sellers have a significant ($p<0.05$) negative effect on prices and rented land is sold for significantly ($p<0.10$) less. Further, the proximity to recreational areas has a positive effect on farmland prices, indicating either speculation or the positive effect of possibilities to start up non-agricultural activities such as campsites.

With respect to the more rural farmland areas, about 35 percent of the total variation in land prices could be explained within the model. In these areas prices are mainly driven by farm activities and speculation plays almost no role as indicated by the statistical insignificance of the Reilly-index. Further evidence that farming is the dominant activity comes from the negative externalities created by nearby residential areas and highways. Examples of negative externalities from residential uses on farmland are mobility and environmental effects as well as fragmentation of farmland and complaints from residents about noise and odours from farming activities. Also, as a result of accessibility and because many industrial parks are built along the highway, we would expect a positive impact of proximity to highways and residential areas if speculation plays a role. On the contrary, because farming is still viable in these areas, highways have a negative effect perhaps because nearby highways make it harder for farmers to extend their farming area in the future.

Table 2: *Hedonic Regression Results for Farmland in The Netherlands, robust standard errors*

Dependent variable: Price per ha (in €10,000)	Rural model: Reilly <0.005 (n = 393)	Urban model: Reilly≥0.010 (n = 226)
Reilly index	75.8890	27.4892***
	(0.436)	(0.00)
EHS (parcel within National Ecological	-0.8957**	-0.5083
Network (EHS) = 1, 0 otherwise)	(0.013)	(0.408)
Land use planning mandatory (=1, 0	-0.4231*	-1.6134***
otherwise)	(0.076)	(0.004)
Land use planning voluntarily (=1, 0	-0.0260	-0.6411
otherwise)	(0.886)	(0.270)
Land use indicators		
1 / distance to nearest residential area (km)	-0.1506**	-0.0778
	(0.022)	(0.437)
1 / distance to nearest industrial park (km)	0.0226	0.1136
	(0.450)	(0.537)
1 / distance to nearest recreational area (km)	0.4236*	0.2613*
	(0.070)	(0.053)
1 / distance to nearest nature area (km)	-0.0085	-0.0006
	(0.219)	(0.986)
1 / distance to nearest wet nature (km)	-0.2005**	0.1974
	(0.019)	(0.391)
1 / distance to nearest greenhouse horticulture	0.2684**	0.1353
(km)	(0.021)	(0.108)
1 / distance to nearest fresh water (km)	0.0167	-0.0750
	(0.780)	(0.218)
1 / distance to nearest highway (km)	-0.3548***	0.0055
	(0.009)	(0.981)
Profitability of farmland indicators		
Parcel size (ha)	-0.0113	0.0463
	(0.722)	(0.771)
$NGEperHa^{buy}$ if seller and buyer are not	1.5435	-28.7638***
family, 0 otherwise	(0.431)	(0.008)
$NGEperHa^{sell}$ if seller and buyer are not	-10.5301	82.9490
family, 0 otherwise	(0.417)	(0.451)
$GrazingFarmAnimals^{buy}$ if seller and buyer are	-0.5053**	-1.3748**
not family, 0 otherwise	(0.020)	(0.048)
$GrazingFarmAnimals^{sell}$ if seller and buyer are	-0.3772*	1.2922*
not family, 0 otherwise	(0.073)	(0.080)
Other indicators		
Market power if seller and buyer are not	-2.3751**	2.2467
family, 0 otherwise (N_1)	(0.014)	(0.262)
Land is rented (=1, 0 otherwise)	-0.1828	-1.5490*
	(0.746)	(0.071)
Buyer and seller are family (=1, 0 otherwise)	-2.6712***	-8.9309**
	(0.004)	(0.025)
Constant	4.2956***	12.7091***
	(0.000)	(0.003)
R-squared	0.3527	0.7571

Note: See Table 1. Source: Cotteleer et al. (2008)

With respect to other surrounding land uses, nearby greenhouse horticulture has a positive impact on farmland prices. As greenhouse horticulture is not allowed everywhere, speculation on future zoning takes place. Nearby recreational areas have a positive effect on farmland values. If recreational activities already take place in the area, the profitability of additional on-farm non-agricultural activities such as campsites is very likely to be higher. Finally, the nearness of wetlands has a negative impact on the prices of farmland, due to higher ground water levels in these areas.

With respect to zoning, we find a negative impact of land zoned for future nature purpose. Within EHS areas, statistically significantly ($p < 0.05$) lower prices were paid for agricultural land, probably because land in these areas does not have potential future farm or urban use, which lowers its speculative value. Restrictions on farm uses, such as agro-environmental schemes, are likely in place in these areas. No significant effects are found for voluntary participation within land use planning projects, although, for mandatory projects, a significant ($p < 0.10$) negative effect on farmland prices is found. These mandatory projects might not serve farmers' best interests because farmers have no say in the way land is redistributed between different land use functions.

Although, farming is the main activity in more rural farmland areas, indicators of farmland profitability are not very significant in our model estimates. Proxies, such as soil type and NGE per ha, are not statistically significant although evidence suggests that farmers who 'graze farm animals' value land less ($p < 0.10$) than other farmers. As farms that graze farm animals require mainly pastureland, land quality is lower and so are prices. The reason that indicators of farmland profitability are not very important is likely due to technical improvements in agriculture.

Not surprisingly, market power has a significant ($p < 0.05$) impact in rural land markets. With relatively more buyers than sellers on the market, sellers have market power and prices are higher. On the other hand, with a relatively low number of buyers compared to sellers, buyers have market power, generally resulting in lower prices.

Finally, no significant impact of parcel size is found in this model. Therefore, it is not clear that the 'economies of scale' argument of Cavailhes and Wavresky (2003) or the subdivision cost argument of Colwell and Munneke (1997, 1999) is more appropriate for describing the situation within rural farmland markets in The Netherlands.

Discussion

Using empirical results from two studies in different political jurisdictions, we examined whether farmers can survive in the urban-rural fringe, given extant legislation to protect farming. The answer seems to depend partly on how vigorous agricultural zoning is within those areas: If zoning plans change easily, zoning is less credible and speculation about the future ability to develop farmland increases (Blewett and Lane, 1988; Shi et al., 1997; Nickerson and Lynch, 2001).

On the Saanich Peninsula of BC, the price of farmland within the Agricultural Land Reserve is lower than outside the ALR, indicating that zoning schemes are still at least partially credible, even though exclusions of ALR land have occurred. Further, farm parcels that are less fragmented are slightly more valuable than those that are not, and this partly offsets speculation. Yet, some agricultural activities occur outside the ALR, indicating that some farmers are able to survive without ALR zoning and amid highly fragmented landscapes, oftentimes taking advantage of agro-tourism opportunities that are in demand near the urban fringe (Dove, 2007).

Our findings also indicate that speculation or 'rurbanization' is taking place on a large

scale in the Saanich Peninsula, particularly as smaller agricultural lots sell for relatively higher prices. Smaller lots are more attractive to hobby farmers and buyers of rural estates, though they are less attractive to farmers. Higher prices signify that these lots are likely bought for residential or hobby farm purposes by those craving a rural lifestyle in close proximity to a large urban area. Overall, the higher prices for small farm parcels and inexperienced buyers bode ill for sustaining viable commercial agriculture on the urban fringe (Millward, 2006).

In BC, the requirements for farm class status and lower tax rates favour farms of 1 to 4 ha and may, counter-intuitively, work against agricultural preservation as 1-4 ha parcels are clearly preferred by hobby farmers; the low threshold for achieving farm class status makes it cheaper to own a large rural estate that is not farmed efficiently or professionally. If the purpose of preferential tax treatment is to slow down development and retain open space, the policy employed by BC Assessment may be efficient. The literature shows that, although preferential tax rates cannot halt conversion of agricultural land, they can alter the timing decisions for conversion (Conklin and Lesher, 1977; Anderson, 1993). However, if the purpose of farm class status is to help support a viable farm economy, then preferential taxes seem to contribute to the growth of hobby farms and large rural estates by changing the relative price of land (Blewett and Lane, 1988). By raising the threshold or implementing other hurdles to achieving farm class status, the government could reduce the desirability of living on large rural estates.

In The Netherlands, we find that agricultural zoning is more credible in more rural areas than urban ones, as prices in urban areas are affected by speculation to a greater degree. In urban areas, pressures to change zoning plans are much stronger and re-zoning usually favours developers. Therefore, the degree of urban development pressure determines farm profitability and survivability as agricultural returns might then be insufficient to cover higher land costs.

In more rural areas, in contrast, nature and recreational uses of farmland compete with agricultural use. Farmland prices in rural areas are impacted by future nature zoning. The reason is that green development is often loss-generating, and prices in rural areas are still relatively low, so these are the areas where the DLG can still compete with other buyers of land. In urban areas, land values are too high for future zoning of the EHS to be credible because farmers are reluctant to sell land to the DLG because they would earn much more selling at some future date to a developer for commercial or residential use. Furthermore, in both urban and rural areas farmers find that recreational activities, such as campsites, are becoming relatively more lucrative. As a result, more and more farmers are engaging in non-agricultural activities that compete with agriculture uses of land. Dutch farmland is consequently under development pressure in both rural and urban regions, albeit the form of development is much different in the two areas.

We can conclude that farmland in The Netherlands and in rural-urban areas near BC's fastest growing cities is under serious threat, although these threats are expressed in different ways. Urban development and nature preservation, especially in The Netherlands, compete with agriculture for land, while the types of activities constituting agriculture are shifting as well. In order to make land more competitive with urban and other uses, owners of agricultural land in both areas increasingly engage in non-agricultural, tourism-oriented activities (e.g., bed and breakfasts, camping, horse stables, u-pick berry, renting of garden plots) that enable them to earn revenues that cover land costs in addition to labour and other variable inputs. An alternative strategy involves more intensive agriculture, such as greenhouses, or a focus on speciality products, such as organic farming, intensive horticulture and grape growing (Cardone, 2007). In any event, it is clear that agriculture in highly urbanized regions is changing.

Notes

1. As of 1 January 2007, there are 483 municipalities a decrease from early years as a result of the regrouping and merging of various local authorities.

2. Aside from the involvement of the DLG, the central government only acquires land for its own purposes (offices, prisons, etc.) and hardly ever takes on land development (Louw et al., 2003).

3. Only results of urban and rural areas are discussed in this paper, as the transaction prices in semi-urban areas were hard to explain.

4. The Hausman test-statistic had the value 5.45. Under the null hypothesis this is distributed as Chi-squared with 14 degrees of freedom. So the null hypothesis is not rejected (p= 0.9785).

List of Acronyms

ALC – Agricultural Land Commission
ALR – Agricultural Land Reserve
BC – British Columbia
CAP – Common Agricultural Policy
CLI – Canada Land Inventory
DLG – Dienst Landelijk Gebied (Government Services for Land and Water Management)
EHS – Ecologische Hoofdstructuur (National Ecological Network)
GDP – Gross Domestic Product
GIS – Geographic Information System
LNV – Landbouw Natuurbeheer en Voedselveiligheid (Ministry of Agriculture, Nature and Food Quality)
MAL – Ministry of Agriculture and Lands
NGE – Nederlandse Grootte Eenheid (Dutch Size Units)
PDR – Purchase of Development Rights
TDR – Transferable Development Rights
WRO – Wet op de Ruimtelijke ordening (Spatial Planning Act)

References

Anderson, J. E. (1993) “Use-value property tax assessment: effects on land development”, *Land Economics*, vol 69, no 3, pp263-269

Bergstrom, J. C., Dillman, B. L. and Stoll, J. R. (1985) "Public Environmental Amenity Benefits of Private Land: The Case of Prime Agricultural Land", *Southern Journal of Agricultural Economics,* vol 17, pp139-149

Blewett, R. A. and Lane, J.I. (1988) “Development rights and the differential assessment of agricultural land: Fractional valuation of farmland is ineffective for preserving open space and subsidizes speculation”, *American Journal of Economics and Sociology*, vol 47, no 2, pp195-205

Brabec, E. and Smith, C. (2002) "Agricultural land fragmentation: the spatial effects of three land protection strategies in the eastern United States", *Landscape and Urban Planning*, vol 58, no 2-4, pp255-268

Cardone, E. (2007), "Halliburton farm healthy", *Saanich News,* 19 September, A3

Cavailhes, J. and Wavresky, P. (2003) "Urban Influences on Periurban Farmland Prices", *European Review of Agricultural Economics,* vol 30, no 3, pp333-357

Colwell, P. F. and Munneke, H. J. (1997) "The Structure of Urban Land Prices", *Journal of Urban Economics,* vol 41, pp321-336

Colwell, P. F. and Munneke, H. J. (1999) "Land Prices and Land Assembly in the CBD", *Journal of Real Estate Finance and Economics*, vol 18, no 2, pp163-180

Conklin, H. E., and Lesher, W. G. (1977) “Farm-value assessments as a means for reducing premature and excessive agricultural disinvestment in urban fringes”, *American Journal of Agricultural Economics*, vol 59, no 4, pp755-759

Cotteleer, G., Gardebroek, C. and Luijt, J. (2007) "Market Power in a GIS-based Hedonic Pricing Model of Local Farmland Markets", forthcoming in *Land Economics*

Dove, A. (2007) "Working the Urban Farm" *Saanich News*, 2 May, A3

European Commission (2003), "EU Fundamentally Reforms its Farm Policy to Accomplish Sustainable Farming in Europe", Brussels, European Commission

Garrish, C. (2003) "Unscrambling the Omelette: Understanding British Columbia's Agricultural Land Reserve", *BC Studies*, vol 136, pp25-55

Government of British Columbia (1996), *Farm Practices Protection (Right to Farm) Act*, [RSBC 1996] Chapter 131

Green, R. (2006) "Case Studies of Agricultural Land Commission Decisions: The Need for Inquiry and Reform", Environmental Law Clinic, University of Victoria

Hanna, K. S. (1997) "Regulation and land-use conservation: A case study of the British Columbia Agricultural Land Reserve", *Journal of Soil and Water Conservation*, vol 52, no 3, 166-170

Isgin, T. and Forster, D. L. (2006) "A Hedonic Price Analysis of Farmland Option Premiums Under Urban Influences", *Canadian Journal of Agricultural Economics,* vol 54, pp327-340

Kline, J. D. and Wichelns, D. (1996) "Public Preferences Regarding the Goals of Farmland Preservation Programs", *Land Economics,* vol 72, no 4, pp538-549

LNV (1990), "Natuurbeleidsplan, Regeringsbeslissing", Den Haag, Ministry of Agriculture, Nature and Food Quality

Louw, E., Van der Krabben, E. and Priemus, H.. (2003) "Spatial Development Policy: Changing Roles for Local and Regional Authorities in The Netherlands", *Land Use Policy,* vol 20, pp357-366

MAL, (2006), *Fast Stats: Agriculture, Aquaculture and Food,* Ministry of Agriculture and Lands, Government of British Columbia, Victoria

McConnell, V., Walls M. and Kopits, E. (2005) "Zoning, TDRs, and the Density of Development", Resources for the Future discussion paper 05-32, pp1-35

Millward, H. (2006) "Urban containment strategies: A case-study appraisal of plans and policies in Japanese, British and Canadian cities", *Land Use Policy*, vol 23, pp473-485

Nelson, A. C. (1992) "Preserving prime farmland in the face of urbanization - Lessons from Oregon", *Journal of the American Planning Association*, vol 58, no 4, pp467-488

Nickerson, C. J. and Lynch, L. (2001) "The Effect of Farmland preservation Programs on Farmland Prices", *American Journal of Agricultural Economics*, vol 83, no 2, pp341-351

Plantinga, A. J. and Miller, D. J. (2001) "Agricultural Land Values and the Value of Rights to Future Land Development", *Land Economics*, vol 77, no 1, pp56-67

Ready, R. C. and Abdalla, C. W. (2005) "The Amenity and Disamenity Impacts of Agriculture: Estimates from a Hedonic Pricing Model", *American Journal of Agricultural Economics*, vol 87, no 2, pp314-326

Rosen, S. (1974) "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", *The Journal of Political Economy*, vol 82, no 1, pp34-55

Runka, G. (2006) *BC's Agricultural Land Reserve - It's Historical Roots,* presented at the Post World Planners Congress Seminar Planning for Food, Vancouver, BC, 21 June

Shi, Y. J., Phipps, T. T. and Colyer, D. (1997) "Agricultural Land Values under Urbanization Influence", *Land Economics,* vol 73, no 1, pp90-100

Statistics Netherlands (2003), found online at http://statline.cbs.nl/StatWeb/start.asp?LA=nl&DM=SLNL&lp=Search%2FSearc

Van Geest, H. J. A. M. and Hodl, P. J. (2002) *Spatial Planning Act (Wet op de Ruimtelijke Ordening)*, Kluwer, Deventer

Van Klaveren, M. H. (2005) *Land Use Planning Act (Landinrichtingswetgeving, Landinrichtingswet)*, Kluwer

Wu, J., Adams, R. M. and Plantinga, A. (2004) "Amenities in an Urban Equilibrium Model: Residential Development in Portland, Oregon", *Land Economics*, vol 80, no 1, pp19-32

Xu, F., Mittelhammer, R. C. and Barkley, P. W. (1993) "Measuring the Contributions of Site Characteristics to the Value of Agricultural Land", *Land Economics*, vol 69, no 4, pp356-369.